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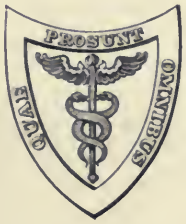

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THE

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JULY, 1902.

PROGNOSIS AND TREATMENT OF TUBERCULAR PERITONITIS,

AS BASED ON THE EXPERIENCE OF THE MASSACHUSETTS GENERAL HOSPITAL FOR THE PAST TEN YEARS.[1]

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"The termination of tuberculous peritonitis is always fatal, either from the disease itself or from tuberculosis of the lungs or other organs. The duration is from one or two months to a year or more." So said Austin Flint in his *Practice of Medicine*, and, curiously enough, the editors of the editions which have appeared since Dr. Flint's death seem to have overlooked this statement and have left it unchanged. We now know as well as we can know almost anything in medicine that tuberculous peritonitis not infrequently gets well. For this important increase in knowledge we are indebted indirectly to Ephraim McDowell, who blazed the path to the operative treatment of ovarian disease. Spencer Wells operated on a young woman, the subject, as he supposed, of an ovarian cyst. He found the peritoneum universally studded with miliary granules resembling those of tuberculosis, sewed up the belly as fast as he could, and, to his surprise, the patient recovered, afterward marrying and becoming the mother of a family. Other ovariotomists had similar experiences, and thus cut the ground from under the feet of those who maintained that recovery from tuberculous peritonitis was proof of an error in diagnosis.

Thus modern surgery proved the curability of tuberculous peritonitis, not the least of its services to humanity.

[1] Read at the meeting of the Association of American Physicians, in Washington, April 30 1902.

The next step from the demonstration of curability by surgical intervention to its curative action was a wholly natural one, and attempts were, of course, made to explain how the action is curative. None of these explanations are really explanatory, as far as I know. Flint's statement is doubly inaccurate, for not only is tuberculous peritonitis not always fatal, but the subject may recover if parts or organs other than the peritoneum are also involved in the disease.

For some time the evidence has seemed to warrant the belief that somehow surgery may cure when all other treatment fails. The wish to obtain guidance as to which cases are adapted to medical, which to surgical, treatment; when to abandon medical for surgical treatment —the hope that I might secure more fixed therapeutic principles, useful to myself and possibly to others—led me to the following analysis of the medical and surgical records of the Massachusetts General Hospital for the past ten years. For this opportunity I wish here to thank my colleagues on the hospital staff; for indispensable and laborious assistance Dr. W. H. Smith, of Boston. The amount of work involved in such an investigation, especially when end-results are sought from hospital patients, is fully appreciated only by those who have personally pursued it.

From 1889 to 1900 there have been 98 cases of tubercular peritonitis treated at the Massachusetts General Hospital, either on the medical or surgical side. An attempt has been made to ascertain the end result in as many of these cases as possible. Including those patients who were discharged dead, and those in regard to whose condition replies have been received, the end-result is known in 57 cases, or in 58.1 per cent. In the cases included in this series the shortest time which has elapsed since the patient left the hospital is two years, the longest eleven years.

The more important facts in regard to these cases may be of interest, as serving to show the character of cases which have made up the series.

Age.		*Age.*	
From 1 to 5	6	From 40 to 50	5
" 5 " 10	7	" 50 " 60	1
" 10 " 15	8	" 60 " 70	2
" 15 " 20	17		—
" 20 " 30	39		98
" 30 " 40	13		

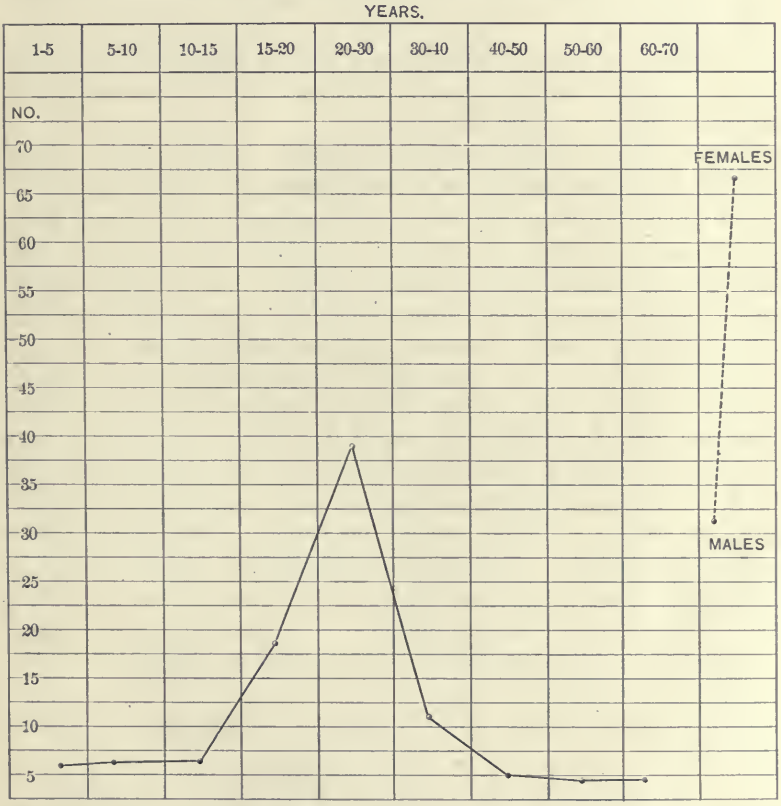
Between the ages of fifteen and thirty years there were 56 cases, or 57.1 per cent. of the whole number. The youngest case was thirteen months; the oldest case was sixty-two years.

The above list does not fairly represent the frequency of the disease in childhood, as the number of children entering the Massachusetts General Hospital is relatively small. In 1889 the number of children admitted was 43, the number of adults 3419. In 1899 the number of

children admited was 348, the number of adults 4468. Speaking broadly, the number of children admitted during the years 1889 to 1900 averaged about 4 per cent. of the total number admitted.

Americans	62
Foreign	31
Not stated	5
	98
Number of males	31
Number of females	67
	98

Included in this number were six of the colored race.



Family History. The presence of tuberculosis in the family history is recorded as follows:

In 2 cases the mother died of phthisis; in 7 cases the father died of phthisis; in 2 the father died of lung trouble; 1 had one brother die of phthisis; 1 had two brothers die of phthisis; 1 had two aunts die of phthisis, and 1 had one aunt die of phthisis; 1 had a mother and sister,

and 1 a mother and brother die of phthisis; 1 had a sister and brother die of hydrocephalus; 1 had a mother die of phthisis and a sister of meningitis; 1 had a father die of fistula in ano; 1 had a husband die of phthisis; in 20 cases there seems to be a distinct history of tuberculosis in the family. In 1 association with a tuberculous husband was recorded.

Previous History. With our present belief in the possible tubercular origin of many if not most of the primary pleurisies, it has seemed best to note a previous attack of pleurisy when stated: One pleurisy, eight months previous; 1 pleurisy, seven years ago; Pott's disease three years ago; 1 pleurisy, eleven months previous; 1 pleurisy, one year ago; 1 pleurisy, three years ago; 1 pleurisy, seven years ago, repeated attacks since; 1 pleurisy, eleven months previous; 1 pleurisy, one year ago. The record states that 3 of these had effusion, requiring tapping; 3 out of the 8 cases of pleurisy occurred in those with tuberculosis in their family history.

Symptomatology. It is extremely difficult to draw any hard and fast lines as to whether the onset of the disease was acute or gradual; patients showing upon examination evident ascites or abdominal masses would date their beginning symptoms to abdominal pain of a few days' duration. In 66 cases it is stated as of gradual onset; in 29 as acute; in 3 it is not stated. Tightness of clothing may be the first thing noticed, or, as in 1 case, pregnancy may be thought present.

Abdominal Pain. This was noticed in 68 cases. One patient, not included in this series, as the operation occurred in 1900, had had abdominal pain for seventeen years, or since the age of eighteen. At operation the intestines and omentum were bound together by firmly organized adhesions extending into the pelvis, matting together the tubes and ovaries. On the parietal peritoneum several small calcified tubercles were found. The pathological report of a small piece of the peritoneum over the cæcum filled with minute grayish granulations showed the process to be tuberculous.

Diarrhœa. In 23 cases diarrhœa is recorded as present for a longer or shorter time.

Nausea and Vomiting. In 28 cases nausea or nausea and vomiting were present.

Fluid in Abdomen. In 63 cases there was fluid in the peritoneal cavity. In 26 cases the abdomen was tapped, either for relief or for diagnosis. The character of the fluid obtained either at tapping or at operation was as follows: In 22 cases it was clear; in 6 it was bloody or slightly bloody; in 1 case it was high in color; in 5 cases pus was present; in 1 case it was chylous; in 4 it was greenish; in 2 it was brown; in 1 turbid. In 14 cases the specific gravity of the fluid is recorded. The highest was 1035; the lowest, 1008. In 10 of the 14

cases the specific gravity was above 1020. The highest percentage of albumin was 3.4 per cent.; the lowest, 0.1 per cent.

Masses. Masses are recorded as present in 29 cases. On the right side, 5; right hypochondrium, 2; right iliac region, 4; right epigastrium, 1. On the left side, 1; left hypochondrium, 1; left low down, 1; left iliac region, 1. At umbilicus, 1; right and left umbilicus, 1; below umbilicus, 2; right to umbilicus, 1. Above pubes, 1; between recti, 1; in psoas, 1; iliac region, 1; in 4 not stated.

Crepitation. In 1 case it is reported present after tapping. One record states doubtful crepitation; 1 friction over the surface of the liver.

The superficial abdominal veins were dilated notably in 2 cases, both in children.

Tuberculin Reaction. In 13 cases tuberculin was injected as an aid to diagnosis. In 8 cases the reaction was positive; in 3 negative, and in 1 not satisfactory. In 1 other case reported as negative the temperature was irregular when it was given, and the reaction was considered negative. The use of tuberculin in relatively so small a number of the cases is due to the fact that its earliest use in this series was in 1896; that it is used practically in only one of the medical services. Its use is also limited by the fact that it can only be employed in those cases, the four-hourly chart of which shows slight rise of temperature above the normal. The preparation used is a 1 per cent. solution of Koch's 10 per cent. tuberculin. The dose now given is from 7 to 10 minims. Reaction consists in a rise in temperature (it may reach 105) with constitutional disturbance, as chilliness, headache, pain in the back, or malaise. That a negative reaction may at times be of diagnostic value is well illustrated by the following cases:

One patient in whom the probable diagnosis of tubercular peritonitis was made had two tuberculin injections without reaction. Operation showed no tuberculosis of the peritoneum. She died one month later of probable renal disease.

Another patient discharged relieved, with diagnosis of tubercular peritonitis, did not react to tuberculin. She had a recurrence of symptoms later, and was operated upon at another hospital, and an adenocystoma of the ovary was found; she has since been well.

Leucocytosis. If we accept 10,000 white cells as within normal limits, where the blood-counts were made at all hours of the twenty-four, and under the most varied conditions, there were 34 out of a total of 46 cases which were below this number, or, 70.8 per cent. which had no leucocytosis. Where the white count is above 10,000, pus may or may not be present; if present it may be sterile, or it may contain a variety of organisms. One case with a white count of 13,000 contained streptococci and bacilli. One with 14,000 white cells

was sterile. One of 11,000 contained the colon bacillus. In 3 cases where the leucocyte count was above 10,000, pus tubes were also present at the operation. The blood was otherwise not remarkable beyond an occasional moderate secondary anæmia.

Diazo. In 12 cases the diazo-reaction was present. The test is practically limited to the medical sides. It may be more or less constant, fleeting, or absent. It seems to be of but little practical significance in this series of cases. It has occurred in cases with high temperature and in cases with normal or subnormal temperature.

Temperature. There is nothing characteristic about the temperature charts in the series. In 48 cases the temperature, as a rule, was above 100. In the remaining cases the range of temperature was from normal to 100, or from subnormal to normal with slight variations. The temperature was usually higher in the evening, occasionally reaching 104, rarely 105.

Stay in Hospital. The longest stay of any patient in the hospital in this series was 347 days; the shortest two days. The average stay was 43.5 days.

In brief, in the 98 cases of tubercular peritonitis over one-half occurred between the ages of fifteen and thirty years, and two-thirds of the patients were females. In about one-fifth there seemed to be a distinct tubercular family history, while one-twelfth had had previous pleurisy. In two-thirds of the cases the onset was gradual; in about two-thirds abdominal pain and ascites were present, while about one-quarter had diarrhœa and one-quarter nausea or nausea and vomiting. In a little less than one-third of the cases abdominal masses were present. In 8 out of 13 cases the tuberculin reaction was positive, and in two-thirds of the cases there was no leucocytosis. The diazo-reaction seemed to be unimportant in this series, and the temperature to show nothing characteristic.

The cases have been divided into medical and surgical. Many of the cases entered on the medical side and were transferred to the surgical for operation; a few entered the surgical side and were transferred to the medical. There were 46 cases which are included under medical; there were 52 cases under surgical.

MEDICAL CASES.—Condition at discharge.

Relieved or improved	16	Well	2
Much relieved	6	Dead	7
Not relieved	10		—
Against advice or ?	5		46

SURGICAL CASES.—Condition at discharge.

Relieved or improved	24	Well	4
Much relieved	14	Dead	6
Not relieved	1		—
Against advice or ?	3		52

Of the 46 medical cases the end-result is known in 25; of the 52 surgical cases the end-result is known in 32; out of 98 medical and surgical cases the end-result is known in 57 cases, or 58.1 per cent.

The prognosis in a sense may be said to depend on the diagnosis. That there is liability of error in the diagnosis of tubercular peritonitis may be inferred from the fact that the following cases have been considered as cases of tuberculosis of the peritoneum—the mistake has been shown at operation or at autopsy: Tuberculosis of retroperitoneal glands and pericardium; fibroma of ovary; lymphosarcoma of mesenteric glands and intestines, with perforation and general peritonitis; schirrhus cancer of the stomach with cancerous peritonitis; retention cysts with chronic peritonitis; colloid carcinoma; adenocystoma of ovary. Several of the cases, especially in the earlier part of the series entering with high temperature, abdominal distention, absence of leucocytosis, with diazo, were at first considered to be cases of typhoid.

The prognosis as to life, if estimated from the hospital mortality, would be good in about 87 per cent. of the cases in this series. Seven cases died in the hospital out of 46 treated on the medical side, and 6 died out of the 52 treated on the surgical side; 13 in all out of 98 cases, a mortality of 13.2 per cent. A more accurate prognosis as to life can be formed by estimating the mortality from the whole number of cases in which the end-result is known. In 57 of the whole number of 98 cases the end-result has been obtained, covering a period of from two to eleven years after discharge from the hospital. The list follows:

Medical. Of the 16 cases discharged relieved or improved from the medical side, 9 have been heard from, 4 have died, 2 are well, and 3 have had no return of symptoms. Of 6 discharged much relieved, 2 have been heard from; both have died. Of 10 discharged not relieved, 6 have been heard from, 4 have died, 2 are well. Of 5 discharged against advice or? none have replied. One well at discharge had a recurrence, but is now well. Of 46 medical cases, including those who were discharged dead and those who have died outside, there have been 17 deaths, or 36.9 per cent. Of 25 medical cases in which the end-result is known, 17 have died, or 68 per cent.

1. Uncomplicated	Died at home in a few months.
2. Tubercular peritonitis and phthisis .	Discharged dead.
3. Uncomplicated	Died at home; brain fever six months.
4. Tubercular peritonitis and pleurisy .	Discharged dead.
5. Tubercular peritonitis (pleurisy one year before).	Died outside in one month.
6. Uncomplicated	Died in three and a half years of phthisis.
7. Tubercular peritonitis and nephritis? .	Discharged dead.
8. Tubercular peritonitis, phthisis, and nephritis.	Died at home in a few weeks.
9. Uncomplicated	Dead four months; general tuberculosis and cirrhosis of liver.

10. Uncomplicated	Died four years. Cause?
11. Uncomplicated	Discharged dead.
12. Tubercular peritonitis and tubercular pleurisy.	Discharged dead. Autopsy: Chronic tuberculosis and pleural peritonitis.
13. Tubercular peritonitis, cardio-renal .	Discharged dead. Autopsy: Tubercular peritonitis, tubercular liver, chronic nephritis, and hypertrophied heart.
14. Tubercular peritonitis, glandular . .	Dead four years.
15. Tubercular peritonitis, phthisis? and fistula.	Dead a few months.
16. Tubercular peritonitis and phthisis .	Dead four months.
17. Tubercular peritonitis, fistula from tapping, and rhachitis.	Discharged dead. Autopsy: Tubercular peritonitis, focal tubercular liver, spleen and kidneys; tubercular mediastinum and post-mesenteric glands; no ulcers in intestines; puncture wound of abdomen.

The high mortality of 68 per cent. of those patients having received only medical treatment may in part be accounted for by the fact that in only 6 of these cases was the tubercular peritonitis uncomplicated, as shown by physical examination during their stay in the hospital. The other 11 cases showed one or more of the following complications: Phthisis, fistula, tubercular glands, rickets, pleurisy, cardiac or renal disease. Three cases in which post-mortem examinations were obtained also showed evidence of tubercular infection elsewhere.

Surgical. Of 24 cases discharged relieved or improved, 11 have been heard from, 3 are dead, 1 has had a recurrence and is now better, 7 are well. Of 14 cases discharged much relieved, 10 have been heard from—2 are dead, 1 is better, and 7 are well; 1 case discharged not relieved, died within one month. Of 3 cases discharged against advice, or (?) 1 replied and was well two years later. Of 4 cases discharged well, 3 have reported well. Of 52 cases surgical, including those discharged dead and those who died outside, there have been 12 deaths, or 23 per cent.

1. Discharged dead, ten weeks after operation; pus and fecal fistula.
2. Discharged dead. Sinus persisted, and died twenty-four hours after second operation.
3. Discharged dead, twenty-four hours after operation. Autopsy: Tubercular peritonitis, local peritonitis, healed focus in lung.
4. Discharged dead, twelve hours after operation.
5. Discharged dead, eleven days after operation; peritonitis and fecal fistula.
6. Discharged dead, seven weeks after operation; early autopsy record not to be found.
7. Discharged, relieved or improved. Dead three months; general sloughing of wound (gall-bladder).
8. Discharged, relieved or improved. Dead two months; fluid returned, tapped.
9. Discharged, relieved or improved. Dead four yrs.; tuberculosis of pleura and peritoneum.
10. Discharged, much relieved. Dead four months; "bowels decayed."
11. Discharged, much relieved. Dead nine months; phthisis.
12. Discharged, not relieved. Dead one month (?); (gall-bladder).

The prognosis as to life when viewed from the end-result obtained in 57 cases of this same series gives a mortality of 47.3 per cent. (2 cases in which the cause of death is doubtful have been excluded), instead of the hospital mortality of 13.2 per cent.

It is interesting to note that of the 16 cases which have died since leaving the hospital, 10 died within a few weeks or months of the time of discharge. Four years was the longest period that any of these patients lived after discharge.

Prognosis as to Recovery. Of the 8 cases heard from treated medically in which there has been no return or which are now well, the length of time intervening is as follows:

1 well 11 years
1 recurrence 1 year later, now well 7 years . . or 1 patient 11 years.
1 no returns 5 years . . . . . " 1 " 7 "
1 good health 5 years . . . . . " 2 patients 5 "
1 well 3 years . . . . . " 2 " 3 "
1 good health 3 years . . . . . " 2 " 2 "
1 no return 2 years 3 months.
1 no return 2 years.

Of 32 surgical cases in which the end-result is known up to the present time, 20 are better, or have had recurrence and are now well.

4 cases	2 to 3 years.	4 cases . . .	6 to 7 years.
3 "	3 " 4 "	2 " . . .	7 " 8 "
2 "	4 " 5 "	3 " . . .	8 " 9 "
1 case	5 " 6 "	1 case . . .	9 " 10 "

Of 25 cases treated on the medical side, 68 per cent. have died, 32 per cent. are now well or have had no return of symptoms or have had a recurrence and are now well (1 case).

Of 32 surgical cases in which the end-result is known, 37.5 per cent. have died, 62.5 per cent. are better, well, or have had a recurrence and are now well.

Recurrence. In 2 patients recurrence has occurred, but both are now well.

Character of Fluid, with a View to Prognosis. In 4 cases in this series in which pus was present, 1 died of fecal fistula, 1 had a fecal fistula and recovered two and one-half years; 1 a persistent sinus, now better two years; 1 local sepsis, well two years. In 4 cases which have been heard from in which the fluid was bloody or slightly bloody, 1 died in a few months; 2 well six years; 1 well nine years. One case heard from in whom the fluid was turbid has been well two years. In 14 cases heard from in which the fluid was clear, 9 are dead; 4 are well; 1 is better.

Absence of Fluid. In 7 cases heard from without fluid, 1 has died, 6 are well.

Masses. In 19 cases with masses heard from, 12 have died, 7 have recovered, or a mortality of 37 per cent. In 30 cases with ascites without masses, 12 have recovered, 18 have died, or a mortality of 60 per cent.

Treatment. The treatment on the medical side was in the main symptomatic and hygienic. Tapping was resorted to whenever necessary

for the comfort of the patient. The treatment on the surgical side consisted of simple abdominal incision, sponging or washing out of the abdominal cavity with normal salt solution or sterile water, and removal of masses of tubercular material when possible. In 8 cases one or both tubes were removed at the time of operation ; 32 of these cases were sewed up tight, 20 were drained with gauze or tubing. The pathological report is stated as tuberculous in 26.

Of those cases with ascites treated medically and tapped, the record is complete in 10, 7 were discharged dead or have died since discharge, 1 is well after an interval of eleven years, 1 has no return at five years, 1 no return in two years and three months.

Of especial interest in those cases which were tapped are the following: A woman, aged fifty years, entered the Massachusetts General Hospital in 1894 with tuberculosis of the peritoneum and glandular tuberculosis. There was marked ascites. She was tapped and discharged relieved. She re-entered one year and six months later, saying her health had been excellent since leaving the hospital. She had, however, lost flesh and color. Two months after leaving the hospital her abdomen was again tapped and nine quarts of serum withdrawn. In the preceding eight months before her re-entrance the abdominal swelling had increased so that she had to give up work. At re-entrance her abdomen was very much distended and fourteen and three-quarter quarts of fluid were withdrawn. Specific gravity, 1022 ; albumin, 3.4 per cent. She was discharged relieved, but died in 1898, four years after her first entrance.

A farmer, aged nineteen years, single, entered the hospital in September, 1889. One year previous glands of neck had suppurated, one abscess opened (a few months after recovery from mumps). With this there was some bronchial trouble from which he recovered. Two weeks before entrance he took cold, had a headache, backache, soreness in lower part of the abdomen. At entrance there was some ascites, which disappeared after one week. Three weeks after entrance one of the glands of the neck opened. He was transferred to the medical side, and three days after transfer the record states : " Encysted fluid in abdomen, some fluid in right pleural cavity, questionable right apex." He was kept out-of-doors daily, and January 4, 1890, the gland had nearly stopped discharging, the fluid had disappeard from the chest, there was still a little ascites. He was discharged on the above date, having shown steady improvement. He re-entered November 3, 1890. Except for a touch of " la grippe " had been improving. The abdomen had remained about the same, there was slight suppuration from one gland of the neck. Other scars had closed. There was some ascites present, and he was tapped November 8, 1890. Three and one-half quarts of slightly bloody fluid, with specific gravity

1017, and with much albumin, were removed. He was discharged November 20th, doing well. He reported December 20, 1890, looking much better. There was some resistance in the right flank. On March 8, 1891, "Feels as well as ever." Reported October 14, 1891, said that he had caries of rib which had been tapped, drained, and later curetted. This was now nearly healed. Weight, 134¾ pounds. Had been doing light work on a farm and had never felt better in his life. October 19, 1892, "never better, no symptoms, no cough," weight 140 pounds. May 16, 1896, rides a bicycle ten to twenty miles a day, no cough, feels well. November, 1901, reported excellent health.

Of those cases treated medically in which there were abdominal masses the record is complete in 6, as 3 have died, 1 had no return, and 2 are in good health. Of this number the following case is of interest:

A woman, aged twenty-six years, with abdominal pain of eight months' duration, with masses in the right hypochondrium, who gave a reaction to tuberculin, was discharged unrelieved after a two weeks' stay in the hospital. She was told of her condition and advised to live out-of-doors as much as possible. She went immediately to the seashore, where she says she had plenty of fresh air and good food. She rested for one entire year. Since that time she has been working constantly and considers her condition to be excellent. It is at present six years since discharge..

It has seemed well to record the ill results of operation. Fecal fistula occurred 6 times; 2 died in hospital; 1 recovered; 3 not heard from since discharge.

Local Abscess. Three cases: 1 died in hospital after second operation; 2 not heard from.

Shock of Operation. Two patients died within twenty-four hours.

Local Sepsis. Two cases: 1 died in three months; 1 recovered. In 2 cases sinuses persisted, ultimate recovery two years and four months, respectively. One case died four months, "decayed bowels." Two died, return of disease, four years and two months, respectively. There was 1 case of phlebitis and 1 case of hernia in the scar of operation. In 2 cases on the medical side the intestines were punctured during tapping; 1 with no ill result; 1 with development of fecal fistula.

Conclusions. The mortality when based on the condition of the patients at discharge, in a series of 98 cases of tubercular peritonitis at the Massachusetts General Hospital, is 13.2 per cent. The mortality of the same series of cases after a period of from two to eleven years is, on the contrary, 47.3 per cent. The ultimate mortality of patients in this series under medical treatment is 68 per cent.; under surgical treatment 37.5 per cent.; 2 patients have had recurrence, but are now well. None of the other patients at present report themselves as suffering from the disease.

In conclusion, I must confess that I am somewhat disappointed by not getting as definite indications from this series of cases as I had hoped for.

Recognizing that the number of cases is not large and that in many of those reporting themselves as now well, the lapse of time is, after all, relatively short, I am disposed to state the main therapeutic lessons which I derive from the analysis 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.

PNEUMOCOCCIC ARTHRITIS.[1]

By James B. Herrick, M.D.,
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It is a well-known fact that the diplococcus of Fraenkel is not limited, as to its habitat, to the lungs, nor, as to its effects, to the production of acute croupous pneumonia. In many of the inflammations that complicate pneumonia bacteriological examination has revealed the same pneumococcus that induced the primary pulmonary lesion, the mode of transport from the lung to the more distant organ being made clear by the detection of the micro-organisms in the blood during life or after death. It has also been shown that pneumococcic infection with primary localization other than pulmonary may occur, *e. g.*, in the middle ear, the meninges, the valves of the heart, the joints, etc. These facts are so generally recognized as true that they need no further comment, established as they are by numerous clinical, post-mortem, and experimental observations. Weichselbaum's[1] statement, made in 1888, has been repeatedly confirmed: "The diplococcus pneumoniæ can cause not alone pneumonia, but also various other processes, either at the same time as pneumonia or entirely independent of it."

[1] Read at the meeting of the Association of American Physicians at Washington, April 29, 1902.

There is scarcely an organ or tissue of the body that has not been mentioned as occasionally attacked by the pneumococcus either primarily or secondarily. These secondary localizations are commonly seen during or following a croupous pneumonia. Thus are recorded cases of pneumococcic tonsillitis, stomatitis, lymphadenitis, ulcerative gastritis, enteritis, peritonitis, encephalitis, meningitis, myelitis, otitis media, parotitis, cellulitis in various parts of the body, myositis, phlebitis, endocarditis, pericarditis, bronchitis, pleuritis, orchitis, ovaritis, metritis, nephritis, angiocholitis, conjunctivitis, keratitis, panophthalmitis, tenovaginitis, osteomyelitis, and arthritis. It is to the last-named pneumococcic inflammation—that of the joints—that attention is here directed.

The study of the subject is rendered easier by the fact that recently it has been very thoroughly gone into by Leroux,[2] whose monograph, with its collection of twenty-eight cases and its collocation of facts, must of necessity be freely drawn upon in the preparation of this article. In truth, Leroux's article makes such a paper as the present one seem much like repetition and almost unnecessary; but pneumococcic arthritis has received little notice in this country, and this paper may serve to call the attention of American physicians more forcibly to this subject, and it will add a few hitherto unrecorded cases to the list of Leroux and to that of Cave,[3] who has recently reviewed the topic in England.

Historical. Stray references to arthritis occurring during the course of pneumonia are found in periodical and text-book literature before the time of the recognition of the pneumococcus. Undoubtedly many cases passed as rheumatic or as pyæmic; but some observers clearly differentiated between the joint of ordinary rheumatism and this form of arthritis, with its frequent monarticular localization, its permanent rather than shifting character, the presence of fluid, and the absence of other ear-marks of rheumatism. No better illustration of such cases can be given than the ones cited by Leroux from Grisolle's *Traité de la Pneumonie*, 1864. I quote Cave's abstract: "Four patients, who had never suffered from any form of articular or muscular rheumatism, were attacked either early in the course of a pneumonia, or shortly after its subsidence, with acute arthritis, affecting in one case the two shoulders, in another the right knee, in the third the left ankle, and in the fourth the right wrist and the left knee. The last case was examined after death, and both the affected joints were distended by odorless pus, and the synovial fringes were injected. The joint affection was always a continuous one, with none of the fugitive character of true rheumatism; and after discussing the relations with this latter disease Grisolle came to the conclusion that the nature of the two affections was quite distinct."

Between 1883 and 1888 the pneumococcus was proven to be the cause

of croupous pneumonia, and it was discovered also that inflammation of structures other than the lung could be produced by this organism. In 1888 Weichselbaum reviewed the whole subject of the rarer localizations of the pneumonic virus, and described the case that, with Leroux, we must look upon as the first one clearly worked out in its details, and indisputably a pneumococcic arthritis. Since that time several cases have been recorded, so that, while a relatively rare complication, there were found by Vogelius, in 1896, 11 cases; by Leroux, in 1899, 28 cases; and by Cave, in 1901, 3 more, making a total of 31 cases. To this number I am able to add 9 cases that have been seen in Chicago—1 by Billings, 1 by Billings and Preble, 1 by Preble, 1 by Hektoen, 1 by Quine, 1 by E. F. Wells, and 3 by myself. Raw reports 7 cases from England as seen by himself. Allen and Lull report an interesting primary pneumococcic arthritis of the knee. I have been able to find a few cases also that had escaped the notice of Leroux and Cave. My attention was called to 2 of these by Dr. E. F. Wells, who kindly gave me the references. Altogether I add to Cave's list 21 cases, making a total of 52. In all of these bacteriological examination has proven the presence of the pneumococcus in the joint. Two other cases I have seen where there is no reasonable doubt as to the nature of the joint affection; but as these cases lack bacteriological confirmation I am forced to omit them from the series, as also 3 others—2 of Preble's and 1 of Bernheim's.

Frequency. Pneumococcic arthritis is a relatively rare affection. Cave found no recorded observations in England before his, though, of course, cases had previously occurred, but had not been recognized. In running through a number of German inaugural dissertations, most of them statistical studies on pneumonia, I find the following figures:

Name of reporter.	Hospital.	Year.	No. of cases of pneumonia.	No. of cases of arthritis.
Sello,	Urban Hospital, Berlin,	1890–1897	750	One case, right shoulder.
Moosberger,	Zürich (Eichhorst),	1884–1890	359	No case mentioned.
Samter,	Breslau,	1881	331	No case mentioned.
Herrmann,	Leipzig,	1893	235	One case with serous gonitis ("gelenk rheumatismus?").
Fricke,	Göttingen,	1886	169	No case.
Pöhlmann,	Erlangen (Strümpell)	1886–1888	239	No case.
Morhart,	Erlangen (Strümpell)	1888–1892	209	No case.
			2292	2 cases of arthritis.

Vogelius cites the figures of the Charité, in Berlin, for 1874–1889, 3293 pneumonias, with 2 cases of arthritis; Munich, for eleven years,

650 pneumonias, 1 arthritis; several clinics in Paris, 1215 cases of pneumonia, 3 of arthritis.

Netter finds figures of 4156 cases of pneumonia reported from German clinics, with but 6 cases of arthritis. In Allbutt's *System* no mention is made of arthritis as a complication of pneumonia, nor does Aufrecht, in Nothnagel's *System*, refer to it.

These figures and the experience of physicians in general practice bear out the statement that the complication is quite rare, being found once in perhaps 800 cases; yet, like many other affections, when one is on the lookout for it, it will less easily escape detection, and it will probably be found that its frequency is greater than these statistics would show.

Raw found it in 1 per cent. of his cases. Its frequency in Chicago might excite comment; but most of the Chicago cases referred to in this article were seen in the Cook County Hospital, where many of our pneumonics are also alcoholics—a condition recognized as favoring the occurrence of arthritis, and referred to by Raw as helping to explain his high percentage. We have also in the last few years had a great deal of pneumonia in Chicago of a severe type and presenting atypical and complicated forms; and, as I have said, when one is on the lookout for these things they do not escape notice as they otherwise might.

The following is made up of Cave's table (the first 31 cases), with the additional cases which I am able to add. The first 28 cases are those collected by Leroux. For the sake of completeness I have copied this table entire, and have added the other cases, as Raw has done, with the same order of tabulation of facts as adopted by Cave. The references to the literature of the first 31 cases will be found in Leroux's and Cave's article. I give references, therefore, only for the cases which I have added.

In 47 cases there were 40 males and 7 females. The greater frequency in the male sex may perhaps have a partial explanation in the fact that pneumonia is more frequently seen in males, at least in hospital practice, and that a larger proportion of males would present the favoring influence of previous alcoholism, plumbism, and traumatism, which factors to a certain extent seem to determine the localization of the pneumococcus in the joint. Adding my figures to those of Cave, we have the following facts concerning the age and also the joints most commonly affected. Before ten years, 4 cases; from ten to twenty years, no cases; from twenty to thirty years, 5 cases; from thirty to forty years, 9 cases; from forty to fifty years, 15 cases; from fifty to sixty years, 11 cases; from sixty to seventy years, 4 cases; from seventy to eighty years, 2 cases.

Table of Cases of Pneumococcic Arthritis.

No.	Observer.	Date, sex, age.	Relation to pneumonia.	Seat of arthritis	Nature.	Complications and remarks.	Result.
1	Welchselbaum,	1888 ? 54	Pneumonia, 3 days before.	Right shoulder	Suppurative.	.....	D.
2	Belfanti,	1889 ?	Pneumonia, 11 days before.	Right wrist.	"	.....	D.
3	Monti,	1889 ?	Pneumonia.	Metacarpo-phalangeal.	(?)	.....	D.
4	Ortman and Samter,	1890? M. 34	Pneumonia, few dys. before.	Shoulder.	Suppurative.	Arthrotomy.	R.
5	Macaigne and Chipault,	1891 F. 60	Pneumonia, 4 days before.	Right knee.	"	"	R.
6	Chautemesse,	1891 adult	Pneumonia, crisis 2 d. before	Elbow; knee.	Serous.	Meningitis.	D.
7	Boulloche,	1891 M. 5	Pneumonia, 3 days after.	Knee; both elbows.	Suppurative.	.....	D.
8	Picqué and Veillon,	1891 M. 36	Pneumonia, 4 days before.	Right knee.	"	Arthrotomy.	D.
9	Brunner,	1892 M. 52	Pneumonia, 2 days before.	Left wrist.	"	"	D.
10	Juvigny,	1894 M. 52	Pneumonia.	Both knees; ankle.	"	"	D.
11	Dominici,	1896 M. 44	Pneumonia, 12 days before.	Right shoulder	"	Peri- and endocarditis; meningitis; lead.	D.
12	Griffon,	1896 F. 71	None.	Right ankle.	"	Endocarditis; meningitis; arthrotomy.	D.
13	Mercantonio,	1896 M. 71	Pneumonia, some dys. before	Right shoulder	"	Arthrotomy.	D.
14	Oliva,	1896 M. 8	Pneumonia, 7 days after.	Arms and feet (multiple).	Serous.	Pneumococcus found in sputa only.	R.
15	Vogelius,	1896 M. 38	Pneumonia, 5 days before.	Right sterno-clavicular.	Suppurative.	Arthrotomy.	R.
16	Vogelius,	1896 M. 60	Pneumonia, some dys. before	Hip.	"	Endocarditis; empyema; lead; arthrotomy.	D.
17	Schabab,	1896 M. 45	Pneumonia.	Left hip and knee.	"	.....	D.
18	Ausset,	1896 M. 41	Pneumonia, 7 days before.	Both knees.	"	Rheumatism two years before.	D.
19	Fernet and Lorraine,	1895 M. 56	Pneumonia.	L. sterno-clavicular; r. shoulder (recover'd).	"	Endocarditis; meningitis. The arthritis of shoulder subsided before death.	D.
20	Widal and Meslay,	1896 M. ad.	None.	Left first metatarso-phalang'l	"	Purulent pericarditis; lead.	D.
21	Duflocq and Ledamany,	1896 M. 32	Pneumonia, 9 days before.	Both elbows; left shoulder; right knee.	"	Old rheumatic arthritis.	D.
22	Tournier and Courmont.	1896 M. 50	Pneumonia, 6 days before.	Left knee and shoulder.	Serous.	Empyema; secondary syphilis.	D.
23	Widal and Mercier,	1897 M. 46	Pneumonia, 4 days before.	Multiple, wrist and ankle.	Suppurative.	Endocarditis; typhoid arthritis 25 years before.	D.
24	Galliard and Morèly,	1898 M. 44	Pneumonia, 9 days before.	Right wrist.	"	Stiffness and grating of joint; arthrotomy.	R.
25	Widal and Lesné,	1898 M. 68	None.	Left sterno-clavicular; left wrist.	" (?)	Old chronic rheumatism of small joints of hands and feet.	R.
26	Petit,	1898 M. 42	Pneumonia, 5 days before.	Left knee.	Suppurative.	Meningitis; arthrotomy.	D.
27	Sorel,	1898 M. 48	Pneumonia, 8 days before.	Left shoulder.	"	Empyema.	D.
28	Leroux,	1899 M. 45	Pneumonia, 9 days before.	Left wrist.	"	Endocarditis; pleurisy; peritonitis; meningitis.	D.
29	Fernet and Lacapère,	1900 M. 47	Pneumonia, 3 or 4 dys. before	Right wrist.	Serous.	Joint stiff.	R.
30	Rendu,	1900 M. 66	Pneumonia, 15 days before.	L. sterno clavicular; l. knee.	Suppurative.	Arthrotomy.	R.
31	Cave,	1900 M. 51	Pneumonia, 9 days before.	Left shoulder.	Serous.	.....	D.
32	Nicolaysen,	1896 M. 3 wks	10 dys. from onset of sympt'ms of infectious disease involving bronchi and lungs.	Right elbow.	Suppurative.	Double empyema; suppurative pericarditis; bronchitis; no operation.	R.
33	Mühsam,	1897 M. 55	Entered surg. ward 24 days after onset of pneumonia.	Right shoulder	"	Incision and drainage; desperate case; regarded as hopeless at time of operation; alcoholic.	R.

No.	Observer.	Date, sex, age.	Relation to pneumonia.	Seat of arthritis	Nature.	Complications and remarks.	Result.
34	Heubner,	1897 5 mos.	At least 3 wks. after onset of pneumonia; several days after normal temperature.	Left shoulder.	Suppurative.	Incision and drainage.	R.
35	Flament,	1898 M. 55	.....	Knee.	"	Resection.	R.
36	Raw,	1898 M 28	Pneumonia, 3 days before.	Right sterno-clavicular joint	"	Free incision and drainage; right otitis media and abscess of thigh.	R.
37	Raw,	1899 M. 52	Pneumonia, 2 days after.	Right ankle, right sterno-clavicular.	"	Incision, arthrotomy, stiff joint, right empyema.	R.
38	Raw,	1900 F. 49	Pneumonia, 2 days before.	Right shoulder	"	Incision, drainage, arthrotomy, septicæmia.	D
39	Raw,	1897 M. 23	Pneumonia, 2 days before.	Right knee.	Serous.	Aspiration.	R.
40	Raw,	1898 M. 51	Pneumonia, 2 days before.	Both knees.	"	General treatment; alcoholism; a severe infection and toxæmia.	D.
41	Raw,	1900 M. 58	Pneumonia, 3 days before.	Right knee.	Suppurative.	Incision and drainage; stiff, though fairly useful joint.	R.
42	Raw,	1901 M. 42	Pneumonia, about same time.	Right shoulder	"	General treatment; severe general infection, with extensive cellulitis of shoulder.	D.
43	Billings and Preble,	1899 F. 43	Pneumococcic septicæmia; no lung involvm't; pneumococcus from blood, joints, and by lumbar punct.	Elbow, wrist, ankle, knee.	"	Pneumococcic septicæmia with localization in pericardium, meninges and joints. Autopsy.	D.
44	Preble,	1899 M. 33	Exact date of arthritis uncertain, but joints swollen at time of first observ. 14 days from initial chill of pneumonia.	Right foot; left knee, elbow, wrist, and second metacarpo-phalangeal joints.	"	Pneumococci from blood during life.	D.
45	Billings,	1900 M. 23	16 days after chill of pneumonia.	Rt. shoulder, lt. knee, lt. metatarso-phalangeal joint of great toe.	"	Meningitis; distinct trauma to joints.	D.
46	Hektoen,	1901 M. 47	.....	Left knee.	"	Pneumococcus in heart's blood at autopsy.	D.
47	Allen and Lull,	1901 F. 40	Primary in joint; no pneumonia, no pneumococcus in the blood.	Left knee.	"	Arthrotomy, and later amputation.	D.
48	Quine,	1902 F. 30	7 days from onset of an angina and 5 from beginning of pneumonia.	Right sterno-clavicular.	"	Incision; endocarditis, nephritis, probable pericarditis.	D.
49	Wells,	1902 F. 32	2 days after crisis of pneumonia.	Left sterno-clavicular.	"	Incision and drainage.	R.
50	Herrick,	1902 M. 32	7th day of pneumonia immediately following crisis	Left elbow.	"	Aspiration; useful and movable joint.	R.
51	Herrick,	1902 M. 41	15 days from beginning of pneumonia.	Left hip and knee.	Knee, serous; hip, unknown.	Plumber, alcoholic; previous injury of hip and knee; aspiration of knee; useful joint; hip not treated; ankyiosis.	R.
52	Herrick,	1902 M. 26	12 days after crisis of pneumonia.	Left knee.	Suppurative.	Incision and drainage; severe toxæmic symptoms; pericarditis.	D.

In 23 of the 52 cases the upper extremities alone were involved; in 18 cases the joints of the lower extremities alone; in 11 there was involvement of joints of both the upper and lower extremities. These figures show a slight preponderance in favor of limitation to the upper extremity, but so slight that little or no significance can be attached to it. In fact, the knee seems to be the joint oftenest affected, being involved in 22 of the 52 cases, in 3 of which both knees were affected, so that out of a total of 84 joints the knee makes up 25, or about 30 per cent. The involvement of other joints was as follows: the sternoclavicular, 8 times; the shoulder, 12 times; the elbow, 9 times; the wrist, 8 times; the metacarpophalangeal twice; the hip, 3 times; the knee, 25 times; the ankle, 3 times; the metatarsophalangeal, 3 times. The arthritis was monarticular in 32 instances, or in 61.5 per cent. of the cases. The joints thus solitarily involved were: shoulder, 10 times; knee, 9 times; wrist, 5 times; elbow, twice; sternoclavicular, 4 times; and the hip, ankle, metacarpophalangeal, and metatarsophalangeal each once. Of the remaining cases there were involved two joints, 9 times; three joints, 4 times; four joints, once; more than four, 3 times. These figures bring out the fact that the larger joints—the knee, shoulder, elbow, and wrist—are more often affected than the smaller, though it is to be noted that one of the smaller joints—the sternoclavicular—was inflamed 8 times; oftener, it will be seen, than the hip, which was involved but 3 times.

The influence of trauma in bringing about this form of arthritis has been noted by many writers upon the subject. Five of the number had distinct histories of injury of the joint affected, by sprain or bruise either shortly before or during the course of the pneumonia. One of my patients—Case LI.—four weeks before the onset of the pneumonia had fallen through a trap-door, sprained the knee, which later became infected, and had been for several days confined to the bed on that account. In this connection the case of Billings—Case XLV.—is interesting and instructive. In both these cases the influence of trauma in inducing localization in a given joint seems clear; and, again, it is seen how the arthritis is prone to occur during convalescence.

This production of a locus minoris resistentiæ in the joint by traumatism, thus favoring the localization of the pneumococcus, is in accord with experimental work along this line, dealing not only with this microbe but others, and in connection with such conditions as osteomyelitis, endocarditis, etc. The experimental work in connection with pneumococcic arthritis shows that injection of the pneumococcus directly into the joint, or injection into a vein, the joint being at the same time injured, frequently results in suppurative arthritis. Subcutaneous injection under similar conditions less frequently results in arthritis. The work of Bezançon and Griffon will be referred to later.

In some cases, too, there has been a history of previous damage to the joints by rheumatism. Lead-poisoning was present in two cases, and in one of these uratic crystals were found in the cartilage of the joint inflamed through the pneumococcus, constituting the point d'appel of Netter. One of my patients was a plumber, though I could not make out any evidence of chronic lead-poisoning; and the man in whom Dr. Hektoen found at autopsy a pneumococcic arthritis of the knee was a painter. Of the influence of the damage to the joint by a mechanical trauma there can be little doubt. Whether previous rheumatism, gout, syphilis, and lead-poisoning also act in this way is less easy of proof, though it would seem to act as a favoring cause in some cases. The possible influence of chronic alcoholism, nephritis, and previous disease in lessening the resisting power of the patient should not be overlooked. In several instances the patients were alcoholics and the pneumonia of the alcoholic type.

For the sake of completeness I give brief abstracts of the cases that I have added to Cave's list.

Case XXXII. (Nicolaysen).[6]—A boy, aged three weeks, was taken, July 30th, with fever, cough, and rapid respiration. August 9th he cried all night as with pain, and his right elbow was found red and tender, the swelling, later, extending down over the forearm. Death occurred a few days later, and the autopsy revealed a double empyema, suppurative pericarditis, bronchitis, and suppurative arthritis of the right elbow. The pneumococcus was found in the blood during life, and after death was found in the pus in the pleuræ and in the joint.

Case XXXIII. (Mühsam).[7]—A laboring man, aged fifty-five years, alcoholic, was taken, August 2, 1897, with pneumonia of the right lower lobe. August 31st the right shoulder-joint was opened, and 200 c.c. of thin fluid pus containing the pneumococcus were removed. The joint was much disintegrated. Notwithstanding the serious and seemingly hopeless condition of the patient at the time of operation he made a slow yet permanent recovery.

Case XXXIV. (Heubner).[8]—A child, aged five months, after a bronchitis and a pneumonia of the upper lobe of the right lung, improved but slowly. No fluid was found on exploratory puncture of the still dull upper lobe. Four weeks from the beginning of the illness the left shoulder became suddenly inflamed, with a rise in temperature. Pus containing the pneumococcus was obtained on free incision. The child recovered.

Case XXXV. (Flament).[9]—Flament reported to the Medical Society of Lille, at its meeting of June 22, 1898, the case of a man, aged fifty-five years, who had a suppurative inflammation of the knee following a pneumonia. The pneumococcus was found in the pus. Under resection the patient recovered.

The next 7 cases are those of Raw.[10] I quote his abstracts verbatim:

Case XXXVI. (Raw).—H. G., aged twenty-eight years, was admitted into Mill Road Infirmary with acute pneumonia of the right lung. The whole lung was involved, and the attack was a very severe one, with

considerable pleurisy. He had his crisis on the eighth day, and was apparently doing well, when, on the eleventh day of his illness, he had a rigor, and was seized with intense pain in the right ear, accompanied by a sudden rise of temperature. Next day a swelling appeared over the second right costal cartilage, with great pain and tenderness. Two days afterward a large abscess rapidly formed over the right buttock. His condition became very critical, and his temperature high and erratic. An incision was made over the swelling on the chest, and was found to be an abscess of the right sternoclavicular joint pointing between the first and second ribs; the abscess of the buttock was drained, giving exit to a large quantity of sweet-smelling pus. The abscess in the middle ear burst the same day, giving great relief. Very careful precautions were taken in examining microscopically and bacteriologically the pus from every source above described, as well as the sputum.

In all cases apparently the same organism, the pneumococcus of Fraenkel, was found in pure culture. The man made a good recovery, and is well to this day. I have no doubt that in this case prompt surgical interference saved his life.

Case XXXVII. (Raw).—T. A., aged fifty-two years, was admitted on January 5, 1900, with severe pain in right side of chest, and profuse, dark expectoration. He had also pain and swelling of right ankle and swelling, with great tenderness, over the right sternoclavicular joint. Next day he was found to have definite pneumonia at the right apex, with effusion at the base.

The joints seem to have swollen before the onset of his pneumonia, and he had suffered from rheumatism on several occasions. As soon as the pus was found in the joints they were freely incised and drained, both articulations being found roughened and bare. The pneumonia ran an ordinary course and his temperature fell, but later he developed an empyema which was also opened and drained. This man had a most severe general infection by pneumococci, and although repeated cultures were made from the pus and sputum no other pathogenic organisms were found except diplococci. After a long illness he made an excellent recovery, his chest quite healed, as also the sternoclavicular joint; the ankle healed up, but the joint remained stiff.

Case XXXVIII. (Raw).—K. F., aged forty-nine years, charwoman, admitted June 11, 1900, with severe pain in right chest and abdomen, with all the symptoms of acute pneumonia. She was an alcoholic, and had a severe struggle until the crisis, which occurred on the seventh day. Two days after this a swelling appeared under the right deltoid muscle, with great pain on movement. A needle was inserted into the joint and pus withdrawn. I freely incised the joint, and let out eighteen ounces of curdy, sweet-smelling pus. I noticed at the operation there was considerable infiltration between the muscles around the joint. Her temperature dropped and she appeared to be doing well for twelve days, when she developed empyema of the right side. This was opened and drained; then a large abscess developed in the abdominal wall, which was drained, but the patient sank into a condition of general pyæmia, and died on the twenty eighth day. Pneumococci in pure culture were obtained in all the samples of pus and sputum.

Case XXXIX. (Raw).—A man, aged twenty-three years, was admitted with an ordinary attack of acute lobar pneumonia of the right

lung. His crisis occurred on the seventh day. Two days afterward he developed a painless swelling of the right knee, with a temperature of 100° F.; a needle drew off clear serous fluid. Under the microscope, however, pneumococci were found in abundance. The joint was aspirated of seven ounces of fluid and firmly strapped. After a slow and tedious convalescence he eventually recovered and walked out with a useful joint.

Case XL. (Raw).—A man, aged forty-three years, a confirmed alcoholic, was admitted in a collapsed condition with acute lobar pneumonia of the right lung. Two days after admission, being the sixth day of the disease, he developed a painless swelling of both knees. A needle showed serofibrinous effusion which, on cultivation and examination, was found to be a pure culture of pneumococci. He died on the following day, and at the post-mortem examination he was found to have a most severe pneumonia, with inflammation of both knee-joints. The organisms recovered from the lung and the knee-joints appeared to be identical.

Case XLI. (Raw).—A man, aged fifty-eight years, also a drunkard, was admitted on April 13, 1900, with acute pneumonia of the right lung. He had his crisis on the seventh day, and appeared to be comfortable, when he was seized with great pain in the right knee and rapid distention of the joint. A needle showed sero-pus, which on being stained revealed pneumococci with well-defined capsules. Dr. Pitt-Taylor opened and drained the joint, which continued to discharge pus for two weeks and eventually healed, leaving the man a very useful joint. He was discharged, recovered, but his knee was fairly stiff, although not in any way ankylosed.

Case XLII. (Raw).—F. D., aged forty-two years, tram driver, was admitted on July 12, 1901, with acute pneumonia of the right lung. On admission he complained of great pain in his right shoulder, which was dusky-red and inflamed, but without any definite fluctuation. He died before any operation could be performed, and careful examinations of the fluid from the shoulder showed pure culture of pneumococci. In this case, also, an extensive intramuscular infiltration was found around the shoulder-joint.

Case XLIII. (Billings and Preble).[11]—A seamstress, aged forty-three years, was taken with chills and became so delirious that she was removed to the Detention Hospital. She was sent a few hours later to the Cook County Hospital, where it was found that she had, in addition to the fever and delirium, a choked disk, a rigid neck and unequal pupils. In the pus obtained by lumbar puncture the diplococcus of pneumonia was found. It was extracellular. The elbow, wrist, knee, and ankle were swollen, red, tender, and painful. From the left wrist a few drops of thick, whitish muco-pus were obtained, showing the pneumococcus; the blood also revealed the same organism. Pericarditis was recognized.

The autopsy (Hektoen) showed pneumococci in the blood, with suppurative inflammation of the meninges of the brain and cord, of the joints, and of the pericardium. The pneumococcus was recovered from each of these locations. There was no involvement of the lung in pneumonia.

Case XLIV. (Preble).[12]—A male, aged thirty-three years, early in January, 1899, had la grippe. January 23d he had a chill, followed

by pain in both sides of the chest, as well as in the right shoulder and all the joints of the left arm. When he came under Dr. Preble's observation he had the evidences of consolidation of the left lower lobe, fluid in the right chest, with some pleural friction. The joints of the right foot, left knee, elbow, wrist and second metacarpophalangeal joint were red, swollen, painful, and tender. Smears and cultures from the left wrist and from the blood showed only the pneumococcus. Death. No autopsy.

Case XLVI. (Billings).[13]—A male, aged twenty-three years, non-alcoholic, who had several years before suffered from pneumonia and also from rheumatism, was taken ill with severe chill, pain in the left chest, followed by fever, cough, yellowish expectoration changing to rusty. After six days he entered the hospital, where was found a consolidation of a portion of the left upper lobe, the process migrating until the entire left lung became involved. The breathing was rapid, the temperature high, reaching normal by lysis on the ninth day after admission to the hospital and the fifteenth from the onset of symptoms. On this day the patient's mind was clear and he appeared convalescent. Previous to this he had been delirious, and while in this state had jumped from the second-story window to the ground, a distance of twelve or fifteen feet. No bones had been broken, but the right shoulder and left knee were injured. On the day after the temperature reached normal the patient complained of great pain in the right shoulder and the left knee, and the latter was swollen and tender, and fluctuated. The metatarsophalangeal joint of the left great toe was also swollen and tender. Symptoms of meningitis now appeared, and three days later, on the thirteenth day of his stay in the hospital, or the nineteenth from the initial chill, he died. No autopsy. A few hours before death the left knee, right shoulder and spinal subarachnoid space were punctured, each yielding a turbid, purulent-looking fluid that coagulated spontaneously. The fluid from each of these places contained an encapsulated diplococcus that stained by Gram. In cultures the growth was typical of the Fraenkel diplococcus.

Case XLVII. (Hektoen, personal communication).—The clinical history is lacking. The patient was a male, aged forty-seven years, by occupation a painter. The anatomical findings showed a lobar pneumonia of the upper and lower lobes of the right lung, acute bronchitis of the left lung, and a purulent synovitis of the left knee-joint. This joint contained a large quantity of thick, creamy pus. The synovial membrane was swollen and reddened, but there were no erosions in any part of the joint. The right knee-joint was normal; smears from the lung, the heart's blood, and the pus in the joints revealed a diplococcus staining by Gram. Cultures from the pus gave a diplococcus staining by Gram and identified as the diplococcus of pneumonia.

Case XLVII. (Allen and Lull).[14]—A woman, aged forty years, was taken with cramps in the abdomen and pain in the left knee. Rheumatism and then gonorrhœa were suspected. No further facts as to her history were obtainable. The urine was negative. The leucocytes, 27,000. On the fifth day the joint was distended, tense, and very painful. The temperature varied from normal to 101° F. The joint was freely opened, irrigated and packed, thick yellowish pus containing only the pneumococcus being evacuated. The temperature rose, and the next day the patient was delirious. An amputation was made in

the lower thigh, well away from the joint and through apparently healthy tissue. There was some temporary improvement, then pus appeared in the wound; there were leucocytosis, chills, and death, with a temperature of 108.2° F. Death occurred seventeen days after the first symptom.

Autopsy (Dr. W. T. Howard) showed the pneumococcus and the staphylococcus pyogenes aureus in the amputation stump, with interstitial myositis and suppuration. No germs were found in the blood or in the heart, lung, liver, spleen, or kidneys. Death, therefore, seemed to be due to toxæmia, and the primary joint infection had arisen through some unrecognized portal of entry of the pneumococcus.

Case XLVIII. (Dr. William E. Quine, personal communication).—The patient was an anæmic, overworked young woman of exemplary habits. Early in February, 1901, she was ill with rheumatism, which had nearly disappeared, when, on March 5th, she had a hard chill, high fever, and a severe sore-throat resembling a phlegmonous inflammation. No pus was found on puncturing the tonsil, but a nearly pure culture of the pneumococcus was obtained from the throat. Other chills followed, and signs of pneumonia of the lower lobe of the right lung appeared, with evidence of an acute endocarditis. There was a suspicion also of a pericarditis. The urine contained albumin, casts, and a microscopical quantity of blood. March 12th the patient was in a nearly moribund condition. A swelling was at this time noticed over the right sternoclavicular articulation. How long it had been forming is not known. Two drachms of thick pus were evacuated, which pus contained only the pneumococcus. The patient died a few hours later.

Case XLIX (Dr. E. F. Wells, personal communication).—A lady, aged thirty-two years, was taken, January 17, 1898, with a chill, followed by fever, pain, cough, expectoration, and all the ordinary symptoms and signs of pneumonia of the lower lobe of the right lung. The attack was one of moderate severity, with a temperature ascending to 104° F., respirations to 32, pulse to 124, and leucocytosis to 24,000. There was no delirium, but after the first three or four days there was noticeable pallor. On the sixth day there were, for several hours, pain and tenderness along the course of the left femoral vein. On the seventh day the temperature began to decline and reached the normal point on the following morning. The pulse, however, remained well above 100, and the patient felt weak and tired. On the morning of the ninth day the left shoulder was reported as sore and painful when moved. In the evening a small, tender swelling was discovered over the left sternoclavicular articulation, which, on the next day had increased to the size of a large hickory-nut, and was reddened and softened. This was incised, giving exit to about three drachms of greenish-yellow pus. The cavity was washed out with peroxide of hydrogen. A seropurulent discharge continued for three or four days, when it ceased and the wound closed, without further symptoms. The pus contained only pneumococci, which were stained by Gram's method. Cultures, also, showed only the pneumococcus. Recovery was perfect, but convalescence was unusually tedious. It is interesting to note that the pain was referred, indefinitely, to "the shoulder," although there was no evidence that this joint was affected.

Case L. (Herrick).—Thomas L., single, aged thirty-two years, laborer, came under my care in the Cook County Hospital, April 10,

1898. His mind was clear, and from him were obtained the following facts: There was no hereditary taint, though several brothers and sisters had died young, the exact cause of death being unknown. The patient had been a free user of beer and whiskey. He had had gonorrhœa and a soft chancre, though no fresh venereal disease for more than two years. He had regarded himself as in good health until four days before, when, after an ordinary "cold," he had a slight chill, began to cough more, and noticed pain in the right axilla. He at once quit work.

On examination the typical physical signs of consolidation of the upper and middle lobes of the right lung were found, the dulness and bronchial breathing, with a few fine moist râles, being accurately limited to this area. The heart and other organs revealed nothing abnormal except that the urine contained a moderate amount of albumin and a few hyaline casts. Its specific gravity was 1021. There was slight icterus. For three days the respiration was rapid, 36 to 50; the pulse varied between 96 and 144, and the temperature from 101° to 104.3° F. On the morning of the seventh day of the illness the temperature was 98° F., and from that time on there was a gradual improvement, though it was not until April 19th, the thirteenth day, that the evening temperature did not rise above 99° F. At this date the breathing was 30, pulse 84; the patient still quite weak. The treatment was by large doses of digitalis, after the method of Petrusco. April 14th, the seventh day of his illness and on the morning of which the temperature was 98° F., the following note is recorded: "Since morning the patient has been complaining of pain in the left elbow, and keeps the left arm quiet. The left elbow is swollen, reddened, tender to pressure, and extremely painful on motion. There is considerable œdema, especially over the external aspect of the joint. There has been no extension of the pneumonic process in the lungs. The heart tones are normal, though the action is rapid and the pulse is rather weak. The urine still contains some albumin." Hot boric-acid dressings were applied to the joint. April 20th there was slight fluctuation; and in the clinic, under aseptic precautions, I withdrew by means of an aspirating syringe about two drachms of a yellow, creamy pus. I withdrew all that I could. Smears were made at once, and showed a diplococcus morphologically like the diplococcus of pneumonia. Further examination of the pus by cultures showed the organism to be the diplococcus pneumonia. No other germs were found. Several specimens of sputum taken at different times during the course of the disease revealed abundant diplococci, but no tubercle bacilli. The joint showed immediate improvement after the aspiration, and from that time there was a gradual return to the normal condition of the elbow. When the patient left the hospital, May 16th, there was no redness or swelling, and but slight pain on firm pressure over the joint. The motion of the elbow was free. On the date of discharge the patient's lung had cleared up, and he was rapidly regaining his strength.

Case LI. (Herrick).—John H., white, aged forty-one years, married, a plumber by trade, enjoyed good health since childhood. He denied syphilis, and had had no sign of gonorrhœa since an attack ten years ago. He had never had any manifestation of lead-poisoning; had indulged rather freely in alcoholics. His father died of pneumonia; his mother and one sister of phthisis.

August 15, 1900, he fell through a trap-door and sprained his left knee, causing great pain and some swelling, and making him drag his leg for a few days. By September 1st he felt all right, and regarded himself as recovered. He then began drinking heavily, and suffered from vomiting, diarrhœa, and some pain on the inner side of the thigh. The history here is rather vague, as the patient was under the influence of liquor most of the time; but he remembers some pain in the thigh, some swelling of both legs, and the vomiting. He was kept in bed by a doctor for a time.

September 18th he began to cough, and had pain in the chest, with fever. He was sent to the Cook County Hospital, where he came under my care September 21st. He was nervous, sleepless, soon delirious, had a coarse tremor. There were dulness, bronchial breathing, and a pleural friction over the lower left chest. The heart was normal as to size and sounds, and was not displaced. The examination of the abdomen revealed nothing abnormal, as also did the examination of the genitalia and lymphatic glands. There was some œdema about either ankle. The urine contained a trace of albumin, but no casts. The temperature for a week ranged from 100° in the morning to 103° F. in the evening; the respirations rose to 40; the pulse averaged 130. The patient ran the course, for a week, of an alcoholic pneumonia, and was seriously ill. He became rapidly emaciated, and, the fever not disappearing by crisis, tuberculosis was suspected. Several examinations of the sputum failed to reveal tubercle bacilli, however, and the lung gradually cleared up. On September 27th a to-and-fro friction rub was heard over the præcordia, thought to be pericardial. It disappeared in twenty-four hours.

October 3d the pulse was 110, respiration 30, temperature 100° F., the lung clearing. On this day he complained of quite severe pain in the left hip and knee. He lay with the thigh partly flexed on the abdomen; no local swelling could be made out in either joint. This pain continued with varying intensity, and was relieved somewhat by hot fomentations and later by extension by a weight and pulley. No local redness, swelling, or œdema could at this time be made out in either the hip or the knee. The temperature remained for four weeks between 98° and 99.8° F.

By November 27th, after the extension had been discontinued for several days, and when the hip showed very limited motion, and this very painful, the left knee had become decidedly swollen and fluctuated. By aspiration 30 c.c. of slightly reddish, thin fluid were withdrawn. A second aspiration was made nine days later and 15 c.c. of a similar fluid withdrawn. The fluid from the joint contained in smears an encapsulated diplococcus staining by Gram, and in cultures was identified as the diplococcus pneumoniæ. The knee was bandaged tightly, and the patient left the hospital December 27, 1900, using a crutch.

In September, 1901, I sent for him to come to my office, and I found him in good general condition, with normal heart, lungs, and abdominal organs. The urine was non-albuminous. There was no blue line on the gums. The left knee was freely movable, and appeared normal in every respect except for a very slight tenderness. The left hip, however, was fixed, though painless. With every movement the pelvis was tilted, and a seeming shortening of the left limb was found by careful

measurement to be apparent rather than real, and due to a tilting of the pelvis. There was no patellar reflex on the left side; it was present on the right. The left thigh was smaller in circumference than the right by three inches; the left leg measured twelve inches, the right twelve and a half. The man walked with a cane, was free from pain, and was ready to do light work. The muscular atrophy and loss of the patellar reflex in the affected limb suggests the possibility of a simultaneous involvement of nerve and joint, or the nerve or the muscle may have been inflamed secondarily. In several autopsy records the muscle has been described as involved in the pneumococcic inflammation. Bezançon and Griffon make the statement that in their experimental work they were struck by the absence of muscular atrophy in the vicinity of the joint, a fact "not in accord with what has been observed in man." Further observations on this point would be interesting.

Case LII. (Herrick).—Walter F., aged twenty-six years; single. Family history negative. December 9, 1901, when in apparently good health, suffered from earache. That night he had a temperature of 103° F., and on the following day was told by his physician that he had pneumonia. There were no chills and no pain in the side. He coughed, but the sputum was scanty. The temperature ranged between 102° and 104° F. December 14th he became delirious, and the next day was brought to the Presbyterian Hospital, and from that time on was under my care.

He was a well-developed and well-nourished man of medium size; was quite delirious. Over the left lower lobe were dulness, bronchial breathing, and increased voice sounds as in croupous pneumonia. A pericardial friction rub, to and fro in character, was best heard in the right third interchondral space. The respiration for three days was between 40 and 50, the pulse 110 to 136, the temperature 102° to 104.6° F. The urine showed some albumin and a few hyaline and granular casts. On the evening of December 17th the temperature fell by crisis, and was practically normal for five days. During these five days the respiration was easy and regular, 28 to the minute, the pulse was never over 90, the mental condition was one of brightness, and the local signs were those of slow resolution.

December 25th he complained of earache, and that night his temperature rose; no new local changes could be made out in the lung, nor was anything abnormal discoverable on examination of the ear, Dr. W. T. Montgomery kindly making this examination for me. The patient's general condition became steadily worse, the mind becoming dull, the tongue dry, the pulse rapid and quick, even to 144, and the temperature never below 103° F., and often nearly 106° F.

The case looked like one of severe septicæmia. An examination of the blood, four drachms being taken from the right median basilic vein, showed no growth on agar plates. December 29th he complained of pain in the right knee. Examination showed very little tenderness to pressure, no redness, but a little fulness, particularly at the inner side of the patella. There was a suspicion of fluctuation. The next day there was more swelling and distinct fluctuation. Exploratory aspiration revealed a thick, creamy, yellow pus. The joint was opened and drained by Dr. D. W. Graham, two ounces of pus being removed. At the same time the left elbow was opened because of redness and tenderness, though no pus was found. No drainage-tube was here inserted.

There was no improvement in the general condition, which was one of high temperature, rapid, often uncountable pulse, dry tongue, delirium, subsultus, involuntary evacuations—in a word, that of a pronounced septicæmia or toxæmia. Death occurred early on the morning of January 1, 1902.

No autopsy was to be obtained, but the house physician, Dr. Loomis, immediately after death made a puncture of the pericardium, drawing off about two ounces of reddish-yellow fluid, which showed no growth in cultures. Blood from the heart also showed no growth on bouillon, gelatin, and blood-serum. The original pus from the puncture of the knee showed in smears an organism in pairs or short chains, the individual organisms varying somewhat in size, the majority being small and somewhat elongated. It stained by Gram's method; no capsules were seen. About ten drops of the pus were injected into the ear vein of a rabbit, but beyond producing a local reaction resembling a dry gangrene there was no result. Cultures on agar, glycerin-agar, bouillon, gelatin, and potato showed reactions that were identical with those of the pneumococcus. Unless transplanted every few days it quickly died out. Cultures from four agar tubes from two to four days old were scraped up, suspended in bouillon, and injected into the posterior ear vein of the same rabbit one week after his first injection with the pus. The animal appeared quite sick inside of twenty-four hours, but recovered. Its failure to cause death of the rabbit may have been due to a lack of virulence, or, in the first inoculation experiment, to the small dose employed, and, in the second, to the partial immunity resulting from the first inoculation.

I have seen two other cases of what were, I am quite sure, pneumococcic infection of a joint during the later days of a croupous pneumonia. As no cultures were made, however, the crucial proof is lacking. The first concerns a female child, aged two and a half years, who ran a typical course of croupous pneumonia, with involvement of the right lower lobe. Crisis on the tenth day. The next day the child cried whenever the left foot was touched, as in bathing. Over the tarsus, just below and in front of the external malleolus, was an area of redness, swelling, and extreme tenderness that appeared to involve a tarsal joint. There was no elevation of temperature. The lung was rapidly clearing. The heart valves were normal. In three days I was sure there was fluid, and urged consultation with a surgeon. This was flatly refused by the parents, who feared an operation and consented to take all responsibility for the non-surgical treatment of the trouble in the foot. In my own mind I was convinced that surgery would be necessary; but, to my surprise, after ten days there was distinct lessening of all evidence of inflammation, and in the course of three weeks the swelling and redness had disappeared. In six weeks the child was up and walking about without a limp.

In a second case, an adult male, the day after the crisis of an alcoholic pneumonia, complained of severe pain over the outer side of the right foot, where were seen some redness and swelling. Movement of the foot

and pressure caused great pain, the inflammation seeming to be in one of the tarsal joints. That night the patient had a convulsion, became delirious, had retraction and stiffness of the neck, with sharp rises of temperature, and died with the manifestations of an acute meningitis. No autopsy was permitted. Here, apparently, was a pneumococcic infection of the joint and of the cerebral meninges due to pneumococcic septicæmia, with metastatic localization in the joints and the meninges.

In adding these 21 cases to the list I follow the rule that Leroux and Cave have adhered to, with the single exception of Oliva's case, and include only such as were proved by direct examination of the fluid to contain the pneumococcus in the joint. Five other cases were, in all likelihood, of the same nature, and might, without straining one's conscience very much, be added to the list. Two in my own practice I have already alluded to. One case is referred to by Lippmann[15] as reported by Bernheim—an old rheumatic alcoholic with a double pneumonia, suppuration in the left scapulohumeral joint, meningitis, and death, the autopsy revealing vegetative endocarditis. Two of Preble's cases could also be safely classed here. The one concerned an adult male, who, several days after recovery from typhoid fever and erysipelas, had a right upper lobe pneumonia, with arthritis of right knee and left shoulder, with several abscesses of the soft parts. No cultures were made from the joints, but from an abscess of the back and from one of the scrotum the pneumococcus was recovered. The patient died, and no autopsy was permitted. His second case was in a child, aged fourteen months, with pneumonia of the left lower lobe. On the third day a swelling of the left hand appeared, with swelling and redness of several of the small joints. Pus from a periosteal abscess over the external condyle of the humerus revealed the pneumococcus. Later, other abscesses in the soft parts appeared, as did an otitis media, and there was a relapse of the pulmonary trouble. Ultimately recovery ensued.

Symptomatology. The clinical manifestations may be briefly described as those common to all acute inflammations of joints. The frequent occurrence of this complication during convalescence from pneumonia, at a time when the patient's mind is clear and the attention of the physician is not attracted too particularly to the lung, causes the complaint of local pain to be recognized by the patient and heeded by the physician. The pain varies in severity from that which is slight and has come on gradually to that which is of extreme severity and of abrupt onset. The tenderness is usually pronounced. The joint becomes rapidly or gradually swollen, and when the accumulation of fluid is great, fluctuation can be detected. There is also, in many cases, periarticular involvement. Redness, superficial tenderness, and wide-spread œdema may show that the inflammation is not confined to the joint proper, but

involves as well the structures about the articulation. The appearance of the joint in these cases is not unlike that seen in many cases of gonorrhœal arthritis, and the resemblance is the more striking when we remember the tendency of each of these forms of arthritis to attack the larger joints, only one or a few joints at a time, and for the inflammation to be permanent and not shifting from one joint to another. The periarticular œdema is more likely to be pronounced in the cases with a subacute course. Here, as shown by clinical and experimental observation, there is greater destruction of joint structures and greater invasion of surrounding tissues.

As regards the diagnosis in the cases with much periarticular swelling, it is to be remembered that the inflammation and the resulting abscess may be near or about the joint, and yet not involve the joint proper. Such periarticular localizations of the pneumococcus have been reported by Gabbi and Puritz.[16] Netter also refers to them. And in the County Hospital recently an autopsy was made on a patient in whom the pus was found to be not in the joint, as had been suspected during life, but in the subdeltoid bursa—a localization referred to as common by Netter. This case—one of Dr. Preble's—was an instance of a croupous pneumonia, with the abscess containing a pure culture of the pneumococcus. In the child with the abscess on the side of the foot—the case which I regarded as involving the joints of the foot—it is possible that the joint itself was not invaded, but that the abscess was periarticular.

The occurrence of an arthritis during the course of a croupous pneumonia, and especially during convalescence from the same, would naturally lead to the suspicion of a pneumococcic inflammation; and color would be lent to this supposition if the patient were an alcoholic or if his affected joint were the seat of a previous trauma or injury from rheumatism or gout. But an arthritis complicating pneumonia need not be due to the pneumococcus. Other organisms may enter the circulation and lodge in the joint. This point is well brought out by Mauclaire,[17] who quotes Smirnow[18] as finding in ten cases of pyarthritis complicating pneumonia five in which were found organisms other than the pneumococcus, such as the typhoid bacillus, the streptococcus, and the staphylococcus. It becomes necessary, therefore, to make an exploratory puncture of the joint, and, by smears, culture, and inoculation, to determine as to the presence of the pneumococcus and its degree of virulence. The existence of fluid and its character is thus determined in doubtful cases—a fact of no slight importance from its influence on prognosis and treatment.

Cases of single or multiple painful joints during or following pneumonia are referred to by Netter, who has seen several. In some of these slight local swelling is seen; in others the affection seems to be

little more than an arthralgia. Spontaneous recovery seems to be the rule.

The constitutional symptoms show great variations. In many cases the symptoms due to the bacteriæmia, or to the involvement of some important structure like the pericardium, pleura, or meninges, completely dominate the picture, and the joint symptoms seem wholly insignificant by comparison. High fever, rapid pulse, dry tongue, delirium—in a word, the clinical picture of a severe septicæmia—are present. Apparently, too, this can be present without true bacterial invasion of the blood, as the case of Allen and Lull seems to show, where toxæmia seemed to be the cause of the profound and fatal constitutional disturbance; and in my own case (Case LII.), though no autopsy was made, the examination of the blood during life did not reveal organisms, though the symptoms were of the most virulent type. In other cases the constitutional symptoms are relatively slight, except that the patient is weak and exhausted from his pneumonia, and makes but a slow convalescence. The joint involvement, when subacute in its course, may have but a slight influence on the temperature or pulse.

Prognosis. The prognosis is, from the nature of things, grave. The primary lung involvement is in itself serious, and the arthritis implies, at least in most cases, a bacteriæmia, with the probability of other metastatic foci of inflammation. The combined toxæmia and involvement of other structures often more vital than the joints—*e. g.*, the pleura, meninges, endocardium, or pericardium—must make the prognosis grave. Of the 52 cases 34 died and 18 recovered—a mortality of over 65 per cent.

Treatment. That pneumococcic infections of other structures are often relatively benign is well known. The prognosis in a pneumococcic empyema is better than where the trouble is due to the streptococcus. The treatment in these cases might, therefore, be less radical than in other cases of pyarthritis. Where, however, the fluid is purulent it would certainly seem wise to incise at once and drain the joint. It would seem to me questionable, however, whether several incisions, with numerous drainage-tubes or gauze drains, with free irrigation—in other words, whether too much manipulation of the joint—is advisable. In many of the acute and most virulent forms there are no solutions of continuity in the synovia or cartilage; the coarse insult to the joint from a radical and unusually thorough operation may be the means of causing local spread of the inflammation or of opening up more freely channels of absorption, so as to aggravate rather than ameliorate constitutional symptoms. There seems to be a general agreement among surgeons that a pleural empyema due to the pneumococcus is best treated by incision and drainage, without much disturbance of the pleura even by irrigation. May not the same be true of a joint?

In one of my cases (Case L.) a simple aspiration of the elbow-joint, with the removal of all the pus that could be withdrawn, resulted in recovery. Widal and Lesné[19] removed two drops of pus for diagnostic purposes from the sternoclavicular joint of their patient; a week later two more drops, the fluid this time seropurulent. Recovery followed in six weeks, which recovery may be called, as they themselves term it, spontaneous. These were cases in which thick, creamy, yellow pus was present. In several cases spontaneous recovery has followed where a thinner fluid, seropurulent or serofibrinous, has been present. In my case (Case LI.) recovery with a good joint followed the removal by two aspirations of a serofibrinous fluid. Netter says that even where there is redness, swelling, and exudate the lesion is susceptible of recovery by simple medical treatment of immobilization and compression. Raw had a recovery by aspiration.

While, therefore, the prognosis, for the reasons above stated, must always be uncertain and generally grave; and while, with pus in the joint, an early, free incision is to be advocated, it is well to remember that with serous exudate, and in a few cases even with purulent exudate, recovery has ensued either spontaneously or by the simpler measures of rest, compression, or aspiration. And we believe that in the arthrotomy, which should be done early when it is indicated, there should be as little damage as possible to the joint structures by unnecessary manipulation.

Pathology. The pneumococcus reaches the joint through the blood-current. The joint is occasionally primarily involved. Five of the reported cases are of this character. In one—that of Allen and Lull—there was no other part of the body infected, nor did the blood, post-mortem, reveal the pneumococcus. This would seem to show the great importance of toxæmia in such cases, this particular one being attended by unusually severe and even fatal constitutional symptoms.

The factor that determines the involvement of a particular joint is not always clear; yet experimentally it has been shown that a joint previously damaged is far more likely to be the seat of the local action of the pneumococcus when it is injected into the blood than one that has not been injured. (Gabbi, Ausset, Zuber.) Clinically, the occurrence of pneumococcic arthritis in joints recently sprained or bruised is so common as to excite comment of all observers and to be looked upon as more than accidental. Joints the seat of rheumatic, gouty, or saturnine damage are, according to some, especially prone to this form of arthritis.

A point of interest, and one not easy of an entirely satisfactory explanation, is the fact that this form of inflammation is especially prone to appear after the crisis of the pneumonia and when the patient seems past danger and well on toward convalescence and presumably immune.

The experimental work of Bezançou and Griffon[20] is in accord with these clinical facts. While working on problems of immunity, and while vaccinating rabbits against pneumococcic infection it was discovered almost by accident that suppurative arthritis occasionally appeared long after the injection of the microbe, and they concluded that pneumococcic arthritis is more likely to appear when inoculation is made with a culture that is attenuated through age, or when inoculation is made with a large dose—a brutal dose—of a virulent culture, but the animal rendered relatively immune by previous vaccinations. Possibly, as has been rather imaginatively expressed by Lippmann, the germ of feeble power having broken into the general circulation is unable to produce a generalized infection, is repelled on all sides, by the other stronger tissues and finally ensconces itself on the serous articular surfaces that are less able to defend themselves than other parts of the body. Leroux calls attention to the fact that this articular localization of the pneumococcus during convalescence from pneumonia is but an exemplification of a general pathological law that microbes of attenuated virulence are prone to lodge readily upon the various serous surfaces and especially upon the articular surfaces of the joints, and that it accords with the clinical observation that the articular determination of infectious diseases appears chiefly during the period of convalescence.

The changes that occur in the joints vary largely with the duration of the inflammation, and also undoubtedly with the virulence of the micro-organisms, as well as the resisting power of the body in general, and in particular the joint structures. In the acute cases often little more is seen than a synovitis, with redness and swelling of the synovia, and the ordinary histological changes of an inflammation of a serous membrane. The exudate varies from a serous or serofibrinous fluid to the more commonly found thick, creamy, yellowish pus, which contains the pneumococcus. In the same patient one joint may contain a purulent and another a serous exudate. In other cases, and particularly those of a subacute or more chronic character, the changes are more extensive and destructive. The cartilage may be eroded, the bone invaded, the ligaments destroyed, the tendon sheaths and muscles in the vicinity of the joint involved, so that the inflammation is a peri-arthritis as well as an arthritis. The destruction may be extreme as in the case—and that an acute one—of Fernet and Lorraine.[21] Here the autopsy showed that the left sternoclavicular joint did not in reality any longer exist. The peri-articular fatty tissues were infiltrated with serum, the muscles were disintegrated and marked with streaks of pus, the ligaments, the synovial membrane, the cartilages were destroyed and the articular surfaces were represented on the side of the clavicle, as well as of the sternum, by rough, denuded bone, exposing the spongy portion.

Strange to say, there was a minimum amount of pus in the joint cavity, though a virulent pneumococcus was found. In the cases of longer standing attempts at regeneration are made, and healing may occur, with more or less deformity from bony outgrowths and from the adhesions of scar tissue. The functions of the joint may, of course, be more or less interfered with in this way. In a rabbit that was killed seven months from the injection of the pneumococcus and six months from the first sign of lameness, the appearances of the joint reminded Bezançon and Griffon of an old fracture with vicious union and exuberant callus.

Conclusions. From my study of, and experience with, arthritis due to the pneumococcus, I would agree with nearly all of the conclusions reached by Leroux, some of which are here practically repeated:

1. It is a rare affection, found oftener in men, sparing no age.

2. It appears oftenest during or shortly after croupous pneumonia, sometimes as late as the third week after the crisis.

3. It may be primary in the joint, and severe and even fatal constitutional symptoms may result from the toxæmia thus induced; in these cases of primary pneumococcic arthritis pulmonary localization may or may not occur.

4. Previous damage to a joint as by trauma, rheumatism, or gout favors the localization.

5. The lesions may be limited to the synovia or may be more extensive, involving the cartilages and bones. The peri-articular structures may be involved. The subacute cases are sometimes highly destructive to the joint, and the same is true of some of the acuter ones.

6. The lesions are usually monarticular (61.5 per cent), the larger joints being oftenest involved. The knee is the joint most frequently affected. The joints of the upper extremity are affected a little oftener than those of the lower, but the difference is insignificant.

7. The condition is recognized by the ordinary signs of an acute or chronic inflammation of a joint. Exploratory aspiration, with bacteriological examination of the fluid, is the only means of recognizing the pneumococcic nature of the inflammation. The gonorrhœal arthritis and peri-arthritis have to be carefully excluded, as well as the arthralgias following pneumonia.

8. The prognosis is grave—mortality 65 per cent.—largely because of the accompanying bacteriæmia and involvement of other more vital parts of the body (meninges, pleura, pericardium, etc.). Yet spontaneous recovery occasionally follows, even where there is a purulent exudate.

9. The cases of suppurative pneumococcic arthritis should be treated by immediate incision and drainage. Serous arthritis may often be healed by aspiration, rest, and compression.

As this paper is going through the press there appears in the *Jahrbuch für Kinderheilkunde*, April 5, 1902, an article by Pfisterer, of Basel, on the same subject. Pfisterer adds several cases seen in children. He does not, however, refer to the monograph of Leroux, by all odds the best article yet written upon the subject.

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A CASE OF JACKSONIAN EPILEPSY CAUSED BY TUMOR OF THE BRAIN RELIEVED BY OPERATION; HEMIPLEGIA AND MUSCULAR ATROPHY; DEATH IN TEN MONTHS.[1]

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The interesting points in this case from the medical point of view are its duration—seven years—the late period at which the symptoms other than Jacksonian epilepsy appeared, and the occurrence of great

Read at the meeting of the College of Physicians of Philadelphia, April 2, 1902.

muscular wasting on the palsied side after operation. The history is as follows:

W. W., an unmarried white man, aged twenty-five years, consulted Dr. Burr in February, 1895. His family history was very bad. His father died of some brain disease accompanied by mental symptoms. One brother was insane for years, and another died of some acute brain disorder. The patient's personal history was good. He had never had any venereal disease and had never used alcohol. He had received an excellent college education, and was filling a position requiring much intelligence when he was taken ill. He dated the onset of his illness from March, 1894, at which time he had an attack described as follows by a friend who was present: Suddenly, and while apparently in good health, the left hand and mouth began to twitch, speech became inarticulate, the jerking movements spread over the entire body, and he became unconscious. The sphincters did not relax, nor was the tongue bitten. There was neither somnolence nor headache after the attack, which lasted about five minutes. During the following year he had seven similar attacks. Their duration varied from five to twenty minutes. They all began in the same way and followed the same course. He also had many attacks of momentary unconsciousness or partial unconsciousness without convulsions.

At my first examination he presented no signs of disease. He was a well-built, healthy looking-man. Gait and station were normal. There was no palsy of the cranial nerves, legs or arms. There was neither ataxia nor tremor. The knee-jerks were normal. The abdominal and thoracic viscera showed no evidence of disease. The urine contained neither albumin, sugar, nor casts, and was of normal specific gravity. His mental condition was good. He was somewhat depressed, but not more so than would be natural in a man who feared he was suffering from a serious malady. Speech was normal and his ability to write (he was right-handed) good.

Two weeks later I saw him in an attack. He suddenly stopped speaking. His eyes became fixed, looking straight forward. The mouth was drawn strongly to the left and the left hand became rigidly extended. Mouth and hand seemed to be affected synchronously. Still conscious, but speechless, he crawled from the sofa to the floor, and the tonic spasm extended to the left leg. In a moment the spasm became clonic and extended to the right side, but was not so severe as on the left, and he lost consciousness. The face was livid, the tongue bitten, the breathing stertorous, and he frothed at the mouth. He was unconscious about one minute and the entire attack lasted about five minutes. After it was over he remembered questions I had asked him at the beginning, and was able to tell how he came to be upon the floor. He had no headache or somnolence after the attack, and was mentally clear.

Dr. Thomas H. Fenton examined his eyes on February 23, 1895, and reported:

"I saw the patient first in March, 1894. The ophthalmoscope showed finer definition defective throughout, optic disks good size, liberally capillarized, but showing some quadrants of pallor, and with

degenerating borders; vessels easily emptied by pressure on globe; slight hypermetropic astigmatism, visual acuity, with and without glasses, good; muscular balance somewhat weakened, insufficiency both lateral and vertical; field of vision for white good, for colors markedly contracted. I made a correction of his optical defect, and three months later found some improvement in the color and definition of the fundus, noting, however, that there was still degeneration of the borders of the optic disks."

On March 15, 1895, Dr. Fenton reported further:

"I have taken his fields again with extreme care, and enclose a copy. I also went over his muscles, but I find no disturbance of muscular balance. The ophthalmoscope shows, especially in the right eye, some slight tortuosity of the superior vessels, with a disturbance of the definition of the visual margins. There is no marked alteration in capillarity. His pupils are fairly active and show nothing noteworthy; his visual acuity is up to the standard for near and far, with and without correcting lenses. I think the fields are really more contracted than is shown in the diagram. They are symmetrically correct, but I think they would bear general contraction."

In February, 1897, Dr. Archibald G. Thomson examined his eyes and found the fundus normal.

He was treated with many drugs with little result. The major convulsions occurred at irregular intervals, sometimes several in a month, sometimes none in several months. The minor attacks of momentary unconsciousness occurred daily, and sometimes oftener. Rarely was he free from attacks of either kind for several weeks. In February, 1900, he had an attack lasting several hours, in which the only symptom was continuous twitching of the left hand. Dr. Thomson examined his eyes again on February 23, 1900, and found that "in the right eye the veins were just becoming a trifle enlarged. There was possibly the faintest evidence of swelling of the disk which was hardly present three days before. In the left eye there was decided evidence of neuritis, especially on the nasal side. As you know, afterward the swelling of the disks developed very rapidly, producing a swelling of 6 or 7 D. in a few weeks."

In the latter part of February he began to complain of headache. He described it as stabbing and shooting, but could not localize it definitely. It would come on suddenly, last for hours, and pass off gradually. In May his eyesight rapidly failed on account of the rapidly increasing choked disk in each eye.

My diagnosis was tumor of the brain. As long as he presented no other symptom than Jacksonian fits I was unwilling to make a positive diagnosis as to the nature of the trouble, but when headache and choked disk were added I felt sure of the existence of a tumor. Its location was more difficult to determine. The motor cortex itself, or

the white matter immediately under it, could scarcely be the primary seat of the disease because of the entire absence of palsy. The preservation of sensibility in all forms, and of the stereognostic faculty excluded the region immediately posterior to the motor area, or, if we accept the motor cortex as being also sensory, then the preservation of sensibility helped to exclude the motor cortex. On the other hand, it seemed the tumor must be situated near the motor cortex or the convulsions would not all have begun locally. A tumor situated at a distance may cause a fit which begins locally, but scarcely a whole series extending over years, all of which begin in the same extremity and run the same course. Hence, I located, for operative purposes, the tumor in the prefrontal lobe, adjacent to but not invading the motor area. A meningeal tumor over the motor area could also have caused the symptoms. As the patient was rapidly growing worse, the headaches becoming more frequent, and the eyesight dimmer, I sent him to Dr. William J. Taylor, who admitted him to the Orthopædic Hospital and Infirmary for Nervous Diseases in June, 1900, with a view to operation. Dr. Archibald Thomson examined his eyes on June 6th, and reported:

"Pupils are equal and react normally. The media are clear. There is marked choked disk in the eye, the swelling about four diopters, with several small hemorrhages over the disk. No hemorrhages apparently in the fundus. The form and color fields are normal. No hemianopsia. At present he does not have any diplopia for distance, but during his illness he complained a great deal of it, although no apparent squint. As he finds it much more difficult to turn the eye to the right than to the left, I take it that he has a weakness of the right external rectus and that when he had his diplopia it was due to a paresis of the right externus."

On June 12, 1900, he was operated on by Dr. William J. Taylor, who will discuss the surgery of the case. Immediately after the operation there was a left-sided hemiplegia, including the face, with hemianæsthesia to touch. Deep pressure he could feel, but could not localize. At first he was speechless, but on the following day he could use single words, though he frequently made mistakes. Some days after the operation the disks were much less swollen and vision had greatly improved.

On the day of his discharge from the hospital, August 6, 1900, he could feel touch, but could not tell whether an object were sharp or blunt. A deep prick he felt as pain, and deep pressure was felt distinctly. There was beginning contracture of the left wrist. Wrist clonus was present on the left side, ankle clonus was absent. The left arm was completely palsied. He could move the left leg a little by action of the hip muscles. Speech was very slow. He neither misused nor mispronounced words, but said he was compelled to stop to think of them. One week after leaving the hospital he had a convulsion affecting the right side only and not accompanied by unconsciousness. (This was the only convulsion of any kind after the operation.) He slowly improved, and on September 4, 1900, his condition was as follows: He could walk, but with distinctly hemiplegic gait. He could slightly flex

and extend the forearm and lift the arm a little by the shoulders, but could not move the fingers, which were strongly flexed upon the palm. There was slight lower left face palsy. The tongue protruded straight. There was wrist clonus and ankle clonus on the left side. The left biceps tendon-jerk was increased. The right knee-jerk was a little too active, the left was very spastic, that is, it was quick, rapid, and the foot did not fall, but was pulled back. Tactile sensibility was normal on the face and somewhat blunted on the left leg and arm. He understood all that was said to him, and could read aloud slowly but understandingly. He could write correctly without difficulty, but had trouble in spelling words aloud. On September 21st he was seized with pain in the frontal region, lasting several hours. He had many similar attacks of headache, in all of which speech was greatly affected, but without increase of palsy. Sometimes the headache was followed by coma lasting several hours without convulsion. In October he began to retrogress rapidly, and by the end of the month he could not walk nor move the arm, and at times he was mildly delirious, at others in coma for several hours. In March there was absolute palsy of the arm and leg, and some palsy of the lower part of the face. The palsy was flaccid and without the slightest rigidity. There was great muscular wasting in the left forearm and hand, some, but not so marked, in the calf, thigh, and shoulder. The wasting came on acutely. The biceps tendon-jerk was very active on the left side. The knee-jerk was scarcely present on either side. Wrist and ankle clonus were absent. On the right there was a slight normal plantar jerk, on the left none. There was complete insensibility to touch, pressure, temperature, and pain on the left arm and leg. The anæsthesia was not bounded by a distinct line, but faded off on the shoulder and neck. On the face sensibility was normal. He was almost blind. The pupils were widely dilated. The bowels were moved only by injections. The bladder was incontinent. The attacks of coma became more frequent, and he finally died in one on April 25, 1901, seven years after the onset of the trouble. A necropsy could not be obtained.

Notwithstanding the absence of a necropsy there is much that is interesting in the case. Though Dr. D. G. McCarthy's and my own microscopical examination of the tissue removed at the operation failed to reveal any evidence of tumor, still I think a tumor was present, but deeply seated. The inflammation present in the part removed may have been caused by a tumor in the neighborhood. The only other diseases that could have caused the Jacksonian fits are idiopathic epilepsy, Bright's disease, and chronic lead-poisoning. The last two were excluded by repeated and careful examination for the other signs and symptoms. In idiopathic epilepsy the fits may in rare cases begin locally, but choked disk never occurs. Surely Jacksonian fits, choked disk, and headache of the kind this man had are sufficient grounds on which to base a diagnosis of tumor. At the operation we were misled by the pathological appearance of the brain, and removed an area of inflammatory tissue, leaving the tumor behind. This is an error which has been made before, and which will occur again.

The muscular wasting is of interest because the influence of the motor cortex on muscular nutrition is still undetermined. In the hemiplegias of infancy there is often retardation of growth upon the palsied side, affecting not only the muscles but also the bones. Not infrequently in hemiplegia occurring in adults there is a gradual decrease in the volume of the paralyzed extremities, and especially the arm. This is always slow in progress, never reaches more than a moderate degree, and is not a true atrophy. It is brought about by disuse, exercise certainly being a stimulus to muscular nutrition, and probably by the smaller volume of the blood, the circulation being less active in palsied parts. There is also sometimes less subdermal fat on the hemiplegic side in cases of old palsy. The wasting in our case was of an entirely different and much rarer kind. It was a true melting away of muscle fibres. It came on acutely nine months after the operation, progressed very rapidly, picked out individual muscles, or rather groups of muscles, in the forearm and hand especially, and with its appearance the contractures disappeared and the deep reflexes were abolished. It is curious that the knee-jerk on the right side was greatly diminished at the same time. The absolute anæsthesia antedated the wasting, and it is probable the two conditions were independent of each other. The wasting resembled that which occurs in acute disease of the anterior horns of the spinal cord.

In recent years quite a number of cases of muscular atrophy occurring in central palsies have been reported. The nature of the disease seems to be of no importance. Wasting may occur after hemorrhage, embolism, or thrombosis, and during the course of a tumor. The location of a central disease also seems to be of no importance, provided it is somewhere in the motor tract. Wasting may follow disease in the basal ganglia, the white matter, or the motor cortex. The duration of the cerebral disease is of some importance. Usually the wasting occurs some weeks or months after the onset of the primary disease, and it may come on at an even later time. A few very early cases have been recorded.

There are several theories to account for true muscular atrophy in cerebral palsy. Charcot held that the descending degeneration of the pyramidal tracts is continued into the anterior horns. But later investigations have shown that there may be atrophy without descending degeneration. Another theory is that the motor cortical cells and certain cells in the basal ganglia have trophic functions. Some authors explain the matter by saying that there may be a dynamic disturbance of the anterior horn cells without visible disease. The weight of evidence is in favor of the opinion that the cells of the anterior horns are the true trophic centres of the muscles. The percentage of cases without evident spinal cord disease, never very large, is growing smaller

with improvements in the methods of examination. If the motor cortex or the basal ganglia exerted a trophic influence the cases should be common instead of rare. The fact that total transverse lesions of the spinal cord high up are not followed by wasting of the legs, unless there is also disease of the lumbar swelling, is also against the existence of a cerebral trophic muscular centre. The whole matter is as yet too obscure for dogmatic statement. Though it is probable that there is always disturbance of the anterior horns, how cerebral disease causes it is unknown.

Apart from these cases local atrophy from traumatic neuritis is not uncommon in hemiplegia. My impression is, though I cannot prove it by statistics, that the nerves in palsied parts are more susceptible than in health. We often see a trifling injury to the shoulder, which in a healthy man would soon be recovered from, followed in hemiplegics by neuritis and atrophy. Local atrophy may also be caused by the neuritis associated with the arthritis which occurs in hemiplegia. Indeed, arthritis has been claimed to be the cause of the general wasting, but this seems hardly true.

Another rather unusual point in the case is the long duration of the disease, from March, 1894, until February, 1900, before any other symptom other than the fits appeared. As a rule, the march of cerebral disease is much more rapid.

Operation, June 12, 1900, by Dr. William J. Taylor.

A large osteoplastic flap in the right parietal region over the Rolandic area was made by means of Pyle's chisels. The time consumed in opening the skull was thirty minutes. The dura was very tense, but more so over the site of the supposed tumor. There was no pulsation when the dura was opened, but there was great tension, and when the dura was cut and turned down a mass of brain tissue immediately presented itself in the pre-Rolandic region and pushed outward to such an extent that it was presumed to be a tumor. The exact topography of the brain could not be definitely determined, as the amount of tension and protrusion of the substance of the brain prevented it. An effort was made to enucleate this protruding mass, but it was found to be impossible, as it had no distinct outline. A large mass, however, was taken out, partly by cutting and partly by scooping with the fingers and a spoon, the whole mass removed being about the size of a small hen's egg. This did not have the same feel as the surrounding tissue, being distinctly more dense and easily separated. It was immediately put in 5 per cent. formalin for microscopical examination. The hemorrhage at a few places was quite profuse, and especially where the larger veins of the pia were torn. This was controlled by silk ligature, and the oozing from the surface and from the cavity from which the brain tissue had been removed was easily checked by a small amount of iodoform gauze packing. The dura was then carefully sutured with silk, the iodoform gauze removed, and the whole wound in the dura accurately approximated except at the anterior border, for

here the pressure of the underlying brain tissue was so great that this could not be done. The wound was then closed by silkworm-gut sutures. Following the operation his recovery was continuous and uneventful. His temperature, at no time high, speedily reached normal, and although for a number of days there was quite a free discharge of blood and broken-down brain tissue, this gradually lessened until it finally ceased. His appetite was good, he slept well, and had only occasional twinges of headache. Following the operation there was total palsy of the left side. He was examined daily from the neurological stand-point by Dr. Burr, who tested him both as to sensation and reflexes. Surgically he was well in ten days.

For the slight pains in his head he was ordered inunctions of mercurial ointment, which had in the past relieved him.

The pathological findings in this case have been to me most perplexing, for I was quite certain we had had to deal with a subcortical infiltrating growth, and so believed until the report of the microscopical examination was made. The brain bulged immediately the dura was opened, and it was thought that the protruding mass was more dense than the surrounding cortex. The gray matter was discolored, not normal in appearance, and, although there were no distinct limits to this supposed growth, it separated easily and seemed of different texture.

This apparent change in the cerebral substance must have been caused by the congestion of the intracranial pressure and to the manipulation during the operation. I firmly believe a tumor was present in the deeper structures, but of such a density that it gave no evidence of its presence by palpation.

Some years ago, in assisting Dr. Keen in an operation upon a case of tumor of the cerebellum, search was made in various directions with a probe, and no difference in resistance or density whatever could be demonstrated, yet at the death of the patient some six weeks afterward a large sarcoma was found and in such a portion that the probe must have passed completely through it in several directions. I have never yet seen such a condition of tension and protrusion of the cerebral substance after the dura was opened, unless a distinct new-growth was found at subsequent autopsy. I regret extremely that no examination could be obtained in this case to demonstrate the correctness of this assertion.

The cortex and the substance of the brain are both so extremely sensitive to the gentlest manipulations, and changes in their color and appearance occur so rapidly, that it may be difficult to say positively at the time of operation whether there be true pathological changes. This was the case in one instance where the amount of intradural pressure was so great that the cortex was lacerated by being pressed against the cut edge of the dura, and it was only after some of the bruised tissue was placed under the microscope that its true nature could be absolutely demonstrated.

Certainly we have very much yet to learn concerning the conditions

found in these cases of suspected cerebral new-growth and of the macroscopical appearance of the cortex and underlying tissues.

Remarks. There are certain points in the surgical treatment of tumors of the brain, and particularly in the technique of operation, which are of great interest.

An osteoplastic flap which makes a large opening in the skull should always be employed. This permits of careful examination of the dura before it is opened and before there is bulging of the brain. In cases of great intracranial tension this permits of the examination of a wide area, and can be done almost as quickly as if the opening were made by a large trephine (from one and one-half to two inches in diameter). It gives greater space in which to work, and does not necessitate the use of a rongeur forceps to cut away the edges of the bone. It enables this bone flap to be replaced, thus covering the opening in the skull with a solid protection, and prevents the danger of injury to the brain by subsequent accidents. A small trephined opening should be made at one of the angles of the incision to test the thickness of the skull, and when this is ascertained the chisel may be used with greater speed and without danger of doing damage to the dura. The electric engine, if of sufficient power, is the ideal method of making this flap, and the reason why it is not more generally used is from want of familiarity with it on the part of the surgeon. The objections which have been raised to it have been the danger of sepsis, but this I consider easily avoided by care in manipulating the machine, and the difficulty in controlling the speed and movements of the cutting instruments. The use of the chisel and mallet is undoubtedly very satisfactory, but has several disadvantages. The first is the length of time which it takes to open the large flap in the skull—this varies, according to the thickness of the bone, from thirty to fifty minutes, working as rapidly as it is safe to do —because we must bear in mind the possibility of the chisel slipping through and wounding the dura and brain. Although it is said that the hammering of the mallet and continual tapping and knocking against the bone does no harm, I cannot see why damage is not done if this is kept up for any length of time. We know what severe headache and how much disturbance would be produced to our own heads if such a method were used, and I think anything that will get rid of this is a distinct advantage.

Hemorrhage of the scalp is frequently very severe and often difficult to control, and particularly is this the case in dural growths, where just the opposite condition would be expected. Usually hæmostatic forceps are sufficient, but it is my intention in the next operation for suspected dural growth with great congestion of the vessels of the scalp to use catgut basting threads to control the bleeding from both sides of the incision in the scalp. Horsley's bone putty is of the greatest

value in controlling the bleeding from the bone, and may be used freely while the chiselling is being done. New-growths of the dura in my experience have always been accompanied by a very congested scalp, from which the hemorrhage is most profuse, and it is very pronounced also from the vessels in the dura and from the small penetrating vessels between the dura and the inner surface of the skull. I have seen but one case of new-growth of the dura, and that a fibroma of many years' standing, recover after operation. All the others, now a considerable number, have died of hemorrhage, none living longer than eight or ten hours after the operation, and yet this is remarkable, as in all of them the growth was absolutely limited, not attached to the substance of the brain itself and easily shelled out. On the other hand, I have seen case after case recover where the growth was infiltrated and deep in the substance of the brain itself, and I always feel that the chance of operative recovery in these cases is very good, but the likelihood of recurrence and ultimate destruction of the patient by the growth is, of course, very certain.

In the future I propose in all instances of dural growths to baste the edges of the wound in the scalp, to open the bone quickly with a chisel, or, preferably, with the electric engine, and raise a large osteoplastic flap. Now, if there be much free hemorrhage from the vessels of the dura, and, as a rule, this hemorrhage is from all over the surface, and not from any one or two large vessels, I propose to pack the wound with several layers of gauze, replace the bone flap and bind it tightly to the skull and wait for a couple of days before proceeding to take out the growth. At the end of this time the bone flap is again to be turned back, the dura opened, and the tumor removed.

I am quite confident that many cases of operation for brain tumor are unsuccessful surgically from our desire to complete the operation at one sitting, and that if we would exercise a little more care in guarding against hemorrhage, and especially venous hemorrhage, our results would be better. I have repeatedly seen death occur from venous hemorrhage from the dura and scalp; it is very difficult to control by ligature and clamp, and the prostration generally seems to be out of all proportion to the quantity of blood lost. In other parts of the body I have frequently seen much greater hemorrhage without the same collapse. The long-standing congestion incident to intracranial pressure seems to destroy the contractility of the vessels.

TWO CASES OF PARTIAL INTERNAL HYDROCEPHALUS FROM CLOSURE OF THE INTERVENTRICULAR PASSAGES:

WITH REMARKS ON BILATERAL CONTRACTURES CAUSED BY A UNILATERAL CEREBRAL LESION.[1]

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Internal hydrocephalus is not a very uncommon finding at necropsy, but the cause of the increase in the amount of the cerebrospinal fluid within the ventricles has often eluded detection.

Two cases that have come under my observation, and have been studied by means of microscopical sections, have shown that the hydrocephalus was the result of closure of the interventricular passages, each case being one of partial dilatation of the ventricular cavity.

Partial internal hydrocephalus is more uncommon than is the form of the disease in which all the ventricles of the brain are implicated, and affords a better opportunity for determining the location of the primary lesion.

It is not necessary to study the different works on hydrocephalus very exhaustively to find that actually observed lesions are much rarer than theories explanatory of the causes of hydrocephalus. Oppenheim,[2] in the recent third edition of his text-book, remarks that we have very little positive knowledge regarding the pathogenesis of congenital hydrocephalus. It is assumed, he says, that an inflammatory condition of the ventricular ependyma, or an occlusion of the communicating passages between the ventricles, or between the ventricles and the subarachnoid space, is the cause. It is certain that this occlusion may be a cause of congenital hydrocephalus, but it is not known how often it occurs. Great importance is attributed to it by d'Astros, Boenninghaus and Dexler, and pathological findings showing that occlusion of these spaces may cause hydrocephalus are reported by Luschka, Monro, Neurath, and Bourneville and Noir.

Birch-Hirschfeld[3] and Ziegler[4] also say that the cause of internal congenital hydrocephalus is obscure. They refer to the various theories offered, and Ziegler states that in a few cases of unilateral hydrocephalus the foramen of Monro has been found closed, but he does not mention the names of those who reported these cases.

[1] Read, in abstract, at the meeting of the American Neurological Association, June, 1902.
[2] Lehrbuch der Nervenkrankheiten, third German edition, p. 811.
[3] Lehrbuch der pathologischen Anatomie. [4] Lehrbuch der speciellen path. Anatomie.

Dexler[1] has studied internal hydrocephalus in the horse, and believes that the condition in this animal is caused by occlusion of the aqueduct of Sylvius.

In the case of hydrocephalus in a child, published by Bourneville and Noir,[2] the aqueduct of Sylvius was completely obliterated and the fourth ventricle was only slightly dilated. A microscopical examination of the tissues apparently was not made.

Neurath's[3] case was one of occlusion of the foramen of Magendie.

A case similar to the second case reported by me in this paper has recently been placed on record by Touche.[4] The patient, a child, was in perfect health until the age of four years. At this period of its life it had repeated convulsions, and the head gradually increased in size, and both sides of the body became paralyzed. The lower limbs remained paralyzed, but some power was regained in the upper limbs. The patient lived to be twenty-nine years old. At the necropsy the

FIG. 1.

Unilateral internal hydrocephalus, causing bilateral contracture. Photograph taken after death. (Case 1.)

fourth ventricle was found to be of normal size, but the aqueduct of Sylvius was completely obliterated, and the third and lateral ventricles were greatly dilated. A microscopical examination of the specimens is promised.

A case of unilateral hydrocephalus has recently been reported by W. C. White.[5] A woman, seventy-four years of age, had repeated hemiplegic attacks of comparatively short duration. The limbs on the paralyzed side were one centimetre less in size than those on the opposite side. The hemiplegic attacks had been diagnosed during life as the result of embolism. Intense unilateral internal hydrocephalus was found, the only causative lesion being obstruction in the left

[1] Neurologisches Centralblatt, 1899, p. 977.
[2] Le Progrès Méd., July 14, 1900, p. 17.
[3] Neurologisches Centralblatt, 1896, p. 87.
[4] Bulletins et Mémoires de la Soc. Méd. des Hôpitaux de Paris, 1902, No. 7, p. 141.
[5] W. C. White. American Journal of Insanity, vol. lviii., No. 3, p. 503.

choroid plexus. The foramen of Monro was patent. White refers to a case of unilateral hydrocephalus following tapping for congenital hydrocephalus reported by Baskett.

The first case that I report in this paper was one of unilateral internal hydrocephalus. The right cerebral hemisphere was a mere sac, while the left was normal. Bilateral contracture from this unilateral cerebral lesion was very intense. Bilateral contracture from

FIG. 2.

Unilateral internal hydrocephalus, causing bilateral contracture. Photograph taken after death. (Case 1.)

unilateral lesion is uncommon. The patient was an inmate of the New Jersey Training School for Feeble-minded Children. For the photographs (Figs. 1 and 2) I am indebted to the principal of the school, Mr. E. R. Johnstone.

Little is known of the history and clinical condition of E. R. At the time of death he was fourteen years and eight months old, and had been in the New Jersey Training School for Feeble-minded Children four and a half years. He came from the Hudson County Almshouse, and his parents were unknown. He was said to have had no convulsions during the time he was at the almshouse. He walked when he first came to the training school, but his gait was peculiar, and he went up and down stairs with difficulty. He was an idiot, and was never heard to speak. His ocular condition was unknown.

The following notes were made by Dr. Wilson, December, 1899. "The record of April 1, 1897, says: Ezra was quite sick last month, and was in bed for a number of days. Since then he has been more helpless than usual, and does not stand or walk.

"He has become more helpless the past year, so that he could not sit up straight. Since June, 1897, he has been bedfast."

Notes by Dr. Corson, August, 1897: "When E. R. was admitted he could walk and help himself quite a little, but since his last sickness he is entirely helpless; cannot walk, stand, or sit up, but lies down all the time. He had five spasms in the month of July."

The boy had several severe convulsions during the week ending December 9, 1899, and had been having them for at least two or three years. He died December 10, 1899. I never saw the boy during his life.

The necropsy was made by me Tuesday, December 12, 1899, at 10.30 A.M. I am indebted to Dr. C. W. Burr for the pathological material. My notes are as follows:

The left lower limb is firmly contractured at the knee and hip, so that the posterior part of the left leg is closely drawn to the posterior part of the left thigh. The left thigh is contractured on the pelvis to a right angle with the latter. The left leg can scarcely be extended at all at the knee, and the left thigh cannot be extended at the hip beyond a right angle with the pelvis, and when the left thigh is moved the pelvis is moved with it. The right leg lies at a right angle with the right thigh and cannot be extended beyond a right angle. The right thigh lies at an oblique angle with the pelvis, and the movement at the hip-joint is exceedingly limited. The left lower limb is much smaller in circumference than the right. The middle of the left leg measures 13 centimetres (5⅛ inches) in circumference; the middle of the right leg measures 15 centimetres (6 inches) in circumference; the middle of the left thigh measures 18 centimetres (7⅛ inches) in circumference; the middle of the right thigh measures 22.5 centimetres (8⅞ inches) in circumference; the right thigh from the great trochanter to the head of the fibula measures 28 centimetres (11 inches); the left thigh measures 28 centimetres (11 inches); the right leg from the head of the fibula to the external malleolus measures 28 centimetres (11 inches); the left, 28 centimetres (11 inches). The left foot is smaller than the right, and the fourth toe is almost the same size as the fifth toe on the left side.

The right arm from the greater tuberosity of the humerus to the external condyle measures 23 centimetres (9 inches); the left, 22 centimetres (8⅝ inches); the right forearm from the external condyle to the styloid process of the radius measures 18 centimetres (7⅛ inches); the left, 16.5 centimetres (6½ inches). The middle of the left forearm measures 10 centimetres (4 inches) in circumference; the middle of the right forearm, 10.5 centimetres (4⅛ inches) in circumference; the middle of the left arm, 11.5 centimetres (4½ inches) in circumference; the middle of the right arm, 15.5 centimetres (6¼ inches) in circumference.

The right upper limb is fully extended, but the fingers show slight contracture. When the right hand is flexed on the forearm the fingers can be fully extended, but when the right hand is extended the fingers are flexed and cannot be extended—*i. e.*, the flexor tendons are shortened.

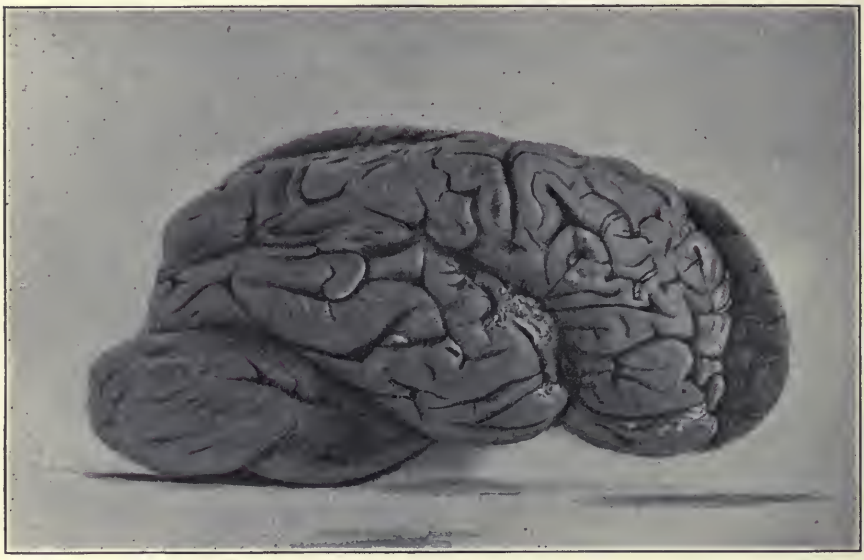
The ends of the fingers of the right hand are very blue. The left arm is firmly drawn to the side of the thorax, and can only be moved slightly. The left forearm is at an acute angle with the left arm, and cannot be extended at all. The fingers are mainly in extension, although there is a tendency to flexion.

The thorax is markedly pigeon-breasted, but other signs of rickets are not very evident.

The circumference of the head is 46.5 centimetres (18¼ inches). The distance from glabella to inion is 28 centimetres (11 inches). The lower part of the face is protruding. The forehead is narrow. The pupils are equal. The left corner of the mouth is slightly higher than the right, as though facial contracture were present on the left side.

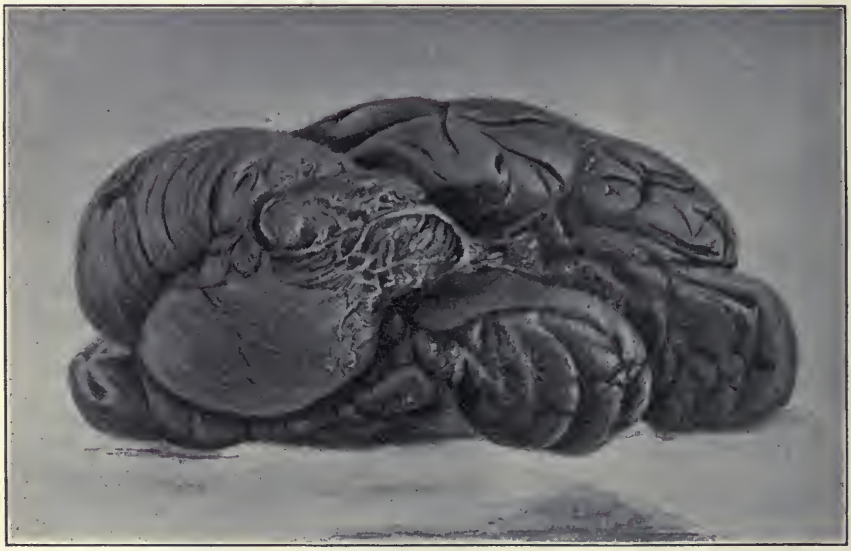
The skull is exceedingly thick, especially in the right frontal region,

FIG. 3.



Brain from a case of internal hydroccphalus of the right cerebral hemisphere. The right cerebral hemisphere was much smaller than the left, and was merely a thin-walled sac. (Case 1)

FIG. 4.



Basal aspect of brain from a case of internal hydrocephalus of the right cerebral hemisphere. The left lateral lobe of the cerebellum is much smaller than the right. (Case 1.)

where it measures 1.2 centimetres (½ inch). Before the dura is cut the frontal lobe on the right side is much less prominent than that on the left side. The brain is not very œdematous. The right cerebral hemisphere measures 15 centimetres (6 inches); the left, 16.5 centimetres (6½ inches). The resistance to the finger on palpation is much less over the frontal area of the right side than over the corresponding area of the left side, while the brain is within the cranium. The entire right cerebral hemisphere forms the wall of a cyst. (Figs. 3 and 4). The weight of the brain is 26.5 ounces. The cerebro-spinal fluid on the exterior of the brain is not abnormal in amount. There is a distinct kyphosis involving the entire vertebral column.

The pericardial fluid is small in amount. The heart weighs 43 ounces. A chicken-fat clot is found in the right ventricle. The tricuspid valve is normal. The wall of the right ventricle is thin. The pulmonary valves are normal. A chicken-fat clot is found in the left ventricle. The aortic valves are normal.

No excess of fluid and no adhesions are found in the pleural cavities. The right lung weighs 4 ounces and is crepitant throughout. A piece of this lung placed in water floats. The left lung is crepitant and shows hypostatic congestion. Weight of left lung is 7.5 ounces.

The liver extends to within two fingers' breadth of the last rib. The liver on its under surface and the adjoining structures are deeply stained with bile. Numerous apparently fatty areas are found in the liver. The weight of the liver is 14.5 ounces.

The right kidney contains numerous cysts and also a pus cavity. One of the cavities is filled with a cheesy granular mass. The right kidney weighs 2.5 ounces.

The right suprarenal body appears to be tuberculous.

The left kidney is much larger than the right. The capsule strips easily on each kidney, and no cysts are found in the left kidney. The weight of the left kidney is 4.5 ounces. The left suprarenal body is normal.

The spleen is small and apparently normal in appearance. It weighs 1.5 ounces.

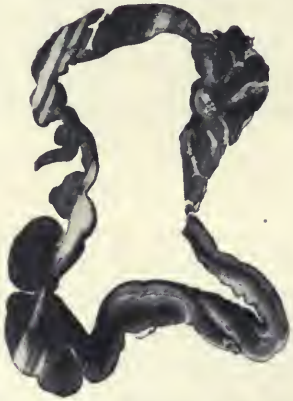
The wall of the bladder is not thickened and is filled with purulent urine.

A series of microscopical sections of the basal ganglia of the right cerebral hemisphere and sections of the pons and parts below were made. The structures of this cerebral hemisphere were found much atrophied. The choroid plexus was much thickened at the right foramen of Monro, and contained numerous masses of cells with round nuclei. A nodule, in continuity with the external wall of the foramen, projected into the foramen. This nodule at one part was bordered by cells with round nuclei several layers deep, and these were evidently derived from the ependymal lining. Similar layers of cells, derived from the ventricular ependyma, bordered the external wall of the foramen and the adjoining parts. The nodule was composed of tissue like that of the brain substance, although its structure resembled also fibrous connective tissue. The inner wall of the right foramen of Monro contained a small nodule in which were many cells with round nuclei, and the nodule projected slightly into the foramen. The alteration of the walls of the left foramen of Monro was slight. The pyramidal tract on the right side of the pons was much smaller than

that on the left, but the bundles of fibres present in the pyramidal tract on the right side were very slightly degenerated, as shown by the Weigert hæmatoxylin stain. The right anterior pyramid was only slightly degenerated, but it was smaller than the left. The left crossed pyramidal tract in the spinal cord was slightly degenerated. The right crossed pyramidal tract in the spinal cord appeared a little less deeply stained by the Weigert hæmatoxylin method than the surrounding parts of the antero-lateral column. The nerve cell bodies in the anterior horns of the cervical and lumbar regions were equally numerous on the two sides and apparently normal in form and number.

SUMMARY. The patient, a boy, was fourteen years and eight months old at the time of death. Little is known of his history, as he had come from an almshouse. Four years before death he had been able to walk with difficulty and to ascend stairs, but he gradually lost this power and became bedridden. Contractures were very pronounced in

FIG. 5.



Photograph of a microscopical frontal section of the right occipital lobe (natural size), showing great distention of the posterior horn of the lateral ventricle. The walls of the posterior horn have become approximated during the process of hardening. (Case 1.)

the left limbs, and also, but to a less extent, in the right lower limb and fingers of the right hand. The right cerebral ventricle was intensely dilated, so that the ventricular wall in some places was very thin, the occipital lobe at parts being only $\frac{1}{8}$ inch thick. (Fig. 5.) The right internal hydrocephalus was the result of partial closure of the right foramen of Monro from inflammatory changes about this foramen, and the condition must have been congenital or have developed early in life, as shown especially by the arrest of development of the left upper limb. The cause of these inflammatory changes and proliferation of neuroglia at the foramen of Monro is unknown, but it may possibly have been the result of tuberculosis, as a condition of some of the viscera suggestive of tuberculosis was found. Anglade[1] has described neurogliar pro-

[1] Revue Neurologique, February 15, 1902, p. 113.

liferation in the walls of the ventricles, occurring in cases of general tuberculosis, and produced by the toxin of the tubercle bacillus. This neurogliar proliferation resembles very closely that found in cases of cerebral syphilis or paretic dementia. These ependymal nodules do not contain bacilli. Probably there are many causes for neurogliar proliferation of the ventricles.

Notwithstanding the very intense muscular atrophy in this case the cell bodies of the anterior horns of the lumbar and cervical regions appeared to be normal. This finding is important and shows the difficulty of explaining muscular atrophy in hemiplegia as a result of tertiary degeneration—*i. e.*, a degeneration of the cell-bodies of the anterior horns of the spinal cord resulting from the degeneration of the pyramidal tract.

Bilateral contracture from unilateral cerebral lesion is not mentioned in most of the text-books, and is of rare occurrence, especially in the intensity observed in my case. It seems to be almost unknown outside of the French school.

Brissaud,[1] in his monograph on hemiplegic contracture, published in 1880, refers to an observation of Poumeau, reported by Hallopeau,[2] in which a hemiplegic became paralyzed on the "sound" side. Hallopeau believed that the extension of the paralysis was the result of extension of secondary myelitis. In this monograph Brissaud stated that there were many hemiplegic women in the Salpêtrière who after a certain number of years had become paralyzed, and the paraplegia was complicated by contracture to such a degree that the thighs were drawn against the abdomen and the chin touched the knees, and extension of the lower limbs had become impossible. He gives two illustrations of this bilateral paralysis, in each of which one lower limb was considerably more contractured than the other. Brissaud thought that these cases were not very rare, but as regards the pathology he could merely say that some day we should learn the cause of this bilateral paralysis.

Paul Dignat,[3] writing in 1883, remarked that secondary contracture is not always limited to the hemiplegic side. In the great majority of cases, he says, it is found only in the limbs of the paralyzed side, but in some cases it develops in both lower limbs. Cases of this character are relatively rare, and in this statement he seems to disagree with Brissaud, who apparently regarded them as more common than did Dignat. The latter refers to Hallopeau's case, in which all four limbs were contractured, the hemiplegia of the left side having existed since childhood. A cyst was found within the right parietal lobe. He

[1] "Recherches anatomo-path. et phys. sur la contracture permanente des hémiplégiques," par E. Brissaud, Paris, 1880, p. 76.

[2] Arch. gén. de Méd., 187?, p. 449.

[3] Le Progrès Médical, 1883, vol. ii. p. 802.

refers to two similar cases with necropsy, published by Pitres,[1] and to a case published by Féré[2] without necropsy, and reports two cases himself without necropsy.

In one of his cases the patient was eighty-seven years of age, and the hemiplegia had existed for a year, and this case shows that bilateral contracture is not confined to those cases in which the hemiplegia develops in childhood.

Marie[3] refers to the contracture of both lower limbs occurring in hemiplegia, but he gives no examples of this except in the picture he borrows from Brissaud's monograph published in 1880.

One of the most recent works on nervous diseases is by Dejerine.[4] He mentions Hallopeau, Brissaud, Pitres, and Dignat as having observed contracture of the "sound" side in hemiplegia, but he gives no references to recent observations on this subject.

Brissaud[5] asserts that contracture is never found in the upper limb on the "sound" side, and my case alone would show that this statement is erroneous.

The explanation for the bilateral contracture in hemiplegia is to be found in the innervation of both sides of the body from each side of the brain. There can be no doubt that each cerebral hemisphere innervates both sides of the body, but the fibres innervating the so-called sound side are fewer in number, and therefore the contracture on this side, when it occurs, is less intense than on the more paralyzed side, and this was the condition in my case.

Von Monakow[6] refers to the remarkable fact that the intensity of contracture need not be proportional to the number of degenerated pyramidal fibres; in other words, that sometimes partial interruption of the pyramidal tract may cause a more intense contracture than complete destruction of this tract. The contracture in partial destruction of the tract is the result of irritation of the remaining pyramidal fibres and of the partial loss of inhibition through degeneration of some of the fibres. Von Monakow accepts the teaching of Exner and Sternberg, that excito-motor ("bahnende") fibres exist in the central nervous system as well as depresso-motor fibres, and by irritation of the former the muscular tonus may be exaggerated and contracture result. The excito-motor fibres are contained in the pyramidal tract, but are not confined to this tract.

The bilateral contracture in my case possibly may be explained by a partial loss of cerebral inhibition, as a result of which the muscular

[1] Soc. de Biol., 1880, and Soc. Anat., 1881.

[2] Archives de Neurologie, 1882, No. 10, p. 61.

[3] Vorlesungen über die Krankheiten des Rückenmarkes (translated from the French), pp. 25, 27.

[4] Sémiologie du Système nerveux, p. 486.

[5] Traité de Médecine, p. 41.

[6] Gehirnpathologie, p. 302.

tonus was exaggerated, this exaggeration being also occasioned in part by irritation of the excito-motor fibres. The early age at which the hydrocephalus developed may have aided in the increase of muscular tonicity. The pyramidal tract from the right cerebral hemisphere was only slightly degenerated, and the case is proof, therefore, of the correctness of von Monakow's statement, that partial interruption of the motor tract may cause a more intense contracture than complete destruction of this tract.

The second case that I report was in the service of Dr. C. K. Mills, at the Philadelphia Hospital, and I am indebted to him for the clinical notes and the pathological material. I saw the patient with Dr. Mills many times. The internal hydrocephalus was the result of closure of the aqueduct of Sylvius by proliferation of the neuroglia, and caused the symptoms of cerebellar tumor. The ventricles, except the fourth, were much dilated, the fourth being of normal size.

H. C. was admitted to the Philadelphia Hospital on October 28, 1901. He was a well-developed youth, aged nineteen years. He said that he had had slight headache once or twice a week since he was a child, and each attack of headache was associated with vomiting. About July, 1901, the headaches became more intense, although they did not increase in frequency. The vomiting continued, and he now began to have difficulty in walking. He felt dizzy at times, and staggered like a drunken man. This disturbance of gait came on suddenly, and had persisted. He did not have pain in the eyes, and had always slept well. While lying on his back he occasionally felt dizzy, and the dizziness was relieved by turning on his side.

He had been a constant cigarette smoker, using as many as thirty to fifty cigarettes in a day. He used coffee and tea to excess, and had been a moderate drinker of alcohol. He denied all venereal disease.

An examination made October 30, 1901, gave the following results: The eyes show some exophthalmos, which patient asserts has always been present. He has always been myopic. The irides react to light and in accommodation. The tongue is protruded straight, and shows slight tremors. No palsy of the muscles of the arms is detected. The grip of the hands is fair. Both knee-jerks are exaggerated, but no ankle clonus is obtained. Slight patellar clonus is present on each side. The muscle-jerks are increased. The Babinski reflex is absent on each side. The station with feet apart is good, but with feet together is poor, and sway is not increased by closure of the eyelids. The gait is unsteady, and at times he has to catch hold of the bed to keep from falling. Sensation to touch and pain seems normal.

Notes by Dr. de Schweinitz are as follows: "The patient has always been myopic. The myopia is between 3 and 4 diopters. In each eye there is well-marked beginning optic neuritis. Arteries about normal in size. Veins are tortuous. On right side a few small hemorrhages down from disk are found. The neuritis is about even on the two sides. Reactions of irides are normal. The form fields are normal. Rotation of eyes is normal. The patient has had double vision."

January 2, 1902. The patient to-night had a slight tremor of the muscles of the arms and face, lasting a few seconds; this was followed by unconsciousness, stertorous breathing, and irregular and rapid pulse. He became cyanotic. The saliva flowed from the mouth, and slight nystagmus of both eyes, lasting about five minutes, occurred during the attack. The pupils were contracted. The pulse at the beginning of the attack was of good tension, but later became very rapid and weak, and stopped about four minutes after cessation of breathing. The pupils became dilated as the pulse became rapid.

The patient died at 7.25 P.M. January 2, 1902. The necropsy was made by Dr. F. J. Kalteyer, January 3, 1902.

Pathological Diagnosis. Œdema and congestion of the lungs; internal hydrocephalus.

On removing the skullcap, which was extremely thin, the brain substance and its membranes bulged outward. On the internal surface of the skullcap the moulding of the convolutions of the brain could be distinctly made out. The third and lateral ventricles of the brain are distended with clear fluid having a specific gravity of 1010. The aqueduct of Sylvius is not patulous.

SUMMARY. The patient, a boy, aged nineteen years at the time of death, had had some headache once or twice a week, with vomiting, since childhood; but about six months before death the headaches became severe, and cerebellar gait was observed. Dizziness was also experienced, especially when the patient laid on his back. This dizziness was probably the result of pressure of the distended cerebral ventricles on the cerebellum. Slight exophthalmos was observed. Distinct optic neuritis was present in each eye. The knee-jerks were exaggerated. Death occurred suddenly.

The skull was very thin—hardly thicker than a sheet of paper at the sides of the calvarium. The cerebral ventricles were much distended, but the fourth ventricle was of normal size. The aqueduct of Sylvius was entirely occluded when examined by the naked eye, but in microscopical sections (Fig. 6) a very small opening was found, which may have been absent during life. It is questionable whether any fluid passed through this opening during life. Small groups of ependymal cells were seen in several places, and these had evidently been separated from the ependymal lining by the proliferation of the neuroglia.

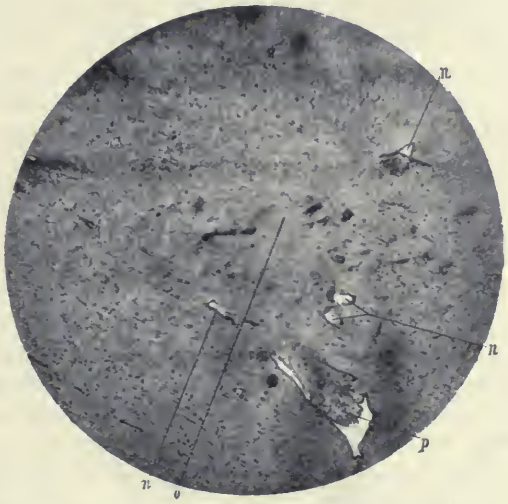
Oppenheim[1] has described a case of myasthenia gravis pseudoparalytica in which he found bridging over of the aqueduct of Sylvius, and in some sections a third canal. Such anomalies of this region he believed had never previously been described. The occlusion in the case H. C., reported by me, must be of the same character as the partial occlusion in Oppenheim's case, and was probably congenital or acquired early, on account of the history of headache and vomiting dating from

[1] Monatsschrift für Psychiatrie und Neurologie, March, 1900, p. 177.

childhood. The occlusion must have become complete about six months before the patient's death, when the symptoms became much more intense than they had been previously. The closure of the aqueduct of Sylvius resembles in the changes of tissue produced by it the condition often seen in the region of the central canal of the spinal cord.

The symptoms were exceedingly suggestive of cerebellar tumor, and in every case where a tumor of this portion of the brain is suspected the possibility of internal hydrocephalus should be borne in mind.

FIG. 6.



Occlusion of the aqueduct of Sylvius, causing internal hydrocephalus of the third and lateral ventricles. The fourth ventricle was not distended. *n*, *n*, *n*. Small masses of ependymal cells from the lining of the aqueduct, cut off by proliferation of the neuroglia. Other similar masses are not included in the photograph. *p*. Lower part of the aqueduct of Sylvius, almost entirely closed by the proliferated neuroglia. *o*. Area where the aqueduct formerly existed. (Case 2.)

This is by no means the first case in which the symptoms of brain tumor were caused by internal hydrocephalus. Byrom Bramwell,[1] some years ago, reported cases in which the characteristic symptoms of cerebellar tumor were present; but a distention of the ventricles, apparently the result of closure of the foramen of Magendie from localized meningitis, was found.

[1] Brain, Spring, 1899, vol. xxii. p. 66.

A CASE OF TYPHOID FEVER, WITH TRICHINOSIS AND EOSINOPHILIA.

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(From the clinic of Dr. Osler, the Johns Hopkins Hospital.)

Trichinosis and typhoid fever have frequently been associated, but most commonly the trichinosis has been in the patient and the typhoid fever in the mind of the physician. The association in the patient of these two diseases appears to be exceedingly rare. In a search of the literature only one instance was found, and this of considerable interest. It was reported by H. Fischer[1] in 1898, although the case had been seen in 1862. This was in a butcher's assistant, aged twenty-four years, who had eaten raw tainted pork. He was taken ill on August 21st with chills, general malaise, etc., and admitted to the hospital on August 27th, with the usual symptoms of typhoid fever. The attack was severe and a bed-sore formed. In the removal of the slough a portion of sound muscle was taken, and in this trichinæ were seen macroscopically. They were also found microscopically. The patient died on October 11th. At the autopsy (von Recklinghausen) very many trichinæ were found in the muscles. The lesions of typhoid fever were also present. In discussing the case Fischer notes that the clinical picture was one of typhoid fever. There was neither œdema nor rigidity of the muscles. Only the accident of the bed-sore made a diagnosis possible during life.

The present case is reported both on account of the rare association of the diseases and as another example of the value of eosinophilia in the diagnosis of trichinosis. Since attention was called by Brown,[2] in 1897, to eosinophilia in trichinosis, a number of confirmatory cases have been published. In the present case the association with typhoid fever and the occurrence of pneumonia during the course are of special interest in connection with the blood-findings. The history is as follows:

Typhoid fever; trichinosis; eosinophilia; typhoid relapse; pneumonia; recovery. T. B., male, aged twenty-three years, German, occupation tailor, was admitted to Dr. Osler's wards on June 4, 1900, complaining of headache and fever. His family history was negative, except that it had been noted that both his brother and himself bled easily and profusely from any cut. In the previous three years he had three attacks of hæmoptysis, but otherwise he had been healthy. He drank but little alcohol. His appetite and digestion were usually good. He had been in the habit of eating raw sausage every week and raw ham occasionally.

His illness began fourteen days before admission, when he noticed some abdominal pain which he referred to the stomach. This became

more severe at the end of a week. He had some diarrhœa, the bowels moving three or four times a day. There was headache and severe pains in the eyes. For a few days before admission he had complained of some pains in the joints. There had been some swelling about the eyes, but none elsewhere. He had not had any nose-bleed. He gave up work three days before admission. None of the others living in the same house were affected as he was.

On admission he was very dull and stupid. The temperature was 103.2° F. The tongue was coated. There was some puffiness of the eyelids, but no œdema elsewhere. No tenderness was found on pressure anywhere over the muscles. There was marked capillary stasis everywhere. The lungs and heart were clear. The pulse was 112 to the minute, soft, and markedly dicrotic. The abdomen was flat. There were numerous rose spots. The respiratory movements were well marked. On palpation of the abdomen there was general tenderness and gurgling in the right iliac fossa. The muscles were tense, rendering palpation difficult, but the edge of the spleen could be felt. The urine was negative, the diazo-reaction was not given. The leucocytes were 11,000 per c.mm., and a differential count showed 65 per cent. of polymorphonuclears and 28 per cent. of eosinophiles. The occurrence of marked eosinophilia being considered in the clinic as suggestive of trichinosis, a piece of muscle was removed from the gastrocnemius. A portion of this was examined fresh, but showed no parasites, and while subsequent stained sections showed some myositis, no trichinæ were found. The Widal reaction was not given.

It was noted in the blood-slides stained with the triple stain that the granules in the eosinophiles were not typical, but were rather in size and staining between the neutrophilic and eosinophilic granulations. In the case of some cells it was difficult to say to which class they belonged. All doubtful forms were classed as neutrophilic. On June 6th a differential count was made in specimens stained with eosin and methylene blue. This gave polymorphonuclears, 48.2 per cent.; mononuclears, 8 per cent.; eosinophiles, 4.38 per cent.

In all the cells classed as eosinophiles there were some typically staining granules, but in many these were comparatively few in number, the majority having only about one dozen typical granules. In addition to these were numerous granules which took on a more or less feeble eosin stain. There was no question as to these cells being eosinophiles. Among the 219 cells, among 500 leucocytes, which were classed as eosinophiles, only *one* was a perfectly typical eosinophilic cell such as one finds in normal blood and such as were later found in large percentage in this case.

The fever persisted, the temperature twice reaching 104° F., but it gradually fell, and for some days varied from 99.5° F. to 102.5° F. There was persistent headache. There was no diarrhœa, and the examination of the stools was negative for parasites. On June 9th the leucocytes were 12,000 per c.mm., of which 39 per cent. were eosinophiles. In specimens stained with triple stain there was still some difficulty in distinguishing between the neutrophilic and eosinophilic granules. On June 10th there was still some puffiness of the eyes, and tenderness was noted over the cervical and calf muscles. There was also some pain in the arms on raising them. Rose spots were still present. Cultures were made from these with negative results. The

spleen was not felt. The tongue was furred. On June 11th the leucocytes were 12,500 per c.mm., and a differential count by Dr. Futcher showed 37 per cent. of eosinophiles. The eosinophilic granules now took on a more typical stain. The fresh blood showed marked eosinophilia, and the eosinophiles were actively amœboid. Dr. Osler saw the patient frequently and discussed the question of diagnosis. He considered that the patient had typhoid fever without doubt. The eosinophilia and other conditions suggested trichinosis, but thus far the results of examinations of the muscles have been negative. On June 14th a positive diazo-reaction was given. Neither albumen nor sugar was found in the urine at any time.

The patient's general condition during this time was good. His temperature gradually came down, touched normal on June 13th—the twenty-third day—and was normal for some hours on the following day. On June 16th he had sudden severe pain in the right side, cough, bloody expectoration, and with these there was a decided change in his condition. Dulness was found over the lower right back, with feeble breath sounds and fine crackling râles with inspiration. The next day a friction rub was heard. The temperature gradually rose, and on June 18th reached 104° F. The next day it was 104.5° F. The sputum contained large numbers of diplococci. The temperature continued at about an average of 103° F. for a week. Without giving the details, it may be said that there were typical signs of pneumonia, first in the lower and later in the upper right lobe. Repeated examinations for tubercle bacilli were negative. The temperature came down very slowly, and it was about three weeks before it reached normal—about the fiftieth day after the onset of the illness. The lung signs had cleared before this, and the condition seemed more like a typhoid relapse, accompanied by pneumonia, than a pneumonia alone. A moderately marked Widal reaction was given on July 7th.

The blood-findings during this time were as follows: On June 15th, at the beginning of the relapse, the leucocytes were 15,250 per c.mm., of which 29 per cent. were eosinophiles. With the pneumonia on June 19th they were 11,500 per c.mm., of which 24 per cent. were eosinophiles, while on June 26th, with consolidation of the lower right lung, the leucocytes rose to 21,700 per c.mm., of which 71 per cent. were neutrophiles, and only 12 per cent. were eosinophiles. On this date aspiration of the pleural cavity was done, but with a negative result. By July 4th the percentage of eosinophiles had fallen still lower, the leucocytes were 16,000 per c.mm., of which 78 per cent. were neutrophiles and 4 per cent. eosinophiles. At this time the temperature was not over 101° F., and the lung signs were clearing. On July 21st the patient was well, the leucocytes were 16,000 per c.mm., of which 17 per cent. were eosinophiles.

Despite the negative results of the examination of the portion of muscle removed from the gastrocnemius, the persistent eosinophilia so strongly suggested trichinosis that before the patient was discharged a second piece of muscle was removed from the biceps. Trichinæ were found in the sections cut from this. The muscle substance showed no signs of myositis except just about the capsules.

The patient was discharged on July 21st in good condition. His subsequent history is of interest, especially in regard to the question as to the duration of the eosinophilia. He was seen on December 26,

1900, and found to be very well and in good physical condition. His blood-count was: Hæmoglobin, 85 per cent.; red corpuscles, 4,800,000; white corpuscles, 6200. The differential count of 500 leucocytes showed: Polymorphonuclears, 78.3 per cent.; small mononuclears, 12 per cent.; large mononuclears and transitionals, 8.2 per cent.; eosinophiles, 1.5 per cent. The stained specimen was normal in every way.

In considering the case there are some points of special interest. 1. The rare association of the diseases, which has already been referred to. 2. The diagnosis of the two conditions. 3. The persistent eosinophilia leading finally to the diagnosis of trichinosis. 4. The influence of the various conditions present on the blood. In reference to the diagnosis on admission, the œdema of the eyes, the eosinophilia, and the characteristic history all suggested trichinosis. The absence of muscular tenderness, the negative findings in the stools, and no trichinæ being found in the portion of muscle removed from the leg, were against it. The general picture was rather one of typhoid fever. There was constant fever, a furred tongue, a palpable spleen, and successive crops of rose spots, all of which spoke for typhoid fever, although at first the diazo-reaction was not given in the urine and the Widal reaction was absent until some time after admission. The question of diagnosis was frequently discussed by Dr. Osler, and the opinion expressed that the patient had typhoid fever, whether or not he had trichinosis. The probability is that had there been only trichinosis present the patient might not have gone to bed. The recent work of Williams[3] has emphasized the degrees of severity of the infection with trichinæ. The present case, with the rather slight symptoms, suggests a mild infection.

There are certain symptoms common to both typhoid fever and trichinosis, especially fever, general malaise, and intestinal features, but attention may be called to some signs which are usually present in typhoid fever and which may also occur in trichinosis, namely, rose spots, enlarged spleen, and the presence of the diazo-reaction in the urine.

Rose Spots. In all the description of trichinosis the frequent occurrence of various rashes is noted, of which, perhaps, miliaria is the most common. The majority of the articles on the disease make no mention of "rose spots," but these have been described in the reports of several cases. Thus, among the cases reported with eosinophilia (which number between twenty-five and thirty) there were five with a rash apparently identical with the roseola of typhoid fever. In all of these, however, the rose spots were apparently few in number, and so far as can be gathered from the descriptions, there was no instance of the appearance of successive crops as in the present case.

Enlarged Spleen. This was noted in six cases out of the series with eosinophilia, but in no instance does it seem to have been marked.

Diazo-reaction. This was present in seven cases out of the series. With so many of the symptoms and signs common to the two diseases, it is little wonder that mistakes should be made. The first impression of a case may be so strong that, provided the course is satisfactory, marked symptoms would be necessary to lead to a revision of the diagnosis. In doubtful cases the value of the blood examination is evident. The presence of the Widal reaction in one disease and the occurrence of eosinophilia in the other are all important. The eosinophilia is of special interest.

Eosinophilia in Trichinosis. Since the first instances published by Brown, in 1897, there have been between twenty-five and thirty confirmatory cases published. The diagnosis has not been confirmed in all the reported cases by finding trichinæ in the excised muscle. But in certain of these the diagnosis was rendered certain by other findings, such as trichinæ in portions of the sausage eaten. It is to be hoped that those reporting cases in the future will always endeavor to render the diagnosis sure by finding the trichinæ in the muscle. The harpoon, so often referred to, is not necessary. A small portion of muscle can be readily removed under cocaine. The lower end of the biceps is probably the best available situation, and, as shown in the present case, trichinæ may be found there, and not in a portion of muscle removed from the gastrocnemius.

There are two reported cases of trichinosis without eosinophilia. In one of these, that of Howard,[4] no count was made during life, although slides were examined, and there was no evident eosinophilia. A second is reported by Da Costa,[5] in which, with a leucocyte count of 12,000 per c.mm., there was only half of 1 per cent. of eosinophiles. Repeated examinations showed practically the same result. The portion of muscle examined showed large numbers of trichinæ, and it was also noted that it was rich in eosinophilia cells. While such exceptions show that eosinophilia in trichinosis is not of invariable occurrence, still it occurs so frequently as to be a sign of great value. This is well shown in the present case, as, but for the persistent eosinophilia, the diagnosis of trichinosis would not have been made.

In the present case the leucocytosis was not specially high. The greatest number of leucocytes—21,700 per c.mm.—occurred during the attack of pneumonia. The highest percentage of eosinophiles was 43.8, which was found two days after admission. The blood-counts are given in tabular form—in the first the leucocyte counts with the percentage of each variety, and in the second the relative number of each variety per cubic millimetre.

TABLE I.—LEUCOCYTE AND DIFFERENTIAL COUNTS.

Date.	Leucocytes per c.mm.	Polymorphonuclears.	Small mononuclears.	Large mononuclears and transitionals.	Eosinophiles.
June 4	11,000	65	3.4	3.6	28
" 6	11,000	48.2	4.5	3.5	43.8
" 9	12,000	51	5	4.7	39
" 11	12,500	54.4	5.4	2.5	37.2
" 15	15,250	60	6.4	4.6	29
" 19	11,500	67.4	9	9.6	24
" 26	21,700	71.2	11	5.5	11.9
July 4	16,000	78.6	15.5	1.4	4.5
" 14	18,000	57.7	14.5	5.7	22.1
" 21	16,000	65.1	13.8	4.4	16.7
Dec. 26	6,200	78.3	12	8.2	1.5

NOTE.—The typhoid relapse began on June 15 and the attack of pneumonia on June 16th. The temperature reached normal on July 10th.

TABLE II.—LEUCOCYTE COUNTS WITH THE ABSOLUTE NUMBER OF EACH VARIETY OF LEUCOCYTE PER CUBIC MILLIMETRE.

Date.	Leucocytes.	Polymorphonuclears.	Small mononuclears.	Large mononuclears and transitionals.	Eosinophiles.
June 4	11,000	7,150	374	396	3080
" 6	11,000	5,302	495	385	4818
" 9	12,000	6,120	600	564	4680
" 11	12,500	6,800	675	312	4650
" 15	15,250	9,150	976	701	4372
" 19	11,500	7,751	1035	1074	2760
" 26	21,700	15,450	2387	1193	2582
July 4	16,000	12,576	2480	224	720
" 14	18,000	10,386	2610	1026	3978
" 21	16,000	10,416	2208	704	2672
Dec. 26	6,200	4,854	744	508	93

In considering these counts the occurrence of typhoid fever and pneumonia has to be kept in mind. That the former influenced the relative numbers of the various forms is doubtful; certainly no increase is to be noted in the large mononuclear forms, which, perhaps, might have been looked for when the usual increase of these in typhoid fever is remembered. It will be noted that throughout the number of polymorphonuclears per c.mm. never fell below normal (which may be put as about 5000). The change during the attack of pneumonia is marked. There was both a relative and absolute increase of the polymorphonuclear neutrophiles which continued while the patient was under observation and after the lung had cleared. The small mononuclears were at first much below normal, but gradually increased and reached normal with the onset of the pneumonia. With this they increased much beyond normal, and remained so until the patient was discharged. The large mononuclears and transitionals showed much the same course, and they also increased markedly with the pneumonia. There was a curious drop in their number on the count of July 4th, with which

there was no special change in the patient's symptoms or condition, and on the next count they had again risen. Rapid variations in the differential counts of the blood of patients with trichinosis have been frequently noted, and there may even be marked differences found between daily counts. The eosinophiles were increased throughout, both in percentage and in absolute number. The influence of the attack of pneumonia is striking. With the onset of this and an increase in the polymorphonuclears, the eosinophiles decreased, and by July 4th, when the former were at their highest percentage, the eosinophiles were low. By July 14th, when the pneumonia was over, the polymorphonuclears had fallen and the eosinophiles again risen in number. The same influence of an intercurrent pneumonia on eosinophilia has been noted in other conditions than trichinosis. Thus, Ehrlich and Lazarus[6] note that in a case of ankylostomiasis, with 72 per cent. of eosinophiles in the blood, these fell to between 6 per cent. and 7 per cent. during the febrile period of an attack of pneumonia, rising after it to 54 per cent.

The ratios between the different varieties of leucocytes agree with the findings of Brown in his cases. He found that the mononuclears showed but slight fluctuations, while there was an inverse relationship between the neutrophiles and eosinophiles, an increase of eosinophiles occurring with a decrease of neutrophiles. There are not many records of an intercurrent pneumonia with which to compare. In one of the cases reported by Blumer and Neuman[7] complicated with pneumonia, a count taken at the time of the crisis showed 8000 leucocytes per c.mm., of which 33.6 per cent. were eosinophiles Subsequent counts gave much the same percentage.

Lastly attention is to be drawn to the staining characteristics of the cells in this case. When the patient came under observation the first differential count was made with specimens stained with the Ehrlich triple stain. It was at once noted that there were a number of cells which in their staining seemed between normal neutrophiles and eosinophiles. The staining of many of the granules in cells which were evidently eosinophilic was not as brilliant as is the case in normal cells. There was no doubt in the majority of these cells that they were to be classed as eosinophiles, and in making the counts any cell about which there could be any question was classed as a neutrophile. It could almost be said that there were all grades of variations between typical neutrophiles and eosinophiles, although the great majority of the cells were more eosinophilic than neutrophilic. There were in the majority of these cells a certain number of granules which took on a typical eosinophilic stain. This was better brought out in specimens stained with eosin and methylene blue, with which practically all of these "intermediate" cells showed a certain number of

typically staining eosinophilic granules of ordinary size—but many had not more than a dozen of these—while the granules, which with the triple stain took on only a partial acidophilic stain, showed only a faint color from the eosin solution. These atypical granules were between the ordinary neutrophilic and eosinophilic granules in size. In fresh specimens they looked like typical eosinophilic granules, and the whole cell had the appearance of an eosinophile. They were actively amœboid. By June 19th the Ehrlich triple stain was taken much more sharply, and there were very few of these "intermediate" cells. After this date there were practically none, and all of the eosinophiles were typical. Atkinson[8] found much the same condition in his case. There were cells apparently between the neutrophiles and eosinophiles. In some the granules were larger than the ordinary neutrophilic granules, but lacked the typical eosinophilic staining. Other granules were of the normal size of the neutrophilic ones, but took a more brilliant stain, while some of the eosinophilic granules did not have the typical size, but took the acid fuchsin stain well. One week later he noted that there was less difficulty in distinguishing between the neutrophiles and eosinophiles. His observations are much like those made in the present case.

The question arises as to the significance of these leucocytes containing granules between those of the normal neutrophilic and eosinophilic cells. Do they speak for the derivation of eosinophilic from neutrophilic cells? In his studies of the changes in the muscle in trichinosis, Brown noted that at first there were cells found which suggested transition stages between neutrophiles and eosinophiles. On later examination it was found that these cells had diminished in number, but there were more typical eosinophiles present. These atypical cells were not found in the circulating blood in his cases, as in Atkinson's and the present case. They appear to be only of very occasional occurrence in the circulating blood in trichinosis. One explanation for their appearance is that they are cells such as Brown found in the muscle, which, for some reason, have been swept into the blood-current. Subsequent examinations showed them to be diminished both in the blood in these cases and in the muscle substance in Brown's case, while in both at the same time the number of typical eosinophiles had increased. This may be interpreted as supporting the possibility of the transition of one variety into the other. The inverse ratio found between the relative numbers of eosinophiles and neutrophiles may be used to support the same view. In a case such as the present one, however, with the marked influence on the relative varieties of leucocytes due to the attack of pneumonia, one is rather inclined to accept the explanation of chemotactic action. The increase in the neutrophilic cells commonly seen in pneumonia is probably best explained by this theory. The increase in the number of eosinophiles in cases with

an intercurrent pneumonia may be due to chemotactic action, which while positive for the neutrophiles is negative for the eosinophiles. Such an explanation might be given for the inverse ratio between the eosinophiles and neutrophiles observed in uncomplicated trichinosis.

In conclusion, emphasis may again be placed on the value of eosinophilia as a means of diagnosis in trichinosis. It was only on account of the persistent eosinophilia that the diagnosis was made in the present case.

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FECAL IMPACTION IN TYPHOID FEVER, WITH REPORT OF CASES.

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Fecal impaction is not mentioned as a complication or sequela of typhoid fever in any of the text-books on medicine,[1] and yet, while a rare condition, it is not so uncommon as to warrant its omission from consideration in both categories.

Perhaps the difficulty in drawing the line of definition between marked degrees of constipation and the condition of fecal impaction has led to the classification of many cases among those of extreme constipation when in reality they had passed the dividing line.

Cribb, writing in the *Australasian Medical Magazine*, speaks of fecal impaction as a common complication of typhoid fever in New South Wales, and expresses surprise at the lack of reference to it in text-books. He also reports several cases with fatal results.

Brannan, in his article on typhoid fever, in the *Twentieth Century Practice*, states that constipation more often calls for treatment than diarrhœa, also that he regards diarrhœa as beneficial, "an effort of nature to rid the system of poisonous matter," but makes no mention of fecal impaction.

Melville, in writing of intestinal conditions in typhoid fever in India, places diarrhœa as the symptom of most importance in determining

[1] Musser in the third edition of his "Physical Diagnosis" mentions fecal impaction as a complication.

prognosis. To quote his own words: "The more severe and the more persistent the diarrhœa the worse the prognosis. The converse I hold to be almost equally true, viz., the more persistent the constipation the better the prognosis." Some authorities state that they have never seen constipation do any harm. In cases of fecal impaction in typhoid fever when not due to foreign bodies, gallstones, etc., the progress to that condition has, of course, passed through the stage of constipation, and in that event constipation may be the cause of much harm. If, as is not uncommon in these cases, the impaction be accompanied by signs of diarrhœa, producing a condition we might speak of as concealed constipation, then Brannan's estimate of diarrhœa as an effort of nature to rid the system of poisonous material is particularly applicable.

Of the cases about to be cited, three occurred in the wards of the Pennsylvania Hospital, one under the care of Dr. F. A. Packard, and two under my care while substituting for Dr. Lewis and Dr. Scott. A fourth case occurred in my term at the Church Home for Children, Angora.

In Case I. the impaction extended from the anus far up into the large intestine, and could be palpated externally as a series of hard masses. At no time was there any distention of the abdomen. The fecal masses almost blocked up the lumen of the bowel, were exceedingly hard, and adhered to the intestinal mucosa, so that in dislodging those within reach of the finger some hemorrhage would follow and small fragments of the mucous coat would be brought away. So adherent and packed together had these fragments become that in order to get rid of them we were compelled to mine them out by means of a uterine curette, the process being assisted by enemata of sweet oil. After two days of this treatment the lower bowel within reach was fairly cleansed, and with enemata and purgatives the whole intestinal tract was finally relieved. The condition was overlooked for some time, as the case was apparently doing exceedingly well at the end of a mild attack of typhoid fever, the bowels were regular, moving every day or every other day, the abdomen was not distended, and it was not until after repeated small hemorrhages of bright fresh blood occurred, with scanty bowel movements, that suspicion was directed to the cause, and rectal examination revealed the condition.

In Case II. the impaction occurred early in the third week. The patient's abdomen became greatly distended, the pulse and respiration rapid, and the temperature reached 105.4° twice in twenty-four hours. The bowels had been loose since the onset, and generally moved twice daily. The only cause which could be assigned for the condition was overdosing with milk. A new nurse had taken charge of the case a few days before the onset of the bad symptoms, and had given the child six fluidounces of milk every two hours night and day. Calomel in divided

doses was given, and on the following day I received a small box, carefully wrapped up in wax paper, containing a lump of hard casein and a note stating that the child's condition was greatly improved after several enormous evacuations of lumps similar to the one enclosed, and that the reason for sending this particular lump was that the matron thought it was "sprouting."

Cases III. and IV. are quite alike, and the bowels were moved after repeated small enemata, there being difficulty in getting the nozzle of the syringe in the rectum to any distance until by degrees the masses were brought away in small quantities.

Case I.—F. R., aged fifteen years, paperhanger, admitted to the Pennsylvania Hospital July 17, 1897. Previous history, no typhoid, pneumonia, malaria. Present illness, three days ago had severe headache, compelling him to stop work. Slight nose-bleed. Had since grown worse with fever, headache, diarrhœa, and weakness. Temperature, 104° on admission.

July 26*th*. The note states that a small quantity of blood was passed without a bowel movement. On August 1st he again passed some bright red blood.

August 2*d*. Rectal examination made and rectum found to be full of hard fecal masses intimately attached to the mucosa. Curetted out. Large clay-colored lumps came away, and those that could not be brought away were loosened. Enemata of oil given.

5*th*. Has been passing the lumps by degrees. None can now be felt.

7*th*. Seems to have passed all the lumps. Temperature normal. No more blood; no pain in bowel movement.

17*th*. Discharged cured.

Case II.—E. S., aged seven years. Pupil. Admitted to Infirmary May 8, 1899. Had been sick several days, with loss of appetite and headache. Temperature, 101° on admission.

May 12*th*. Temperature shows typical typhoid variations, reaching 104° at night, and falling to 101° in morning.

19*th*. Temperature reached 105.6°. Abdomen much swollen and tympanitic; pulse rapid, expression anxious. No very great tenderness in abdomen. Calomel ordered and quantity of milk reduced.

20*th*. Large quantities of lumps were passed in several bowel movements. Temperature lower; abdomen less distended and general condition much improved.

June 1*st*. Temperature has reached normal.

10*th*. Uninterrupted convalescence.

Case III.—S. S., aged twelve years. Was admitted to the Pennsylvania Hospital on July 23, 1901, with the following history: One brother and one sister are already in the hospital with typhoid fever. Patient has never been ill before. Present illness began three days before admission, with headache, diarrhœa and slight cough. Marked anorexia; no epistaxis

Examination. Poorly nourished child. Tongue heavily coated; pulse of good volume. Temperature, 103.4°, respiration 24, pulse 112 on admission. Heart and lungs were negative. Abdomen soft and flat; liver normal; spleen slightly enlarged; no rose spots present.

No tenderness anywhere. Remainder of physical examination negative. Widal reaction the day after admission was negative. Four days later Widal was suggestive, and temperature reached 104.4° F., not having been below 100° F., although frequent sponges given.

On August 2d, ten days after admission, Widal was positive, and rose spots appeared. From this time on till August 19th, the thirtieth day, the disease ran an uncomplicated course, the only fact of interest being that the bowels never once moved without the aid of an enema, given every other day. On the 19th patient complained of some pain in the abdomen, and screamed with pain when an enema was given and bowels moved, the movement consisting of a very small, hard mass. On examination of the abdomen the following condition was noted:

Child very fretful and irritable; temperature 99.4° F., respiration 24, pulse 92. On right side of abdomen, parallel to Poupart's ligament and about two inches above it, can be felt a number of irregular masses in the ascending colon, extending for a distance of four inches. The masses are not tender, are movable, and can be indented on pressure. On left side, on deep palpation, a few smaller masses can be felt above the sigmoid flexure. The abdomen is slightly distended, but nowhere tender. Rectal examination reveals a quantity of doughy, fecal masses, not adherent to the mucous membrane, but considerably distending the rectum. An enema containing an ounce of glycerin was given, and was followed by a very large stool resembling putty in color and consistency. Several looser stools followed, and convalescence was uninterrupted and uneventful.

Case IV.—M. G., aged twelve years, admitted to the Pennsylvania Hospital on August 4, 1901, with the following history: Family history negative; past history, had scarlet fever when a small child; since then, healthy. Present illness: had been sick six days previous to admission. Began with headache and anorexia, general malaise and feeling of weakness. Had two attacks of epistaxis. Bowels have been very loose all week. Has had a slight cough; no chills.

Examination. Well-nourished child, face slightly flushed. Faint icteroid tinge of scleræ. Tongue very dry and coated along dorsum; pulse somewhat accelerated. Slight tremor of hands; temperature 104.2° F., respiration 24, pulse 120 on admission. Heart and lungs negative. Abdomen round, soft and not tender on palpation. Liver normal; splenic dulness considerably increased; one or two suspicious spots present. Three days after admission a positive Widal was returned, and a number of rose spots appeared. Leucocytes, 5000. From this time until August 22d, the twenty-fifth day of the disease, course was mild and uneventful. At this time the patient complained of difficulty and pain at stool, and the temperature, which had been almost normal for several days, rose to 103.2° F. Examination of abdomen revealed the following condition:

A hard accumulation of feces occupies the lower bowel, especially the ascending colon. The lumps can be easily felt through the abdominal wall, and are slightly doughy on pressure. Castor oil was administered, and an enema given containing one-half ounce of glycerin. This treatment resulted in a few hours in the evacuation of a large quantity of hardened feces, followed by two loose stools, after which the temperature rapidly fell again, and thenceforward convalescence was rapid and uneventful.

[N. B.—Previous to the impaction reported the patient's bowels, while exhibiting a tendency to constipation, were always moved once in forty-eight hours, often without the assistance of enemata.]

The question of the etymological definition of fecal impaction is rather unsettled. The author has assumed impaction to exist where, from adherence of feces to the bowel or from mutual pressure of masses of feces, the lumen of the intestine is either narrowed or completely obstructed.

Dr. F. A. Packard remembered having seen four cases of fecal impaction in typhoid fever, three presenting masses in the left iliac fossa, evident on inspection, while the fourth was a case similar to Case I. in this paper, the feces likewise being quarried out with instruments. The points the author wishes to make are that this condition of fecal impaction is not so uncommon as the paucity of the literature on the subject would lead one to suppose. Second, that diarrhœa may accompany impaction, and thus divert suspicion from the real state of affairs. Finally, that overdosing of milk, especially in the case of children, is an important etiological factor.

UPON AN EXTENSIVE OUTBREAK OF FOOD INTOXICATION AND INFECTION OF UNIQUE ORIGIN.[1]

(ABSTRACT.)

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During the three days succeeding November 29, 1897, 118 male and 100 female inmates of the Ohio Hospital for Epileptics, at Gallipolis, became acutely sick and took to bed. A number of other inmates were also affected by the prevalent illness, but not confined by it. The resident patient population of the institution at that period was 607.

The illness manifested itself by the following symptoms: chilliness, especially up and down the spine; cold hands and feet; aching limbs; severe headache, with sense of pressure; nausea, and vomiting in some cases; profuse watery diarrhœa; pain in abdomen, especially about umbilical region, griping and cramps with soreness of abdomen; dizziness and staggering gait; fever and prostration. The pulse was accelerated 100 to 120 beats a minute; the fever averaged 102.5° F.,

[1] Read by title, March 29, 1902, at the second annual meeting of the American Association of Pathologists and Bacteriologists, Cleveland, Ohio.

persisting at least four days along with the diarrhœa. A number of victims were severely prostrated. None died.

Food-poisoning was suspected as the cause of this wholesale sickness, and an investigation[1] was at once instituted.

Suspected food articles, like milk, butter, and apple-butter, were immediately examined, with negative results. It soon developed that the illness was exclusively confined not only to the patients, but to those male and female patients, 506 in number on the morning of November 29th, eating in the central general dining-rooms. The officers, employés, and a group each of male and female patients (those in the two "closed" cottages), with separate dining-rooms and kitchens, were spared. This circumstance confirmed the negative laboratory findings relative to the milk, butter, and apple-butter, and made it possible to eliminate a number of other articles which, like meat, vegetables, canned goods and breadstuffs, were used in common throughout the institution. Evidently, then, some article of diet peculiar to the central dining-room for male and female patients was at fault.

By a process of exclusion, suspicion finally came to rest upon the oatmeal used for breakfast November 29th. It was learned that at this period all the oatmeal for the patients' central dining-rooms was cooked in a single large batch in the steam-table of the serving-room adjoining the dining-room for females. It was customary to steam the oatmeal all afternoon, turning off the steam at 6 o'clock P.M., by which time the batch had gradually cooled, reaching the body heat about 9 or 10 o'clock. Before breakfast the oatmeal was warmed by turning on the steam for a short time.

Certain peculiar conditions existed in the serving-room containing the steam-table in question. There was no provision for the escape of the clouds of steam issuing from the table while in operation, except through doors and windows; consequently, the steam arose to the high ceiling of the room and condensed. During the dry summer preceding the outbreak, quantities of dust from the then unpaved road, the main thoroughfare of the institution, entered the adjacent double doors and windows of the serving-room and collected on the ceilings dampened twice a day by the steam and vapor of cooking. That the bacterial inhabitants of the dust were thus exposed to favorable vegetative conditions seems quite plausible.

Now the effect of this moisture on the ceiling was to gradually loosen the plaster of which it was composed, and it eventually became necessary to replace a considerable portion of it. Accordingly, at 9 or 10 o'clock on the evening of November 28th, 600 square feet of plaster

[1] This study was pursued by the writer in the Pathological Laboratory of the Ohio Hospital for Epileptics. Clinical data were furnished by Drs. Richard O'Connell, W. G. List, and S. J. Webster, assistant physicians at the hospital.

over the steam-table were knocked off and new plaster laid. In the steam-table were three large pans, with loosely-fitting tin lids, containing 20 gallons of partially cooled oatmeal, for breakfast on the 29th. The top of the steam-table was covered with a layer of paper sheets and one of rubber sheets. This protection sufficed to keep the coarse masses of plaster out of the oatmeal, but did not prevent the sifting in of the fine plaster dust which filled the room in a cloud and insinuated itself everywhere. At this time the temperature of the batch of oatmeal was about that of the body heat (incubator heat), and this was largely maintained through the remainder of the night by virtue of the covering over the table. To these peculiar circumstances the outbreak of food-poisoning and infection was ascribed after all other reasonable possibilities had been excluded, on the assumption that the oatmeal had become contaminated by the bacteria-ladened dust from the ceiling, the micro-organisms multiplying in the warm oatmeal as in a culture medium and producing their toxic products.

Laboratory confirmation of the conclusion reached as just stated was apparently afforded by the following experiments:[1]

Experiment 1. Scrapings from an intact portion of the original ceiling adjoining the newly-laid surface, and ground bits of plaster, obtained with bacteriological precautions, were used to inoculate tubes and flasks of bouillon. This contaminated bouillon became diffusely cloudy and *foul in odor* after twenty-four hours' incubation.

Experiment 2. Plate cultures from the contaminated bouillon yielded predominating numbers of two bacterial species, one fully identified as *B. coli communis*, and the other a putrefying, liquefying, non-chromogenic, gas-producing, motile bacillus of the *proteus* group, probably *Proteus vulgaris*.

Experiment 3. *B. coli* and *Proteus vulgaris* were also isolated in plate cultures prepared from suspensions of the plaster dust in bouillon.

Experiment 4. Three guinea-pigs subjected to intraperitoneal injection of 0.5 c.c. to 1 c.c. of the twenty-four hours' bouillon mixed culture contaminated with plaster dust died in twenty-four to thirty-six hours of septic peritonitis.

Experiment 5. Finally, oatmeal prepared as for consumption by the usual cooking was inoculated with scrapings from the ceiling and incubated overnight. Portions of this oatmeal fed directly to cats and rabbits produced no noticeable effects. From the bulk of the oatmeal an extract was prepared by the Stas-Otto method, yielding a small quantity of a yellowish, oily fluid. A few drops of this fluid administered by the mouth to three cats produced a rise of temperature (2° F. or 3° F.) within half an hour, and vomiting in one in fifteen minutes. In another of these animals a diarrhœa persisting for two days was set up. In the third fibrillar tremor, rapid breathing, convulsions, and opisthotonus followed in half an hour after the administration of a drop

[1] At this time (December 3d) it was too late to obtain any of the original oatmeal, and the patients had so far recovered as to render a bacteriological examination of the vomitus impossible.

or two of the ethereal extract. A batch of oatmeal like the first, but not contaminated with plaster dust, was treated similarly, and its extract used as a control, with no effects.

A CASE OF CHRONIC INTERSTITIAL PANCREATITIS, WITH INVOLVEMENT OF THE ISLANDS OF LANGERHANS IN A DIABETIC.

By J. Dutton Steele, M.D.,
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In 1900 Szobalow[1] reported two cases of diabetes, with chronic interstitial pancreatitis, in which he could find no trace of the islands of Langerhans, but the credit of the first systematic study of the relations of the finer microscopical lesions of the pancreas to diabetes mellitus is due to Opie,[2] who in January, 1901, reported a series of cases in which the concurrence of glycosuria and lesions of the islands of Langerhans of the pancreas was very plainly shown.

Opie's first paper was quickly followed by a second report,[3] and then by communications by Wright and Joslin,[4] Weichselbaum and Stangl,[5] Herzog,[6] and M. B. Schmidt.[7]

Each observer has in turn reviewed the work of his predecessor, which it is unnecessary to give here in detail. A "Critical Summary" upon the subject, by the writer, recently appeared in the *Philadelphia Medical Journal*.[8] However, a brief review and classification of the recorded cases may not be out of place.

There have been reported in all thirty-five cases of diabetes in which autopsy showed an atrophy of the pancreas which involved the islands of Langerhans, and in which other causes of pancreatic atrophy were absent. In none of them could any other reason for the existence of glycosuria be discovered.

Of the six papers referred to, those of Opie and of Weichselbaum and Stangl are much the most important. They have described three distinct types of lesions in such cases.

1. An atrophy of the pancreas affecting the secretory glandular epithelium, but much more intensely the islands of Langerhans. These bodies show evidence of cellular degeneration and are diminished in number. There is an increase in the connective tissue, both interlobular and interacinar, which Weichselbaum and Stangl hold to be secondary to the atrophy of the epithelium. All other causes for the existence of the atrophy are absent in these cases, and there is much to suggest some factor specific to diabetes. The centro-acinar cells described by Opie are increased, perhaps, as Weichselbaum and Stangl

suggest, secondarily to increased tissue activity. The fat droplets described by Stangl in the normal pancreas are more numerous, both in the secretory epithelium and in the islands of Langerhans, but probably the increase is but relative, due to atrophy. The zymogen bodies described by Stangl are increased in number, probably for the same reason.

2. Hyaline degeneration of the islands of Langerhans first described by Opie. The process appeared to commence in the capillaries, destroys the islands, and sometimes involves the glandular tissues adjacent. These hyaline bodies began peculiar staining reactions, and have been described by Wright and Joslin as well.

3. A chronic interlobular and interacinar interstitial pancreatitis in which the islands have been involved apparently rather late in the process, as the result of the excessive proliferation of the connective tissue. In this variety the islands appear to resist the fibrous invasion quite vigorously, and the secretory glandular epithelium is in a much more advanced stage of degeneration than the cells of the islands of Langerhans. The occurrence of glycosuria in this type is usually less pronounced.

4. Schmidt has also described a case of acute diabetes in a boy, aged ten years, in whom there was an acute inflammation of the pancreas involving the islands of Langerhans.

The classification of the thirty-five reported cases is as follows: (This includes that of the writer.)

I.	Atrophy confined to or greater in the islands . . .	24 cases.
II.	Hyaline degeneration of the islands	6 "
III.	Chronic interstitial pancreatitis with secondary and late involvement of the islands	4 "
IV.	Acute necrotic destruction of the organ, involving the islands	1 "

Various theories have been advanced to explain the relation between the islands of Langerhans and the sugar-consuming function of the pancreas. The most prominent of these is that the islands secrete some substance to the blood which influences the assimilation of carbohydrates. This is supported by the work of Szobalow, who found that after feeding dogs with carbohydrates the islands of Langerhans became granular, and also by the fact that when the pancreas is totally removed glycosuria results, while in the intense atrophy of the pancreas following the ligation of its duct, the islands of Langerhans are never involved, and glycosuria is absent. Owing to the intimate relation between the islands and the rest of the pancreas, experimental work upon these bodies alone is almost impossible, and the study of the subject must be carried on by the collection of cases of pancreatic diabetes. Consequently it is of extreme importance that all cases of

so-called pancreatic diabetes should be put on record, and this has been the incentive to publish the case that follows.

The patient was a German, aged seventy-two years, a shoemaker by occupation. He suffered from acute articular rheumatism at thirty years of age and again at fifty years. Following the last attack there was dropsy of his legs. He had had epileptiform attacks, beginning ten years before death, and occurring every month or so, for a period of eight years.

His appetite was fairly good, and thirst was not immoderate. The first record of a urinary examination occurred in 1894, and from that time until June, 1900, there was polyuria and glycosuria. The amount of urine passed in the twenty-four hours varied from 75 ounces to 135 ounces, and contained from 3 per cent. to 6 per cent. of sugar. He died July 20, 1900.

The autopsy showed a small area of tuberculosis at the apex of the right lung. Atheroma of the mitral and aortic valves; fatty degeneration of the myocardium; general arterio-capillary sclerosis; chronic interstitial nephritis and hepatitis; an atrophic condition of the gastric mucous membrane, and some dilatation of that organ.

The pancreas was hard, and even to the naked eye presented evidences of the increase in fibrous tissue. There was no obstruction in the ducts. Pieces were taken for microscopical examinations from six places at more or less regular intervals from the head to the tail. They were hardened in the formol-Müller fluid and the sections were stained by hæmatoxylin and casein, Ribbert's phosphomolybdic acid-hæmatoxylin stain, and ammonia carmine.

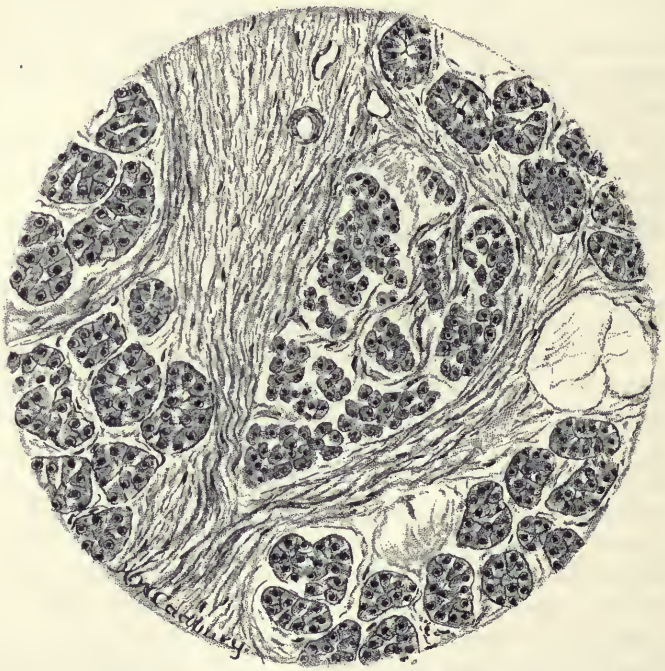
The sharpness of the microscopical pictures was obscured by digestive changes, which in some places were quite advanced. Good differentiation was hard to obtain by hæmatoxylin, and ammonia carmine gave a better result in the study of the nuclei. Examination showed first a very marked increase in the connective tissue of the glands. The sclerosis affected the whole organ equally, and was of the interlobular as well as the interacinar type. The connective tissue separated the acini, pressed upon their cells, and in some places had apparently caused their entire destruction, and had taken their places by the formation of broad bands of fibrous tissue in which are embedded the islands of Langerhans and remnants of the much degenerated acini.

The cells of the parenchyma presented changes that range from irregularity of the nuclei and loss of staining power to total degeneration and disintegration. The ducts were usually surrounded by considerable fibrous tissue, and were apparently unaltered.

The islands of Langerhans appeared to be diminished in number when compared with sections from the same portion of the pancreas of a case of syphilitic interstitial pancreatitis of much the same type, but

without involvement of the islands. The average size of the islands is rather less than in the second case. Many of them present no decided change, and invasion of connective tissue cannot be demonstrated. In other places the cells of the islands appear to be crowded, the nuclei are closer together, and the protoplasm is less prominent, giving the impression that the cells are compressed. Certain portions of these islands show invasion by connective tissue, which appears to follow the capillaries. This invasion varies in degree. Perhaps the

FIG. 1.



Section from near the tail of the pancreas, showing an island of Langerhans invaded by fibrous tissue and with some cellular degeneration. The interacinar type of the chronic interstitial inflammation is well shown. Stained with ammonia carmine. Leitz, oc. 3, ob. 5.

most pronounced example is found in Fig. 1. Here the cells are crowded and their protoplasm is diminished, while in places their nuclei are irregular and stained very deeply, indicating some digestive process. In other islands the fibrous invasion appears merely as spindle cells and delicate bands running between the epithelial cells.

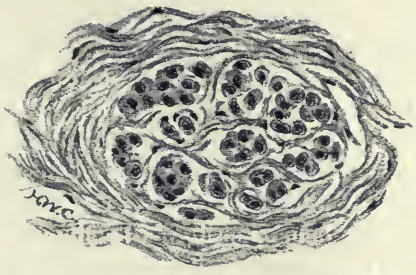
Ribbert's phosphomolybdic acid-hæmatoxylin stain demonstrates these fine fibrous trabeculæ very plainly (Fig. 2). Nowhere were the hyaline changes observed by Opie present. The tissue was too much affected by digestive changes to determine definitely the proportion of

the centro-acinar cells described by Opie, or to study the fat droplets in the epithelial cells described by Weichselbaum and Stangl. The small arteries were much thickened. The new-growth of connective tissue affected particularly the intima.

The case may be classified as an instance of chronic interstitial pancreatitis of the interlobular type which had become interacinar as well.

The islands of Langerhans are diminished in number and size, a certain proportion of them are invaded by fibrous tissue, causing compression and a certain amount of degeneration of their cells. In some of the islands the involvement is quite pronounced, in others Ribbert's stain is needed to demonstrate the invasion of the fibrous tissue. These changes are associated with very advanced degeneration of secretory

FIG. 2.



Section from near the tail of the pancreas, showing a slight invasion of an island which lies in an area of dense fibrous tissue in a greatly degenerated portion of the gland. Phosphomolybdic acid-hæmatoxylin stain. Leitz, oc. 3, ob. 5.

glandular epithelium, and the involvement of the islands of Langerhans must be considered distinctly less severe than that of the secretory portion of the glands.

The case here reported, morphologically at least, belongs to the form referred to as chronic interstitial pancreatitis with secondary and late involvement of the islands of Langerhans. The secretory epithelium is in a far more advanced state of degeneration than are the islands of Langerhans, but the latter are decidedly involved and probably reduced in number.

Clinically, however, the case is a well-marked one of diabetes mellitus extending over a period of at least six years. The findings suggest that the indurative or interlobular interstitial pancreatitis may be associated with cases of diabetes as typical clinically as those that occur with that form of atrophy attributed by Weichselbaum and Stangl to a specific cause, and in which they suppose the process attacks the islands of Langerhans earlier and more severely.

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HYPERTROPHY OF THE LYMPHOID TISSUE AT THE BASE OF TONGUE AS A CAUSE OF COUGH.[1]

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Coughs, especially those reflex in character, so annoying and so distressing to the patient as to call for treatment, often tax the skill and patience of a physician. While these may be due to various causes, I wish to call your attention to one which, while not entirely new, yet is usually overlooked by the general practitioner. In fact, it is only the very recent text-books that touch upon the subject in any definite manner.

I allude to those due to hypertrophy of the lymph tissue at the base of the tongue, of the lingual tonsil, or the lingual adenoid, as it is variously termed. This tissue is situated at the base of the tongue between the circumvallate papillæ and the epiglottis, and is sometimes at the sides in continuity with prolongations from the faucial tonsils. To inspect it, the laryngoscope must be placed a little higher and further forward than when viewing the larynx. Normally we see a few small, irregular elevations on the back of the tongue, but the medio-glosso-epiglottidean ligament and the fossæ on either side are quite visible. It is superimposed upon a firm base of solid muscular tissue, fasciculi from which run into its substance and interlace between its crypts, and is sparingly supplied with bloodvessels.

When this tissue becomes hypertrophied it is seen to more or less fill up the glosso-epiglottic fossa and to encroach or impinge upon the epiglottis, perhaps touching its laryngeal surface, and producing various symptoms. Sometimes bloodvessels become varicose, forming, as Lennox Browne termed them, "lingual hemorrhoids," but these are usually associated with some systemic disturbance.

The symptoms due to the chronic hypertrophy are: feeling of foreign body in the throat, loss or impairment of singing voice, huskiness, radiating pain in the ear and chest, tickling and feeling of fulness in

[1] Read before the Harlem Medical Association.

the throat, dysphagia, vomiting, glottic spasm, and, lastly, the one considered in this paper—cough.

This cough may be a short, hacking one, an irritating or exasperating one, one of violent paroxysms, or of a croupy, barking nature, and is accompanied by no expectoration.

Of the following twelve cases all but four showed no other abnormality; the cause of the trouble being the enlargement of this mass of tissue. The results of treatment were very gratifying.

Case I. is of special interest, as tuberculosis was feared.

Case I.—Rhoda H., aged fifteen years, Detroit, Michigan. Family and previous history negative until she was ten years old, when she was affected with hip disease, right side, and had, also, pain in the knee. Plaster casts were employed, and in six months she was pronounced cured. She had pneumonia four years ago, being confined to her bed for three or four weeks, and was compelled to be under treatment for four months following.

In September, 1898, she was taken with a croupy cough, accompanied by paroxysms of choking, and from time to time with complete loss of voice. The young lady was compelled to discontinue her studies. Various methods of treatment were tried, but without avail. From her history a tubercular taint was suspected. In June, 1899, she called at my office, complaining of these paroxysms and of loss of voice. I found her a fairly well-nourished girl. The examination of the lungs was negative. In the vault of the pharynx there were a few small masses of hypertrophied lymph tissue not enough to cause obstruction. The larynx was normal. The epiglottis was somewhat prolonged and buried itself on phonation in a marked hypertrophy of the lymph tissue at the base of the tongue. On watching her I found that only when the epiglottis tried to free itself would the paroxysms occur.

The hypertrophied lymph tissue in the pharyngeal vault, although small, was removed under an anæsthetic administered by Dr. M. Schiller.

The patient was allowed a rest of about two weeks. As the paroxysms still continued the hypertrophic tissue at the base of the tongue was removed with Myles' lingual tonsillotome, several sittings being required for the purpose. The patient had aphonia follow, but the voice soon returned and the cough completely stopped.

She has been thoroughly well since, as I have received several letters from her, the last about a month ago. Rice gives a very interesting description of a similar case.[1]

Case II.—Miss S., aged forty-two years, consulted me in May, 1897, for a hacking cough, for which she had received anodyne cough mixture, inhalations, tablets, etc., with no relief. Examination of the chest negative. Nose, slight deviation of septum to left, but no obstruction to breathing. The lymph tissue at base of tongue was thickened and raised so as to fill the glosso-epiglottic fossa. I advised operation, but this was refused, and so applied a solution composed of iodine crystals, ʒj; potass. iodide, ℥j; glycerin, ad. ℥iv; ol. menth. pip., q. s. ad. to flavor, at three different times, causing a shrinkage of the growth, with relief from the symptoms. Cough reappeared in February, 1898, and

[1] New York Medical Record, May 1, 1886.

same treatment was applied with same good result. Since then the patient had returned with the same trouble three times, the last time being two months ago, being each time cured with the same applications.

Case III.—Miss B., aged twenty-nine years, referred by Dr. H. Bernstein, complained for several months of a scratchy feeling in the throat, causing a short, dry cough. In the morning blood-streaked expectoration would appear. Examination of chest negative. Throat examination revealed hypertrophic lymph tissue at base of the tongue, touching the epiglottis at the sides. Operation not consented to. These were treated with the iodine solution at six different sittings within a short period. She has had thus far no return of the cough or bleeding.

Case IV.—Miss Pauline S., aged thirty-five years, consulted me in 1898 for a hoarse cough caused by an irritation in the throat. Examination showed slight hypertrophy of the lymph tissue at the base of the tongue. This was touched up with the iodine solution—as she would not submit to an operation—several times, and the symptoms disappeared. Since then the symptoms reappear about twice yearly, and disappear again with the same treatment.

Case V.—Miss G. S., aged sixty-three years, came under my care at the Manhattan Eye and Ear Hospital, complaining of constant cough, of a dry, hacking nature. Examination revealed a double uvula, one limb of which rubbed slightly against the faucial tonsil of the left side, and a large hypertrophy of the lymph tissue at the base of the tongue at the right side. The extra uvula was removed, and the patient requested to report back in two weeks. Examination then showed the wound completely healed, but no diminution in size of the lymphoid hypertrophy, and, as the symptoms continued, this was removed, with Myles' lingual tonsillotome, with complete cure.

Case VI.—Mrs. C. G., aged fifty-nine years, was referred by Dr. I. Heller, because she complained for the four past months of a sensation as of a pin sticking in her throat, causing an irritating short cough. Examination showed only a one-sided hypertrophy of the lingual tonsil. This was removed with the lingual tonsillotome, with complete relief to the patient.

Case VII.—Mrs. E. R., aged twenty-seven years, consulted me for a cough, coming, as she said, from her throat. Upon examination an evenly distributed, marked hypertrophy of the lingual tissue was seen touching the epiglottis. Auscultation revealed bronchial breathing and in the sputum tubercle bacilli. Upon explaining the nature of the trouble, she still desired something done. With the lingual tonsillotome, from time to time, extending over a period of one month, I removed some of the hypertrophic mass. While she still coughed, yet, as she said, her throat felt better and the hacking was only half as much. I lost all trace of her one month later.

Case VIII.—Mr. M. S., aged thirty-two years, has had a cough for the past year, but for the past four weeks constant in character. The middle portion of the lingual tonsil was enlarged, presenting two small masses. These were snared off with the cold wire, with complete cessation of cough, or, as the patient expressed it later, "cured as if by magic."

Case IX.—James E. C., aged forty years, complained of a hacking cough which he had for nine months. Examination revealed only the

lingual hypertrophy, two small masses on the left and three on the right side, all touching the epiglottis. These were touched up with the galvanocautery at a red heat, cocaine having been previously applied. There was very slight reaction, and in a week the resulting pain had disappeared with the cough.

Case X.—Miss M. R., aged nineteen years, whom I treated at the Manhattan Eye and Ear Hospital, complained of a croupy cough for the past two years, which was then getting so bad that she was hoarse all the time. She felt something sticking in her throat, and cough would come on. Examination showed a marked deviation of septum to right and hypertrophy of the lymph tissue at base of tongue. I removed this mass with the tonsillotome, and the cough ceased. About one month later I straightened the septum by the use of the saw. About three weeks ago the patient reported she was perfectly well.

Case XI.—Mr. H. S., aged thirty-six years, referred by Dr. Bernstin, complained of a dry cough. Examination showed lingual adenoids, to which—as he refused any operative procedure—I applied the iodine solution. The patient also had an exostosis of the septum, left side. He left town the next day, but later I learned from his doctor that he was much improved, the cough having materially lessened.

Case XII.—Mrs. F. W., aged thirty-four years, consulted me, saying that for the past twelve months she had been troubled with irritation in the throat, making constant attempts at clearing it and suffering from hoarseness and cough. Upon examination I found a marked hypertrophy of the lingual tonsil and a slight trachomatous nodule on the left vocal cord. With a tonsillotome I removed all the hypertrophic tissue. Patient reported one month ago that the cough had stopped, but that she was still hoarse. I have not seen or heard from her since.

In concluding this paper, I will say many patients present hypertrophied lingual tonsils without giving any undue symptoms. The cure affected with cases reported could hardly be ascribed to the psychical effect of the treatment. Eight of the cases presented no other trouble. The tubercular case showed a marked relief.

The after-treatment consists of antiseptic sprays, pieces of ice, cocaine spray, or lozenges in case of pain, which is usually of short duration. The food should be mild and soft. The hypertrophies can be removed by chemical caustics, astringents, silver nitrate fused on a probe, and iodine solution in the way of drugs. Instruments employed can be any of the tonsillotomes, curved scissors, cold snare, or the heated one, galvanocautery knife to burn off, to puncture, or the flat electrode to pass over the whole growth. These last must be used at a red heat. In using the chemicals, caustics or cautery, care must be taken to avoid injuring the epiglottis. The cold snare is only effective in the flabby granulations, otherwise the scissors must be used to divide the mass embodied in the snare, on account of the connective-tissue fibres. In my hands Myles' lingual tonsillotome has been the instrument giving the best results, and, as you have seen, the cutting instruments give the only complete cure.

The hemorrhage caused has been very slight in every instance, except in the case of the deviated septum when it poured forth for a few minutes, but it stopped without any interference.

To render a diagnosis positive, an application of 5 to 10 per cent. of cocaine applied to the hypertrophy will stop the symptoms, except, perhaps, in those cases where the epiglottis buries itself in the mass.

A CLINICAL LECTURE ON GOITRE.[1]

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REPORTED BY FRANCIS D. PATTERSON, M.D.

The first patient exhibited to you to-day is a man, aged thirty-two years, who was sent to us from Ohio. By occupation he is a presser. His father died at the age of fifty-seven years because of a complication of diseases; his mother died at the age of sixty-seven years from pneumonia. One brother, when twenty-seven years of age, perished as the result of an accident. Three brothers and three sisters are living and in good health. You will observe, therefore, that no fact becomes evident in the family history which bears even indirectly upon this patient's disease.

He had an attack of scarlet fever when five years of age, and also had typhoid fever in childhood. Three years ago he had an attack of malaria. During the past ten winters he has suffered from repeated attacks of influenza, which have had the effect of making him weak, nervous, despondent, and generally miserable.

Some seven months before admission the patient began to feel completely tired out. He felt, he tells us, like a man who had worked day and night without rest. No matter how long he remained in bed he was unable to get rested, and arose tired, morose, and depressed. He became extremely nervous, and noticed that his limbs trembled and that his hands shook. He had great difficulty in sleeping, his appetite failed, and even slight exertion rendered him breathless and caused his heart to beat violently.

In the month of May, 1901—*i. e.*, five months before his admission to this institution—he observed that there was an enlargement in his neck. This has continually increased in size until the present time. In July, three months before admission, he observed that his eyes were becoming prominent, the projection of the right eye being more evident

[1] Delivered at the Jefferson Medical College Hospital.

than that of the left. He says that the eyes looked as if they were too large to move in their sockets. A heavy, aching pain in the brow and eyeballs was almost continually present. This pain was much worse on getting up in the morning than on going to bed at night.

During the few weeks preceding his admission into this hospital his appetite returned, and, strange to say, became ravenous. He was unable to satiate it, and had cravings for extraordinary articles of diet. These, when obtained, failed to satisfy him. His mouth and throat constantly felt dry.

We may sum up the history as follows: A man in the third decade of life, whose health had been shattered by repeated attacks of influenza, developed a train of distressing nervous symptoms, among which were mental depression, tremor, cardiac palpitation, dyspnœa on even slight exertion, and insomnia. After suffering for a number of weeks from these nervous symptoms, an enlargement appeared in the neck, the eyeballs became prominent, the appetite returned, but as a capricious and ravenous appetite, and most persistent headache became a factor in the case.

Let us investigate the present condition of this patient. There is a very marked enlargement in the thyroid region, which all of you can see. It is symmetrically developed on each side of the neck, each portion being the size of a duck's egg. The enlargement is certainly the thyroid gland, or is connected with the thyroid gland, as it presents the important sign of a thyroid tumor, viz., during swallowing it rises up and descends with the larynx and trachea. Of course, this sign is not absolute proof that a tumor is thyroid, but it is very suggestive. In rare instances a non-thyroid tumor will rise and fall with the larynx and trachea—for instance, some of the congenital cysts of the neck will do so; but if a tumor that does this is not a thyroid tumor it is either high up in the neck and near the hyoid bone, or a demonstrable, malignant growth with infiltration, or an inflammatory process with adhesions. The mobility of the symmetrical enlargement before us, its situation and its history are conclusive evidence that it is not inflammatory or maliguant, and that it is thyroid.

When we look closely at the swelling in the neck we observe that it seems to pulsate. If I lay my hand upon this enlargement I feel a moderate thrill. By listening with the stethoscope I am able to detect a systolic murmur. The pulse is extremely rapid, running from 120 to 140 per minute. The apex-beat of the heart is very forcible. The man himself is thin, pallid, and anxious-looking. He is extremely tremulous. The tremors are quite rapid and are noted even when the patient is at perfect rest. They are most marked in the hands.

The eyeballs protrude very markedly. When we direct the patient to turn his eyes downward toward the floor we notice that the upper

eyelids are immovable; this symptom is known as Graefe's sign. Furthermore, when we ask him to close his eyes it looks as if they do not close completely, a certain amount of white still being visible. The ophthalmologist reports that the visual apparatus is entirely normal.

Every few days the temperature of this man reaches 100° F., without obvious cause, and then again sinks to normal; and whenever he has the elevated temperature he has also a profuse sweat. The symptom which disturbs him the most, however, is the dyspnœa, which is at times so severe as to make him fear that he is suffocating. When it comes on he is unable to lie down. He sleeps poorly, is much depressed mentally, and of late the very poor appetite is again complained of. The urine report shows that the fluid is turbid, amber-colored, acid, and of a specific gravity of 1024; and that it contains no albumin, no sugar, 2.5 per cent. of urea, amorphous urates, squamous epithelium, and a few short granular tube-casts.

It is evident from the symptoms which I have set forth to you that this patient is laboring under that interesting and remarkable disease known as Graves' disease, Basedow's disease, and exophthalmic goitre —a disease characterized, particularly in typical cases, by rapid pulse, exophthalmos, and thyroid enlargement; although any one of these factors may be absent. In fact, early in the case, as was noted in this man, two of these elements may be wanting.

Graves' disease does not seem to bear any relation to ordinary goitre, for it is not more frequently met with in the districts in which ordinary goitre is endemic than in those in which ordinary goitre is unknown. In some cases the symptoms come on with great rapidity, constituting what is known as acute exophthalmic goitre. In an acute case there is furious tachycardia, great protrusion of the eyeballs, and exhausting vomiting and purging, and death is apt to occur in the course of a few days. Such cases have been reported by Lloyd, Potts, and others. The case before us, however, is of the chronic type, and is consequently less dangerous. This form of the disease may follow upon overwork, either physical or mental; anxiety and worry, or certain acute maladies. In this patient influenza seems to have been the exciting cause.

Exophthalmic goitre is rare in children, is extremely rare in old age, is most frequent in adults, and is more common in females than in males. Its essential cause is involved in obscurity. There are three well-known theories as to its cause. One view is that it is due to some malady of the central nervous system—a view that finds support in the observation that emotional disturbances are often influential in the production of the affection. Another theory is that some disease of the cervical sympathetic is responsible. This view probably originated from the supposition that the goitre of Graves' disease is largely pro-

duced by dilatation of the bloodvessels; but, as a matter of fact, and as Mr. Berry insists, it is not caused in that way; for the goitre contains fewer bloodvessels than are met with in the ordinary goitre, and even these are of smaller size. The sympathetic theory entirely lacks demonstration. The view which finds the most advocates is that the thyroid gland is itself diseased and is furnishing too much thyroid secretion, or an altered secretion having a peculiar toxic character; and that the symptoms are, to a great degree, dependent upon the toxic action of the internal secretion of the thyroid gland. This is known as the theory of hyperthyroidization, and is the most generally accepted view.

The hyperthyroidization theory gains probability from the fact that by the administration of thyroid extract to an individual who has not exophthalmic goitre, toxic symptoms can be produced which resemble the symptoms met with in Graves' disease; and that by giving it to an individual with exophthalmic goitre the symptoms are made worse. But when we remember that Graves' disease can exist without thyroid enlargement, that the removal of the thyroid gland may not cure it, and that purely emotional causes may produce it, we must fall back upon the theory that we are dealing with a malady of the central nervous system, which, in most cases, by an unknown method, causes enlargement and altered secretion of the thyroid gland, and that this morbid secretion is the secondary cause of various toxic symptoms.

The next point to be considered is: What shall we do for this man? Shall we perform an operation, or shall we undertake to treat him medically? Before reaching a conclusion we must first bear in mind that operations, whatever their nature, frequently fail to cure Graves' disease. Often an operation will cure the goitre but will not cure the other symptoms. This is so well recognized that in the average case we advise operation only when some particular necessity which imperatively demands it arises. The very contradictory views which exist as to the cause of this condition should make us conservative in advising an operation, for the nature of the procedure which we should recommend must depend upon our idea as to the causation of the disease.

Further, in reaching a conclusion as to the advisability of operation we should remember that exophthalmic goitre is, in some cases, cured by rest or by the administration of drugs; and that in rare instances it disappears spontaneously after a shock to the nervous system or after an operation upon a distant part of the body performed for some other trouble. Again, operation is more dangerous than in common goitre, and sudden death may occur during its performance or after its completion. For these reasons it is wise, in the majority of cases, to employ medical treatment; but if that fails to cure or to ameliorate, and if the symp-

toms are urgent, then the advisability of an operation must be considered.

The surgical procedure which is usually undertaken is a thyroidectomy; not a complete but a partial thyroidectomy. The complete removal of the gland would probably lead to the development of that curious disease myxœdema. Partial thyroidectomy is the operation to be preferred unless the goitre is very small, the nervous symptoms being the predominant factors; or, unless the goitre is very large, in which case the operation is exceedingly dangerous. If the patient is in an extremely hysterical condition, such a severe procedure is inexpedient. As a matter of fact it has been found that when an exophthalmic goitre is very large, thyroidectomy relieves the patient of the thyroid enlargement, but does not cure the symptoms. If it is quite small it is evident that thyroidectomy is unnecessary; and if the hysterical element is well marked, the operation is generally perfectly useless. What I want to render clear to you is that thyroidectomy is not to be performed simply because a person has an exophthalmic goitre. It is not to be thought of in many cases, and is, after all, to be applied to but certain forms of the disease.

Another operation which has of late attracted a great deal of attention is the bilateral resection of the cervical sympathetic ganglia. This procedure is founded upon the view that exophthalmic goitre results from a disease of the sympathetic system. The operation is, as yet, of but doubtful value. It is a pure experiment. Cures have been reported as following it, but it is difficult to determine whether these cures have resulted because of the definite curative tendency of this particular operation, or because of the general effect of the operation, *per se*, a point to which Dr. J. William White has particularly directed attention. Jonnesco maintains that many cures can be obtained by this procedure, and asserts that it produces a sclerotic change in the thyroid gland. The theory that the operation saves the heart from the excessive stimulation of an irritated sympathetic does not seem sufficient to justify its performance, when we recall that the sympathetic theory of causation has been abandoned by most neurologists. If this operation does produce benefit, it probably acts by causing a hyperæmia of the brain, and thus preventing those attacks of vasomotor constriction which arise during the progress of exophthalmic goitre. The true status of the procedure is uncertain. It is not free from danger, and takes some time to perform. As a matter of fact, reports indicate that at least some of the symptoms are improved by it; but the permanency of the results is not as yet determined. Wölfler suggested tying the four thyroid arteries, but experience shows that this procedure may be followed by tetany or myxœdema. Kocher ties three of the arteries, and in some cases this seems to be a useful operation.

In the case of the patient before us we will, for the present, at least, reject operation, and undertake treatment by medical means. In the first place, we will insist upon rest, perfect rest—rest in bed, and nothing less than this. Rest is of the first importance in every case. In addition we will apply an ice-bag over the thyroid gland. The application of cold is frequently found to relieve the distress of the disease. An ice-bag over the heart is a valuable means of controlling the too great activity of the circulation.

Under no circumstances will we give thyroid extract in this case. In exophthalmic goitre thyroid extract aggravates the symptoms and makes the patient definitely worse. Many physicians employ digitalis; others use belladonna; and still others pin their faith to electricity. Probably the most useful agent is suprarenal extract, which is one of the most powerful drugs known for raising the blood pressure. The initial dose should be one grain three times a day, and the amount should be gradually increased until the patient is taking four or five grains three times a day.

If this man's circumstances permitted of it we would advise his removal to the highlands or even to a mountainous region where medical treatment could be applied. Such a change often gives great relief and favors cure. Some of these patients recover and never suffer again from the disease; some recover but develop fresh attacks; many get better, but do not completely recover; many more go from bad to worse, and finally die. The prognosis is always uncertain.[1]

The next patient, whom I now show you, also has an enlargement of the neck, and this enlargement likewise affects the thyroid gland. Yet the disease is not the same, and the state of affairs is vastly different from that prevailing in the former case. This patient is a single woman, aged seventeen years. Her father was an Italian, and died of a cause unknown to her. She had a brother who died of diphtheria at the age of four years. Her mother and two brothers are living and in good health. There is no family history of either tuberculosis, malignant disease, or of enlargement of the neck.

The patient had an attack of typhoid fever when eleven years of age. Her menstruation began at the age of fifteen; it has always been regular, and is never painful. About one year ago she observed for the first time a lump on the anterior part of her neck extending on both sides of the median line and situated about an inch and a half above the sternum. Nervous symptoms were absent, and there was no tremor, no cardiac palpitation, and no exophthalmos. For about a month she noticed that this enlargement was daily increasing; then it

[1] This man was greatly benefited by treatment, and returned to his home after being much improved, but not cured.

seemed to become stationary for several months, at the end of which period it again began to increase. At the termination of the first four or five months after the appearance of the lump it had attained the size of a large walnut. Menstruation had no effect in adding to its size. She herself noticed that the tumor moved up and down during the act of swallowing.

About four months before admission to this hospital she observed that the growth was becoming more noticeable, the swelling seeming to increase on both sides of the neck; but it is said to have been slightly larger on the right side. Its increase in size was rapid, and the mass became so large that it began to produce uncomfortable pressure and to interfere with respiration. Because of her discomfort she came to the out-patient surgical department, where I saw her with Dr. Spencer.

At that time both lobes were enlarged, the right side being slightly larger than the left; but there was not sufficient difference to suggest the presence of a cyst of any size. We placed this patient upon a course of thyroid extract and used local inunctions of the red iodide of mercury. For a short time—but only for a short time—the growth of the tumor seemed to be arrested. The patient then became so uncomfortable that I advised her to come into the hospital and submit to an operation.

You will observe that a large mass now extends across the anterior portion of the neck—a mass which is bilateral and fairly symmetrical. It is regular in contour and elastic to the touch; it does not fluctuate, is free from pain and tenderness, and moves up and down with the larynx and trachea on swallowing. There is absolutely no projection of the eyeballs; there are no nervous phenomena; there is no tremor of the hands. Upon a hasty examination it would seem as if the tumor pulsates; but a careful investigation shows that the pulsation is transmitted from the carotid artery. Several large veins are distinctly visible over the goitre, and one of these veins is the anterior jugular.

The patient is short of breath, even when quiet, and suffers from a great deal of dyspnœa on exertion. Every now and then she has violent seizures of coughing, the cough being metallic in tone. The voice is not at all affected. In view of the metallic nature of the cough and the absence of trouble with the voice, we conclude that the dyspnœa results from pressure upon the trachea and not from involvement of the recurrent laryngeal nerve. This form of dyspnœa is the kind met with in innocent goitre; dyspnœa due to involvement of the recurrent laryngeal nerve is apt to be met with in malignant goitre. Swallowing is not interfered with in this patient; in fact, dysphagia is rare in innocent goitre. The pulse is rather rapid, running up to about 90; but not nearly so rapid as was the pulse of the previous patient, which, you will remember, was from 120 to 140.

The case before us is an instance of ordinary goitre. It is a parenchymatous goitre, a simple goitre, or, as some have called it, although not quite accurately, an hypertrophy of the thyroid gland. It is very common in the valleys which are at the foot of certain mountain ranges in Switzerland, in Southeastern France, in Northern Italy, in the Tyrol, in the Himalayas, and in the Andes; in fact, in the regions mentioned it is often so common as to be endemic. It is an enlargement which very frequently forms the basis of other forms of goitre; for instance, an adenomatous growth might take place in either lobe of this gland, or multiple adenomatous growths might form, the condition in either case being adenomatous goitre; or an adenoma might undergo cystic degeneration, the case being then known as cystic goitre. Of course, an adenomatous goitre may begin as an adenoma in an apparently healthy gland; but, not unusually, it begins as an adenoma in a parenchymatous goitre. The adenomatous goitre and the parenchymatous goitre are most common in the same sorts of people and in the same regions. In England goitre is so common in a certain locality that it is called the Derbyshire neck.

There are many theories as to its causation. It is evidently due to the introduction of some poisonous element into the system. What that element is is in doubt. Some think that an individual becomes liable to the disease because of his habits of life. Some think hygienic surroundings create susceptibility. Some attach great importance to hereditary influence. The probabilities are that a poisonous element is introduced in the drinking water. Some observers have blamed snow water; many have blamed water impregnated with the salts of lime. The real reason is wrapped in obscurity.

Such a goitre as we see before us begins insidiously; grows slowly; occasionally ceases to grow for a considerable period, or even shrinks; frequently undergoes temporary enlargement during menstruation or pregnancy; and occasionally attains an enormous size by a change into a cystic form. It is in a case of parenchymatous goitre that medical treatment is often extremely serviceable; in an adenomatous or a cystic goitre medical treatment is perfectly useless. It is in parenchymatous goitre that the iodides internally are frequently useful. The local use of red iodide of mercury has come to us strongly recommended from India. The treatment which is of the greatest value, however, is the administration of thyroid extract.

Several years ago in this clinic-room I suggested the view that in some cases of simple goitre the gland enlarges and becomes distended with colloid, because the human body is calling for more of the secretion of the thyroid gland than the normal gland is able to furnish; as a consequence, the normal gland enlarges its capacity and increases its output. It undergoes a species of hypertrophy in order that it may

furnish the required amount of secretion; it undergoes what John Hunter would call an enlargement under "the stimulus of necessity." It does exactly what an accessory thyroid does when the thyroid gland is completely removed; hence, if thyroid extract is administered by mouth, the demand upon the gland ceases, the output of the gland is lessened, and the enlargement passes away. This may be the explanation of the cures which have followed the administration of thyroid extract; but it will apply, after all, to but few cases; for as we see the disease in this country in cases of sporadic goitre few of them are really markedly improved by the administration of the drug. Occasionally, however, one is greatly benefited by the treatment; and in parenchymatous goitre we always give it a trial.

If medical treatment fails, shall we operate? I believe definitely that we should. We are justified in operating if the goitre is rapidly or steadily increasing in size, or if it is producing dyspnœa, marked discomfort, or annoying deformity. If it is producing marked pressure, operation is imperatively necessary. In the girl before us pressure effects are manifested. The pressure effects in her case are dyspnœa, a metallic cough, and distention of the veins; and we, therefore, advise operation.

Beyond thirty years ago the operation was only occasionally performed, and was extremely fatal; but the introduction of hæmostatic forceps and of antiseptic surgery made the operation comparatively safe and caused it to be largely performed, especially in countries in which goitre is endemic. Reverdin, Kocher, and Socin became particularly noted as operators. These surgeons showed the world that the operation can be rapidly and successfully performed.

Kocher, more recently, has demonstrated that in many cases of goitre, if there is dyspnœa the administration of ether or chloroform adds to the danger.

If the patient is given a general anæsthetic the already large veins become larger, and the hemorrhage met with during the operation is greatly increased; furthermore, during the operation, if the patient is unconscious from the anæsthetic, dangerous pressure may be made upon the trachea, and the recurrent laryngeal nerve may be injured. In most instances—certainly in all cases in which there is a distinct dyspnœa—it is advisable to use merely a local anæsthetic. If the local anæsthetic is carefully inserted the operation can be performed with very trivial pain, and the hemorrhage will not be great; furthermore, by asking the patient to speak from time to time, we can tell by the change of the voice when we are approaching or are touching the recurrent laryngeal nerve. I shall, therefore, operate on this case with merely the aid of a local anæsthetic. I shall use Schleich's fluid for the skin and superficial tissues, and a 2 per cent. solution of eucaine for the deeper parts.

Many operations have been suggested for the cure of goitre. In cystic goitre tapping has been used by many, or tapping followed by the injection of iodine or alcohol; but tapping is uncertain and unsafe, and in a solid tumor of this description would be absolutely useless and very dangerous.

Some surgeons have advised the injection into the enlarged gland of various materials; for instance, tincture of iodine, iodoform emulsion, Fowler's solution of arsenic, alcohol, etc. In such a method the hope is that the injection of these irritant materials will lead to the formation of fibrous tissue, which tissue will contract and cure the goitre; but injection is probably more dangerous, and is certainly less satisfactory, than radical operation; and although a cure may occasionally be produced, many deaths have occurred.

Ligature of the thyroid arteries finds some advocates. This operation was introduced by Wölfler, but at present it is practically restricted to the treatment of exophthalmic goitre. When the operation was first employed the custom was to tie all four arteries of supply; but it was found that this exposed the patient to the dangers of tetany and myxœdema, so, at the present time, if the operation is employed, the surgeon takes Kocher's advice, and ties but three of the arteries.

Occasionally, when the patient is in a desperate condition, when the goitre is very large, when we are certain that a radical operation would be productive of death, and when a tracheotomy is impossible, the operation known as exothyropexy may be performed. In order to perform this operation make a large incision, exposing the capsule of the gland, pull the goitre itself—or, at least, a part of it—out of the wound, and leave it exposed to the air. This dislocation of the goitre relieves the dyspnœa, and may be followed by atrophy of the gland.

Some surgeons have advised a simple division of the thyroid isthmus —an operation which may relieve the dyspnœa and may produce glandular atrophy; but it is uncertain and often of no avail.

The two operations most in vogue are enucleation and extirpation. Enucleation is an operation frequently practised in cystic goitre and in adenomatous goitre, but it cannot be performed in parenchymatous goitre, which is the nature of the case before us. In enucleation a circumscribed tumor or cyst which lies within the thyroid gland is removed from within the gland, the capsule of the thyroid being incised over the tumor, but not being taken away, and hemorrhage being disregarded until the enucleation has been completed. Intraglandular enucleation is the proper term for this process, and it is an extremely satisfactory method for suitable cases.

Extirpation is the removal of the gland and the capsule, after the arteries of supply have been ligated and divided. In the case before

us there is a uniform enlargement of the thyroid, not a circumscribed tumor or cyst within it. Enucleation is, therefore, not to be considered, and extirpation will be performed. Those of the class who wish to understand these operations more thoroughly should read Kocher's *Operative Surgery* or Mr. James Berry's admirable work upon *Diseases of the Thyroid Gland*—a work which I have found of the greatest service in understanding this subject.

We place the patient upon a table and fasten a screen of sterile cloth below her chin. This screen preserves the wound from infection and prevents the sufferer from observing the hemorrhage or any other occurrence of the operation. I now carefully infiltrate the skin with Schleich's fluid in the line of the purposed incision. This incision is the shape of an incomplete horseshoe, the convexity of which is downward. It begins at the inner border of the sternocleidomastoid of the right side, passes down along the anterior margin of that muscle until it reaches a point just above the clavicle; it is then taken inward above the suprasternal notch, and is finally carried upward for a short distance. The first incision passes through the skin, the superficial fascia, and the platysma myoid muscle. Several large veins are found to have been cut, and we proceed to ligate them with care.

Step by step we divide layer after layer, carefully infiltrating the tissue in advance of us with Schleich's fluid; and if any pain is complained of by the patient, we now and then use a 2 per cent. solution of eucaine instead of Schleich's fluid. In this case it is impossible to separate widely enough the muscles which are attached to the hyoid bone. We therefore divide them high up, leaving stumps sufficiently long to permit of subsequent suturing.

The utmost care is employed to definitely expose the capsule of the gland, in order to be sure that we are really down upon the capsule. We do not want to break through this smooth layer of tissue, and we observe the very large veins which are visible beneath it. If these veins be torn the hemorrhage will be very difficult to arrest, because the thyroid substance and the veins always tear when an attempt is made to apply an artery clamp.

We now separate the capsule from the parts outside of it, dissecting with much care and clearing the upper portion of the gland, where we find the superior thyroid vessels. I tie the artery and then the vein with two ligatures each and cut between the ligatures. The gland is now stripped toward the median line, and the veins met with in that situation are tied and cut.

Next the lower portion of the goitre is cleared and the inferior thyroid vessels are ligated. It is just at this point that the recurrent laryngeal nerve is met with. As I feel around in these tissues with the handle of the knife I ask her how she feels; she answers, "It hurts

some," and you notice the modification in her voice, proving that I am in the immediate neighborhood of the nerve.

The goitre is now lifted from its bed and brought out of the wound —in other words, it is dislocated, and the dyspnœa under which she has been laboring up to this time is at once relieved. After the complete dislocation of the goitre the inferior thyroid vessels can be tied with the utmost ease. They are tied close to the border of the gland in order to avoid the recurrent laryngeal nerve, and are then cut across.

We now work inward toward the isthmus and expose and ligate the isthmus before it is cut. Every care must be taken to prevent the colloidal material of the gland from entering the wound. If it does enter the wound it will produce symptoms. These symptoms may be trivial, consisting simply in rapid pulse and some elevation of temperature (thyroid fever); or they may be very grave, and death may actually ensue from a poisonous dose of this material. The isthmus is cut through with a knife. A little oozing is found at one place, which is quickly arrested by the application of a ligature.

The goitre has now been removed; and there has been very little hemorrhage and almost no pain. The patient has scarcely uttered a sound during the operation; she has not spoken a word, except in answer to questions; and, although no one has been holding her hands, she has never even raised them.

We are, therefore, justified in believing that this operation has been practically free from pain.

I now suture together the muscles which were transversely divided, using catgut as a suture material; insert a medium-sized drainage-tube in the lower angle of the wound; suture the skin and superficial tissues with interrupted sutures of silkworm-gut; and apply a plentiful dressing of sterile gauze. The under layer of the gauze must be fluffed up, so as to make a certain amount of pressure, and thus keep the sides of the wound in contact. The outer layers are laid on flat. The bandage which I apply runs around the forehead, the neck, and the shoulders, and thus prevents undue movement, and maintains a certain amount of pressure.[1]

[1] This patient made an excellent recovery. During the first twenty-four hours there was considerable oozing of blood; and, in consequence, the drainage-tube was removed, and a small piece of gauze packing inserted instead. The day after the operation the temperature was 100°; but it soon fell to normal, and remained so. The pulse was decidedly rapid for several days—from 90 to 110.

ORBITAL ABSCESS ASSOCIATED WITH ANTRAL AND ETHMOIDAL DISEASE.

By Charles A. Oliver, A.M., M.D.,

AND

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OF PHILADELPHIA.

On June 21, 1901, Dr. S. P. Glover, of Altoona, Pennsylvania, sent a thirteen-year-old school-girl to Dr. Oliver's clinic at Wills Eye Hospital. The patient gave a history of rather severe toothache in the left upper jaw for some time before the appearance of a pronounced pain in the left eye, which had come on about six weeks previous to the primary examination. These symptoms were followed in a few days' time by a swelling of the lids of the left eye, protuberance of the left eyeball, diplopia, and divergent strabismus. A few days later vision with the affected organ was reduced to the ability to see to count fingers at six feet distance. At this time a thick, yellowish discharge began coming from the left nostril, accompanied with considerable obstruction to nasal breathing; this continued for a period of three weeks, and was followed by a dropping of very offensive mucopus from the posterior nares.

The swelling of the eyelids soon subsided, revealing the presence of a hard mass in the anterior part of the lower inner portion of the orbit. Vision with the left eye also began to improve, while that with the unaffected right eye began to grow worse. There was a history of attacks of recent moderate delirium, though the appetite was good, the patient slept well, and there were not any headaches, nausea, or vomiting. No history of traumatism except an injury to the back of the head, the result of a fall from a wagon when the patient was seven years of age, could be elicited.

The patient was admitted to the wards of the hospital for careful study of the conditions and operative interference.

There was a left proptosis, which carried the summit of the cornea to a distance of 3 millimetres in advance of that of the other eye. The left eyeball was turned down to 2 millimetres' distance and out. The movements of the globe were impeded with a resultant diplopia the moment that attempts were made to move the eyeball to the nasal side. Careful study of the double images along the median line showed two degrees of left hyperphoria for distance, which remained the same during fixation for close work, and an exophoria of two degrees for distance, which increased to twelve degrees when the fixation object was brought to a point 35 centimetres in front of the eyes. There was considerable infiltration of the subcutaneous and orbital tissues just above the infra-orbital ridge. Decided palpation revealed the presence of a dense, unyielding mass following the orbital rim, which was limited to the inferior nasal portion of the right orbit. Both eyelids were red and œdematous. The pupil of the affected eye was larger than that of its fellow. The iris of the left eye was not so freely mobile to light stimulus as that of the right eye. The irides were quite prompt to efforts for accommodation and apparently unsuccessful attempts for

forced convergence. Vision and accommodation with the left eye were practically normal. Uncorrected vision with the right eye, which was markedly astigmatic, was reduced to one-seventh of normal, the patient being able to read test-type of one diopter size from 10 to 25 centimetres' distance without the use of a correcting lens. Corrected vision and accommodation with the right eye were normal. The fields of vision for white and red in each eye were contracted to about one-half of their usual sizes, this contraction being slightly the more pronounced with the fields of the affected eye. Slight indentations in the field borders, particularly above and below for red, and more marked in those of the left eye, were noticeable.

With the exception of a tortuous condition of the retinal arteries and veins, especially the main venous stems of the left eye, the eye-grounds were normal. A spontaneous pulsation of the retinal veins in the left eye was discernible.

The lymphatic glands at the angle of the jaw on the left side were slightly enlarged. The left nasal fossa was free along the floor. The inferior turbinal was normal, while the middle was greatly swollen and pressed against the septum. The unciform process of the ethmoid was pushed toward the median line, making a slit-like aperture between it and the middle turbinal; from this opening a copious purulent discharge was exuding and running over the inferior turbinal. There was a small and unimportant ridge on the septum. The right fossa was free, while the turbinals on this side, though somewhat swollen, did not exhibit any other abnormality. The teeth, except for the first upper molar on the left side, which was quite extensively decayed (the cavity extending for a considerable distance into the root), were in excellent condition. The palatal arch was normal. The faucial tonsils were small, and the pharyngeal tonsil, while full, did not encroach on the choanæ. The choanæ themselves were free, but a large quantity of pus escaping from the middle meatus on the left side ran down over the soft palate. The lingual tonsil was somewhat roughened. The larynx was normal.

On transillumination of the antra it was found that the light readily penetrated the facial tissues of the right side, illuminating both the cornea and infra-ocular spaces; but on the left side the corneal and infra-ocular light-reflexes were absent, the upper portion of the cheek being in shadow. This shadow, however, did not extend as far downward as is generally seen when the antrum is filled with purulent exudate. Transillumination of the frontal sinuses was not sufficiently satisfactory to afford any data.

As the result of these findings the diagnosis seemed to rest between the following possibilities: 1. Malignant growth starting in the orbit, giving rise to suppurative disease of the antrum and anterior and middle ethmoidal cells. 2. Primary antral disease induced by a carious molar, producing secondary ethmoiditis and necrosis of the lamina papyracea, with orbital abscess. 3. Primary ethmoiditis, followed by necrosis, with orbital abscess and involvement of the antrum.

Six days later, June 27, 1901, the left antrum was opened through the canine fossa while the patient was under ether. In order to ascertain whether the disease originated from the alveolus the carious molar was first extracted. The root of the tooth, however, was found to be normal, thus eliminating this source of infection. After the cheek had

been freed and the periosteum had been lifted from the surface of the maxillary bone up to the infra-orbital foramen, an opening sufficiently large to admit a finger into the antrum was made through the canine fossa. The cavity was large and did not contain much pus. In it a mass of moderately soft tissue could be felt in the region of the orbital wall. A piece of this tissue was removed for examination, and later was found to consist of a simple inflammatory hyperplasia of the mucous membrane. The antral cavity was lightly packed with iodoform gauze, though considerable pressure was employed in the wound itself in order to prevent closure of the artificial opening.

The patient did very well until June 30th (the third day after the operation), when the lower eyelid became more swollen and œdematous, and it seemed as though an orbital abscess was about to rupture through the lower lid.

On July 3 a curvilinear incision was made through the left swollen lower eyelid. The fibres of the orbicularis muscle and the ocular tendon were cut through in order to reach the ethmoidal cells. This done, there was a gush of blood-stained pus, followed by a considerable amount of pus from far back in the orbital cavity. The region of the lamina papyracea was curetted, and several pieces of necrosed bone were removed. A finger placed in the antral opening could readily feel pressure exerted by a finger passed into the depths of the orbit through the wound in the lower eyelid, proving the presence of a dehiscence in the orbital plate of the antrum. The finger in the orbit could also determine the presence of denuded bone in the region of the lower border of the os planum. No communication between the orbit and the left middle meatus could be found. The middle turbinal bone was fractured, and was displaced slightly upward and inward in order to permit better drainage from the ethmoidal cells. The packing in the antrum, which had been renewed once since the former operation, was found to be saturated with foul-smelling pus. The cavity was repacked. The external wound was practically healed within a few days' time. From this time the ocular symptoms improved, the eyelids, which were greatly swollen and œdematous for a few days after the operation, decreased in size, the proptosis lessened, and the eye continued in good condition. Upon removing the packing from the antrum on the second day after the operation a great quantity of fetid pus with a small bony sequestrum came from the opening, necessitating a repacking of the cavity every other day, until on the sixteenth day after the operation the wound through the canine fossa had sufficiently healed to permit the fitting and insertion of a hard-rubber plug. During this time several pieces of necrosed bone escaped through the opening. The discharge gradually decreased in amount and became less offensive in character.

The patient was instructed how to cleanse the antral cavity as might be required, and was permitted to return to her home.

On September 23 (two months later) Dr. Glover wrote that " The nasal opening has healed. The discharge from the antrum, though much less, continues to exude at times through the artificial opening in which the plug is still worn. There has not been any escape of bone." He also stated that soon after the patient had returned from Philadelphia she had " showed symptoms of nephritis, with considerable albumin, which has gradually grown less."

One month after this Dr. Glover wrote that some few days before he had made a careful examination of the case. Vision was the same as that at the last examination. He noted that "The infiltration of the lower lid about the cicatrix is growing more normal. The left nasal cavity shows some swelling of the middle turbinal, with discharge of pus at times. The cavity of the antrum still discharges pus, which seems to form mostly at its upper portion where the parts are congested and granular, as can be seen through the opening in the mouth." Her general health at that time was good.

On November 9 of the same year the patient again came to Philadelphia, during which time a most extended and painstaking re-examination was made, showing that all of the gross ocular symptoms for which she had first reported had practically disappeared. The left nasal fossæ were free. The turbinals were normal except that the middle one on the left side was slightly redder than is usually seen and was somewhat glazed at its anterior end. No discharge of any kind could be detected in the nasal fossæ. The pharyngeal tonsil was full, though it was not obstructing nasal respiration. The choanæ were free. The opening through the canine fossa was large and admitted a good view of the greater part of the antral cavity. A scar on the orbital plate of the antrum and several large bloodvessels running over its internal wall could be seen. The position of the osteum maxillare was easily recognized. The light from transillumination penetrated the upper portion of the face to a moderate degree, though no corneal light could be seen. On the right side of the face the normal illumination of the infra-ocular space and the corneal light were seen.

The only pathological condition that could be noted was a slight œdema along the artificial opening, which had been probably caused by irritation from the rubber plug.

The patient was, for the time being at least, considered as well.

Up to the present time, April, 1902, there has been but little if any discharge from the antrum, and this only from the edges of the artificial opening. The other local and general symptoms have disappeared.[1]

Remarks. In reviewing this case there are several points of interest which come into our minds; but the most important is that concerning the origin of the disease.

There are three possibilities: 1. Primary disease of the antrum. 2. Primary disease of the ethmoidal cells. 3. Abscess beginning in the orbit itself. The third method of origin of the disease can be excluded, as there was not any history or appearance of direct trauma nor any definite causative dyscrasia.

If it were not for the rarity of cases of antral empyema opening into the orbit this condition would seem the most likely, as the clinical history and symptoms strongly indicate such a possibility.

The points which seem to favor primary antral disease are:

1. The proof of existing disease of the antrum, as shown by the findings on opening the antral cavity. There was not much pus evacuated,

[1] Further studies of the condition will be made and continued for a future report of the case.

but the natural opening was very large. Considerable inflammatory œdema of the orbital wall was noticed, and pieces of the lining membrane of the antrum studied with the microscope showed a condition of inflammatory hyperplasia; while the packing, which was removed on the second day after operation, was saturated with pus.

2. The presence of a dehiscence in the orbital wall of the antrum, as evidenced by a finger in the antrum being able to perceive motion imparted by a finger in the orbit at the second operation; the first operative procedure did not involve the region of the orbit.

3. The cessation of discharge from the nose after free drainage from the antrum had been established.

4. The relief of all of the ophthalmic, orbital, and ethmoidal signs of the disease after the cure of the antral disturbance.

The points which seem to favor primary ethmoidal disease are:

1. The fact that disease of the ethmoid is a much more frequent causative factor in the production of orbital abscess than disease of the antrum of Highmore.

2. The presence of probable necrosis of the lamina papyracea of the ethmoid bone.

3. The relation between the small amount of pus which was found in the antrum at the time of the first operation and the profuse discharge that came from that cavity after the second operation. This increase can be most readily explained by considering that the opening between the orbit and antral cavity was either artificially created or was much enlarged at the second operation, permitting the orbital abscess to freely drain into the antrum.

4. The transillumination previous to the opening of the antrum did not give the characteristic shadow that is cast by empyema of the maxillary sinus, the shadow in this case being limited to the upper part of the face. This limitation may be accounted for either by an undeveloped condition of the antrum itself (which was not so in this case), or by an abscess of pus in the antral cavity; the shadow in the latter condition being probably caused by a thickening of the orbital wall of the sinus.

It will thus be seen that there is something to say in favor of both an ethmoidal and an antral origin of the disease, and it is at present impossible to state with any degree of positiveness from which of these two accessory sinuses the disease started. It is not improbable, however, that there was an original antral disease affecting first the ethmoidal cells and thence the orbit, or *vice versa*.

A most interesting condition, and one which was fully established by the clinical and operative findings, was that necrosis of the orbital or upper wall of the antrum had developed without any special cause in this—an acute case of simple accessory sinus inflammation.

The absence of any specific inflammation, such as tuberculosis and syphilis, is proven by the rapid recovery after proper drainage had been furnished. Another interesting fact was the development of a post-operative nephritis.

Nearly all of the text-books mention the possibility of primary empyema of the antrum terminating in abscess of the orbit. Reports of such cases, however, are excessively rare. On the contrary, numerous instances of orbital abscess originating from ethmoidal disease can be quoted, but this aspect of the question is so well known that proof of the same would be superfluous. We desire, however, to state that while admitting that ethmoidal disease is a much more frequent cause of orbital abscess, yet the fact that antral disease, leading, as it frequently does, to necrosis of the bony walls of the cavity, may produce perforation of the orbital plate, cannot be cast aside.

THE CLINICAL ASSOCIATION OF CANCER AND TUBERCULOSIS WITH REPORT OF A CASE.

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It is occasionally a useful process to remove from the shelf an old question which has apparently been settled and laid aside and examine it in the light of recent facts. The clinical association of cancer and tuberculosis appears to me to be such a question.

Considering the great frequency of each of these diseases, very nearly one-fourth of the total mortality of the civilized world being due to tuberculosis[53] and a large and apparently increasing proportion to cancer, the two diseases are not associated as frequently as they would be if there were no influences at work mutually antagonistic. My attention was especially drawn to this question recently by the study of a case in which the two diseases were associated, and which was, so far as I know, the first that I have ever met. The case presents a few other features of interest in diagnosis, and I will briefly present its main points.

Mr. H., aged forty-five years, an undertaker by occupation, was first seen August 26, 1899, at his home in Leipsic, Ohio, in consultation with Drs. W. H. Hickey and J. C. McClung. The patient was bedridden, moderately emaciated, having lost only twelve pounds within the preceding year, although this hardly expressed the degree of emaciation, inasmuch as his health had been gradually depreciating on account of digestive disturbances for a dozen years or more. With the exception of these occasional attacks of indigestion his health was fairly good

until the beginning of his present illness, which he assigned to June, 1899, less than three months prior to my visit. The cancerous processes, which will be described, must have existed a much longer time, but it was only then that inordinate gaseous distention of the abdomen called his attention to some unusual trouble in this locality. The symptoms of general abdominal distress and disturbances of the digestive functions became progressively more marked, and the debility gradually increased until he became bedridden August 2d, three weeks before my visit. Shortly after taking to his bed the extreme abdominal distention disappeared, and the principal complaint from that time on was of nausea associated with little or no spontaneous pain. The stomach became quite intolerant of food, which caused slight pain, quickly relieved by vomiting, with occasional eructations of considerable quantities of green fluid. The pulse ranged from 75 to 90, and the temperature was practically normal throughout the entire progress of the case. Once or twice a temperature of 99.5° F. to 100° F. was found, but this could easily have been due to disturbances of metabolism, and could not, or at least did not, create any suspicion of the pulmonary tuberculosis which the autopsy showed to exist. For one or two months before taking to his bed obstinate constipation had developed, and had been a constant feature in the case. The stools were not clay colored, but the urine was exceedingly dark. Physical examination revealed marked tenderness to the right of the epigastrium and extending down to the umbilicus. This tenderness, which was associated with some spontaneous pain, had been present for about a year, which probably marked the beginning of the active cancerous growth in the liver. The pain was not constant, but paroxysmal, the paroxysms occurring three or four times a week, of considerable severity, and lasting a few hours each time.

Physical examination revealed nothing wrong with the chest organs. Resonance was apparently normal, and nothing distinctly morbid could be detected by auscultation. The symptoms did not point to any pulmonary disease, and it is possible that this part of the examination was not made as critically as could have been desired in the light of the autopsy. It was made, however, with considerable care, and was absolutely negative throughout. Abdominal palpation elicited the tenderness above referred to, with more or less hypersensitiveness over the entire abdomen. The liver was found notably enlarged, especially the left lobe, which extended far into the left hypochondrium, and the portion of the liver corresponding to the left lobe was distinctly hard and nodulated. No other physical alterations could be detected by palpation or percussion. A troublesome question involved in the diagnosis was as to the presence or absence of organic stomach disease. An attempt was made to get the gastric juice for analysis, but the food was rejected too soon to furnish the desired secretion. Irrigation of the fasting stomach gave the usual evidence of chronic gastritis in the way of numerous epithelial cells and leucocytes, both of which were present in great abundance, but no pathological tissue fragments were found. All efforts to outline the stomach by inflation or filling with water were very unsatisfactory, and left me entirely in doubt in regard to its location and size. At a subsequent visit the gastrodiaphane was introduced, but gave absolutely no transillumination whatever. The record of the blood examination was unfortunately lost, but there was an extreme oligocythæmia (about 1,500,000 red cells) and leucopænia.

The urinalysis was as follows: total quantity in twenty-four hours, 630 c.c.; specific gravity, 1022; color, deep red; total solids, 32.13 grammes; urea, 3.3 per cent., or 20.79 grammes; highly acid, containing 9 per cent. by bulk of serum albumin; no sugar; 0.57 gramme of uric acid, its ratio to urea being 1 to 37; total sulphates, 1½ grammes—simple sulphates 0.9 gramme, ethereal 0.6 gramme, the ratio being 1 to 1½. The ethereal sulphates were largely represented by "indican," which was present to the extent of about 0.03 of 1 per cent.

The diagnosis of cancer of the liver was made, the question of the stomach involvement being considered impossible of solution.

The patient died about one month later, and autopsy was made twenty-four hours after death. The liver was found to be the seat of a diffused carcinomatous process, greatest in the left lobe, although involving the right lobe as well. In addition to this and what could not be determined during life, there was cancerous involvement of the pancreas and surrounding structures. The stomach, however, was free from any trace of induration or other evidence of carcinoma. It had escaped completely. An interesting point with reference to the failure of the gastrodiaphane to render any aid in diagnosis was the fact that the liver had extended forward and downward and become adherent by extension of inflammatory processes to the transverse colon, which had to be torn loose. This formed a compartment back of the liver from which the stomach could not escape, and transillumination was therefore impossible.

Upon opening the chest cavity and examining the lungs they were found to be studded from apex to base on both sides with minute deposits, microscopical study of which showed them to be typical tubercular nodules. The pulmonary lesions were at first thought to be metastatic miliary carcinosis.

The principal interest in the case centred in the coexistence of an extensive carcinomatous process coupled with wide-spread tubercular disease involving practically the entire area of both lungs. The carcinomatous process did not extend above the diaphragm nor the tubercular process below it, so far as could be determined.

The absence of fever and pulse acceleration in a case of generalized pulmonary miliary tuberculosis are points worthy of note. It naturally suggested the possibility of an antagonistic action of the toxins of cancer and tuberculosis upon the thermogenic centres. This suggestion is probably not entitled to very serious consideration in view of the fact that an occasional apyretic course of chronic miliary tuberculosis is recognized by several writers—*e. g.*, Berg[50] and Delafield.[51] It is certainly a very exceptional phenomenon. This is especially true when taken in connection with a very nearly normal pulse-rate. Berg,[50] indeed, lays stress upon the constant frequency of the pulse as an important diagnostic sign during the occasional apyretic course of miliary tuberculosis.

The controversy with reference to the frequency of the clinical association of cancer and tuberculosis began with the teachings of Rokitansky. He is commonly reputed to have taught their incompatibility.

Hamilton, for instance,[45] says explicitly that "Rokitansky taught that phthisis and cancer are incompatible diseases."

I am strongly inclined to doubt that Rokitansky ever held the extreme view above credited to him. In the only discussion of the subject by him that I have been able to find, after saying that cyst formations and tubercle do not easily occur together, he proceeds:[5] "A similar disposition—(*i. e.*, not to occur together easily in 'the same organ or organisms,' G. W. M.)—appears, though on the basis of unequally numerous observations, between tubercle and cancer. Even if they appear beside each other as of demonstrated general significance, cancer regularly follows tuberculosis; more rarely the tubercle has developed after the destroyed cancer and its crasis. Besides it is well to observe that sometimes a tubercle appears, especially in the lungs, joining with the inflamed and sanious cancer," etc. Certainly, this is very different from his reputed teaching concerning this question.

Moreover, the cases of Krauss,[1] in 1832, and Carswell,[2] in 1834, being the first recorded cases of the clinical association of these two diseases, were both published in Germany, four and six years respectively after Rokitansky's graduation, and ten and twelve years before he reached the rank of Professor, when, and probably not much before which time, his opinions may have attracted attention. He was scarcely ignorant of these observations.

But be this as it may, the question continued to receive intermittent discussion for about forty years, and resulted, as will be seen by the appended bibliography, in a considerable literature.

Some of the earlier observations, reporting the association of the two diseases, appear to be open to suspicion. For instance, in 1840, Annan[3] reports a case of pulmonary tuberculosis with six carcinomatous ulcers of the ileum. It would probably require more accurate methods than were available at that time to convince us that multiple ulceration of the intestines occurring in a case of pulmonary tuberculosis was not itself tubercular.

It was during the two decades, 1860 and 1880, however, that most of the reports were made, and the question apparently settled and dismissed. In 1863 A. B. Clarke[18] reported a case and expressed surprise that anyone should maintain that the diseases were antagonistic.

The elaborate brochure of Croizet,[34] in 1875, reporting twenty-two cases, and quoting fourteen more from Weissberger, followed by that of Gouin,[42] in 1878, reporting thirty-four cases, practically closes the history of the discussion, and it only finds brief reference, if mentioned at all, in subsequent literature.

It appears to me to be a remarkable fact that it took the accumulated observations of several decades to dispose of the question of the mutual absolute exclusion of cancer and tuberculosis, each by the

other; for this was the form the question really assumed. One-fourth of the human race in civilized countries are afflicted with tuberculosis, with an approximate mortality of 50 per cent. In 1896 very nearly 5 per cent. of the total mortality of England and Wales was due to cancer. Either the clinical picture or the findings at the autopsy are fairly distinctive in the average cases of both cancer and tuberculosis. Here, then, are two characteristic and totally distinct diseases, both very chronic, as a rule, implicating very nearly 30 per cent. of the population of the civilized world, and associated so rarely that their very co-existence was a matter of dispute over several decades, and by the ordinary laws of coincidence the association of two such diseases should easily come within the frequent observation of every clinician of large experience. Yet such is certainly not the fact. The case above recorded, for instance, being the only one that I have ever seen, was reported to a pretty full meeting of the local medical society in this city, and not one of the members had ever met with such a case. I have recently talked with four surgeons of national reputation, and not one of them was able to recall having seen a single case of combined cancer and tuberculosis.

One of the most recent utterances on the question of the association of cancer and tuberculosis is that of Williams,[48] in the *Twentieth Century Practice of Medicine*. He says: "Although cancer and tuberculosis are thus intimately connected (*i. e.*, in family history), it is very rare to find both diseases in active progress in the same individual. I have met with this conjunction only twice in 136 cancer [illegible]. Kelynack, at the Manchester Infirmary, found it only twice in 145 similar necropsies.

From what has been stated, it is obvious that there is a certain antagonism between *active* tuberculous disease and cancer. The outbreak of cancer often follows or coincides with the healing of pulmonary tubercle, although in most cases the intervening period is fairly protracted. It is also evident that active tuberculous disease is of much less frequent occurrence in the cancerous than in the non-cancerous. There is, however, no absolute incompatibility between these morbid manifestations, but the comparative rarity of their co-existence is noteworthy. I even know of a few instances in which tuberculous disease and cancer of the same part have co-existed: thus Crawford has met with this conjunction in the mamma; Franque, in the uterus; Frerichs, in the liver; Crone, in the larynx; Dalton, in the large intestine; Naegli, in the rectum, ileum, and cæcum; and Friedlander reports the development of cancer in the wall of a tuberculous cavity in the lung. Instances of 'lupus cancer' have also been described."

It will thus be seen that while about 25 per cent. of the total population are afflicted with tuberculosis, it was only found four times in

281 autopsies of cancer patients, or in about 1.4 per cent. In other words, if we can judge from these data, it is nearly twenty times as frequent in the non-cancerous as in the cancerous. Coupled with the acknowledged rarity of the association of the two diseases from the stand-point of clinical observations, it presents a question of great scientific interest.

Boas[52] has recently reported 141 cases of gastric cancer, with pulmonary tuberculosis, in five cases, or about 3.5 per cent. In one series of autopsies of cancer patients about 12 per cent. of the cases showed *obsolete* tubercles. This, of course, has no bearing on the real question of antagonism between the two morbid processes, as this can only be supposed to exist when the diseases are in an active state, especially if the " antagonism " is in the nature of a chemical poison. The fact that a patient has had an active tuberculous lesion indicates a lowered resistive power of the organism, which might even be favorable to the genesis of cancer whatever its pathology may be. The contrary could only be assumed on the basis of a special diathesis of each disease, for which the evidence is lacking. Indeed, so far as family diathesis or " tendencies " are to be considered the two diseases are apparently closely related instead of being in any degree opposed to each other.

The exceptional occurrence of cancer and tuberculosis in the same patient, or even in the same organ, cannot be considered as completely invalidating a general law of antagonism of the two diseases. This would not be in keeping with the logical principles which have heretofore governed us in deciding questions of this sort. Take, for instance, the general law of immunity to the acute infectious diseases produced by a single attack. No one questions the adequate basis of such a law. It is commonly enunciated without qualifications. The exceptions are so rare that they are practically ignored ; and yet Mycelius[49] has collected from the literature 514 cases of smallpox, 33 of scarlet fever, 37 of measles, 208 of typhoid fever, and 34 of cholera, which had from two to four attacks.

The fact that carcinoma has been known to develop in the wall of a tubercular cavity is an interesting observation, but is not entitled to as much weight in the question under discussion as might at first sight appear to be the case. It is, of course, rare enough to rank as a pathological curiosity, and proves no more than exceptions to other pathological laws of a general character. But, in order to have any weight at all, it is necessary to know that the tuberculous process is active at the time. It is well known that there are inactive periods in the history of many if not most cases of tuberculosis ; and in the " quiescent state " the tubercle bacilli may fairly be assumed to be less virulent. They would produce less toxins, or none, and it is to these that the " antagonism " to cancer, if such exists, is probably to be imputed.

It should be borne in mind in this connection that the formation of a tubercular cavity is preceded by a very active tissue proliferation, which ends in a coagulation necrosis, and that these irritative phenomena are really very favorable to the genesis of cancer.

This is a fact well recognized in pathology and especially well attested in the special fields of gynecology and gastrology. It is, I think, generally held by gynecologists at the present time that lacerations and other irritative lesions of the endometrium are favorable starting points for the development of cancer. In the stomach it is a well-recognized fact that carcinoma is engrafted on a benign ulcer with considerable frequency. Whatever may be the etiology of cancer, these irritative processes, with surface erosions and more or less unprotected stomata and tissue interspaces, favor the inception of cancer either by local infection or nutritional tendencies. With the well-recognized incidence of cancer upon the basis of non-specific ulceration it ought to be frequently found in tubercular ulcerations if there were no deterrent influences. Such is certainly not the case. This finds a partial explanation, it should be observed, in what might be termed the anatomical predilection of the two processes. In this connection, the observations of Rokitansky are worth producing, as he gives them in the tabular form :

Frequent:	Pulmonary tuberculosis.	Rare:	Pulmonary cancer.
"	Ovarian cancer.	"	Ovarian tubercle.
"	Salivary gland cancer.	"	Tuberculosis of the salivary glands.
"	Cancer of the stomach.	"	Tuberculosis of the stomach.
"	Cancer of the œsophagus.	"	Tuberculosis of the œsophagus.
"	Cancer of the rectum.	"	Tuberculosis of the rectum.
"	Tuberculosis of the small intestine (ileum).	"	Cancer of the small intestine (ilenm).

Still, there are locations, such for instance as the upper end of the respiratory and digestive tracts, where both processes are sufficiently common to furnish an adequate basis of observation, and the frequency of both diseases in this and other locations, coupled with the extreme rarity of their association, is certainly a notable circumstance.

Summary. 1. Cancer and tuberculosis are so rarely associated in the same individual as to indicate a mutual antagonism between the two diseases. Autopsies on 281 cancer patients revealed only 1¼ per cent. of cases of tuberculosis. In the non-cancerous its frequency is nearly twenty times as great.

2. The antagonism is not " diathetic," but is probably due to the chemical products of the two morbid processes, that of each being inimical to the other.

3. There is a rather intimate relationship existing between the two diseases in certain families. The existence of either appears to favor the occurrence of the other, probably by a lowering of " resistive power " in the individuals of such families.

4. The two diseases are not absolutely incompatible. They may very exceptionally exist in different parts of the same individual. Still, more rarely, they may exist in the same organ, and even in identically the same tissue. In the latter case it is probable that the primary disease was quiescent when the secondary one developed.

5. In view of these apparent antagonisms, and the occasional retrocession of cancer after the use of tuberculin (though very doubtfully attributable to the latter), it would seem worth while in properly selected inoperable cases of cancer to try the systematic local injection of tuberculin in the cancerous tissue.

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PRIMARY CARCINOMA OF THE URETHRA IN WOMEN.

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Primary carcinoma of the urethra in woman is a very rare affection. In cases of primary carcinoma of the vagina and vulva, which also is an infrequent disease, secondary involvement of the urethra by extension is not uncommon. Excluding these cases as not belonging to the

class under consideration, E. Ehrendorfer[1] (to whose exhaustive article I am indebted for many of the data contained in this paper), in 1899, was able to collect only twenty-seven cases, including his own case, in which the urethra was primarily affected with carcinoma. Since then I have been able to collect from the literature and personal communication eight more cases (McGill, C. Kynoch, Sanderlin, Orthmann, C. Jeff. Miller, Goffe, Brothers), including my own. It is interesting to note that three of these cases should have occurred in this city within a year.

Mrs. L. W., was referred to me August 10, 1900, by her physician, Dr. E. Hochheimer, for some affection of the urethra. She was aged thirty-six years, had been married fourteen years, and was the mother of three children, the youngest being nine years of age. In October, 1899, she had had a severe attack of dysentery, and ever since then there has been moderate enlargement of the liver. For years she has suffered from frequent micturition, but the act was never attended with any pain, and she never consulted a physician for it. For the past six months, however, she has suffered with a burning sensation in the region of the urethra, and for about the same period the act of micturition has been attended by a smarting pain. She has never passed any blood per urethram, nor has she ever had any urethral discharge.

Her menses were regular and profuse, as they always had been. Her family history was negative.

Present Condition. She is a well-built woman, well-nourished, and moderately anæmic.

The urethral meatus looks normal, though moderately dilated, but just within its margin appears a firm growth which seems to involve the outer two-thirds of the urethra. The growth completely surrounds the urethral canal, but is much thicker posteriorly and laterally. The visible portion of the growth just within the meatus presents a somewhat granular appearance, the free surface of which bleeds readily to the touch. The affected two-thirds of the urethra is very hard and firm and corresponds in size to a small-sized thumb. The vaginal mucous wall overlying it is perfectly normal and is freely movable. There is no enlargement of the inguinal glands. I could readily introduce a No. 9 Kelly's cystoscope into the urethra and could see that the vesical sphincter, as also the urethral mucosa immediately adjacent to it, was normal. The bladder mucosa presented nothing abnormal. The uterus was found in retroversion and rather firmly fixed; the adnexa apparently normal. The liver border extended down to a level on a line with the umbilicus, but was perfectly smooth and had been of this size since the attack of dysentery, as previously stated. The diagnosis of primary carcinoma of the urethra was made and immediate extirpation of the growth was urged.

The patient was operated upon three days later (August 13th) at St. Mark's Hospital. In order to go wide of the disease the whole urethra, including a fairly wide strip of the overlying vaginal mucosa, was extirpated. It was my intention, however, to leave the vesical sphincter intact. But after dissecting the urethra beyond what I took to be a safe distance from the inner margin of the growth, and on dividing it from above downward, I found that the urine was not entirely retained

FIG. 1.

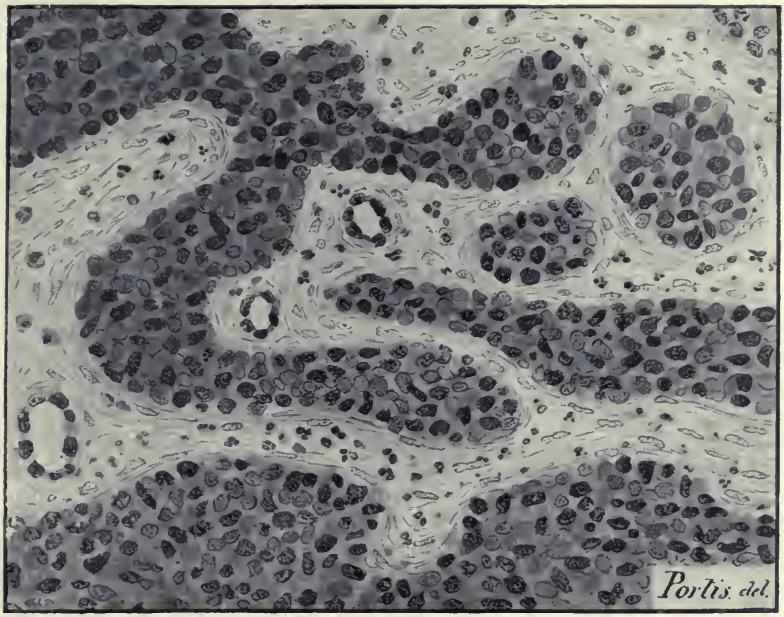
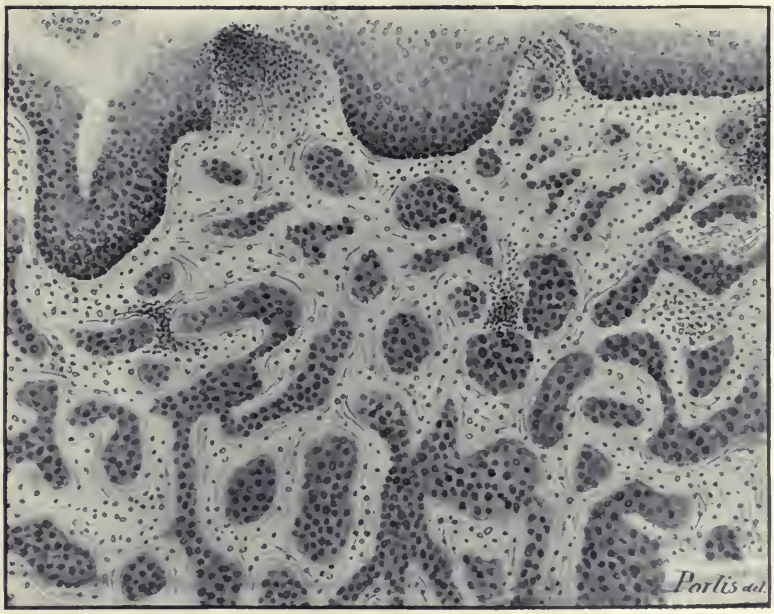


FIG. 2.



within the bladder, and began flowing out through what seemed to me a vesical sphincter that had lost its function. As far as I could tell the incision had stopped short of the sphincter, but evidently not enough of the urethra had been left to permit the sphincter to exercise its customary function. After the numerous vessels that had been clamped during the operation had been ligated, I passed a catheter into the bladder and narrowed the sphincteral opening by a couple of sutures, as one would a torn rectal sphincter. The deep and large raw surface created by the excised urethra was diminished in size by several catgut sutures, and then it was easy to bring into coaptation the cut edges of the vaginal mucosa by several interrupted silkworm-gut sutures.

Two days later the catheter was removed and the bladder was irrigated. There seemed to be good control. On August 20th (the seventh day after the operation) the sutures were removed, and now for the first time the urine came away involuntarily. For the following month the patient would at times have fairly good retentive power, and at times she had scarcely any. Later on, however, she had no retentive power whatever, and the urine kept constantly dribbling away from her. The loss of function on the part of the sphincter seemed to be due in part to the traction of the vaginal wall backward by the displaced cervix (the uterus being in fixed retroversion), and in part to the absence of any urethral canal. I proposed an attempt to remedy the defect by an operative procedure to bring the uterus in antroversion, and to build up an artificial urethra. The patient would not consent to any extensive operation, but was willing to submit to the lesser procedure at her own home (a small apartment) of building up an artificial urethra. This attempt was accordingly made on November 23, 1900. A strip of about an inch wide of vaginal wall just beyond the bladder opening was dissected out, and this was made to glide forward in the direction of the pubis, and was sutured by interrupted silkworm-gut sutures to a denuded line on either side of the proposed new urethra. The meatus of the new urethra was carried pretty high up on the vestibule. A catheter was left *in situ*. This had to be removed after the lapse of twenty-four hours on account of the irritation it caused. The patient was allowed to void urine herself, and she could easily retain her urine for four hours at a time. On the night of November 27th (four days after the operation) the patient retained her urine from 11.30 P.M. until 7 A.M (7½ hours).

November 30, 1900. Removed most of the sutures. Some of them have suppurated through the tissues. The new meatus has dropped back quite a distance.

December 2. Removed the remaining sutures. Patient has fairly good retentive power.

February 1, 1901. The new urethra has given way for the greater part. Still the patient has much better retentive power than before the operation; with care she can hold her urine for two hours at a time.

January 2, 1902. She has little or no retentive power; the urine dribbles away constantly. In the supine position at night she can retain her urine for an hour or longer. The parts look perfectly healthy. The opening in the bladder is fairly constricted, and one wonders why she has no retentive power. The retroflexion of the uterus and the consequent traction upon the anterior vaginal wall, draw-

ing the vesical opening backward, may be the chief factor in the loss of vesical control. I feel rather confident that a vaginal fixation and another attempt at building up a urethral canal would give fair retentive power. The most careful examination fails to detect any evidence of a recurrence. The general health of the patient is excellent.

Dr. F. S. Mandlebaum, pathologist to Mt. Sinai Hospital, kindly made a microscopical examination of the extirpated growth. He found it to be a flattened cell carcinoma, a diagnosis with which several prominent pathologists who had seen the slides concurred. The vaginal wall which was removed with the growth was found to be normal.

The excellent drawings of the microscopical findings were made by my friend, Dr. M. M. Portis, of Chicago, to whom I take this opportunity of expressing my indebtedness.

Considerable confusion exists in the classification of cancerous growths in the region of the vestibule and urethra. This confusion has arisen in part from the circumstance that in advanced cases it is difficult to determine whether the growth originated first in the vulvar tissues and later extended to the urethra. The classification by Ehrendorfer into " urethral carcinoma," that originating in the urethral mucosa, and " vulvo-urethral carcinoma," that developing in the tissues immediately surrounding the urethral mucosa, seems the most practical and most in accord with the pathological findings. In the latter variety the mucosa may become involved, but it does so by a process of extension from the peri-urethral tissue.

Vulvo-urethral carcinoma, by far the most common variety, is rather a superficial process, and is a squamous-cell carcinoma. It begins either in the form of a papule or as a hard nodule lying apparently underneath the mucosa, or as a deep-seated infiltration which only after the lapse of some time shows superficial ulceration. It may also develop as a corroding cancerous ulcer lying in contiguity to the urethral meatus and extending gradually inward and outward. It has a predilection for the peri-urethral tissues, so rich in blood and lymph vessels, thus constituting what is commonly known as peri-urethral carcinoma.

Primary urethral carcinoma is that form which develops from the epithelia in the urethral mucosa, or more especially in the glandular structures. It extends in both directions, and finally involves the vesical sphincter and the bladder in the form of papillomatous carcinoma. Even in advanced cases the vestibule and vaginal introitus may remain free from the cancerous process. When the distal part of the urethral mucosa is affected after the growth has undergone ulcerative degeneration a crater-like dilatation of the meatus occurs, with marked infiltration of the borders. In some very advanced cases the ulcerative process breaks through the urethro-vaginal septum, forming a urethro-vaginal fistula.

In those cases in which a polypoid growth of the urethral mucosa, or a partial prolapse of it, undergoes malignant degeneration, the cancerous mass takes the form of an intensely red, cauliflower-like growth, bleeding readily to the touch, which may be as large as a walnut protruding from the meatus, and apparently being attached by a pedicle.

The distinction between *vulvo-urethral* and *urethral* carcinoma is easy in the early stages, but when the disease is more advanced it is attended with great difficulty and can only be made after a thorough anatomical and histological examination.

Urethral carcinoma (epithélome primitif de l'urethre) is by far the rarer of the two affections. In Ehrendorfer's collection of twenty-seven cases only seven belonged to this variety. They were the cases of Bardenheuer, Thomas, Winckel (two cases), Soullier-Picqué, Swan, and Ehrendorfer's own case.

In my collection of eight cases, three (Goffe's, Miller's, and my own) may probably come under this heading.

Case XXVIII.—A. F. McGill (*London Lancet*, 1890, p. 966. Overlooked by Ehrendorfer). The patient, aged fifty years, had painful and difficult micturition for five months. A hard nodular mass extending from the urinary meatus to the base of the bladder. Operation, suprapubic incision, through which the growth was pushed with the fingers down into the vagina and removed through that canal. The vesico-vaginal fistula was closed and a tube inserted in the suprapubic opening. Ultimate result not stated.

Case XXIX.—C. Kynoch (*British Medical Journal*, vol. i., 1901). The disease affected the outer two-thirds of the urethra. Full data of case not given. Disease recurred in three months, and patient died ten months after the operation.

Case XXX.—Sandelin (*Centb. für die Krankheiten der Harn und Sexual Organe*, 1900). Notes meagre. A woman, aged sixty-five years. Urethra and growth extirpated. Result not stated.

Case XXXI.—Orthmann (*Zeitschrift für Geb. und Gyn.*, 1901, Band xlv.). Patient, aged seventy-five years. For two years suffered with irregular hemorrhages, which have increased in quantity lately. On examination noticed a cauliflower growth projecting between the labia, which resembled a prolapsed cervix, but on close inspection it was seen that the tumor involved the urethra. Growth was extirpated together with 3 cm. of the urethra. The patient had incontinence at first. Later on had full retentive power. No mention of condition of inguinal glands.

Case XXXII.—J. Riddle Goffe (*New York Medical Record*, July 6, 1901). The patient, an unmarried woman, aged twenty-eight years, suffered with frequent and painful micturition for the past six years. The symptoms were growing steadily worse. She had been treated by various gynecologists for supposed anteversion of the uterus. A small growth was detected by palpation in the region of the vesical sphincter. Cystoscopic examination of the bladder showed its mucosa to be normal. The small growth was found to be attached to the vesical sphincter, which it had infiltrated. It was generously dissected. The patient

made a good recovery, and was free from symptoms two months after the operation. Microscopical examination showed the growth to be an epithelioma. Condition of inguinal glands not stated.

Case XXXIII.—C. Jeff. Miller (*American Gynecological and Obstetrical Journal*, November, 1901). A widow, aged fifty-two years, had difficult urination for two months; a sessile growth upon the floor of the urethra. The patient declined operation for a month, when the disease had evidently extended to the bladder. The urethra was removed flush with the sphincter. Recurrence in two and one-half months. The patient died eight months later.

Case XXXIV.—A. Brothers (*American Journal of Obstetrics*, January, 1902). The patient, aged fifty-nine years. Multipara. Frequent and painful micturition for ten months. Latterly inability to void urine. The entire length of the urethral canal was embedded in a hard sausage-shaped mass, which encroached upon the vaginal lumen below and to a lesser extent involved the sides and upper portion of the vestibule. The whole urethra and adjacent portion of the vaginal wall was extirpated. Incontinence at first. Four months later the patient is in good health, and "has practically regained perfect control over her bladder." Pathological report, "pure epithelioma."

It is doubtful if this case belongs to either of the varieties classified by Ehrendorfer. It presents rather the features of carcinoma of the anterior vaginal wall involving the urethra secondarily.

Dr. Brothers kindly permitted me to examine the specimen, and from its appearance it is impossible to tell whether it originated in the vaginal wall and extended secondarily to the urethra, or *vice versa*.

Etiology. The age of the patients affected with carcinoma of the urethra varied from twenty-eight to seventy-five years. Under forty years of age there were seven cases (cases of Bardenheuer, Thomas, von Winckel, Zweifel, Goffe, Vineberg); two cases were over seventy years; three cases occurred between the fortieth and fiftieth year; thirteen cases between the fiftieth and sixtieth year, and ten cases between the sixtieth and seventieth year. With the exception of seven cases, including the writer's, all the patients had reached the menopause.

It would, therefore, appear pre-eminently to be a disease of middle and advanced life. Ehrendorfer ascribes as a predisposing factor local chronic inflammatory processes. He says, inasmuch as carcinoma of the male urethra is known to develop in cases of stricture, the same probably holds good for the urethra in women, in whom stricture may exist without any symptoms. Knowing with what frequency stricture of the male urethra occurs and how rare the occurrence of carcinoma is (scarcely a dozen cases in the literature), such an assumption does not seem warranted. Still, it seems plausible that long-continued traumatism may play some rôle in the causation. Most of the women in whom the disease developed were multipara, in whom a gaping of the meatus and some prolapsus of the urethral mucosa is not uncommon.

Ehrendorfer is also of the opinion that urethral caruncles (polypoid angioma, glandular polypi, and cystic adenomas) under continued irritation may develop into carcinoma. Of course this cannot be denied. Still, the writer has seen a fairly large number of so-called urethral caruncles which had existed for a long time without showing any malignant tendencies.

Symptoms. Owing to the comparative shortness of the urethra in women and its comparative width, the disease may exist for some time without giving rise to any symptoms. Considerable length of time may elapse before the disease interferes with the act of micturition. The first symptom may be a burning sensation attending the act of voiding urine. My patient complained of a smarting sensation in the urethral region. Other patients have complained of a pruritus in the vicinity of the urethra and vestibule. Hemorrhage and discharge are very late symptoms.

On inspection there may be seen a small cauliflower growth projecting from the meatus, which, on careful searching, may show the fine finger-like processes so fully described by Cullen as occurring in squamous-cell carcinoma of the cervix. Such a growth will bleed readily on the slightest touch. The affected part of the urethra will have the characteristic hard, infiltrated feel common to malignant growths.

In other cases (as in the writer's case) the growth does not project beyond the meatus, and in some an endoscopic examination may be necessary to detect its presence (Goffe's case). When the affection is more advanced, crater-like ulcerations, with hard, infiltrated edges, and covered with a dirty, grayish, foul discharge, will be observed. Fortunately in the majority of cases the disease does not extend rapidly, and may exist for a long time before involving the bladder.

Diagnosis. The conditions most frequently met with in the urethra in women and which must be differentiated from carcinoma are: (1) Urethral caruncle (papillary polypoid angioma of Winckel); (2) prolapsus of a portion of the urethral mucosa; (3) fibroid mucous polypi.

Urethral Caruncle. These tumors vary in size from a pin-head to a cherry, are usually of a bright red color, smooth in appearance, and do not readily bleed. They are usually multiple, but may be single, and are situated near the meatus, generally on the posterior lip. They show no great tendency to increase in size, and generally are extremely tender.

Prolapse of the Urethral Mucous Membrane. In multiparæ it is not uncommon to see a condition which is often mistaken for urethral caruncle. On close observation it will be seen that the meatus is irregularly torn and that a portion of the mucous membrane has prolapsed. The apparent growth has not the bright red color nor the sensitiveness of a urethral caruncle. It is found to be continuous with

the remainder of the mucous lining and does not possess the hardness nor the tendency to bleed of a malignant growth. It seldom gives rise to any marked disturbance.

Fibroid or Mucous Polypi. These are comparatively rare. They are usually situated within the urethral canal, and can then only be detected with the aid of the endoscope. They are pale in color and do not show any tendency to bleed. They are usually pedunculated. The writer operated upon a case during the past summer in which a fibroid the size of a kidney bean was situated in the posterior wall near the meatus.

Prognosis. This will depend, as in carcinoma of other parts, upon the extent of the disease.

Melchiorj's[2] division into three stages is of practical prognostic value. In the first stage, where the disease does not extend to over half of the urethra and metastases are absent, a radical extirpation of the diseased parts may be followed by a freedom from recurrence for many years. In the second stage, where the disease has affected the whole urethra and has extended to the periosteum of the pubic bones, the outlook for a permanent cure is not very promising. In the third stage, where the disease has extended to the neck of the bladder and the adjacent soft parts, a radical operation is scarcely feasible. Latterly cases even in this stage have been subjected to extensive operations, but sufficient time has not yet elapsed to determine the efficacy of such procedures.

Treatment. Of course, so far as the disease itself is concerned, only one course deserves any consideration, and that is total extirpation when this is feasible. As already stated, when the disease has extended to the periosteum of the bones and to the neck of the bladder, the propriety of subjecting the patient to an operation is very questionable. In operable cases the growth is usually so situated as to be accessible through the vagina. McGill, however, found it necessary in his case to make a suprapubic incision into the bladder, so as to enable the fingers to depress the growth into the vagina. When, as in McGill's case, the disease involves the neck of the bladder, it is better to close the bladder below and create a suprapubic fistula, after the method of Witzel. In this way the patient may have a certain degree of control. In other cases, when the urethra is excised quite close to the vesical sphincter, there may be loss of control at first, but as the parts cicatrize the patient regains a fair degree of retentive power. In some of these cases the degree of control may be increased by a plastic operation, having for its object the creation of a new urethra. The attempt in my case was not very successful, but as I have already stated, the failure was, in part, due to the backward position of the uterus. For this class of cases when the lack of control is in a measure due to an absence of any urethral canal, Gersuny[4] has resorted to an ingenious device which has been attended with wonderful success in

his hands. He injects liquefied paraffin ointment (which has a melting point of 40° C.) into the submucous connective tissue about the opening into the bladder, thus forming an elevated ring resembling the projection of the prostate gland in the male urethra. This ring offers a resistance to the flow of urine, requiring a certain degree of voluntary force to overcome, thus enabling the patient to void her urine at will.

The ring thus formed remains for an indefinite time. In one of Gersuny's cases it had existed in *statu quo* for over a year.

I was very much tempted to resort to this procedure in my case, which seemed to be especially suitable for it. But shortly after the publication of Gersuny's article Pfannensteil[5] reported a case in which the procedure was followed by alarming symptoms, evidently due to a paraffin embolism in the lung. I did not care to run the risk of a similar experience, and consequently refrained from carrying out the method in my patient.

In cases when the incontinence causes great annoyance to the patient and is productive of extensive excoriations, and when a suprapubic fistula is not feasible, as in a very fat patient, Fritsch has proposed and carried out the complete closure of the vagina and the creation of a rectovaginal fistula. The urine thus collects in the ampulla of the rectum and is discharged with the stool. This procedure is not free from danger from subsequent bladder infection, although Fritsch claims there is very little danger of this, providing the bladder is healthy at the time of the operation. The procedure, from its nature, would necessarily be very much limited in its application. Both husband and wife would have to give their consent after receiving a full explanation of what the operator proposes doing.

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THE USE OF THE RÖNTGEN RAYS IN SKIN CANCER, ETC., WITH REPORT OF A CASE.

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Dating almost from the discovery of the Röntgen rays there have been occasional reports made of their use in the treatment of different forms of chronic skin troubles, notably eczema, lupus vulgaris, sycosis, favus, etc.

In 1897 Dr. H. Kaposi[1] showed a patient to the members of the Vienna Dermatological Society upon whom exposure to the rays had caused the hairs of an extensive nævus pilosus to fall off. For a time after the exposure there was an erythematous rash which did not cover all portions of the skin acted upon alike. It was suggested that the action of the rays was due to the chemical effect of the ultra-violet rays producing hyperæmia, and, finally, a paresis of the bloodvessels. It was believed that when the bloodvessels regained their normal tone the hair would be restored, which proved to be the case. In 1898 Dr. Kummel exhibited before the Congress of the German Society of Surgery two cases almost cured of lupus. In 1899 Drs. Castel and Faveau de Courmelles[2] reported two cases of lupus which were so much benefited as to greatly encourage them. Sittings of ten minutes, three times a week, extending over a month, were given without result, but when currents of greater frequency were employed an energetic reaction was noticed, and improvement occurred.

Albero Schönberg,[3] in 1899, refers to two instances of lupus, one cured after eight months by the rays applied mildly for twenty minutes daily. In the second case reaction occurred after five sittings, the case getting well after six months.

Kummel reports further in this year, having treated eight more cases. He says the rays have some peculiar action directly upon the nodules, the dermatitis playing no part in the cure. He regards the treatment as a decided improvement over the older methods of treating the disease.

In the same year Jutassy reports forty cases, and Schiff and Freund seven cases of hypertrichosis, in which a sufficient time had elapsed to make sure the hair would not grow again.

Dr. C. L. Leonard, the same year,[4] thinks the results mentioned are to be accounted for by the electrical stimulation from the static field surrounding the tube, and not by the effect of the light itself. He endeavors to prove this by saying that if the part is protected by an aluminium shield which collects the electricity and carries it off by a wire to the ground, no effect is produced. His position is scarcely tenable when we consider that the shield also shuts off the light and that the same effect can be produced with the shield alone, no ground wire being used. I might add, also, that I have subjected the skin to several minutes' exposure to a much greater amount of static electricity than is ordinarily used in the X-ray, without producing any reaction whatever.

[1] Wiener klinische Wochenschrift, No. 14, p. 375.
[2] Journ. des Maladies Cutanees.
[3] Fortschritte der Roentgen strahlen, 1899, Bd. i. Hefte 2 und 3.
[4] American X-ray Journal.

Thompson[1] says that the best effects are produced upon the skin by low-vacuum tubes, a fact which I can myself confirm.

Holland[2] reports a chronic eczema of the back of the hand cured by five applications of the light. The same writer reports a case of lupus cured in the same way. The hair was lost, but grew out again.

Mackary[3] reports two cases of chronic eczema greatly benefited by using the light at a distance of four inches ten minutes each day for one month. This I believe to be too strong for the ordinary case with the improved instruments now in use.

In 1900 Albers reports two cases of lupus, one of the ali nasi and the other of the cheek, cured, respectively, in eight and six months. He advises the mild use of the remedy, and cautions against inflammatory reaction.[4]

Kummel, in 1900, increased his cures to sixteen, his favorable results having come after from one to six months' daily exposures at a distance of from 20 to 40 cm. He advised avoiding all irritation of the skin. Schiff further reported good results, but advised that no reaction be produced.

Gassman and Schenkel[5] report a case of non-parasitic sycosis cured by the X-ray.

Stenbeck, of Stockholm, 1901, reports a case of rodent ulcer of the tip of the nose which was cured after the second reaction had been produced.

There appeared in the *Philadelphia Medical Journal* for February 1, 1902, a contribution of my own, reporting four cases of epithelial skin cancer and one case of sycosis non-parasitica cured by the X-ray.

The method employed was to cover the healthy skin with thin sheet-lead and to expose the sore or part to be treated for five minutes at eight inches the first day, increasing the time of exposure and shortening the distance each day until a decided inflammatory reaction was obtained, a low vacuum tube giving a soft light being used. I have been unable to obtain any benefit in any case of the kind without an inflammatory reaction. From my reference to Dr. Leonard's views upon the subject I think it can be seen that it is not the static charge which produces the effect. It then remains to be decided as to whether the inflammation causes the death of the cancer cells and tuberculous deposits, or whether the effect is produced by the light itself. My own opinion is that it is the light. Simple inflammation has often been caused by caustics in and around these sores of lupus and epithelioma without producing the death of the process. I am of the opinion that

[1] American X-ray Journal, November, 1898.
[2] British Medical Journal, April 15, 1899.
[3] British Journal of Dermatology, April, 1899.
[4] Fortschritte a. d. Gebiete Roentgen strahlen, p. 1.
[5] Ibid.

a light sufficiently strong to produce an inflammation of the healthy cells of the part treated is of sufficient strength to destroy cells of lower vitality, as cancer cells are known to be. Whether the point brought out at the Vienna Dermatological Society that the effect upon the skin was produced by the ultra-violet rays is true or not remains to be proven. One thing is certain, the ground taken by Thompson that the low vacuum tube produced more effect upon the skin than the high vacuum tube is well taken.

This might help to substantiate the statement that the effect is from the ultra-violet rays, as they are given off more freely from a low-vacuum tube.

FIG. 1.

Since I reported the above-mentioned cases to the *Philadelphia Medical Journal* I have treated another case of epithelial skin cancer affecting the cheek and lower eyelid. It first appeared about three years ago near the outer corner of the right eye, and grew slowly for a year and a half. It was examined by Dr. Jerome Anderson, of San Francisco, who pronounced it epithelial skin cancer, and by whom the sore and a considerable area of healthy skin around it were removed, the denuded area being partly covered with a patch of skin taken from the cheek further back toward the temple. For a few months the growth seemed arrested, the operation being to all appearances a success. However, about a year ago, the patient noticed a little sore in the edge of the scar near and just below the corner of the eye. This gradually grew, eating away the lower eyelid, as will be seen in Fig. 1. The conjunctiva covering the eyeball below the sclerocorneal junction was very much reddened and thickened.

The diseased process extended from the inner to the outer canthus, and for a distance of an inch and a half down the cheek. It was of the depth of one-fourth of an inch, apparently being very close to the

FIG. 2.

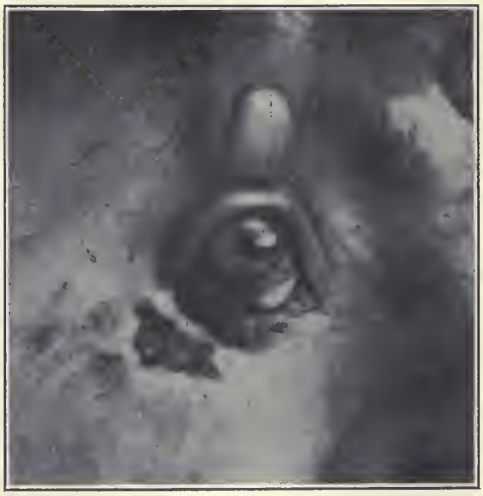
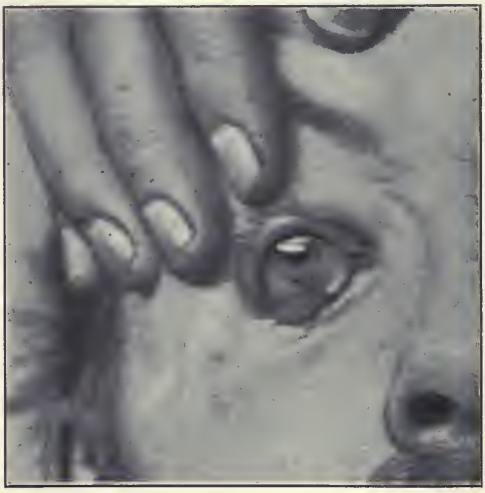


FIG. 3.



bone. He was given the treatment as indicated above for a period of two weeks. The diseased area and one-half inch of the healthy skin around it was exposed. The eyelid was held up with rubber adhesive plaster, and the exposures were made as high as the sclerocorneal

junction, the pupil of the eye and the rest of the face being protected by a leaden mask. The treatments were begun at five minutes, at eight inches' distance, and gradually increased to twenty minutes at four inches, when a decided reaction occurred.

This followed the fifteenth treatment. Fig. 2 shows the same case two weeks after, and Fig. 3 at one month after the last treatment. The sore is perfectly healed, and the redness of the conjunctiva has disappeared except such as would naturally follow having it exposed, from absence of the lower lid. The dark spot seen in Fig. 3, just at the lower edge of the eyeball, is a fold of mucous membrane.

NOTE.—By permission of Dr. M. Gardner, Surgeon-in-Chief of the Southern Pacific Railway, I mention a case of keloid of the breast which I was allowed to examine before and after the same had been treated after the manner laid down in the present article. The growth entirely disappeared after it had undergone inflammatory reaction, which occurred after the sixteenth treatment.—J. F. R.

A REVIEW OF THE SURGICAL DISEASES OF THE GALL-BLADDER AND GALL-DUCTS AND THEIR TREATMENT.

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THERE is a growing tendency to place the affections of the biliary apparatus in the category of surgical diseases, for the surgeon who actually observes their phenomena should have a better grasp of the situation than the casual observer of the conditions seen in the dead house. Moreover, the necessity of surgical intervention is now plainly recognized for many conditions which were formerly only treated by procrastination and the encouragement of the opium habit. As yet in this country biliary surgery is still on an unsatisfactory footing, as the medical public is apt to form its judgment from the results of operative interference in grave cases with a necessarily serious prognosis. The surgeon, however, has not the choice of cases, but has to do his work on the material presenting itself. The future of gallstone operations especially should be in the nature of milder or prophylactic operations. To attain this end the internist must co-operate with the operator, and both come to an intelligent appreciation of each other's views.

The field of biliary surgery has of late become extensive and at the same time better defined. From a clinical stand-point it is fairly easy to group the disorders amenable to surgical treatment, as many of the

diverse lesions seen post-mortem need not be considered except collectively.

Classification. We can here disregard the subject of traumatisms of the biliary apparatus which are to be treated on general surgical principles—arrest of hemorrhage, repair of essential structures, and prevention of extravasation of visceral contents.

We distinguish then four groups of biliary disease:

Inflammatory diseases.
Calculous diseases.
New-growths.
Obstructions other than gallstones.

General Symptomatology of Diseases of the Biliary Tract. The symptoms of certain morbid states of the biliary tract are most clearly defined both as to the nature and the site, for example, of the impaction of stone in the common duct; in others the symptoms may be almost null or latent, *e. g.*, gallstones lying quietly in the gall-bladder for years. Again in others, the differential diagnosis from diseases of contiguous organs is very difficult or impossible, *e. g.*, adhesions of the gall-bladder may give rise to a chain of symptoms and confusing physical signs that make a distinction from malignant disease of the stomach impossible.

Symptoms are both local and general, and in some cases a very probable diagnosis can be made from either independently of the other, *e. g.*, the constitutional reaction manifested by irregular chills and fever, of impacted gallstones, or the localized tenderness over the gall-bladder in empyema—the typical attack of colic or the fluctuating or sudden jaundice due to impaction of a stone in the common duct.

General Diagnosis of Biliary Affections. Three problems are concerned: 1. Diagnosis from affections of other organs. 2. The variety of lesion in the biliary tract. 3. The site of the disease.

The possible confusion with disease of other organs is almost infinite, as no part of the body is richer in possibilities of obscure and severe disease than the upper right quadrant of the abdomen, "the future playground of the surgeon," one of my friends calls it. To exhaust all the possibilities cannot be undertaken here. It is perhaps best to divide them into two main though necessarily artificial groups; those most closely resembling disease of the biliary apparatus and the more remote.

1. (*a*) Diseases of the liver in general, chiefly hypertrophic cirrhosis, carcinoma, abscess. (*b*) Of the pancreas in all forms. (*c*) Of the kidney, chiefly renal colic and floating kidney. (*d*) Of the stomach, gastroptosis, ulcer, carcinoma. (*e*) Of the intestine, chiefly appendicitis and gastroduodenitis, and tumor of the duodenum.

2. Diaphragmatic pleurisy, subphrenic abscess, intercostal neuralgia, mesenteric growths, peritonitis, local or tubercular; intestinal obstruc-

tion, lead colic, inflammatory and other diseases of the pelvic organs in the female, and tumors and inflammatory processes of the abdominal wall.

Of all the elements of differential diagnosis, none is so valuable as a detailed and searching history; by it alone several typical forms of biliary disease can be diagnosed with a reasonable certainty, *e. g.*, impaction of a stone in the common duct, a combination of the three cardinal symptoms, typical attacks of colic, typical chills and fever, and typical jaundice (sudden onset, variations). In the absence of positive physical signs or in the presence of confusing or contradictory signs the history must be the final arbiter. Only brief mention can be made here of the distinguishing signs of some of the more important diseases that may be confused.

(*a*) Hypertrophic cirrhosis with jaundice may sometimes be difficult to distinguish from jaundice due to obstruction of the common duct or from compression by a tumor of the head of the pancreas; but generally the evident physical signs and absence of palpably enlarged gall-bladder (in compression by tumors) with other signs will make the situation clear. Carcinoma of the liver—usually secondary—and careful examination will often reveal primary focus—stomach, rectum; physical signs of isolated cancerous foci on the surface of the liver are generally evident. Abscess of the liver may closely resemble cholangitis or empyema of the gall-bladder; in obscure physical signs reliance may have to be placed on etiological factors (chronic dysentery, septic processes), the use of the aspirating needle introduced into those parts of the liver where such exploration is ordinarily safe, and the detection of peptones in the urine.

(*b*) Pancreatic disease causing blocking of the common duct is so intimately associated with biliary pathology that it will be considered under diseases of the biliary apparatus (obstruction other than calculous disease).

(*c*) The kidney; a right floating kidney is easily mistaken for a distended gall-bladder (obstruction of the cystic duct) or *vice versa*, a mistake which might almost be called classical. Chief distinguishing sign, the kidney when reduced into the flank stays there, the gall-bladder springs back. Renal colic—the history, typical pain running *downward*, and the urinary examination, should decide the point.

(*d*) Extensive inflammatory adhesions around the biliary tract, especially when the stomach becomes involved in them, frequently give rise to conditions which, neither from the history, symptoms, nor physical signs, can be satisfactorily distinguished from lesions of the stomach, particularly carcinoma or ulcer. Ordinarily the history, disturbed state of the gastric functions, the examination of the gastric contents, the preponderance of physical signs in the mid-line or to the left of it, suffice to distinguish these conditions. Gastroptosis resembles the

vague gastric manifestations of milder gallstone disturbances. Its characteristic physical signs and its common associated conditions, especially floating kidney, generally distinguish it.

(*e*) Recently attention has been called to the confusion often existing between attacks of cholecystitis (with or without stone) to appendicitis, especially of the relapsing type. Actually the appendix may be so abnormally situated (non-descent of the cæcum) or so long, and running upward and inward, as to render it quite impossible from the standpoint of location to distinguish between the two. The greatest difficulty is in the height of an attack when there is general tenderness and rigidity over the entire right side. Ordinarily by very careful and delicate palpation we can assure ourselves that the *intensity* of the tenderness is either high or low, and distinguish accordingly, always bearing in mind that the situation of the pain and tenderness over the gall-bladder are constant factors. A high leucocytosis would favor a diagnosis of appendicitis from milder forms of biliary caculus, but would not help in the case of empyema of gall-bladder or cholangitis; but in these severer forms there would ordinarily be physical signs of a distinguishing nature.

Gastroduodenitis ordinarily is not difficult to distinguish; it is accompanied by evidences of intestinal disturbance, is usually acute in its onset and course, pain is not a prominent feature, and usually only excited by the process of digestion, the jaundice generally comes on suddenly, and is usually well-marked and out of proportion to the mild constitutional symptoms. Observation for a few days will usually throw the necessary light on an otherwise obscure case. (For tumors of the duodenum, see below.)

The second group is mentioned only for the purpose of completeness, as these diseases should not ordinarily be confused. The nature and site of intrinsic disease of the biliary tract comes properly under the consideration of the several varieties. A few comments may be in order on some of the features common to many or typical of some.

The history is always of the first importance.

Etiology. This is more a question of predisposition or liability to disease.

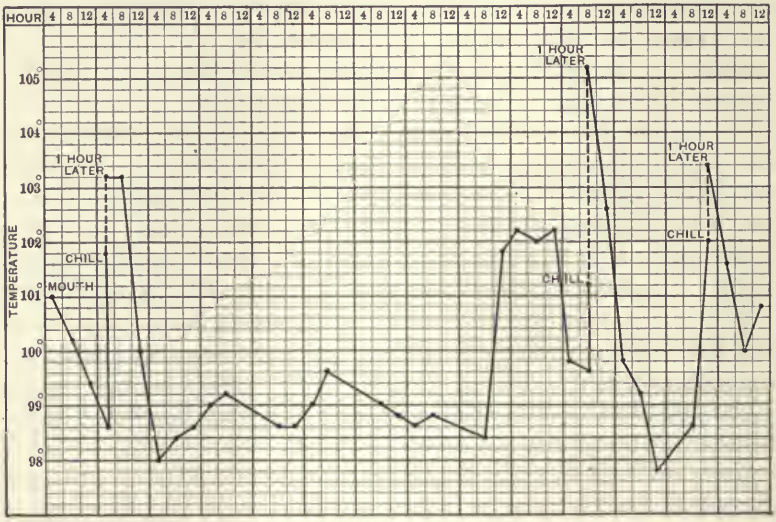
Of late certain observers have been impressed with the possibility of hereditary tendencies toward gallstones. The real explanation is more probably in the habits common to families or communities. The preponderance of gallstones among mature and elderly females, especially in the leisure classes and those of sedentary habits, is quite marked. New-growths, while occasionally observed in younger persons, should always be borne in mind in elderly persons, especially when symptoms first develop in late life, that is, if there is no history of occasional biliary symptoms covering a period of years.

Individual Symptoms. *Pain.* This is both subjective and that elicited by pressure—properly speaking, tenderness. It may be of various kinds, definitely located or vague, may be confined to one spot, or radiate in various directions, may be constant or intermittent. May be entirely absent, may be sudden in its onset or termination, or may be slow to develop, may be characteristic of disease or of location.

Tenderness over the gall-bladder region, even when the gall-bladder is not palpable, is of very varying degree, but is practically always present if there is any considerable degree of cholecystitis with or without stones. Marked tenderness points to active inflammation or empyema of the gall-bladder. Pain radiating from the gall-bladder backward and toward the right shoulder may indicate that the stones are still confined to the gall-bladder, radiating toward the left, generally points to the location of the stones in the common duct. Colicky pains of sudden onset, of variable intensity, but usually of a severe or agonizing type, point to the presence of stone in the common duct in process of working its way out; very sudden remission of the pain generally indicates its escape. Diffuse pain and tenderness over the biliary apparatus, especially if attended with severe constitutional symptoms, generally indicate a diffuse cholangitis. Surprisingly marked degrees of cholelithiasis may exist with only very infrequent and mild pain, described as crampy, needling or knifing according to severity. The gall-bladder may be full of stones, there may even be some in the common duct without the person ever having had his attention called to the slightest painful sensation.

Fever. May be entirely absent at all stages, may be only occasionally present; may be very slight, may reach high degrees, may be constant, may have intermissions, either frequent or infrequent. It seems dependent on two elements—infective reaction and nervous influences. Gallstones when remaining quiescent in the gall-bladder ordinarily give rise to no feverish reaction, and if the latter does occur, it is due to the cholecystitis. Mild grades of cholecystitis give rise to moderate febrile disturbances, not usually exceeding 102° F., and exhibiting tendencies to remissions and exacerbations much like chronic recurring appendicitis. A considerable degree of fever running a steady course, with little or no remission, especially if accompanied with local tenderness and constitutional disturbances, indicates an empyema or diffuse cholangitis; it may also be marked by chills and remissions. The temperature elevations, with chills and remissions commonly seen in impaction of a gallstone in the common duct, especially when it is moving, or the duct is in an inflamed condition, are very typical, and usually settle the diagnosis, or may of themselves make it. When accompanied with typical colic and with jaundice, more especially if this is of a fluctuating character, the diagnosis is absolute.

Ordinarily there will be a fairly marked chill, followed by a rapid elevation of temperature—104° to 105° F. The temperature generally falls abruptly in a few hours. The chills may be repeated several times in twenty-four hours. There are usually irregular intermissions. There may be one or more chills every day for several days, and then intermissions for one or two days or longer. They are essentially *irregular*, which serves ordinarily to distinguish them from the malaria for which these unfortunates generally get treated until or unless the jaundice appears, which makes the diagnosis so clear that it hardly can be



Temperature chart of patient suffering from impaction of a stone in the common duct.

missed. Actual chills may not occur, although the abrupt temperature manifestations may be just as typical, or the patients notice only mild or temporary cold or "creepy" sensations. Whether the temperature remains at or near the normal level during the remissions depends on the degree of inflammatory disturbance of the biliary tract present.

The exact exciting influence of these characteristic chills is not plain. They are often alluded to as of "nervous" origin and compared to urethral chills. The latter, however, are so closely associated with septic disturbances of the urinary tract, having become infrequent with consistent asepsis, that one must look more to the septic origin for their explanation.

For all that, this picture of irregular fever and chills is so typical of impaction of stone, it is of the utmost importance to bear in mind that not infrequently all those manifestations may be absent or may be so

slight or so rare an occurrence as to have no value for diagnosis. That is, absence of this chain of symptoms does not exclude the presence of stones in the common duct.

Jaundice. This may vary from slight tinging of the conjunctivæ to the deeper shades of green-black. It may come suddenly or slowly; it may begin to disappear quickly (the process does not subside at the same rate as it may begin) or only very gradually; it may show a steadily progressive stage, or it may fluctuate and remit or remain unchanged. Two essential diagnostic points are learned by the jaundice and its mode of onset and behavior. Broadly speaking, its absence or presence distinguishes between processes limited to the gall-bladder (and cystic duct) and obstruction of the common duct from within or without. A rather sudden onset favors the diagnosis of stone; if there is a *certain* history of remission it makes it practically absolute. Steady progressive jaundice, *never* remitting, points more to compression from without, chiefly due to growth or other disturbances of the pancreas. The very severest jaundice is usually seen in the latter form of obstruction rather than stone. Very deep jaundice, without history of colic, absence of fever, and with a gall-bladder that can be palpated indicate compression, and not stone obstruction, with reasonable certainty.

Jaundice occasionally develops as an inflammatory manifestation of the condition of the common duct. A stone confined in the cystic duct may cause jaundice, if of large size, by pressure on the common duct.

The Size of the Gall-bladder. Three conditions are especially characterized by enlargement of the gall-bladder. Acute suppurative inflammation, dropsy of the gall-bladder—the cystic duct being permanently blocked—and *compression* of the common duct from without, chiefly by disease of the pancreas. An acute cholecystitis, more especially an early attack, may have a visibly enlarged gall-bladder; in recurrent attacks the gall-bladder is generally of small size, shrunken, and with thickened non-dilatable walls. So that with impaction of a stone in the common duct, when there has probably been considerable antecedent disease of the gall-bladder, the latter is commonly not to be felt. On the other hand, an easily palpable gall-bladder, with marked jaundice, points strongly to compression of the duct, chiefly by tumors of the head of the pancreas.

The carcinomatous gall-bladder may or may not be felt.

The clinical test of an enlarged gall-bladder lies in its recognition on palpation. The expertness of the examiner and the patient's bodily condition are variable conditions. Light superficial palpation with the finger-tips will more readily identify the gall-bladder than deep palpation. The resiliency of a distended gall-bladder is generally evident. That a gall-bladder feels dense and nodular does not necessarily imply a carcinoma, as precisely the same feeling may be imparted by a gall-

bladder tightly packed with stones. Masses of adhesions may also give a deceptive tactile sensation.

The enlarged bladder may point in several directions, ordinarily its fundus is found projecting forward from under the liver in the mammary line. A gall-bladder may be very large, and yet be directed more laterally and concealed by the normal liver; or it may, though of great size, be entirely hidden by a large liver. A "large" gall-bladder is about the size of two fists; it may attain practically unlimited size; it has been mistaken for an ovarian cyst.

The use of the aspirating needle for exploring the gall-bladder prior to opening the abdomen is absolutely unjustifiable.

Gallstones in the Feces. From time immemorial the finding of gallstones in the stools has been thought to be of value, both as to diagnosis of the existence of gallstones, and as to their results, it being held, for instance, that the finding of a stone after an attack of colic signified that the source of trouble had been eliminated. My own feeling is that the search for gallstones in the stool has but little value, as we only learn what has happened to that particular stone which no longer interests us, and fails to throw any light on future possibilities.

X-rays of Gallstones. Some observers have published successes in the detection of stones by the aid of the Röntgen rays. I have had a number of radiographs made of removed gallstones, these observations and the opinions furnished me by experts in radiography lead me to doubt that we can at present include this method among our diagnostic aids.

The Various Forms of Biliary Disease. *Inflammations.* (*a*) Empyema of the gall-bladder. (*b*) Cholangitis. (*c*) Acute and chronic cholecystitis.

These forms occurring independently of gallstone formation are rare, and consequently will not be given much space. Finer distinctions of kind and severity may be drawn; but these are the essential processes, varying in the intensity of their effects. Their general etiology is probably the same, and must be ascribed almost wholly to infection from the intestine, chiefly colon and typhoid bacilli.

(*a*) Empyema of the gall-bladder, a general term which I use for processes varying from simple purulent catarrhal inflammation to ulcerative and phlegmonous processes. The symptoms are local and those of constitutional sepsis. The treatment should be prompt, free drainage with abundant protection of the peritoneum by gauze packing—exceptionally cholecystectomy.

(*b*) Cholangitis is practically the same process applied to the bile-ducts, the infection generally proceeding from the intestine, its essential danger is in the extension to the intrahepatic ducts and fatal sepsis. In well-established cases it ranks among the most dangerous and fatal condi-

tions. Marked constitutional disturbances exist, local pain, jaundice, and more or less swelling of the liver. The prognosis is bad.

The treatment consists in cholecystotomy and drainage, according to the severity and extent of the symptoms; if extreme, drainage of the common or hepatic duct may be indicated.

(*c*) Simple cholecystitis may be acute or chronic. It represents mild inflammatory reaction of the mucous membrane of the gall-bladder, the cystic duct may be involved and become permanently altered, in the latter case the gall-bladder remains permanently distended, secreting a clear mucous fluid. The condition is subject to remissions and exacerbations. The symptoms are mild, the constitutional being in general insignificant or transitory. Locally pain and the presence of an enlarged gall-bladder are noticed. The treatment is either palliative (hygienic) or, if repeated, curative, preferably by cholecystectomy if the gall-bladder can be easily extirpated, otherwise cholecystotomy.

Biliary Disease Due to Formation of Calculi. From the clinical and therapeutical stand-point the importance of gallstones overshadows the entire field of biliary pathology, and, with the exception of cholecystenterostomy, practically all the operations have been directed to their relief. The causative factors of gallstone formation cannot be definitely stated. My own belief is that infection of the biliary tract, especially of the gall-bladder, results in a primary process, the effects being manifested by alteration of the bile and resulting deposit of biliary salts. Bacteria can almost always be found in gall-bladders containing calculi. Bacteria are also found in the *interior* of gallstones quite frequently, and would be oftener found but for technical obstacles. In addition there is the element of predisposition to the deposit of biliary salts; whether this is a seeming primary process, or simply due to the inherent disposition of the individual to the receipt of infection, seems to me to be unsettled. That the stagnation of bile in the gall-bladder is an important factor seems to be certain, and we may simply have to take into consideration those elements of the individual's habits which favor this stagnation. Some of these may be referred to faulty, irregular or infrequent digestion which provokes the flow of bile. Sedentary habits seem also to be a definite favoring element. Other alleged etiological causes are many, but generally fanciful and devoid of any great probability.

Characteristics of Gallstones. Cholesterin usually forms the base of gallstones, to which may be added bile pigments, salts of lime, mucus and other organic substances. They are usually dark-colored, and may be black. They may be crystalline or amorphous in shape, they may be dense (never to the extent of urinary calculi), or soft or brittle. They may be faceted, especially if of a regular shape. Their size varies greatly from fine sand to a hen's egg, or larger, their number

varies up to the thousands. Examination of their nuclei will frequently show bacteria in them.

Location of Gallstones. The vast majority of stones occupy the gall-bladder and originate in it. Stones formed within the intrahepatic ducts are generally of small size, and, according to Langenbuch, of a different chemical composition, and rarely cause mechanical disturbances, though very exceptionally a large stone may form in and block the hepatic duct.

Stones have a tendency to escape from the gall-bladder into the cystic and common ducts, where their effects are more severely manifested. Stones probably remain quiescent in the gall-bladder until some expulsive efforts are made by an inflamed gall-bladder to get rid of them. It is this process that probably gives rise to the minor degrees of pain, the "crampy, needling" variety. Blocking of the cystic duct by stone, while not producing serious disturbance, is apt to prevent the flow of bile into the gall-bladder and the exit of its secretions, and there is frequently a resulting "dropsy" of the gall-bladder. The stone having been passed out of the gall-bladder is one step nearer toward the common duct where its maximum of damage can result.

When a stone has passed into the common duct the result may be threefold. The stone may be in the duct either free or fixed, without causing *definite* manifestations; it may not interfere with the passage of the bile, nor set up inflammatory changes. It may be expelled usually after considerable effort manifested by biliary colic and its attendant symptoms; it may, if small, and occasionally when large, be expelled with little or no attendant symptoms. Or the stone may become impacted and completely block the common duct, causing jaundice, which may vary in its intensity according to the degree of completeness of the obstruction, or if the stone shifts and allows the occasional escape of bile, or if there is contributory blocking from the swollen inflamed mucous membrane which may undergo remissions. The stone may be anywhere in the duct, but the commonest place is in the retroduodenal portion, just before the duct enters the intestine, or it may actually be wedged in the mouth of the papilla.

The size of stones found in the common duct varies, a comparatively small stone with diameters not exceeding a quarter of an inch may cause complete blocking. The stones that do the mischief will run commonly about the size of a filbert, though they may attain an enormous size (hen's egg and larger). The number varies, it is rare to find more than three or four, usually there are one or two (the latter is commonest in my experience).

Gallstones may leave the biliary tract in many ways beside the normal exits, and this escape may take place from the gall-bladder or from the ducts, a suppurative process, perforation or fistulous com-

munication preceding the passage. They may perforate in almost any direction and show themselves in the most bizarre places, and be vomited or coughed up. Generally this perforation takes place from the common duct after ineffectual attempts to pass through naturally. The escape is more often into the intestine, chiefly the small. Such stones may cause intestinal obstructions (the reader is referred to the writer's paper on " Intestinal Obstruction," in *Annals of Surgery*, October, 1900), especially when they arrive at the cæcal valve ; they generally have added to their bulk while in transit.

The symptoms and consequences of gallstone disease vary according to their location. Both their symptoms and sequelæ also vary according to the degree of inflammatory disease present in the biliary tract. It is thus evident that a general symptomatology of gallstone disease presents too varied a picture to have any degree of accuracy, and the symptoms are studied to the best advantage in the consideration of the individual lesions. I follow here closely the classification and tabulated data given by Hans Kehr ; not that I believe that the refinements of distinction made by him are always feasible for the ordinary individual, but because his work represents the highest standard of the present day, which we should strive to attain so far as possible.

1. *Stones in the gall-bladder with slight, if any, or quiescent lesions of the gall-bladder.* Symptoms are very slight, if any ; there may be an antecedent history of cramp or vague gastric disturbances. Examination may be negative, or slight pressure elicits some tenderness. The gall-bladder will very rarely be palpable so long as the cystic duct remains patent.

Treatment. In the present attitude of the profession toward gallstones, operation will not ordinarily be advised. Certainly it will not be entertained for those persons upon whom we ordinarily do not care to perform operations. In younger individuals of fair health, I think we shall eventually recommend operation on the principle of prophylaxis. For here we have much the same indications as exist for mild degrees of chronic appendicitis. The interval operation is so simple and innocuous, while the enforced operation during the attack has so many disagreeable possibilities that it is worth running the risk of performing an operation for a trouble which may never prove serious. Cholecystotomy or cholecystectomy, according to the indications, and the conditions actually found at operation.

2. *Stones in a gall-bladder previously obviously inflamed ; cystic duct temporarily patent ; adhesions.* In this condition the symptoms are not much more distinct, but somewhat intensified, especially when there is lighting up of the cholecystitis, the cystic duct perhaps becoming kinked with distention of the gall-bladder. Locally one can palpate the gall-bladder, especially during the height of the attack.

As regards treatment, the indications are somewhat more pronounced than in the preceding; extirpation of the gall-bladder particularly, if the trouble is long standing, seems the preferable operation.

3. The same condition without stones, but with particularly marked adhesions. The symptoms are about the same. Kehr says the pain may be elicited by change of position, straightening up.

The condition to my mind is of considerable gravity, as the adhesions may produce marked changes and disturbances of the biliary tract and of neighboring organs, particularly the stomach, physical signs being produced very closely resembling ulcer and carcinoma and attended with many of the disturbances and symptoms of these diseases. Conversely an apparently advanced case of pyloric obstruction may be due to adhesions from the gall-bladder and may be cleared up and cured as the result of an exploratory operation.

Treatment. Obviously the best method of treatment would be extirpation of the gall-bladder, but it might be wiser, on account of technical difficulties, not to attempt it, but to compromise with cholecystotomy and drainage.

4. *Acute cholecystitis in a relatively healthy gall-bladder—usually a large stone impacted in the neck, exudative inflammation. Symptoms.* The symptoms heretofore given are exaggerated and acute. In addition we have the enlargement and tenderness of the gall-bladder as constant and marked quantities. The picture, both local and general, is influenced by the relative degree of infection (cholangitis), and, if marked, the constitutional symptoms may be alarming. The presence of the enlarged and tender gall-bladder should make the diagnosis evident.

The treatment is operative, though one may exercise some judgment about tiding the patient over the acute attack and operating in the quiescent stage—the stone probably remaining impacted; if it does not so remain, it will probably have passed and lodged in the common duct. The choice of operation is about the same as in No. 2, with extraction of the stone.

5. *Acute exacerbation of long standing chronic cholecystitis; obliteration (stricture, kinking, adhesions) of the cystic duct, mucopurulent exudate; surrounding adhesions. Symptoms.* The gall-bladder wall being thickened from previous attacks does not dilate, and the gall-bladder is not felt, as it lies well up under the liver. Tenderness over the site of the gall-bladder can be elicited. There will be remission and exacerbation of symptoms which will not usually present the severity or acuteness of the preceding form.

The diagnosis will be difficult on account of the absence of the valuable diagnostic sign of enlarged, painful gall-bladder; the condition may be mistaken for many things: colic, typhoid fever, malaria, sepsis (Kehr).

The treatment is certainly operative, as there is little reason to believe that medical treatment will influence so well-marked a condition. Again, the decision will be between cholecystotomy and cholecystectomy, the technical obstacles may be very marked for either operation and particularly the latter, and will influence the choice between them. If we do a cholecystotomy we may not, and probably will not, be able to stitch the gall-bladder to the abdominal wall (see below under description of cholecystotomy).

6. *Dropsy of the gall-bladder; cystic duct either non-patent or blocked by stone; contents of the gall-bladder non-inflammatory, clear sterile fluid, marked thinning of walls. Symptoms.* These are slight or may be wanting; but the presence of the dilated gall-bladder is evident. The peculiar tongue-shaped enlargement of the liver overlying the gall-bladder (Riedel's lobe), which is often seen after continued gall-bladder irritation may be noted.

Diagnosis. The marked distention of the gall-bladder is the essential feature, but the tumor is so freely movable (absence of all inflammatory adhesions) as to give rise to many mistakes. The classical one is to believe it to be a floating kidney (which has happened to many operators, including myself), as the tumor may often be readily pushed up into the right flank. It, however, tends to return forward again while the kidney stays in place.

The treatment is operative. Cholecystotomy, if the cystic duct is obliterated from causes other than calculus, will not restore the physiological function of the gall-bladder, so that the bladder being no longer useful might as well be removed. If there is a stone in the cystic duct that cannot be dislodged into the gall-bladder, it is better to amputate the gall-bladder and close the cystic duct after removal of the stone. Should one decide not to remove the gall-bladder the incision in the cystic duct may be drained or sutured. Cholecystectomy is here the operation of choice in my belief, as it should ordinarily be very easy to perform, and more completely meets the indications.

7. *Empyema of the gall-bladder with stone in the cystic duct and adhesions.* The earlier stage presents the picture of an acute cholecystitis (No. 4); if remission takes place, the later aspect is that of dropsy of the gall-bladder (No. 6), though the dilatation of the gall-bladder will not be so marked. The symptoms vary with the intensity of the process and whether there is extension beyond the limits of the gall-bladder. In the latter case we have the manifestation of peritoneal irritation up to the extreme degree of perforative peritonitis. The process may undergo spontaneous remission if of not too pronounced type.

The treatment varies from palliative during the height of the attack to cholecystotomy and cholecystectomy, the decision resting on the actual findings.

8. *Acute obstruction of the common duct by stone.* This type is of brisk onset and great severity, with marked jaundice, fever, chills, vomiting, and "biliary colic."

The essential symptom is the agonizing, unbearable pain, it usually only lasts some hours, the stone making its way to the duodenum, or if it fails to pass, the pain and constitutional disturbance subside after a time, probably as a cessation of the expulsive efforts of the common duct, and it then becomes an impacted stone. There is ordinarily no doubt about the diagnosis. The treatment is entirely palliative, the use of anodynes—in extreme cases temporary or partial general anæsthesia—to counteract pain and spasm. One must remember that large amounts of narcotics may be tolerated during the height of the pain, but on its cessation the natural susceptibility returns and may have pronounced effects.

Kehr says that in exceptional cases the hepatic duct might be drained.

9. *Chronic obstruction from impaction of gallstone.* The condition varies according to the actual amount of obstruction, and may be influenced by temporary or sudden changes either in the position of the stone or of the condition of the mucous membrane of the duct.

The symptoms vary accordingly—they may be wanting, incomplete, or intermittent. In marked and typical cases we have pain subject to exacerbations and radiating toward the umbilicus, jaundice (with clay-colored stools and dark urine) of considerable intensity; but usually the orange color rather than the green-black often seen in permanent compression of the duct by tumor; there is the intermittent fever, already fully described under general symptoms. The gall-bladder, although containing stones, generally gives no physical sign unless it is tenderness on pressure over its site, as it is of the atrophic type characteristic of frequent antecedent attacks of cholecystitis. This non-evidence of the gall-bladder is an important physical sign when other characteristics are wanting in making a differential diagnosis from obstruction due to compression of a tumor, especially of the head of the pancreas.

The course of this affection may be and is usually chronic, especially of the milder type with remissions of symptoms. The severer form with marked jaundice is fatal from cholæmic poisoning. Spontaneous termination by the expulsion of the stone is possible, but always problematical, in a given case, and it is more rational to believe that the chances are against it. The problem may be solved by the perforation of the stone into the intestine or otherwise. Sometimes this process has happy and uneventful results, but the disagreeable possibilities which are the more probable should not lead us to await this outcome with equanimity.

The treatment is operative ; it represents severe and difficult measures made the more hazardous by the bad condition of such patients who are reduced in strength by prolonged illness and suffering. Many of them have become morphine habitués, which is a grave complication. The jaundiced condition is also a very serious matter, especially as it tends frequently to a hemorrhagic state, so that without division of visible vessels we may have profuse and even fatal bleeding, the hemorrhage occurring in any tissues, the abdominal wound (I have lost a case with an enormous hæmatoma infiltrating the muscular layer), from separation of adhesions, or from the incision into the gall-bladder or ducts, or from the mucous membrane lining the ducts. It also tends to recur so long as the jaundiced condition lasts.

The operations are: (*a*) Crushing a friable stone in the common duct without opening the gall-duct—a procedure that will and should be very seldom resorted to ; (*b*) choledochotomy or choledocho-duodenostomy. The conditions met with in the gall-bladder will have to be treated according as they present themselves ; it will seldom be necessary to make a direct incision in the cystic duct, for any stone impacted in it can ordinarily be removed through the opening in the common duct.

M. H. Richardson recommends increasing the coagulability of the jaundiced patient's blood by the administration of ox-gall, lime-juice, and similar remedies. The coagulability of the blood is tested periodically by counting the time it takes to coagulate after withdrawal from a vein.

New-growths of the Biliary Passage. Cancer of the gall-bladder is the only new-growth found with any frequency, the others being so rare that we can dismiss them as curiosities whose consideration does not belong in this restricted space.

Cancer is not so infrequent as formerly supposed ; it is generally accompanied by gallstones, and these usually precede it. There are no essential symptoms, the accompanying cholelithiasis or cholangitis will usually give the signs we have studied under these conditions. Occasionally palpation will reveal the hard nodular character of the growth.

Treatment, if any, cholecystectomy, with partial resection of liver—an unpromising operation.

Cancer of the Bile-ducts. This is less frequent than that of the gall-bladder ; it may occur anywhere but chiefly at the duodenal papilla (see below). The symptoms, if any, depend on the location—if occluding the common duct there will be jaundice. The possibility of treatment is problematical (see below, duodenal papilla), possibly a cholecystenterostomy or choledocho-enterostomy.

Obstruction of the Common Duct from Without. (*a*) Pancreatic disease—this is the commoner of the external sources of com-

pression—it may assume the form of tumor (usually carcinoma of the head). (*b*) Chronic interstitial pancreatitis—the condition formerly called fibroid thickening of the pancreas—or cystic changes in the pancreas.

Pancreatic Disease. Both malignant disease and interstitial pancreatitis have lately been shown to be not infrequent, and, from their relation to the common duct, take a prominent part in the pathology of the biliary tract.

Neither for tumor of the pancreas nor pancreatitis can a definite symptomatic picture be drawn; pancreatitis is usually attended with antecedent gastric disturbances, and there may be pain or tenderness, or both, over the pancreas. Both in tumor of the pancreas and in pancreatitis, a considerable or total obstruction of the common duct may exist without an enlargement of the pancreas that can be palpated externally, or even (more particularly with tumor of the head) clearly evident on palpating the pancreas during the course of an operation. In a case of pancreatitis[1] which I refer to here several times, the diffuse enlargement of the pancreas could be outlined after the administration of the anæsthetic before opening the abdomen.

In general the diagnosis is made from the presence of jaundice, which never remits, and tends to increase steadily (occasionally it may show a quick increase), with the usual accompaniment of enlarged gall-bladder and the absence of any characteristic signs of other disease, particularly of stone in the common duct—typical colic, *fluctuating* jaundice, characteristic fever.

We do not know definitely the life-history of pancreatic disease. Cancer of the pancreas is apparently slow in its progress and generalization. One of my patients lived comfortably for a year after successful cholecystenterostomy for an undoubted tumor. The patient with chronic pancreatitis, who also was relieved by cholecystenterostomy, has fully regained her health, apparently uninfluenced by the condition of her pancreas, which presented the appearance of a diffuse and considerable hyperplasia; diagnosis confirmed by the microscopical findings of a small fragment removed without sequelæ.

Treatment. If the diagnosis is made beforehand of carcinoma, shall we operate at all, and if so, what may be done? The answer to this question depends on two conditions: at what stage we see the patient, and how sure one is of the diagnosis. If the patient is very ill and extremely jaundiced, any operation, even the simplest, is attended with great danger; one could hardly perhaps think of doing anything but a simple cholecystotomy (with a distended gall-bladder it might be done under local anæsthesia). This operation then would only give the

[1] Transactions New York Surgical Society, October 10, 1901; Annals of Surgery, January, 1902.

patient relief from absorption of bile and implant a permanent fistula upon the already pitiable condition. Cholecystenterostomy is a valuable operation, but is extremely deadly in these cases, not because the operation is in itself so serious, but because the patients cannot stand anything. The operation, however, is not so serious as would ordinarily appear, if it is done as a pre-determined operation, nothing else being undertaken. Cholecystenterostomy is usually fatal because it is generally done as the end-stage of a prolonged exploration in the attempt to separate adhesions, locate stones in the common duct, etc. If the patient's condition is still fairly good, I earnestly recommend operation for several reasons. Even in apparently clear cases the diagnosis of tumors of the pancreas must generally be open to doubt; and it is a pity not to give the patient the benefit of the chance of having a remediable condition. Even if he has a tumor of the pancreas, he will get marked relief by short circuiting of the bile into the intestine, provided he survives the operation; but a "tumor" of the pancreas is not always a malignant growth, and may quite likely be an interstitial process with a good prognosis, if the urgent symptom, the cholæmia, be relieved. So that I believe sincerely in the operation of cholecystenterostomy, provided the patient's condition is not so far advanced as to forbid it.

The biliary ducts, especially the common, may undergo compression by malignant processes of the liver, primary or secondary; they may also be compressed by secondary infiltration of the glands which are normally situated at the union of the cystic and hepatic ducts.

Obstruction of the Duodenal Papilla by Tumor of the Intestine, Originating Near that Point or by a Tumor, Usually Carcinoma of the Papilla Proper. The latter is to be differentiated pathologically into tumor of the bile-duct presenting at the papilla and tumors of the papilla itself. The tumor of the gut proper is more generally sarcoma, and may give also the symptoms of pyloric obstruction. The symptoms of the papillary involvement differ in no way from the type presented by tumor of the pancreas. Either of these conditions may also be complicated with gallstones in the biliary passages, whose symptoms may be the more prominent. In a recent case of choledochotomy and cholecystotomy for gallstones the patient did badly, and no bile passed into the bowel. He died shortly afterward, and an additional obstruction was found, post-mortem, in a small carcinoma of the papilla not detected by palpation during the operation.

Until recently one would have said that there was either no treatment or else cholecystenterostomy for the relief of this source of cholæmia; but both W. S. Halsted[1] and W. J. Mayo[2] have successfully

[1] Boston Medical and Surgical Journal, December 28, 1899.
[2] St. Paul Medical Journal, June, 1901.

removed the duodenal end of the common duct through an incision in the duodenum.

Compression from Adhesions. The biliary ducts may be obliterated or compressed from the presence of adhesions secondary to disease of the biliary apparatus, especially inflammatory lesions of the gall-bladder. It has happened sometimes that an operator has failed to find any source of jaundice, and yet the operation has resulted in its disappearance, the adhesions compressing the duct having been relieved by the manipulations incident to its exposure.

Operations. The general and local preparations of the patient are such as are customary in abdominal surgery. The hemorrhagic tendency inherent on the jaundiced condition has led operators to seek to increase the coagulability of the blood by administering ox-gall and lime-juice as recommended by Richardson. The previous administration of calcium chloride by mouth and rectum has, in my hands, proved unavailing.

The Incision. The practice of operators varies. In general it may be said that there are two, the vertical, directly in the axis of the gall-bladder or along the outer border of the right rectus muscle, and the transverse. Other incisions are merely modifications, as the L-shaped incision, the transverse portion meeting the vertical at its uppermost point, or the ⌐‾-shaped, the upper transverse incision being directed to the left, the lower to the right. The L-shaped incision may be so made that the transverse portion divides only the sheath of the right rectus, the muscle proper being retracted inward. The transverse incision may be made obliquely. Some operators do all their work through a single vertical incision. My own preference is for the transverse incision with division, if necessary, of the sheath of the rectus and inward retraction of the muscle in all cases in which we expect to have to work on the common duct. The wound gapes more widely, the exposure is in the right direction, and the overlying liver can be better pushed away. I have never had any trouble about its repair, nor is there any disposition to hernia in this part of the abdomen. It has a slight disadvantage in being somewhat more bloody.

Cholecystotomy and Drainage. This is the operation most widely practised in biliary surgery. Its indications are numerous: simple or purulent cholecystitis with or without stones; cholangitis, rarely as a merciful relief to biliary obstruction, other and better means being unfeasible or inexpedient. It enters into competition with extirpation of the gall-bladder in many cases, and to which preference will be given depends somewhat on the technical obstacles to cholecystectomy and the operator's individual fancy. It is always the operation of choice when there is any doubt as to the patency of the lower biliary apparatus. It is manifestly of very limited usefulness if the bile cannot

reach the gall-bladder on account of permanent obstruction to the cystic duct.

Prolonged drainage exerts a markedly beneficial influence on the gall-bladder, and usually is curative of the cholecystitis. It has been found that successive tests of the contents of the gall-bladder during the process of drainage show a progressive tendency toward sterilization.

The time of drainage by tube varies naturally from a few days in simple conditions to months in cases of marked suppuration. Discontinuance of the drainage is generally followed by prompt closing of the fistula, if the common duct is free. In some cases a mucous fistula may persist long after bile has ceased to escape. Eventually the gall-bladder becomes shrunken and atrophic after drainage, and is usually more or less shut in by adhesions. Sometimes there is recurrence of the cholecystitis and subsequent disturbances, probably caused by inflammatory adhesions. Kehr gives the proportion of such relapses as 17 per cent. Very exceptionally a stone may re-form in such a gall-bladder, more particularly if a nucleus is provided by a foreign body such as a silk suture.

The operation may be performed in one or two stages, the gall-bladder may or may not be fastened to the abdominal wall. The usual routine operation is in one stage, with fixation of the gall-bladder to the abdominal wall. The two-stage operation, especially when the gall-bladder can be brought into the abdominal wound, is practically abandoned to-day. It formerly was performed as a prophylactic measure against the contamination of the peritoneum. To-day we no longer employ it, for four reasons. Bile as ordinarily found in the gall-bladder is not very virulent in character; the situation of the gall-bladder in the upper right quadrant of the abdomen offers little chances for generalized infection of the peritoneum. By our modern refinements of technique we can perfectly protect the surrounding parts, and it is highly important to open the gall-bladder for more thorough exploration when accessible during an operation (impaction of stone in the neck of the gall-bladder).

Cholecystotomy in one stage, with fixation to the abdominal wall. All the operative field except the fundus of the gall-bladder is thoroughly protected with pads of sterilized gauze. Two fixation sutures about half an inch apart are placed at that point of the fundus which will best project into the wound. If the gall-bladder is well distended a needle or trocar is introduced between the sutures and the contents removed by aspiration. The gall-bladder is opened at that point sufficiently to introduce the finger or instruments. Stones are evacuated by the finger or suitable scoops and spoons. One may attempt to probe (best with flexible instruments) the cystic duct, but will generally fail owing to bends or diverticula, although the duct may be

perfectly patent to bile. Injection of water to test the patency of the ducts has been suggested, but its performance is not always feasible.

Drainage and Fixation of the Gall-bladder. A fairly stiff-walled tube, about the calibre of a 20 French catheter, is introduced into the opening, the edges of the gall-bladder incision are closed by a suture, preferably reliable chromicized catgut, so that the tube fits snugly in the opening. A purse-string suture passing through the outer coats is applied below the incision, and before it is tied the original opening and tube are invaginated into the gall-bladder and the purse-string drawn taut around the tube above. The ends of the sutures are passed through and tied to the musculo-aponeurotic layer of the abdominal wall, reinforced, if necessary, by one or two more sutures. (This is practically the technique of Kader's gastrostomy.)

The abdominal wound is sutured appropriately, and the drainage of the gall-bladder may be perfected by a siphon apparatus connected with the tube, and the dressing kept free from contamination. The tube is allowed to remain undisturbed until its removal is indicated (sterilization of the contents of the gall-bladder, reappearance of the bile in the stools). Upon its withdrawal the walls of the fistula at once tend to fall together, and the permanent closure is generally only a matter of a few days.

When the gall-bladder is so small or so situated that it cannot be approximated to the abdominal wall, drainage can still be effected by invagination as just described, and protection to the surrounding parts supplied by the introduction of gauze packing around the tube.

Cholecystotomy in two stages: (*a*) The gall-bladder is fixed to the musculo-aponeurotic layer by sutures, but not opened for several days, or until adhesions have formed protecting the peritoneum; (*b*) in cases of small or inaccessible gall-bladder the wound is liberally packed and the gall-bladder is opened several days later.

Ideal Cholecystotomy (*Cholecystendyse*). It consists in opening the gall-bladder, evacuating its contents and closing it by suture without drainage.

It is a worthless and frequently dangerous operation. It is contrary to the treatment on the basis of pathological findings in that it only removes the product and does not attack the cause of the disease.

Cholecystectomy. The removal of the gall-bladder has recently grown in favor among the surgeons with a large experience in biliary surgery. I have always been in favor of it, and find increasing indications for its performance. It enters closely in competition with cholecystotomy, and the decision to resort to it will often be determined by the existence or absence of technical difficulties attending its performance, that is, to remove it if one can do so easily and safely, otherwise simply drain.

My position with regard to cholecystectomy for cholelithiasis is expressed as follows:[1]

1. In a properly selected case it is an extremely simple and safe operation.

2. It is a *curative* operation, doing away with subsequent attacks of cholecystitis and more remotely of renewed stone formation.

3. It eliminates the disagreeable possibilities of long-continued biliary and mucous fistulæ.

4. In certain technical conditions, such as atrophic or inaccessible bladder, obliteration of the cystic duct or impacted stone in the cystic duct, and in hemorrhagic conditions of the gall-bladder, it becomes logically the method of choice.

5. It is a prophylactic measure against the development of carcinoma on the site of long-standing irritation.

6. It offers the prospect of a shorter and easier wound-healing and convalescence.

7. It is not to be employed indiscriminately, but has its proper limitations and contraindications.

Cholecystectomy may also be employed for the carcinomatous gall-bladder. It may be necessary as a secondary operation to do away with fistulæ left after previous drainage.

Ordinarily the removal of the pathological gall-bladder is quite easy, especially if distended, as its hepatic surface is free from peritoneum and can be readily peeled away from the liver. It has a great value as a curative operation, and tends to do away with the painful attacks sometimes seen after cholecystitis with the formation of adhesions provocative of painful sensations. If one has difficulty in investigating the condition of the common duct, especially when jaundice is or has been present, one should be content with cholecystotomy; also, if the gall-bladder is so buried in adhesions or presents other conditions which offer technical difficulties to its safe and speedy performance.

The operation is best performed without evacuation of the contents of the gall-bladder. One seeks either by blunt dissection or by a few snips of the scissors to enter the line of cleavage of the cellular tissue lying between the gall-bladder and the liver, and then the viscus is dissected off down to the neck, which should be brought clearly into view.

If there is no stone in the cystic duct the upper portion of this is surrounded (or transfixed) with a ligature (preferably silk) and the gall-bladder cut away just above the ligature. The cut edges of the peritoneal coat are brought in contact over the stump, securely closing it.

[1] See article by the author in the New York Medical Journal, November 30, 1901.

If a stone is present in the cystic duct and cannot be expressed into the gall-bladder the operative field is well protected, the cystic duct held in place with fixation sutures, the duct incised between them, and the stone expressed. The duct is then closed as above, or, if necessary, the duct can be drained.

The wound should always have a temporary drain for safety (gauze and tube) down to the stump. It may be gradually diminished in size, and may ordinarily be removed in a week or ten days.

The operation may be combined with other steps, such as choledocholithotomy; but in all such cases one must redouble one's assurance concerning the restoration of patency of the common duct; and when in doubt, resorting in preference to cholecystotomy.

Removal of the mucous membrane of the gall-bladder as a substitute for total cholecystectomy (*Mayo's operation*). This operation would seem to have at times very definite advantages, but as the writer is not familiar with it, he will quote Dr. W. J. Mayo, who kindly informs him "that it was first done in 1898, and his cases amount to fifteen, and that the operation has been done over one hundred times to his knowledge. The operation has been modified in cases in which the mucous membrane would not separate easily by removing the free portion of the gall-bladder and enucleating the mucous membrane from the deeper part. It is always loose in the neighborhood of the cystic duct. . . . . The indication in these cases is clear;[1] it is the continuous secretion from the mucous membrane, prevented by the obstruction from draining through the natural channel, which causes the trouble, the peritoneal and muscular coats are harmless, and by removing the mucous membrane down to the obstruction relief is afforded. . . . . It is as a secondary operation that removal of the mucous membrane is most serviceable. Drainage has failed to cure, and the adhesions formed by the previous union of gall-bladder to the external incison vastly increases the difficulty of complete extirpation."

Cysticotomy. Incision into the cystic duct is practically limited to the relief of stones that cannot be pushed up into the gall-bladder and it is inadvisable to amputate the gall-bladder, or when the common duct is not opened. Great care must be exercised not to wound any overlying or contiguous structures, as the cystic artery or portal vein. A couple of traction sutures passed on either side of the proposed incision will simplify subsequent measures. The incision is made directly over the stone. The subsequent treatment of the duct depends on several conditions. If we are to drain the gall-bladder or the common duct at the same time it is probably better to suture the duct in two layers—

[1] Journal of the American Medical Association, December 1, 1900.

mucous membrane and outer coat. If neither of these operations is done, it will be better to drain the duct, especially if there is any considerable catarrh of its mucous membrane. It is drained in the same manner as the common duct.

Operations on the Common Duct. These may consist in choledocho-lithotrity—crushing the stone by the fingers or padded forceps; choledochotomy—opening of the common duct, supplemented by suture or drainage of the duct; choledocho-duodenostomy—incision of the outlet of the common duct through an opening in the duodenum, or choledocho-enterostomy—the making of an artificial fistula between the duct and intestine.

In all operations on the common duct it is extremely important to have a clear operative field with a free view, for these operations may be, and usually are, very difficult. It is occasionally difficult and sometimes impossible to demonstrate the position and course of the common duct. Theoretically it would seem quite simple to open the gall-bladder and pass a guiding instrument through the cystic into the common duct. Actually it is practically impossible, and I have only once seen this attempt succeed. The common duct is concealed under the liver, and is partly crossed and hidden by the duodenum, and can with difficulty be seen, especially if any adhesions exist. Palpation of an object lying within the duct is often the first or only clue to the latter's exact location. The duct overlies the foramen of Winslow, and by hooking a finger into this we can raise and thereby better identify the duct. One traces also by direct sight or palpation the passage of the neck of the gall-bladder into the cystic duct, and from these two points one can generally recognize the upper end of the duct. Below it is sought along the upper outer border of the second or retroperitoneal portion of the duodenum. Frequently one has to depend simply on palpation of the calculus within the duct, and this procedure is likely to give rise to deception, even to the most skilled.

In addition to exposure and palpation of the duct we should in all cases endeavor to demonstrate any extraneous source of obstruction of the duct, as the presence of gallstones may be a minor source of obstruction. The pancreas should be carefully examined for tumors or other morbid conditions, and also the second part of the duodenum, which may be the seat of a tumor affecting the duodenal papilla. I now endeavor, before opening the common duct for removal of a stone, to introduce a short-curved trocar below the stone, and inject water or air through into the duodenum.

Choledocho-lithotrity. This operation will seldom be done as a matter of choice. After one has gotten so far in a difficult and dangerous operation it seems unjustifiable to jeopardize its results by allowing the

stone to remain in the common duct, although it may apparently be reduced to a condition, allowing it to be evacuated piecemeal into the intestine. Moreover, the possibility of doing serious damage to the duct is not inconsiderable.

Choledochotomy. The common duct is almost always opened for the purpose of removing stones. It may also exceptionally be opened for drainage in profound cholangitis or for the purpose of exploring the permeability of the orifice of the duct.

As one generally has to perform it, it ranks as a severe operation, with a mortality which is high even in the hands of experienced operators. The gravity of the operation depends primarily on the patient's condition, which is usually that of a severe jaundice with its attendant dangers, chiefly hemorrhage. Then the operation is more prolonged, the operative field is deeply situated, and considerable preliminary work in separating adhesions may be called for.

The operative field being well protected by gauze, two traction sutures are passed over the site of the stone when possible, and the duct opened over the stone; it may have to be seized by forceps of various patterns—bullet, alligator-jawed, angular, etc., or extracted with scoops of appropriate shapes and curves. One then passes a probing instrument in either direction for the detection of stones that may have been missed by palpation, my favorite being a metal urethral *bougie à boule.* One can only rarely pass such a probe directly into the duodenum.

The after-treatment of the duct by drainage or by suture is an open question. I think the tendency is more and more to drain, it being now realized that the incision will readily close if the pathway to the duodenum is clear. If it is not free and the duct is sutured, the suture will in all probability leak. It is, moreover, an advantage to give the inflamed duct the benefit of a period of drainage. Drainage is best accomplished by a glass tube passed down to the common duct; within it is a rather small rubber tube which is inserted directly into the duct, and packing of gauze all around these tubes to the surface. The glass tube is removed, if all goes well, in about four days. The gauze is gradually removed in about eight days, being only superficially renewed. The rubber tube stays in place till bile reappears in the stools or the external fistula is well established. Suture of the duct should, if feasible, be in two layers. Small "hammers" of Dr. Halsted's may be introduced into the duct to facilitate suture much as a ball used in darning stockings. A safety valve of gauze packing should always be employed.

Choledocho-duodenostomy. This operation, first employed by Dr. Charles McBurney, completed the chain of essential operations on the biliary tract and opened up the otherwise inaccessible retroduodenal

portion and the duodenal papilla, in which calculi frequently get lodged.

The indication for this operation is generally furnished by the recognition of the stone through the overlying duodenum (second or retroperitoneal portion), which is opened between fixation sutures, and the duct exposed, the stone being then easily grasped. Exceptionally, it may be necessary to slit up the duodenal aspect of the papilla to gain access to the stone lying just beyond the papilla. The duodenum is sutured in the usual manner. As has been stated before, a tumor of the papilla may be similarly approached. The results of this operation have been very good.

Choledocho-enterostomy. In exceptional instances it may seem wise to establish an artificial communication between the common duct and intestine. (*a*) When the common duct is permanently obstructed, and one has already made an incision into it, which, under these circumstances, will probably never close, and (*b*) when it is necessary to establish a new exit to the bile, the orifice of the common duct being permanently blocked, and it is impossible from the alteration of the gall-bladder to use it for this purpose, or (*c*) when the gall-bladder has already been removed.

The technical difficulties of the operation are infinitely lessened by the use of the smaller Murphy buttons, which are almost universally used to-day for anastomoses of the biliary tract. The duodenum is generally selected for this purpose; personally, I think it a mistake, as on account of its fixed position there may be an undesirable traction on the anastomosis, and so I always choose the jejunum in performing cholecystenterostomy, and can see no contraindication to its use.

Cholecystenterostomy. This operation is indicated for the relief of *permanent* obstructions to the outflow of bile. In tumors of the head of the pancreas it will markedly relieve the cholæmia, and, as these tumors are not very rapid in their growth, may considerably prolong life. It also relieves the cholæmia due to obstruction from chronic pancreatitis, and apparently influences that process for the better. It may very rarely be employed when it is impossible to dislodge a stone in the common duct which cannot be dealt with in any of the ways just described.

As a single step *per se* the operation is simple and devoid of great risk, excepting when performed on very jaundiced patients or as a sequel to a prolonged exploratory operation, in which case it may attain the mortality of 85 per cent., which one observer has attributed to it.

It may be performed by sutures on the general principle of intestinal anastomosis, or, what is far better and generally employed, the smaller

Murphy button, which in this work accomplishes its best function. The button is introduced into the freest portion or apex of the bladder. The other half I prefer to put into the jejunum rather than the duodenum, for reasons already stated. The button may rarely drop back into the gall-bladder, but will do no harm, or the flanged (intestinal portion) button of Weir may be used. I think one might also throw a second purse-string suture around the portion of the gall-bladder just below the insertion of the button and produce an artificial constriction just sufficient to prevent the button from falling back.

The Prognosis of Biliary Operations. The prognosis depends mainly on the site and severity of the process.

Non-suppurative and uncomplicated lesions of the gall-bladder, such as can be treated by cholecystotomy or an easy cholecystectomy, should have no more mortality than the inherent "accidental" risk of abdominal operations, say 2 per cent.

Operations on the ducts, especially the common duct in a jaundiced patient, are vastly more dangerous, and few operators can consistently show a mortality less than 20 per cent. under these graver conditions.

Complex operations and the establishment of artificial communications with the intestine have an increased mortality.

Fistulæ should not ordinarily result, and generally indicate that a more thorough operation should have been or must be undertaken.

Improvement in our results must be in the direction of earlier intervention, not necessitating operations other than on the gall-bladder. The medical profession, and to some extent the laity, must learn that cholelithiasis, while often insignificant in its consequences, is not necessarily so, and that its unfavorable sequelæ are of a most dangerous type and require severe and dangerous measures for their relief. The lesson finally learned in appendicitis will probably yet be applied to the gall-bladder, and mild prophylactic operations will do away with the necessity of many of the formidable procedures. As it stands now in New York, I think that most of my colleagues would indorse me in saying that the majority of the cases seen by them requiring operation are of the grave type which could or should have earlier been given the benefit of surgical relief.

REVIEWS.

A Text-book of Pharmacology. By Torald Sollmann, M.D., Assistant Professor of Pharmacology and Materia Medica in the Medical Department of Western Reserve University, Cleveland, Ohio. Pp. xv., 894. Illustrated. Philadelphia and London: W. B. Saunders & Co., 1901.

A new book upon an important subject, no matter how numerous may be its contemporaries, always excites interest, for even if its contents do not present any startling addition to the sum of our knowledge, the form and manner of presentation are likely to be novel. For it is in arrangement that the teacher will find his objection to existing text-books, and thus feel the need of something different to make his instruction of the highest value. The author is by no means unknown, for before this we have read and commended his pamphlet entitled *Practical Exercises in Pharmacology*, which is contained in the work under consideration. At that time it seemed to us that aside from measuring what the student might acquire as a foundation for other usefulness the system advocated by the author must result in his being impressed by the fact that drugs are potent for good or evil, and as his judgment becomes more accurate by reason of daily practice, he must cease to regard drugs either as of no importance in the treatment of disease or as of indifferent choice. In other words, a laboratory course as here outlined would diminish in numbers or exterminate altogether that obstacle to therapeutic progress, the breed of therapeutic nihilists.

The author employs the classification of Buchheim (who becomes Buccheim at the bottom of the same page—150), which aims to unite similar drugs into groups on somewhat the same principle as is used in the natural classification of botany. This, as the author remarks, has the advantage that one may begin the study at almost any point; but we would suggest that the point of beginning might be determined on the principles of evolution. The grouping is generally practical for the purposes of the student, although at times peculiar, as, for instance, Chapter XXIII. contains the Ergot Group, Sapotoxin Group, and summarizes the Treatment of Cough. The excellence of the book consists in its bringing the laboratory in closer touch with the clinic, and furnishing a more secure foundation for the work of the physician. That it will succeed better than some other text-books in impressing a working knowledge of therapeutics upon the student depends more largely upon the skill and knowledge of the teacher; the student needs the aid of an experienced practitioner to get the best from it. That it contains a vast amount of material no one can deny; the question is—is this material presented in the most assimilable form? If the student has mastered this book he will know decidedly more of botany, toxicological analyses, pharmaceutical processes, and assaying and physics than the average

text-book will give him. As for the remedies at hand for use, he will not find so great a number, but it is hoped that those of which he has learned will be more thoroughly mastered. The book is marred by various departures from pharmacopœial nomenclature. At times there are instances of careless writing. Some important remedies, as erythrol tetranitrate and quinine carbamide, very properly require presentation. We are very decidedly of the opinion that thirty grains of urotropin after meals is by no means a usual amount. We are sure that practitioners and *advanced* students will find this book an admirable guide. We believe that the student entering upon the study of pharmacology will depend less upon this and more and more upon his teacher; but the practitioner can, with its aid, generalize with more certainty. As for the druggist, let him purchase the *Pharmacopœia*, which most of them do not possess, and use his *National Formulary* and his *Dispensatory* for reference. We can readily believe that "everyone interested in the use of medicines," unless he had enjoyed especial advantages in the way of biological training, would find this book a source of confusion. For the junior student under an excellent teacher, for the advanced student, for the progressive practitioner, we regard the work as especially well adapted, and we congratulate the author upon the success with which he has gathered together an imposing array of facts and the skill with which he has interwoven them. R. W. W.

Surgical Technic. A Text-book on Operative Surgery. By Fr. von Esmarch, Professor of Surgery at the University of Kiel, and Surgeon-General of the German Army, and E. Kowalzig, late Assistant at the University of Kiel. Translated by Professor Ludwig H. Grau, Ph.D., and Wm. M. Sullivan, M.D. Edited by Nicholas Senn, M.D. Pp. 866, with 1497 illustrations and 15 colored plates. New York: The MacMillan Company, 1901.

This most admirable work is the outcome of a prize offered by the German Empress, on the occasion of the Vienna Exposition, for the best hand-book on surgical technic. Out of a number of works submitted in competition, the jury, consisting of Langenbeck, Billroth, and Socin, unanimously awarded the first prize to the work now under review. Since that time it has undergone five German editions, the last of which is in three small volumes. The principal author, von Esmarch, later associated himself with Kowalzig, and the work in its present form is the result of their combined efforts. It has been before the public in the original German for a number of years, but has very recently appeared in one volume, in English, under the able editorship of Dr. Senn.

It is essentially a work on surgical mechanics or surgical technics, and deals not at all with pathology, but simply with the question of how to treat various surgical conditions. So far as the order of its contents is concerned, the subject first considered is the treatment of wounds, followed by bandaging and narcosis. Infiltration anæsthesia is given due consideration, as well as the cocainization of the spinal cord. Then follows mention of those simple operations which are usually included under the term of "minor surgery," including the removal of foreign

bodies and bullets, for whose localization various methods are devised, including the electric or telephone probe. Prevention and arrest of hemorrhage are fully considered, and the ligation of arteries at points of selection is admirably illustrated. Ten colored plates are given up to showing the surgical anatomy of the large vessels and illustrating operations upon them. Then come operations upon aneurisms and varices, the more radical operations, as by obliteration, excision, etc., of veins receiving a fair and favorable consideration. Operations on tendons and on nerves are rather briefly but perhaps sufficiently illustrated, since indications are not considered, but simply the technical part of operations themselves. Skin grafting is well described, but the various plastic operations for covering skin defects are too briefly considered. Operations on bones are summarized in fifteen pages, but the directions are explicit and sufficient for most purposes. To the subject of amputations and disarticulations seventy pages are given up, in which are mentioned about all of the amputations which are of any value or which can be deliberately planned out. Colored plates in this section illustrate also the topographical anatomy of limbs at points of election for amputation. Osteoplastic methods in various parts of the body are amply treated. To the subject of resections some sixty-five pages are devoted, and here again there is little left out that one would desire to see inserted. Operations on the head are made to include all the operations on the face, as well as upon the nerves, the accessory sinuses, the mastoid, etc. The special plastic surgery of each region is given by itself. Removal of nasal and nasopharyngeal polypi is admirably summarized. So also are operations upon the pharynx. And so one might go on through the entire body, to which the balance of the work is devoted, and find that each region has its operative surgery succinctly and admirably summarized. Thus, for instance, all the operations which one practices upon the gall-bladder, as well as the operation for echinococcus of the liver, are tersely but sufficiently described.

The two prominent and distinctive features of the book are the terseness of the descriptions, no superfluous words being used, though at the same time they are almost invariably ample; in addition to this, the wealth and illustrative value of the illustrations—as there are nearly twice as many figures as there are pages in the work, some idea can be gathered from this of the richness of this pictorial aid to verbal description. The translator has done his work well and has admirably imitated the terseness of the original. The task of the editor seems to have been very light, since there was very little which he or anyone else could add to the original text of Esmarch and Kowalzig. The book is an extremely valuable one, and the English-speaking public are certainly under many obligations to the publishers for presenting it in this most useful and admirable form. R. P

ELECTRICITY IN MEDICINE AND SURGERY. By WILLIAM HARVEY KING, M.D. Pp. 504. New York: Boerick & Kenyon Co., 1901.

IN view of the fact that at the present time the profession is almost overburdened with works upon the subject of electricity it has been fondly hoped by those interested in the study of electro-therapeutics that

the day of unscientific publications had passed. Aside from a brief and rather disjointed description of electro-physiology, by W. Y. Cowl, M.D., of Berlin, this book has little to commend it as a valuable adjunct to scientific electro-therapeutical literature. The entire work may be summed up as inadequate for the specialist, too vague and uncertain to the general practitioner, and of very little practical value to the student. T. B. E.

HUMAN PHYSIOLOGY. PREPARED WITH SPECIAL REFERENCE TO STUDENTS OF MEDICINE. By JOSEPH HOWARD RAYMOND, A.M., M.D., Professor of Physiology and Hygiene in the Long Island College Hospital, and Director of Physiology in Hoagland Laboratory, New York City. Second edition, entirely rewritten and greatly enlarged. Handsome octavo volume of 668 pages, 443 illustrations, 12 of them in colors, and 4 full-page lithographic plates. Philadelphia and London: W. B. Saunders & Co., 1901.

IT seems hardly commendable in a text-book of elementary physiology to predicate *ex cathedra* on questions that are still subjects of controversy (the alcohol question, the physiological effects of removal of the stomach in man, the interpretation of laryngeal photography, the status of the uric-acid question etc.); the author, moreover, does not lend the weight of his personal authority to many of the statements made, but contents himself with quoting from other authors who, in their turn, are in some cases merely reviewing the publications of foreign investigators. Nearly four pages, for instance, are given to a paragraph on the sources of uric acid, consisting exclusively of a quotation from Chittenden (*Brooklyn Medical Journal*); in the preface these pages are claimed to be "the most recent contribution of Chittenden to the genesis of uric acid," whereas, in reality, they are a well-written review (by Chittenden) of the "most recent contributions" of some fifteen or twenty other investigators. Of some seventeen pages on Voice nearly fifteen are either in quotation marks or are prefaced by "from articles in this publication (*New York Medical Journal*) we quote freely," referring to the work of "Professor Thomas R. French, of the Long Island College Hospital." The pages on the coagulation of the blood are very good, but again they are quoted; thus, the paragraph on fibrinogen is from a paper by Matthews, and the author announces that there is no better way of presenting the status of the question than by "giving the views of Schaeffer;" this he does over some six or seven pages. The chapter on removal of the human stomach, it appears to us, is too long and out of all proportion to the length of other more important chapters; a brief sketch report of the cases of Schlatter and Brigham, instead of such extensive quotations from these authors, would have been sufficient. And we fail to see what advantage can accrue to a student of elementary physiology from looking at a half-page photograph of an old woman whose stomach has been removed, or a large cut of a Murphy button.

The arrangement of the topics is very practical, and there is such a formidable array of facts and figures that aside from serving as a text-book for students under the guidance, of course, of a teacher and a

laboratory demonstrator, the book promises to be useful as a ready reference hand-book for practitioners and advanced workers. There are a few inaccuracies in the text, and here and there a contradiction: on page 98 the statement is made that "up to the present time no dextrose-producing enzyme has been obtained from the liver," whereas on page 250 we read "a ferment has been obtained from the liver which does convert glycogen into dextrose." If the author chooses to consider the sulphuretted hydrogen in the intestine as a "physiologic ingredient" of the body, if he considers cholesterin or lecithin to be a "constituent of protoplasm," or if he states that "the difference between organized and unorganized ferments is a superficial one," and defines diabetes mellitus as "an affection characterized by an immoderate and abundant flow of urine," we can readily overlook these and some other little lapses in view of the really painstaking treatment that he has given the general subject of physiological chemistry; the author realizes the fundamental importance of this auxiliary subject and appreciates that, "as a rule, medical students have an insufficient knowledge of this branch;" the chemical portions of the book we consider exceptionally good for a text-book of this character, and many an older practitioner, and, we fear, many a younger one, who is a recent "graduate" in this subject—*sit venia verbo*—will find a perusal of these portions of the volume most profitable.

The histological parts of the work are very clear and comprehensive, the neuron theory is well introduced, and the chapter on the reproductive functions, particularly the paragraphs on menstruation and ovulation, are well written and modern; the chapter on the special senses is particularly good. A. C. C.

An Introduction to the Bacteriological Examination of Water. By W. H. Horrocks, M.B., B.Sc. Pp. 300. London: J. & A. Churchill.

In order to determine whether a water is likely to injure the health of those drinking it, one must, as the author says, necessarily have clear ideas as to the hygienic importance of the various micro-organisms which it may contain. The bacteria which may be found in water he divides into three classes:

I. Those found in pure water.
II. Those common to sewage and rarely met with in pure water.
III. Those which give rise to specific diseases in human beings.

Within the 300 pages which make up this volume the organisms which are included in these three groups are treated in detail.

Chapter I. contains a concise and most satisfactory exposition of the limitations of chemical and bacteriological examination of water, and of the exceptional difficulties which attend qualitative bacteriological work. Chapters II. to V. are devoted to the quantitative bacteriological analysis of water, and deal with the preparation of blood cultures, the multiplication of micro-organisms in water, the influence of light, movement, rest, electricity, sedimentation, and chemical composition of water on the same, their duration of life, the bacterial contents of snow, hail, rain, rivers, lakes, wells, and springs, and the relation of quantitative

bacteriological analysis to filtration of water through sand. Chapters VI. to XIV. deal with qualitative work. The author notes that the isolation of the typhoid fever bacillus can be accomplished only under exceptionally favorable circumstances, and that, this being the case, it is highly desirable, in the absence of the discovery of the specific bacterium, to be able to state that the suspected water has been polluted with sewage. Hence the division by him into classes, as above. Bacteria of the first class are arranged into groups of certain well-defined types, and these again subdivided, according to peculiarities of growth. Each species is then thoroughly described; its microscopical appearance, its behavior on the various culture media, motility, spore formation, etc. Then those of Class II. are considered. Of the bacteria in this class, B. coli communis is the most important. The culture characteristics, morphology and serum reactions of the typical bacillus are first considered, and then the more important varieties are compared with the type. The value of B. coli as a sign of sewage contamination is then discussed. The chief arguments against the acceptance of this organism as a certain indication of sewage contamination (*e. g.*, the statement that the organism exists abundantly in all waters and soils) are stated and answered in a spirit of great fairness. Of the organisms falling under Class III. only those of cholera and typhoid fever are considered, since these diseases are really the only ones known to be water-borne. The characteristics of the typhoid organism and the most important of the various tests are described and considered in order, with a very full exposition of the reactions of anti typhoid serum and general conclusions thereon. In but very few examinations has the typhoid organism ever been isolated, if we exclude the early announcements of its discovery, and these should be excluded, or, at least, accepted with very great reserve, since most of the tests deemed essential at present were not applied. The characteristics of the cholera organism also are given, with methods for its isolation from water. Chapter XV. is devoted to the action and comparative value of the Pasteur and Berkefeld filters, and Chapter XVI. is a summary of the procedures recommended for the bacteriological examination of water and preparation of nutrient media. In addition, a full bibliography of the subject is given.

The work is necessarily of a technical nature, but is, nevertheless, very readable, even to one who is not a bacteriologist. It is worthy of the highest praise, and should prove useful to every sanitarian. C. H.

International Clinics. Edited by Henry W. Cattell., A.M., M.D., Philadelphia, with Collaborators. Vol. I. Twelfth series. Pp. viii., 306. Philadelphia: J. B. Lippincott Company, 1902.

The twelfth series of this publication comes to us for criticism presenting but little to invite it. Its contents are various and important; Meigs, on the use of opium in daily practice, while presenting a plea for its employment under special indications, at the same time points out the fact that no argument is required for its present needless employment. Wood, Jr., continues his interesting series of papers on the methods of investigating the action of drugs, more or less elementary, it is true, but at the same time instructive to those not conversant with

modern laboratory methods. Two articles—on the significance of basophilic granules in red corpuscles, with special reference to their occurrence in chronic lead-poisoning, by Simon, and on gastro-intestinal auto-intoxication, by Hemmeter—are of great value to the thoughtful physician. Both are exhaustive and scholarly, as their writers from their past productions have led us to expect. In surgery, Marnoch, Greig, Holmes, Rodman, Griffith, Young, and Kelly present a most miscellaneous collection of notes on topics from coxa vara to the surgical treatment of infantile palsy. He, indeed, must be difficult to please who can find nothing to interest him. In obstetrics, Bustard discusses the contest between the advocates of symphysiotomy and the partisans of Cæsarean section, and Randall presents a brief paper on a deposit of chalk in the tympanic membrane, and a case of mastoid disease due to smallpox. The remaining papers are well chosen and presented

The volume ends with a review of the progress of medicine during the year 1901, by Watson, who divides his subject somewhat peculiarly under the following topics: medicine, neurology, toxicology, therapeutics, new remedies, surgery, obstetrics and gynecology, pathology, new instruments and devices, the eightieth birthday of Rudolph Virchow and the death of President McKinley. As we have said in noting this feature of the series, this section is entirely unsatisfactory, not because the work is not well done, for it is so far as the author has gone, but because the year-books so thoroughly cover the field, and a review limited by space considerations fails to be either competent or comprehensive, no matter how brilliant and painstaking the author may be. In this volume appear biographical sketches of two physicians, accompanied by illustrations supposedly pertinent to the subject. While no one may question the eminence of the individuals chosen, the utility—to the reader—of this innovation is not apparent. The physician who is conversant with medical literature knows their work and attainments; he who reads none is not likely to find them in this volume. It is no compliment to the individual, whose rank is of the highest, to appear as the subject of a sketch which the daily press might readily produce. The entire volume is well and satisfactorily illustrated. The frontispiece alone is open to objection, in that it apparently gives the sanction of high authority to a practise which we had believed obsolete—that is, sitting astride the patient—a practise as undignified as it is unnecessary.

R. W. W.

BIONOMICS: EXPERIMENTAL INVESTIGATIONS WITH BACILLUS SANARELLI AND EXPERIMENTAL INVESTIGATIONS WITH MALARIA, IN CONNECTION WITH THE MOSQUITOES OF NEW ORLEANS. By PROFESSOR GEORGE E. BEYER and DRS. O. L. POTHIER, M. COURET, and I. I. LEMANN. New Orleans, January, 1902.

THIS very interesting report is divided into three parts. Part I. deals with the mosquitoes of the city of New Orleans and vicinity, their seasonal and topographical distribution, and other important data. It appears that of the nine genera of mosquitoes thus far recognized in the United States, no less than seven are represented in Louisiana, and six by no less than fourteen species within the limits of New Orleans. Most of these fourteen species have been thoroughly studied and are well

described. By far the commonest of all is *Culex pungens*, which is common all the year round. Forty-five per cent. of the more than 200 cisterns and other collections of water were found to contain their larvæ, which were found also even in the river in many places.

In but 2 of 210 cisterns, barrels, troughs, and other vessels containing water were no mosquito larvæ found. Those of *Stegomyia* (yellow-fever mosquito) were most numerous, being found in over 60 per cent. Considerable space is devoted to a consideration of *Stegomyia fasciata* and of the three species of *Anopheles*. As a whole, Part I. is exceedingly interesting and useful.

Part II. deals with experiments with Sanarelli's *Bacillus icteroides*. In these experiments two modes of infection were employed: 1, direct inoculation; 2, mosquito inoculation. The work was done with cultures obtained during the epidemic of 1898, from the blood of 20 cases of yellow fever on the second and third days of the disease. Animals were inoculated with these cultures, and then mosquitoes were allowed to bite them. Many experiments were performed, but their results are by no means convincing. It is true that after inoculation the animals commonly died, and showed evidence of great congestion and of degenerative changes. But this does not mean that they had yellow fever. It is true, also, that mosquitoes, after sucking the blood of the sick animals, appear to have become infected, and on biting fresh animals conveyed the infection. But, again, we have no evidence that the disease so conveyed was yellow fever. In fact, in view of the work of the United States Army surgeons in Cuba, we have every reason to believe that the disease was not yellow fever.

Part III. deals with malaria. The malarial parasites and the two different cycles necessary for their development are described; but nothing essentially new is given. From the evidence at hand the authors believe that the pernicious æstivo-autumnal type of malaria is disseminated by *Anopheles crucians*, for this form of the disease is unknown where this species is absent, and the distribution of the two corresponds very closely. The authors make recommendations for ridding the city of mosquito-breeding places, for preventing the insects from breeding in cisterns and other collections of water, and for screening malaria and yellow fever patients, so as to prevent access, and consequent infection, of the specific mosquitoes. So, whether or not their experiments have any scientific value, their recommendations coincide with those based on the work of Reed and Carroll, the value of which is unquestioned, and thus the same end will be attained. The report closes with a very valuable and complete bibliography of malaria and mosquitoes and yellow fever and mosquitoes. The value of the report is increased, also, by a number of very good illustrations of different species of mosquitoes, their eggs and larvæ. C. H.

The Pathology and Treatment of Sexual Impotence. By Victor G. Vecki, M.D. Third edition, revised and enlarged. 12mo., 329 pages. Philadelphia and London: W. B. Saunders & Co., 1901.

It has long been a source of surprise to the reviewer to note not only how little attention was paid to this subject by teachers in medical schools, but also the apparent reluctance of most medical authorities to

deal with this most highly important question with any degree of seriousness and in a scientific manner. That this condition of affairs is not due to want of interest on the part of the profession at large is shown by the fact that the present work has passed through two editions in two years, the present one being the third.

It seems to us to be a sorry commentary on the scientific spirit which the medical man is supposed to possess, to read in the author's introduction that to "write on the much-scouted subject of sexual impotence is a venturesome undertaking under all circumstances," and again, "Many an eminent medical man may have felt a secret desire to take the risk, but refrained through fear of endangering his professional reputation."

That these statements accurately represent the prevailing sentiment among medical authors and teachers at the present day is demonstrated by the scarcity of literature on the subject, and the almost complete absence of general clinics both in this country and, according to Vecki, in Germany, also, upon this disease. The result of all this is that a large majority of unfortunate patients affected with this condition are practically left to the care of charlatans and quacks.

Vecki is to be most heartily congratulated upon possessing the moral fortitude apparently necessary upon entering this field of medical literature. The result of his efforts has been a work most admirable in every particular, dealing with the subject in a most comprehensive manner, and withal absolutely free from the slightest suspicion of having been written for the lay public.

The chapter on treatment affords reading of considerable historical interest, but which may prove from a therapeutic stand-point to be somewhat disappointing. However, in this connection it must be borne in mind that the author is dealing with a most intractable condition, one which ofttimes is never cured.

The work as a whole constitutes the most interesting and instructive book that we have seen upon this subject, and we commend it to the general profession as a sound and reliable guide to the management of this troublesome class of patients. H. M. C.

DISEASES OF WOMEN: A MANUAL OF GYNECOLOGY. By F. H. DAVENPORT, A.B., M.D., Assistant Professor of Gynecology in the Harvard Medical School. Philadelphia and New York: Lea Brothers & Co.

IN this the fourth edition of his book the author has maintained the enlargement first seen in the last edition. His first two editions dealt with the subject from the non-surgical side, but in the last two editions the attempt has been made to deal with the technique of the various operative procedures also. This attempt we believe to be a mistake, since in a volume of this size the requisite space cannot be afforded for their due consideration. Moreover, the man who desires to practise pelvic surgery will, of course, have recourse to the larger works, as well as the training which comes from years of actual assisting at the operating-table. To the general practitioner the details of operative procedure are of no value, and in our opinion their inclusion in the present volume detracts from its general excellence. On the other hand, the preparation of

cases for major surgical procedures and their after-care, with the complications likely to arise, together with their appropriate treatment, are matters of paramount importance to all men engaged in general work, since in many cases the responsibility for these details will rest upon them. The instruction contained in the book relative to these questions is, therefore, well placed.

With regard to the teaching presented by the author upon the various subjects considered, we can in most instances thoroughly agree, but there are a few points with which it is necessary to differ. One of the most important is with regard to the teaching upon the subject of the lowest type of dysmenorrhœa. We do not believe in the gradual dilatation, as advised by the author in the cases of dysmenorrhœa due to anteflexion, either as a therapeutic agent or as a means of determining whether or not a formal operation is demanded. Such teaching is certainly most dangerous when placed in the hands of the ordinary doctor, and if followed will lead to infection in many instances. Furthermore, we do not believe in the possibility of any data of value being furnished by the procedure.

Finally, one statement made while considering the question of uterine cancer is, we think, most unfortunate in that it tends to mislead the reader. Instead of saying that the diagnosis of uterine cancer is easy, as a rule, a statement at present too true, only because of the lack of care in many instances on the part of the medical man, it would certainly have been better to have emphasized the fact that the diagnosis, if it is to be made at a time sufficiently early to be of value from the curative side, is often one of the most difficult in medicine.

W. R. N.

Ophthalmic Myology: A Systematic Treatise on the Ocular Muscles. By G. C. Savage, M.D., Professor of Ophthalmology in the Medical Department of Vanderbilt University. 8vo., pp. viii., 589; with 61 illustrative cuts and 6 plates. Nashville, Tenn.: Published by the author, 1902.

This work offers itself as a most valuable exposition of one of the most important principles underlying the physiology, the psychology, and the therapy of the ocular muscles. In consequence, it not only appeals to the ophthalmologist, for whom it has been primarily written, but also to the advanced physiologist and psychologist.

Careful study of its contents will show that the author has expended much time and study upon the entire question. Many of the thoughts offered, theories explained, and data given are both new and novel, and hence well worth consideration.

The teachings promulgated in this volume—teachings that are situated upon the very threshold of advanced medicine, as it were—should be studied assiduously and in every detail by every thinking mind in these three branches of medical science. C. A. O.

PROGRESS

OF

MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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Basedow's Disease.—ALBERT KOCHER (*Mitteilungen aus den Grenzgebieten der Medicin und Chirurgie*, Bd. ix., Heft 1 und 2) has recently reported in detail the cases of Basedow's disease which have come under the observation of his father, Professor Kocher, in his hospital and private practice, between the years 1883 and 1899. The series includes 93 cases, of which 74 were cases of true exophthalmic goitre. The report, which is really a monograph covering 304 pages, is a most valuable one, owing to the carefully recorded histories and the detailed analysis of symptoms. What is of especial interest in the report is the record of Professor Kocher's results obtained from his operative treatment for the cure of exophthalmic goitre. Owing to the unsuccessful results obtained from most forms of medicinal treatment these operative procedures and their results are of great interest both to the clinician and surgeon.

Kocher insists that the operation should not be done when the patient is in the stage of marked cardiac and psychical irritability. Measures must be taken to reduce these as much as possible first. All the operations were performed with the use of local anæsthesia, a 1 per cent. solution of cocaine being used. No general anæsthetic was given. In all, 59 of the 74 cases of true Basedow's disease were operated on. The following are the operations which were performed, with the number of cases operated on by each method:

(1) Excision of one lobe of the thyroid, 14 cases. (2) Ligature of the thyroid arteries, 16 cases. (3) Excision of one lobe and ligature of the vessels to the opposite lobe, 19 cases. (4) Half-sided excision and partial resection, 4 cases. (5) Half-sided, partial resection and ligature of the arteries, 3 cases. (6) Ligature of the arteries and resection of the sympathetic, 3 cases. (7) Ligature of arteries and partial resection, 1 case.

Four of the 59 cases operated on died with symptoms of tetany within ten days after the operation. Of the remaining 55 cases, 39, or about three-fourths, had unpleasant post-operative symptoms. These consisted of transitory psychical disturbances, irritability, oppression, palpitation, sensation of heat, congestion of the face, general tremor, sweating, vomiting, fever, and irregular, frequent pulse; in fact, temporary increase in the symptoms present before the operation. The fever and tachycardia followed in all the 39 cases. The other symptoms mentioned occurred in the majority of the patients. The possibility that these symptoms are due to an acute toxæmia resulting from absorption of certain substances pressed from the gland during the operation is discussed, but a satisfactory explanation for the aggravation of the symptoms is not arrived at. The other 16 patients operated on had no disagreeable after-effects.

The results of the operative treatment are most satisfactory. Of the 59 cases operated on, 45, or 76 per cent., were cured; 8, or 14 per cent., were decidedly improved; 2, or 3.3 per cent., were only slightly improved; 4, or 6.7 per cent., died with symptoms of tetany as a result of the operation.

In 15 of the 74 true Basedow's cases medicinal treatment of various kinds was used. The results, notwithstanding the fact that several of them were mild cases, are in striking contrast to those from the operative treatment. In only one case could a cure be said to have occurred, and this was really brought about by the patient developing an intercurrent disease. The various forms of treatment adopted are given in detail, and special emphasis is laid on the injurious effects on the disease produced by treatment with iodine and potassium iodide, which are frequently administered in regions where ordinary goitre is endemic.

Out of the 93 cases there were 14 in which a diagnosis of *struma vasculosa* was made, in which the main feature was enlargement of the thyroid due to increased blood-supply to the gland, and in which the other features of exophthalmic goitre were absent. These cases are regarded as being distinct from Basedow's disease, although a few in young individuals are somewhat closely related. Nine of these cases were operated on with most satisfactory results. The operation consisted in tying one or more of the thyroid arteries.

Post-mortems were obtained in three of the four fatal operative cases. Several factors may have played a part in the cause of the fatal termination in the first case. There was a persistent thymus, the heart was dilated, and there was a fluid exudate in the serous cavities, and the superior cervical ganglion was very much enlarged. In the second case death was found to be due to double-sided pneumonia and pleurisy. Death in the third case was believed to be due to the severity of the intoxication. At autopsy the dilated heart, spleen tumor, jaundice, and fatty degeneration of the liver and spleen confirmed this view.

The Leucocytic Changes following Intravenous Injections of Cinnamate of Soda.—SHAW (*The Journal of Pathology and Bacteriology*, March, 1902, vol. viii. No. 1, p. 70) undertook a series of experiments on cats with the object of trying to obtain some additional information regarding the morphology and development of leucocytes. The method adopted in the experiments

was as follows: A count of the red cells and leucocytes and a differential count of the latter was made of the blood from the jugular and splenic veins before the drug was injected. Then an emulsion of one-quarter grain of cinnamate of soda in sterile salt solution was injected into the jugular vein. After the lapse of three or four hours a complete examination of the blood was again made, the animal in the meantime being kept under the influence of ether. As a result of the study of the blood of five cats the following conclusions are drawn:

1. Richter and Spiro's observations on the general leucocytosis produced by cinnamate of soda are confirmed.

2. The effect is *not* produced by depriving the blood of a certain amount of liquid, thereby tending to leave in the vessels relatively more corpuscles per cubic millimetre.

3. As a result of the injection of cinnamate of soda, the simpler lymphocytes are stimulated to transformation into polymorphonuclear cells and intermediate forms. The administration of ether (as shown in a control animal) has a similar effect, though it is not so complete in character.

4. So far as the spleen is concerned, such changes are not greatly more or greatly less marked in the blood of the splenic vein than in that of the jugular vein; in other words, the spleen does not appear to act as an aid or hinderance to the transformation excited by the sodium cinnamate. A series of experiments is now being carried out in which, before injection of cinnamate of soda, splenectomy is performed, with the view of still further estimating whether the spleen has any effect or not upon the leucocytosis brought about by injection of sodium cinnamate.

5. That both cinnamate of soda and ether cause a diminution in the percentage of eosinophile cells in the blood stream.

Shaw's results seem to go toward confirming Uskow's theory that the granulated leucocytes are derived originally from the lymphocytes.

Angina Cruris (Intermittent Claudication) and Allied Conditions, Including Painful Cramps, with Remarks on the Importance of Examining the Pedal Arteries.—Walton and Paul (*Boston Medical and Surgical Journal*, April 3, 1902, p. 351), in a very interesting paper, suggest the name *angina cruris* for the group of symptoms first described by Charcot in 1858, and usually known under the name of "intermittent claudication." They refer to the various other names that have been applied to the affection, and state that they are misleading, in that they unduly emphasize an unessential feature of the disorder (lameness), while drawing no attention to the essential symptom, namely, intense paroxysmal pain.

According to the writers, the clinical picture of well-developed angina cruris consists of more or less frequent brief attacks of intense paroxysmal pain in the leg, affecting, as a general rule, the same region, oftenest the calf, recurring at irregular intervals, generally when in the erect position, but not infrequently while the patient is in bed. The condition is usually accompanied by local asphyxia and cyanosis, and usually in a limb in which pulsation is wanting in the dorsalis pedis or the posterior tibial, or both. The attack resembles in its severity that of painful facial tic. The various causes that have been advanced to explain the group of symptoms are dis-

cussed, but the writers favor Goldflam's view that the pain is of vascular origin, conveyed, perhaps, as Goldflam suggests, from the sensory corpuscles in the vessel walls.

The comparative frequency of the condition has been recently illustrated by the fact that Higier, Goldflam, and Hagelstam have reported 18, 24, and 23 cases, respectively. These authors believed that certain races—for example the Semitic—were peculiarly subject to the complaint.

During the past few months Walton and Paul have observed one typical and fifteen other cases representing a modified type of the disease. They are evidently inclined to the view that many cases of recurring local cramps properly belong to this condition, particularly when associated with vascular changes.

The cases heretofore reported have been largely in males. Nine of the cases here reported occurred in women, however. As to the etiology of claudication, two factors appear with great frequency throughout the literature, namely, a tendency to defective circulation and a constitutional neuropathic taint. An important feature of many of the published cases has been the obliteration of the pulse in the superficial arteries of the affected extremity. It is of interest that the writers found that the blood pressure was markedly increased in the toes on the involved side during the spasms of pain.

The following conclusions are drawn:

1. The concurrence of the paroxysmal pains of angina cruris with pulseless pedal arteries is too constant to be explained by coincidence, though it is true that pulseless arteries may be found without the pains, and, conversely, that such pains may appear with apparently normal arteries.

2. The painful paroxysms are probably of vascular origin, and result from vascular spasm, coupled, perhaps, with increased blood pressure acting on vessels already partially occluded, whether from local or general disease (aneurism, syphilis), from senile changes (atheroma), or from congenital tendency to angiofibrosis.

3. Recurring painful cramps of constant seat probably represent a modified form of angina cruris.

4. It is important to examine the dorsalis pedis and posterior tibial, as well as the radial and temporal arteries, in all cases in which it is desirable to estimate the bearing of the vascular condition upon disease in the central nervous system or elsewhere.

The Leucocytosis of Scarlet Fever and its Complications.—Bowie (*The Journal of Pathology and Bacteriology*, March, 1902, vol. viii., No. 1, p. 82), as a result of the study of the leucocytes of 167 cases of scarlet fever, draws the following conclusions:

1. Practically all cases of scarlatina show leucocytosis.

2. The leucocytosis begins in the incubation period, very shortly after infection, reaches its maximum at or shortly after the height of severity of the disease, and then gradually sinks to normal.

3. In simple uncomplicated cases the maximum is reached during the first week, and the normal generally some time during the first three weeks.

4. The more severe the case, the higher the leucocytosis and the longer it

lasts; the slighter the case, the slighter the leucocytosis and the shorter time it lasts.

5. A favorable case in any one variety of the disease—*e. g.*, simple, anginose, etc.—has a higher leucocytosis than an unfavorable one of the same variety.

6. The fever—*i. e.*, temperature—has no direct effect on the leucocytosis.

7. The polymorphonuclear leucocytes are increased relatively and absolutely at first, and then fall to the normal, the lymphocytes acting inversely to this; this cycle of events occurs in simple cases within three weeks.

8. Eosinophiles are diminished at the onset of the fever. They increase rapidly in simple favorable cases until the height of the disease is past, then diminish, and finally reach the normal some time after the sum total leucocytosis has disappeared—in short, when the poison has all been eliminated.

9. The more severe the case the longer are the eosinophiles subnormal before they rise again, as described above (*vide* 8); in fatal cases they never rise, but sink rapidly toward zero and remain there.

10. The leucocytes, in complications, go through a cycle of events similar in all respects to that of the primary fever, as regards sum total and differential leucocytosis, and the same laws govern the behavior of the leucocytes in both cases.

Bowie thinks that the rather early eosinophilia and its persistence for a considerable time is of value in diagnosing the disease from tonsillitis and septic conditions, with both of which the disease is likely to be mistaken. He also believes that the course of the eosinophiles is of value from a prognostic stand-point. If they are normal or subnormal after the first day or two then the case will in all probability be a severe one. As long as a relative increase of eosinophiles is present, one cannot be sure that some complication will not ensue; where, as if the eosinophiles have come down to normal in the usual way, one should be free from anxiety in this respect.

SURGERY.

UNDER THE CHARGE OF

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The Operative Treatment of Tumors of the Superior Maxilla.—Stein (*Archiv f. klin. Chir.*, 1902, Band lxv., Heft 2) states, in summing up the results of his experience, that operation is to be advised in every case in which the tumor is progressing. As Estlander noted in 1879, the patient who has a sarcoma of the superior maxilla has only about a year and a half from

the onset of his disease to live, and, as a rule, these cases do not present themselves for treatment until a year of this time has passed. Without operation there is no hope, while with it the average mortality is 17 per cent. (in the author's hands it has only been 12½ per cent.); there is an equal chance of being permanently cured, another just as great that life will be prolonged for a year or so, and there will usually be complete relief from pain.

The Influence of Castration (Testicular and Ovarian) upon the Development of the Skeleton.—BRIAU (*Gaz. hebdomadaire de Med. et de Chir.*, 1901, No. 65) states that for many years observers have noted the exaggerated development of the stature in those persons who at an early age were affected with atrophy or arrest of development of the ovaries or the testicles. Godard has noted the development of the skeleton in the Egyptian eunuchs, and states that those who have reached adult age are very tall and thin; a similar change has been noted as occurring in various species of animals similarly treated. With a view to confirming these results the author experimented on young animals. The animals were castrated when fifteen days old, and killed for pathological examination just six months later, when they had not yet reached their full growth. Of the first set of experiments only two male animals survived, one a eunuch and the other the test animal, while in the second set three female animals survived, one of the test animals and two eunuchs. Examination and weighing showed that the skeletons of the castrated animals were very much larger and heavier than those of the ones which had been similarly confined as a control experiment.

Two Cases of Splenectomy.—BLAUQUINQUE (*Gaz. hebdomadaire de Med. et de Chir.*, 1901, No. 99) reports two cases of splenectomy performed in the usual manner, one for the relief of an enlarged spleen of unknown cause, and the other for a leukæmic spleen. The first case was a man aged sixty-two years, whose spleen had reached enormous size. Its removal was not attended with any particular difficulty, and the patient made an uninterrupted recovery. The second case was a man, aged thirty-three years, who had a marked case of leukæmia, the blood showing one white corpuscle to each ten red cells, and the spleen was of enormous size. The spleen was easily removed, but a severe internal hemorrhage caused the patient's death eight hours after the operation. These two observations demonstrate that in splenomegalia or simple splenic hypertrophy the removal of the spleen is indicated and the operation is nearly always a success, while, on the contrary, operative interference is contraindicated in leukæmia.

Gonorrhœal Osteopathies.—PHILIPPET (*Gaz. hebdomadaire de Med. et de Chir.*, 1901, No. 79) states that the complications of gonorrhœa affecting certain joints and serous membranes are well known at the present time and are distinctly separated from true rheumatism. More rare are the osteoperiosteal complications which have often attracted the attention of clinicians. These osteopathies present two different forms: (1) The acute form, corresponding to a periostitis or to the simple inflammation of the periosteum, as described by Fournier, and to the first degree of the osteofibrous gonorrhœal rheumatism, as described by Jacquet. In some cases, as Jacquet has noted, the

periostitis is complicated by a marked degree of osteitis. (2) A chronic form, corresponding to the periostitis described by Fournier, the osteitis of Jacquet, and the hypertrophic periostitis of Hirtz.

In the acute variety of osteoperiostitis the lesion is generally found situated at one of the more prominent portions of the skeleton, as on the tibia, between the insertions of the ligamentum patellæ, the extremity of the metacarpal or metatarsal bones, etc., but it is rare to find more than one of these lesions upon the same patient; however, Fournier has reported one case which presented five separate areas of periostitis. The functional symptoms are of much greater value for diagnostic purposes than the physical signs. As a rule, the patient will complain of pain in a circumscribed portion of a bone. Careful examination will show that pressure over the affected area, which is small, and as a rule not larger than a fifty-cent piece, causes marked pain; pressure in the region around the small area is absolutely painless. When the lesion affects certain portions, as the os calcis, for example, there is an absence of pain when the patient is quiet, but on attempting to walk it becomes marked. In the form without deformity, which is a well-recognized type, the pain caused by walking or by pressure exists, either at the attachment of the tendon of Achilles to the os calcis or under the heel in the region of the calcanean tuberosity. Sometimes, but not always, there exists a certain degree of puffiness of the tissues, forming a slight protuberance in the region of the point of tenderness. More rarely the skin at this point is more or less red. As a general rule, the acute osteoperiostitis is of rapid development. It comes on at the third or fourth week of the gonorrhœa and lasts from one to two weeks. At the end of this time the phenomena of pain and swelling gradually disappears until resolution is complete; there is no tendency to suppuration. More rarely in some cases the swelling persists and increases and causes a plastic deposit upon the bone, which ends by forming a more or less large swelling which constitutes a true periostitis. Patients who have once suffered from this complication are liable to relapses and are also subject to the return of the complications if again infected with gonorrhœa. Fournier has reported a case which had three attacks of periostitis in the course of three successive attacks of gonorrhœa. The diagnosis, as a rule, is easy on careful examination, but as Fournier has noted, it may be difficult in certain rare localizations of the lesions as the acromion process of the scapula or the spinous processes; but too much stress cannot be laid upon the value of the practically pathognomonic symptom of pain on pressure over the small circumscribed area of the lesion. The prognosis is generally good, the patient, with rest and proper treatment, usually recovers; but, on the other hand, neglect is usually followed by the much greater and sometimes irremediable lesion of hypertrophic osteoperiostitis.

In the chronic form, in contradistinction to the acute, the lesion is generally found in the epiphyses and the small bones of the hand and the foot. These last are by far the more usual location, but the osteoperiostitis of the diaphysis of the long bones has been occasionally observed. The objective symptoms are the principal element in making a diagnosis, for subjective symptoms may be entirely absent. In some cases, as where the treatment of the gonorrhœa is entirely neglected, or, as the result of neglected infections, there may be a distinct tumor formation. This tumor is flat, immovable,

adherent to the bone, and gives on palpation the typical sense of resistance characteristic of bony new formation. As a rule it is small; however, it may reach a quite large size. The symptom of pain is very variable, but as a rule there is pain at the onset of the swelling, but not always so. It is not uncommon, as Jacquet has noted, in cases of pain in the heel, with hyperosteosis, for the pain to be very severe on each attempt at walking, and to really make the patient an invalid. Rarely is the skin altered, but in some cases, at the onset, it may be inflamed. The nodulated form of gonorrhœal rheumatism, described by Fournier and Amaral under the name of "progressive pseudo-nodulated deforming polyarthritis" must be considered. This disease consists in a peri articular swelling, affecting usually the extremities of the phalanges or the metacarpal bone or the big toe. Rarely primary, the lesions are usually consecutive to repeated attacks. If one examines the affected region one finds on palpation a diffuse puffiness which gives the sensation of a tumor, hard as a simple, smooth exostosis, but without the inequalities and other peculiarities of the tophi of gout. No redness of the skin nor œdema exists in the region of this tumefaction, which occupies only the extensor side and the lateral face, and never the flexor side. Markedly painful at first, it soon becomes painless except on pressure. The lesion, after remaining for a long time stationary, gradually lessens, and eventually disappears. A particular characteristic of this affection is that when the lesion extends over the joint of the first with the second phalanx there results a characteristic deformity of the finger, which becomes fusiform; it is the "radish finger" of Fournier and more often affects the ring and index fingers. This deformity is pathognomonic of gonorrhœa, for although there is an analogous dactylitis in Haygarth's disease, in this all the fingers of the two hands are equally affected, while in the gonorrhœal variety only one, two, or three of the fingers are involved. A number of authors have considered this particular swelling to be the result of a slight osseous hypertrophy, and above all, of a hyperplasia of the peripheral fibrous tissue; in other words, a purely analogous condition to that of rheumatism deformans. It has been demonstrated beyond doubt that these lesions are osseous. The chronic osteoperiostitis of the diaphysis of the long bones, though rare, requires special mention. Achard and Hirtz have each reported a case in which there was a hypertrophy of the diaphysis of the femur consecutive to gonorrhœal rheumatism. This was characterized by a hard, indolent swelling, of a portion of the bone and accompanied by trophic complications consisting of extreme atrophy of the muscles of the thigh. The diagnosis of the chronic form is usually easy; it may be distinguished from the exostosis of syphilis by the fact that those of gonorrhœa are painless in contradistinction to those of syphilis, which are accompanied by the typical osteoscopic pain. The hypertrophic osteoperiostitis is essentially a chronic condition and may persist for months or years without modification despite appropriate treatment. Fournier has always noted the disease's termination by resolution, while other observers have stated as their experience that the lesion may diminish in size, but never entirely disappear. The prognosis is grave, for the reason that the disease is of indefinite duration, and during its existence the part is of necessity functionally inactive. It is even more likely to reappear or to become accentuated with each new attack of gonorrhœa.

The treatment in the first place should assist in cure of the gonorrhœa by irrigations with a solution of permanganate of potassium or nitrate of silver. Local rest is essential, especially in cases where the heel is involved. Counter-irritation is the best local treatment. In some cases local and general baths composed of equal parts of emulsion of green soap and essence of terebinthine in water, in the proportion of one to four, have proved valuable The general bath should be given at a high temperature, 40° C., and should last about half an hour. The temperature of the local bath should be even higher, 45 or 50°, and a greater quantity of the solution should be used. In some cases massage and hydrotherapy have been followed by good results. The treatment of the pseudo-nodulous deforming polyarthritis requires especial care, for it is a difficult point to decide when the acute period has sufficiently passed to forcibly break up the immobility and when to have recourse to massage and moderate articular gymnastics without risk of provoking an acute relapse. As a general rule, this period has arrived when the peri-articular extremities are not sensible to pressure by the fingers.

THERAPEUTICS.

UNDER THE CHARGE OF

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Bactericidal Action of Rontgen Rays.—DR. H. RIEDER in 1898 began a series of observations on the bactericidal activities of the Röntgen rays, which are continued, and the further results reported. Cultures of the cholera spirillum, the colon bacillus, and the bacillus prodigiosus in Petri dishes were exposed to the action of the rays for from twenty to thirty minutes, after which time it was shown that many of the organisms were killed, and multiplication ceased in nearly all. Animal experimentation, however, has shown that these activities are not as apparent in man, and it is even questioned whether the effects of the X-rays on lupus is a result of anti-bacterial activity.—*Münchener med. Wochenschrift*, 1902, No. 10, p. 402.

Intestinal Disinfection.—M. H. GORDON has been experimenting with izal oil. The practical difficulties in the way of causing sufficiently strong solutions of disinfectants to reach the bowel are such that not many have faith in any which from time to time are presented. This oil is, unfortunately, a proprietary article, recently discovered in investigation of the by-products during the conversion of coal into coke; it has a boiling-point, is insoluble

in water, and is sold in three main preparations: (1) pure izal oil; (2) an emulsion of 40 per cent., called medical izal; and (3) an emulsion of the same strength, but not refined for medical purposes. The experiment was made by adding it in known quantity to a definite weight of fecal matter, seeking to cover the following points: (1) the total number of micro-organisms present in agar plates after twenty-four hours' incubation at 98.6° F.; (2) in gelatin plates after forty-eight hours at 71.6° F.; (3) the degree of fermentation shown by gas bubbles in series of gelatin shake-cultures, inoculated with successive tenths of feces, namely, 0.02 up to 0.000,000,002 during four days at 71.6° F.; (4) the extent of growth in broth-cultures, also inoculated in the same way at 98.6° F. during five days; (5) the growth of bacillus coli in broth after forty-eight hours at 98.6° F. In the first experiment the virulence of the feces, as shown by the virulence of the growth in broth after forty-eight hours at 98.6° F., was also determined before and after taking izal. His conclusions are from laboratory and clinical experiments that the ingestion of izal oil in doses without unfavorable symptoms diminished the number of micro organisms in the feces to a very striking extent. Whether or not, in a long clinical application, it will be serviceable remains to be seen; but the first indications are that it is more active than most of the substances proposed for this purpose.—*Lancet*, 1902, No. 4097, p. 656.

Treatment of Chronic Malarial Fever by Quinine Hydrobromate.—Dr. G. B. Ferguson was led to use quinine hypodermically after several disappointments by stomach and rectal application. After experimenting with the different quinine salts he adopted the hydrobromate as being comparatively soluble in small amounts of water (1 : 6), and causing little or no pain following the injections. The mode of treatment, he frankly says, is not new, but has proved so efficient in obstinate cases of malaria that it is worthy of adding to the evidence now accumulating. The efficiency of the treatment is at times marvellous, and it will often cure malarial joints and malarial rheumatism. The author injects 3 grains of quinine hydrobromate dissolved in 20 minims of water into the thigh or fleshy part of the arm. Sterile water and an aseptic syringe are essential. None of the patients under treatment has needed more than six injections and in most three have been sufficient. The maximum effect of the alkaloid seems to be reached in about a half-hour after the injection, which the author believes is best given two or three hours before the expected paroxysm.—*British Medical Journal*, 1902, No. 2147, p. 439.

New Specific for Malarial Infections.—Dr. Armand Gautier has recently made some investigations with the newer organic preparations of arsenic, the cacodylates, on malaria-infected individuals. The use of arsenic in the treatment of malaria has been in vogue for many years, but its uncertain effects have made the physician rely more and more upon quinine and its salts for the actual poisoning of the parasite, and arsenic has come to occupy the position of an adjuvant to the treatment more directly applicable for the secondary anæmia which follows malarial infection. He has found, however, that in the form of the cacodylates the parasites themselves can be attacked and the patient cured. He has utilized the disodium methyl arsenate, which

has been found to be non-toxic in 1 gramme—20 kilos of animal weight. This new cacodylate salt, as he terms it, has very marked properties. In nine cases of acute severe malaria observed in Constantine, Africa, by Billet, to whom Gautier had sent the drug, hypodermic injections of from 1 to 2 grains have been absorbed very rapidly without pain or other disturbance. The effect on the patients who had been very refractory to quinine was marked. They were cured with great rapidity. Details of the cases are given.—*Les Nouveaux Remèdies*, 1902, vol. xviii. p. 73.

Pneumonia and Suprarenal Therapy.—Dr. Ethan Allen Gray contributes a suggestive article on the use of suprarenal substance in the treatment of pneumonia. He cites reports of six patients, in some of which he believes he has obtained a reaction suggestive of the abortion of pneumonia. The powerful vasomotor stimulation is cited as an essential element in the action. Three grains of suprarenal capsule are given every two or three hours.—*Medical Record*, 1902, vol. lxi. p. 527.

Treatment of Pneumonia.—Dr. S. S. Burt, in a thoroughly Nihilistic paper on the treatment of pneumonia, concludes that inasmuch as this disease is a short self-limited infection, that little should be done for it. Since high temperatures inhibit the growth of the diplococcus pneumonia, high temperature is, he holds, beneficial. Specific medication is unnecessary if not pernicious. It is imperative to disinfect the dejecta and expectoration; aconite and its congeners are injurious; opium, checking renal activity, in large doses is contraindicated; in old persons opium is exceedingly dangerous; oxygen is useful, but not indispensable: alcohol is valuable as a food, and it conserves energy; strychnine, ammonia, alcohol, and nitroglycerin in large doses, as stimulants, should be reserved for emergencies; subcutaneous infusion of physiological salt solution is invaluable for renal elimination of poisonous accumulations; last, though not least, specific remedies at best are but makeshifts; prevention of the infection is the *desideratum*.—*Medical Record*, 1902, vol. lxi. p. 647.

[Recent literature upon the creasote-therapy of this disease seems to indicate that one *desideratum* has been found.—R. W. W.]

Dionin in Respiratory Affections.—Dr. A. Scherer makes a plea for this morphine derivative in the treatment of bronchitis, tuberculosis, asthma, laryngitis, and other affections of the respiratory passages. As it is well known, its action, like that of the other morphine derivatives, depends upon the morphine base, but it is more advantageous to use, since there is less stomachic disturbance, less constipation and less euphoria, which latter makes morphine so sedative.—*Therapeutische Monatshefte*, 1902, vol. xvi. p. 126.

A New Organic Form of Arsenic.—Dr. Armand Gautier submits an account of a new arsenic cacodylate having, as he claimed, very marked curative properties. This new compound, disodicmethylarsenate, as CH_3. $O_3Na_2.2H_2O$, is formed by the action of methyl iodide on sodium arsenate in the presence of an excess of alkali. It forms in colorless crystals, is

soluble in water, slightly so in alcohol, alkaline to taste and in reaction, non-hygroscopic, efflorescent. It represents 45 per cent. by weight of arsenic. Notwithstanding this large proportion of arsenic it can be given in doses of 3 grains without poisonous symptoms. Its therapeutic dose is between ½ to 1½ grain daily. It may be taken indifferently by mouth or by means of the hypodermic needle. Gautier finds much the same indications for the use of this new salt, termed by him *arrhenal*, as for the cacodylates.—*Les Nouveaux Remèdies*, 1902, vol. xviii. p. 97.

Organotherapy in Pancreatic Disease.—Dr. H. Salmon reports *in extenso* the histories of two patients with pancreatic disease in which there were marked fatty stools (steatorrhœa) and distinct azotorrhœa—increased nitrogen elimination. In their treatment he made use of a newer preparation of the pancreas, pankreon, which had a marked salutary effect on the general metabolism and a distinctly curative effect on the fatty indigestion.—*Berliner klin. Wochenschrift*, 1902, vol. xxix. p. 120.

Bromocoll in Epilepsy.—Drs. Reich and Ehrke detail the disadvantages that are incident to the use of bromides in the treatment of epilepsy and take up the study of some of the newer organic combinations of bromide, bromipin, bromalin, and a new claimant, bromocoll, a combination of bromine, tannin and gelatin which contains about 21 per cent. of bromine. It has been shown that this combination passes into the intestines unaffected, but in the presence of an alkaline medium is broken down and liberates the bromine in some non-irritating form. The bromine is ultimately eliminated in the urine. The results of the author's experimentation tend to show that the action of this compound on the motor ganglion cells is similar to that of inorganic bromides. He found that as far as male epileptics was concerned the action of bromocoll was as marked as that of potassium bromide, but was not more active; that the remedy could be taken in large doses without disturbing the digestion, that the bromide acne appeared only when large doses were given and only in susceptible individuals, and, moreover, the eruption when it did appear healed very readily. The authors conclude that in bromocoll a good preparation has been obtained which, because of its cheap price compared with other organic bromides, should be tried in patients requiring bromide therapy.

The authors conclude as follows concerning the efficacy of bromocoll in epileptic conditions: (1) The drug approximately equals in strength potassium bromide; (2) it is pleasant to take even in large doses; (3) gastric and intestinal disturbances do not occur; (4) acne is seen only exceptionally after large quantities, and then is slight and shows a tendency to heal; (5) nervous symptoms also are rare. It is therefore indicated to try it where the bromides are not well stood, and its relatively cheap price should aid in its rapid introduction.—*Therapeutische Monatshefte*, 1902, No. 2, p. 75.

On Urinary Antiseptics.—Dr. R. Stern has shown by a series of bacteriological tests the comparative bactericidal power of a number of the older

and newer remedies. In doses of from 45 to 60 grains a day both urotropin and salicylic acid have a marked bactericidal power. They not only hinder the development of the ordinary micro-organisms, but kill them as well. Salol, camphoric acid, methylene blue, oleum santali and oleum terebinthinæ prevent the development of bacteria, but only in very large and continued dosage. Balsam of copaiba, boric acid, potassium chlorate, and uva ursi were without any action on bacteria. The author brought out the interesting feature that the administration of urotropin or salicylic acid was of great value just preceding instrumentation of any kind. In the deep seated bacterial infections, such as occur in tuberculosis, etc., the urinary bactericidal agents are of very secondary value. The author maintains that the continuous use of urotropin in typhoid to disinfect typhoid stools is unadvisable, inasmuch as large doses used over considerable intervals of time can give rise to marked if not serious kidney irritation.—*Allegemeine med. Central Zeitung*, 1902, vol. lxxi. p. 1.

[The dose of urotropin as above given is decidedly larger than is considered to be necessary.—R. W. W.]

Forman and its Applications.—Dr. H. Suchannek speaks of the limitations in the use of this new formaldehyde-containing compound, and recommends its use in the early days of an acute nasal or laryngeal catarrh in order to both render the attack milder and shorter.—*Fortschritte der Medicin*, 1902, vol. xx. p. 92.

Chronic Bright's Disease and its Surgical Treatment.—Dr. George M. Edebohls gives a complete *résumé* of the question of priority of the first advocate of the surgical treatment of chronic Bright's disease. The article is of value from the bibliographical stand-point.—*Medical Record*, 1902, vol. lxi. p. 651.

Reduction of Sodium Nitrate in the Animal Body.—Drs. C. Binz and P. Gerlinger have again gone over this entire subject. Experiments which show that sodium nitrate can act as a poison, owing to its conversion into nitrite in the animal body, have all been conducted with the relatively non-delicate iodine reaction. In the new experiments a mixture of *α*-naphthylamin and sulphanilic acid to test the excretions, especially the urine, was used. The quantitative estimates were made by pouring the urine into a concentrated solution of ammonium chloride, passing carbonic acid gas through the mixture and then decomposing by heating. The liberated nitrogen is then read off in a suitable azotometer and the amount of nitrite calculated from this. In all the animals tested appreciable amounts of nitrites were found in the urine, and the presence of methæmaglobin in the blood was manifest by its brown color and the grayish tinge of the mucous membranes. The experiments are interesting not only from a toxicological point of view, but also in that they prove that a true reduction may go on in the body. Owing to the small therapeutic doses, little need be feared from this process in man.—*Archives Internationales et Pharmacodynamie et de Therapie*, 1902, vol. ix., fasc. 5 and 6, p. 441.

GYNECOLOGY.

UNDER THE CHARGE OF

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ASSISTED BY

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Leucocytosis in Pelvic Suppuration. — DUTZMANN (*Centralblatt für Gynäkologie*, 1902, No. 14), from observations in forty cases of pelvic disease, arrived at the conclusion that hyperleucocytosis is of great value as a diagnostic sign. In several cases the presence of pus was established in the absence of the usual symptoms. In one instance, with 16,000 white cells to the cubic millimetre, the temperature was actually subnormal. On exploring the uterus and evacuating pus the number fell to 6800. In another, in which the count was 17,800, with a low temperature, the diagnosis of fibroma or hæmatocele was made, and laparotomy was about to be performed, when an abscess ruptured into the rectum, the number of leucocytes dropping to 8300. Again, the writer found no increase in the leucocytes in cases diagnosed as salpingitis and mural abscess, his opinion being invariably confirmed by operation. Another interesting fact was the hyperleucocytosis observed in cases in which abscesses had been imperfectly drained.

Degeneration of Uterine Fibroids.—CULLINGWORTH (*Journal of Obstetrics and Gynecology of the British Empire*, 1902, No. 1) reports 100 cases of operations for uterine fibromyomata, in 52 of which the specimens showed more or less evidence of degenerative changes. Of these 27 were myomatous, 5 fibrocystic, 18 necrotic, 1 sarcomatous, and 1 calcareous.

The writer lays especial stress upon the age of the patient, myxomatous degeneration being most common between forty-two and fifty-two, while necrosis was noted in patients between thirty-six and forty-six years of age. Pain was a marked symptom in 38 cases, especially in connection with necrosis and cystic degeneration.

Peritoneal Adhesions.—KATOUNSKY (*Wratsch*, 1901, No. 29) calls attention to a class of cases in which a broad ribbon-like adhesion extends from the sigmoid flexure to the parietal peritoneum. The cause of this condition has not been explained, though Gersuny has attributed it to traumatism, or to the escape of blood into the peritoneal cavity during menstruation. The symptoms are somewhat vague, such as pain in the hypogastrium, dyspareunia, and obstinate constipation. Pain is experienced on palpation over McBurney's point and over the sigmoid. There is tenderness on vaginal palpation, even when the pelvic organs are normal. The writer admits that a positive diagnosis cannot be made.

Castration for Uterine Fibroids.—KAKOUSHKINE (*La Gynécologie*, February, 1902) reports 105 operations by Russian surgeons. The tumors were nearly all of large size. The mortality was 6.6 per cent., as compared with 9 per cent. in 300 cases reported by Zavarikine and 8.5 per cent. in 900 cases by Olshausen.

In the writer's cases the tumor diminished in size in 72 per cent., remained stationary in 25 per cent., and increased in 3 per cent Pain was relieved in 40 per cent., diminished in 35 per cent., and was not relieved in 25 per cent. He is opposed to the operation.

Formalin as an Intra-uterine Application.—MENGE (*Centralblatt für Gynäkologie*, 1902, No. 13) calls attention to the superior excellence of formalin as an escharotic as compared with chloride of zinc. He employs both the pure drug and the 50 per cent. solution. It is especially valuable in cases of endometritis following abortion and labor at term, a single application often being sufficient to stop hemorrhage and foul discharges. The writer is strongly opposed to intra-uterine injections of caustic solutions.

Vaginal versus Abdominal Myomectomy.—MARTIN (*Centralblatt für Gynäkologie*, 1902, No. 14) emphasizes the fact that since the indications for myomectomy have been so much extended it is important to select a method of operation which gives the best remote as well as immediate results. He is strongly in favor of the vaginal route. The size of the tumor is not in itself a contraindication, since growths of large size can readily be removed per vaginam by morcellation. On the other hand, in the presence of firm suprapelvic adhesions, especially intestinal, the abdominal route is preferable; but deep pelvic adhesions and intraligamentary tumors are best handled from below.

The writer fears injuries to the bladder and ureter more than he does hemorrhage, especially the former. He has never injured the ureters during vaginal myomectomy, though this accident has frequently occurred in his abdominal operations. When it is possible he enucleates tumors without removing the uterus. In young women he tries to leave one ovary. The writer reports the results of his work during three years at the Greifswald clinic—87 vaginal and 31 abdominal myomectomies. The latter were all complicated, and 6 terminated fatally. Of the vaginal operations 35 were total hysterectomies, with no deaths, and 52 were enucleations, with 2 deaths.

Transverse Abdominal Incision.—FELLENBERG (*Centralblatt für Gynäkologie*, 1902, No. 15) reports 70 cases in which Küstner's transverse crescentic incision was made through the skin. The advantages are not only cosmetic, but by opposing a superficial transverse to a deep vertical incision there is less danger of hernia. It is used only in cases in which a small wound is necessary and pelvic drainage is not required.

The disadvantages of this method are the necessity of dissecting off the skin and adipose layer from the subjacent fascia over a considerable area, and the consequent impairment of the chances of primary union. In fact, it occurred in only two-thirds of the cases. Drainage of the skin wound is recommended.

OBSTETRICS.

UNDER THE CHARGE OF

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Complete Rupture of the Uterus, followed by Total Abdominal Extirpation.—AMANN (*Centralblatt für Gynäkologie*, 1902, No. 5) reports the case of a woman in her fifth labor on whom attempts at version had been made to deliver a child in transverse presentation. A second version had proved successful, but the physician at the time had diagnosed rupture of the uterus and had introduced a tampon of gauze.

When the patient was brought to the hospital she was exceedingly pale and with a very rapid and frequent pulse. Transfusion was at once administered and the abdomen opened. An extensive and complete laceration of the uterus was found, filled with the gauze packing and also with several loops of intestine. The rupture had occurred near the peritoneal fold covering the bladder, extending upward upon the right side and practically tearing away the uterus at its cervical junction at the anterior vaginal wall. The round ligament on the right side was torn asunder, but did not bleed. The tear in the peritoneum extended upward on the right above the broad ligament and beneath the cæcum, so that the bowel was loosened from its peritoneal attachment. The bladder was entirely separated from its peritoneal attachment to the uterus. There was blood in the abdominal cavity and meconium in the vicinity of the liver. Total extirpation of the uterus was at once performed, the peritoneal edges being united as completely as possible and a gauze drain placed in the vagina. The patient was freely stimulated. On the following day urine escaped through the vagina, but this terminated on the fifteenth day. On the eighteenth day the patient was discharged convalescent, having not had an abnormal temperature.

Amann has collected statistical information upon the subject, and finds that in cases where the uterus has been ruptured with wounds of the bladder, out of fifteen collected by Klien but two recovered. In complete lacerations, the closure of the lacerated womb gave a mortality of 53 per cent. When the child was removed through the vagina and the uterus then closed, the mortality was 47 per cent. Supravaginal amputation of the ruptured uterus gave a mortality ranging from 45 to 42 per cent. The entire removal of the ruptured uterus through the abdomen had been performed thirteen times, with seven deaths. Of late years the vaginal extirpation of the ruptured uterus has been urged as the best method of operation. Of nine cases collected by the writer six perished, but this mortality must be considered as excessive.

Those cases treated without operation, but by drainage by gauze, show a considerable percentage of recovery. In 198 cases of rupture treated with-

out operation 48 per cent. recovered and 52 per cent died; 42 of these cases were treated by drainage with gauze or with the drainage-tube, and, of these 42, 35 recovered, or 83 per cent.

It seems evident that the result of rupture of the uterus depends more upon the circumstances of the case and the extent of the rupture than upon the method of treatment. Where the rupture is complete the mortality is high under any form of treatment. Where the rupture is incomplete and but a small portion of the fœtus, if any, escapes into the abdominal cavity, the treatment by drainage with gauze gives the best results yet obtained. It is worthy of note that what is called "secondary operation" through the abdomen gives a better result than primary operation. By the term "secondary" is meant the fact that the operator removes the child through the vagina before opening the abdomen to care for the uterus. Whenever possible, the vaginal removal of the child and appendages lessens slightly the mortality for the mother.

The Duration of Pregnancy.—In the *Centralblatt für Gynäkologie*, No. 2, 1902, SCHULTZE criticises the ordinary nomenclature describing the length of pregnancy. The 280 days comprising the ordinary pregnancy are usually divided into ten periods, and these are called months. This, however, is incorrect, for the term month refers to changes of the moon, and ten lunar months comprise 295 or 296 days. If this usage be referred to Hypocrates, it is again incorrect, for he divided pregnancy into four decades or seven periods of forty days each.

The better nomenclature is that which considers the period of pregnancy as composed of ten periods during which the regular menstruation is missed. In this manner the patient is not misled in counting the time of confinement, and confusion is avoided. Schultze calls attention to the fact that in his text-book for midwives this usage is successful, and that he has always recommended it with approbation in various papers and articles upon the subject.

A Case of Sympus or Mermaid.—In the *Maryland Medical Journal*, January, 1902, STOKES and MCNEER describe the case of an unusual monstrosity, the mother, a white woman, having other healthy children. This monster was born at eight months' gestation, the birth being normal in character. The lower limbs were fused together; there was no true pelvis present, the pelvic bones being a solid platform at the extreme lower end of the abdomen. The sigmoid flexure of the colon ended in a large blind pouch. There was no trace of the rectum and no attempt of the alimentary canal to open externally. There was no bladder, but a small, firm, round body, about the size of a pea, resembling a prostate gland. No sexual organs of any kind could be discovered. The ureters ran downward and slightly forward on each side, emptying into the blind pouch in the pelvis at its lower portion.

Total Inversion of the Uterus.—AMANN (*Monatsschrift für Geburtshülfe Gynäkologie*, 1902, Band XV., Heft 1) reports the case of a patient greatly emaciated who complained of total prolapse of the uterus which had been

present for some years. For the last two weeks the prolapsed mass had been increasing in size. The patient had bled excessively and had become much emaciated. There had been fever and pain in the prolapsed tissue. Upon examination a completely prolapsed uterus, to which was attached a fibroid tumor, was found. The mass was removed by vaginal section and the stump stitched into one angle of the wound, and the bladder peritoneum untied to the tissues of the anterior vaginal wall. A drain of iodoform gauze was inserted. The patient did well immediately after the operation, but finally succumbed to pyæmia.

Spurious Abortion.—In the *Medical Chronicle*, October, 1901, FOTHERGILL reports the case of a young woman who had already borne a child. She missed one menstrual period, and symptoms of early pregnancy were present. Inevitable abortion shortly afterward commenced, and the case was treated by tamponing the vagina with a strip of lint. The next morning the tampon was removed and a cast of the uterus was found to have been expelled. It was placed in formaldehyde solution and afterward examined. The patient made an uninterrupted recovery.

The study of the case showed it to be composed of typical decidual tissue. The uterine epithelium was unaltered on a considerable portion of its surface. The uterine glands were unaltered in the deep layer, but dilated and without their epithelium in the middle and superficial layers. There were numerous large decidual cells and spaces filled with fresh blood. No villi or chorionic epithelium were present. Upon examining the body expelled by a large number of sections, it was shown that it was a complete ovum, consisting of a sac of chorion only, and covered completely with chorionic villi. No amnion or germinal area was found. This case is an illustration of an early missed abortion in which the decidua went on growing for some time after the death of the ovum. The practical importance of the case depends upon its relation to the diagnosis of ectopic gestation.

When a decidual cast is passed without any portion of the ovum, the patient should be most thoroughly examined to detect a possible ectopic gestation.

Dystocia following Ventrofixation.—In view of the frequency with which ventrofixation is performed for the cure of retroversion, cases illustrating the permanent results of this operation are of value. BLOOMHARDT (*American Medicine*, January 11, 1902) reports three cases seen within three years in which dystocia occurred as the result of ventrosuspension of the womb. In the first case the patient was placed upon the table for the Cæsarean operation, and in cleansing the vagina the breech of the child was felt presenting. A macerated fœtus was shortly afterward delivered. Earlier in labor the cervix was drawn strongly backward and available with difficulty for examination. In the second case the cervix was high up, very small, and in a posterior position. No fœtal part could be reached through the vagina. Cœliohysterectomy was performed and a living child extracted. The mother recovered. In the third case a multipara was in labor for several days. Nothing could be discovered in a vaginal examination without anæsthesia. Under chloroform, by the insertion of the hand, a small cervix admitting one finger could be detected posteriorly and above the

pelvic brim. The cervix could not be brought down. The patient was greatly exhausted and cœliohysterectomy was performed. Mother and child died. The fundus was firmly adherent to the wall of the abdomen by dense adhesion, two inches long and one inch wide, just above the pubes. The silkworm-gut sutures were firmly embedded in the adhesion. The cervix was drawn out to a length of possibly five inches almost in the shape of a narrow cone.

A Remarkable Case of Puerperal Phlebitis.—In the *Gazette hebdomadaire de Médecine*, December 19, 1901, PINATELLE reports a remarkable case of puerperal phlebitis from the wards of the hospital at Lyons.

The patient was aged thirty-five, and gave a good family history and had had no previous disease. At twenty-two years of age she had a normal confinement at full term. Eight or nine days after this she developed a double phlebitis of both lower extremities. The tissues swelled rapidly and the swelling extended to the abdominal wall. There was no œdema of the lower limbs. For two months the patient had fever at evening, and for four months she remained in bed. At the end of six months she was able to walk. She had œdema between the malleoli, and three years afterward a varicose ulcer upon the internal aspect of the left leg. Since that time the patient had not been pregnant, nor had she been ill. She had, however, passed through two attacks of phlebitis. The first was eleven years after her confinement and obliged her to remain in the hospital three and a half months. She had fever much of this time. The pain and swelling were limited to the left side of the abdominal wall. The vessels appeared like cords of considerable size, reddened and very sensitive to the touch.

Two years after this attack she returned to the hospital with the following history: She had been seized with a sudden sense of oppression, had lost consciousness and had fallen. A fresh attack of phlebitis developed, localized in the right half of the abdomen along the borders of the ribs and toward the tip of the sternum. On entering the hospital the patient's temperature was subnormal and the phlebitis was ascending and had reached the internal mammary vessels of the right side. Enlarged veins could be traced upward from the brim of the pelvis, forming a complete chain. The patient suffered pain, with great variation, sometimes escaping suffering entirely. There was no derangement of motion or of the heart sounds; there was no œdema of the face or arms; the examination of the viscera was negative. Upon examining the abdomen the enlarged veins could be felt, but the abdomen was not distended. The heart was normal, the pulse 82; there was no sign of disease of the respiratory organs and the urine was normal. The patient menstruated irregularly and longer than normal, without much suffering, and had no symptoms of pelvic disease. She was neurotic to a considerable degree. The treatment consisted in making gentle pressure by bandages of thin flannel, rest in bed and attention to the functions of nutrition and excretion. Two months after admission the patient left the hospital considerably improved.

[This case lacks a very interesting and essential element in diagnosis—the examination of the blood. It can hardly be imagined that so extensive a condition of disease should not have been attended by an altered state of the blood.]

OPHTHALMOLOGY.

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Tuberculosis of the Cornea.—GREEFF (*Fortsch. d. Med.*, No. 22, 1901). While tuberculosis of the cornea does not occur so frequently as tuberculosis of the conjunctiva and uveal tract, late researches have shown that it is not so very rare. In 1879 Hænsell showed experimentally that the injection of tubercular matter into the cornea of the rabbit and guinea-pig caused an outbreak of tubercles. He, however, doubted the occurrence of primary tuberculosis of the cornea. It is now certain that this occurs, although it is much more frequent as a secondary process following primary tuberculosis of the uveal tract.

The clinical picture of tubercular disease of the cornea shows great variations. In some cases a typical parenchymatous keratitis occurs. In such cases the primary tubercular nodules are situated in the iris, and especially in the ligamentum pectinatum. According to Bach, the parenchymatous inflammation is caused by diffusion of the toxins of the bacilli within the corneal tissue. The original nodules in the ligamentum pectinatum may also extend into the cornea.

More frequently the affection takes the form of so-called sclerotizing keratitis. In such cases tubercular nodules very gradually penetrate into the deepest layers of the cornea.

In primary tuberculosis of the cornea the nodules arise in the sclero-corneal junction or in the most peripheral portion of the cornea itself. These nodules extend very gradually a little into the cornea, and heal with obliteration of the corneal margin in loco eruptionis, or leave a tongue-like, grayish-white opacity extending into the cornea.

Ulcerations of the cornea are also occasionally tubercular. Such torpid richly vascular ulcers are most frequently found when lupus of the face extends to the cornea

It is noteworthy that tubercle bacilli grow with great difficulty in the tissue of the cornea, so that in undoubted cases of tuberculosis the bacilli can very rarely be found in the cornea itself. The evidence of a tubercular nature in these cases is only the histological examination, or Cohnheim's experiment, that is inoculation of a particle in the anterior chamber of a rabbit.

The Clinical and Anatomical Fundus Changes in a Case of Splenic Leukæmia.—Since Liebreich's first description of the retinal conditions in

three cases of leukæmia forty years ago the ophthalmoscopic findings in this disease have been quite numerously reported. The anatomical changes in the retina, on the other hand, have been rarely recorded, so that every such case histologically examined must be regarded as a not unimportant contribution, especially, if as in the case to be reported, besides confirming some points already known, changes not yet observed are brought to light.

Bondi (*Prag. med. Woch.*, No. 26, 1901) reports the ophthalmoscopic appearances and histological changes observed in a case of splenic leukæmia. Male, aged thirty-four years, entered the hospital February 6, 1893; death took place December of the same year. The patient had noticed in April, 1892, ten months before admission to the hospital, a firm, slowly increasing growth in the upper part of the abdomen on the left side. There was a dull pain, and in walking a feeling of fulness, frequent bleeding from the nose and gums. Examination of the internal organs showed enormous enlargement of the spleen, moderate dilatation of the heart, slight enlargement of the liver, especially of the right lobe. The blood-count gave a ratio of white to red cells as one to four, which afterward increased to one to three.

Ophthalmoscopical examinations were repeatedly made. Upon admission to the hospital the visual acuity in both eyes was normal. There were no subjective ocular symptoms. Pathological changes in the fundus began in the middle of May. These consisted of abnormal fulness of the veins and a small hemorrhage between the papilla and the macula. The visual acuity and field remained even yet entirely normal. May 28th there was great enlargement of all the retinal veins in both eyes and a small retinal hemorrhage in the right eye; no other abnormal findings. The color of the fundus was not changed from the normal. October 11th a change in the papillæ could be noted for the first time. The edges of both were indistinct, the right somewhat more so than the left. The veins were tortuous and enlarged; visual acuity in both eyes 6/18. November 5, papillæ pale, margins indistinct, veins enormously enlarged. November 17th, small, whitish-yellow spots scattered in a large radius about the papillæ, extending far into the periphery of the fundus, the veins being enormously enlarged and tortuous. The color of the fundus hardly changed; the large vessels were, however, somewhat paler than normal; visual acuity 6/36 (?) in both eyes. No decided change occurred in the ophthalmoscopical findings up to the time of death. The last examination was made fourteen days before death.

The autopsy showed leukæmia, swelling of the liver and spleen, leukæmic infiltration of the medulla of the bones, and multiple infarcts of the spleen.

Histological findings of the intra-ocular structures: Papillæ slightly swollen. It was, however, the retina which showed the most marked changes. Its enormously dilated vessels were filled to bursting with blood; in some it was hardly possible to find a single red corpuscle. Where a relatively large number of red blood cells existed the red cells occupied the centre and the leucocytes the peripheral portion of the vessel. The blood contents presented another important phenomenon—intravital coagulation. Some vessels of medium calibre in the equatorial region were entirely thrombosed. The perivascular lymph spaces were everywhere enlarged and often filled with leucocytes. Accumulations of pigment were also sparsely found

at some points. The infiltration of leucocytes was not confined to the perivascular lymph spaces; it extended into the nerve-fibre layer, and at some places penetrated as far as the inner granular layer.

There were also extravasations of blood into the retina. Like the leukæmic infiltrates, these were most common in the peripheral portions; although generally found near the vessels, they were occasionally seen at distant points. All the retinal layers were involved, the external layers especially. The hemorrhages were almost exclusively formed of well-preserved erythrocytes. The nerve fibres also showed degenerative changes, as did the remaining layers. At one point the retina was totally atrophic with deposit of pigment.

The choroid was intimately adherent to the sclera near the papilla. Its vessels, like those of the retina, were enormously dilated and filled to bursting, almost exclusively with leucocytes. Leukæmic infiltration into the choroid was entirely absent. The anterior section of the eyeball was entirely normal. The only change in the nerve and its sheaths outside of the over-filling of the vessels consisted of a certain amount of nuclear proliferation.

The ophthalmoscopical and anatomical findings in this case are partly in accordance with other cases of leukæmia previously observed. Certain other conditions emphasized by some observers are conspicuous from their absence. The yellowish or orange color of the fundus, which has passed into the text-books as characteristic of leukæmia, was not observed at any stage of the disease in this case. The enormous dilatation and tortuosity of the retinal veins, which constituted the most marked pathological change in the fundus, agrees with the testimony of observers in general. The arteries were not enlarged; so, likewise, the hemorrhages and yellowish-white spots in the retina are usual.

The preservation of the visual acuity is to be noted. The vision only became affected in the last two months of the disease—a fact quite explicable from the anatomical conditions.

Histologically, this case is unique in the extensive dilatation of the perivascular lymph spaces in all parts of the fundus, proliferation of the pigment, and thrombosis of the retinal veins. In other respects the anatomical changes agree with those previously found.

A true connection, as Liebreich first pointed out, exists between leukæmia and disease of the fundus. It is more than questionable, however, whether the process is an inflammatory one. It may be best to drop the term "retinitis." The point of departure of the disease is the vascular system of the retina, although inflammatory changes in the vessel walls cannot be shown to occur. Slowing of the blood-current, especially in the capillaries and veins, takes place in the peripheral vessels. This happens the more readily because the contents of the vessels are so largely made up of the sticky white blood cells; these adhere to the inner surface, and thus interfere with the proper circulation; thence follow dilatation of the veins, transudation first into the lymph spaces, then into the nerve fibres and ganglion layers, with destruction of those elements. The retinal hemorrhages, especially those in the macula lutea, contribute to lower the vision.

OTOLOGY.

UNDER THE CHARGE OF

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Experimental Studies concerning the Conduction of Sound in the Skull.—Hugo Frey (*Zeitschrift für Psychologie u. Physiologie der Sinnesorgane*, Band xxviii., Heft 1). How far bone conduction is a factor in hearing—*i. e.*, how great a part of the waves of sound in the air passes by means of the external auditory canal to the end apparatus of the acusticus, and how great a part, impinging on the surface of the skull, passes directly to the end apparatus, has long been a disputed question in the physiology of the ear. As a first step toward the solution of this question Frey has carried out some interesting experiments on the method of transmission of sound through bones. He has attempted to answer the following questions, leaving the solution of the above problem for later researches:

1. In what way is sound conducted in human bone tissue in general, and what influence has the structure of the bone upon conduction?

2. How does the conduction in macerated bone compare with that in fresh bone?

3. In what manner are waves of sound conducted in the bones of the skull; to what extent does this take place, and in what way?

4. How does this compare in a macerated skull with that in a fresh skull?

The method of investigation chosen is as follows: A tuning-fork with a handle fitted with a thread is screwed into the bone, and a microphone, which can be placed by means of a stylet upon any neighboring part of the bone, is used to conduct the sound to the ear of the observer. A stop-watch is used to determine the duration of the sound from the time the tuning-fork is set in vibration to the time when the sound ceases to be heard through the ear-piece of the microphone. To ensure an equal sounding of the tuning-fork a piece of shot is dropped from the same height in each experiment on the prongs of the tuning-fork. A mean of twelve results in each position of the microphone guards against subjective errors.

The first series of experiments is conducted on the human femur, the tuning-fork being screwed into the bone at the upper end between the neck and the great trochanter, so that the tuning-fork prolongs the long axis of the bone. A macerated femur, and then a fresh femur with adherent soft parts, is used. The following conclusions are derived from the experiments:

1. The femur conducts sound waves, which are brought to it directly and in its long axis, chiefly in its compact substance and in the long axis of the bone.

2. Taking the sound that comes to the microphone as a measure for the sound conduction, this takes place better sometimes through the compact bone and sometimes through the spongiosa. It is better in the compact compared with the spongy bone, according to the preponderance of the former.

3. This holds good for the fresh femur with soft parts adherent as well as for the macerated bone.

The conditions of sound conduction in the skull are next studied—first on a macerated and then on a fresh skull. The tuning-fork handle is in these experiments passed through the external auditory canal and screwed into the promontory wall of the middle ear, and the stylet of the microphone is placed at various points on the skull. Two tuning-forks of different pitch, and consequently giving off waves of different length, are used for greater exactness, but the results are relatively the same. The following results are obtained:

1. The direction which waves of sound conducted directly to the bones of the skull take is dependent on the density of the bone-substance.

2. When, therefore, waves of sound proceed from the hearing organ of one side they spread out over the whole skull, but they are conducted *especially* to the symmetrical point of the other side of the skull.

3. There exists, therefore, a conduction of sound from one ear to the other by bone. This may be carried by conduction through the bone alone without the chain of ossicles (Schalleitungskette) playing necessarily any essential part.

4. This is true of the macerated skull, and as well of the fresh skull with adherent soft parts. Frey believes that his experiments show that the peculiar construction of the bone in the vicinity of the ears (the pyramids consist of the hardest bone of the body) explains the conduction of sound from one ear to the other.

Two Physiological Reports Concerning Acoustics.—A. Lucae (*Archiv. f. Ohrenheilkunde*, Band liv., Heft 3 und 4). The first of these reports is concerned with the function of the membrane of the round window.

1. A hitherto unrecognized way in which the so-called artificial drum membrane acts. Lucae is here not concerned with the well-known action of the artificial drum membrane in cases of isolated stapes where the piece of cotton or rubber making the artificial drum membrane is placed directly on the head of the stapes, and where the improvement in hearing is, in the author's opinion, due to increase of intralabyrinthine pressure. He is concerned with the results which he has obtained by placing a wad of cotton on the promontory wall in cases of chronic middle-ear suppuration which have run their course, leaving a loss of drum membrane and absence of the malleus and incus. In a series of such cases, under observation for several years, Lucae has been struck by the improvement in hearing which has resulted when the wad of cotton rested upon the forward part of the promontory wall without touching either the stapes or round window. In some cases—those where the presence of the wad of cotton sets up a slight reaction with consequent thickening of the mucous membrane covering the promontory—the improvement in hearing was permanent even after the cotton was removed. The results in these cases can, according to the author, be explained in the following way: In these cases the waves of sound are conducted to the interior of the cochlea simultaneously through the promontory and the two windows, of which two latter probably only the round window plays any considerable part. In the cochlea, on account of this double conduction, the

two sets of waves come to interfere, and hence a lessened perception results. By means of the wad of cotton the conduction through the promontory wall is excluded, the interference no longer takes place, and, therefore, an improvement in hearing comes about.

2. A successful operation on the round window. The operation was performed on a woman forty-one years old, suffering from progressive deafness, with distressing subjective noises. The whispered voice was heard on the affected side 0.8 m. Drum membrane was relaxed. Lucae's hammer tuning-fork c^4 was heard $\frac{2}{5}\frac{2}{5}''$—. Since, notwithstanding treatment for one month with massage, no improvement resulted, the excision of the drum membrane and extraction of the malleus and incus were undertaken. No improvement followed this operation, and, accordingly, since the first operation showed that the round-window niche, which was easily accessible, was blocked by two exostoses arising from the borders of the niche and touching in the centre, wholly occluding it, a second operation was performed. The exostoses were removed by means of a small burr driven by an electric motor. There was no escape of labyrinthine fluid, which showed that the membrane of the round window was not punctured. The improvement in hearing after the operation was considerable (from 0.8 m. before the operation to 3 m. for the whispered voice about two months after the operation), and the distressing character of the subjective noises was lost. The same c^4 hammer-fork was heard after the operation 32″, an increase of 10″.

Lucae believes that a bony closure of the niche of the round window may be found in any age, even in children, and that in cases of so-called sclerosis the condition of the niche of the round window should be examined, and, when necessary, the above operation, which is quite free from danger, undertaken.

The second report concerns the vibrations of the drum membrane in the living ear, caused by tones, and is an extension of the author's work on the movements of the sound-conducting apparatus when the movement is caused by condensation and rarefaction of the air in the external auditory canal (*Archiv f. Ohrenheil.*, Band liii.). By means of the simultaneous conduction of the sound from two closed whistles of 128 d.v. and 133 d.v. by means of a T-rubber tube to a Siegle speculum, and so to the drum membrane, the latter will receive five beats in the second. By means of the stroboscope and looking through the Siegle speculum one can directly observe that the posterior-superior quadrant of the drum membrane, and that only, vibrates in sympathy with the five beats. Now, according to Helmholtz, beats can come about in an elastic body through sympathetic vibration only when both the tones which arouse the beat are near enough to pitch to the fundamental tone of the elastic body, so that the latter can be set in sympathetic vibration by both tones. It therefore follows that for deep tones the posterior-superior quadrant of the drum membrane is set in sympathetic vibration, and this agrees with the anatomical facts. For it is the posterior-superior quadrant of the drum membrane which is the most loosely stretched of any part, as is shown, for example, by the often-observed fact that in pathological retraction this part is frequently thrown into folds. Lucae promises further investigation with high tones.

DERMATOLOGY.

UNDER THE CHARGE OF

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Case of Gangrene in a Newborn Child.—E. B. Bronson (*Journal of Cutaneous and Genito-Urinary Diseases*, December, 1901) reports a case of superficial, dry, black gangrene occupying the cheek, ear, neck, chest, and hand, which he saw on the fourth day after birth. Immediately after birth it was observed that one side of the face looked black and crusted, and on being touched was "hard, like a board." No local causes for the gangrene could be discovered. The general condition of the child at birth was good, but two months later it was bad. About a week after birth the slough began to detach itself, and by the tenth day had entirely separated, leaving a healthy granulating surface, which within three weeks had entirely healed. Two months afterward the disfigurement was less than would have been expected. (A portrait showing the diseased areas accompanies the article).

The Effect of the Rontgen Ray upon the Skin in Normal and Diseased Conditions.—Scholtz (*Archiv f. Dermatologie und Syphilis*, Band lix., Heft 1, 2, 3), as the result of an experimental, histological, and clinical study of the effects of the Röntgen ray upon the skin in healthy and diseased conditions, concludes as follows: The Röntgen rays themselves are the only, or at least the essentially, active factor in producing the effects peculiar to them. Their effect upon the skin occurs not only at the point of their entrance, but also at the place of exit, and appears always only after some days, reaching its acme, as a rule, after some weeks. A bactericidal effect occurs only to an insignificant degree, and scarcely plays any rôle therapeutically. The rays affect preferably, or exclusively, the cell elements of the skin, which undergo a slow degeneration. This degeneration is manifest chiefly in the epithelial cells, and in a less degree in the cells of the glandular organs, of the vessels of the musculature, and of the connective tissue. The phenomena of this degeneration are of a manifold kind, affecting the nucleus as well as the cell-body. As soon as the degeneration of the cell elements has reached a certain degree phenomena of inflammatory reaction appear, as dilatation of the vessels, imbibition of serum by the tissues, and abundant emigration of white blood-corpuscles. The changes in the vessels probably have much to do with the further development and the slow healing of the ulcerations.

The author employed the Röntgen ray treatment in about two hundred cases of various forms of disease of the skin, with more or less favorable

results. In lupus vulgaris this method of treatment is preferable to the methods hitherto used, not only because it is painless and gives good cosmetic results, but because it is followed by definite cure. In cases of lupus erythematosus vigorously treated excellent cosmetic results were obtained, but recurrences took place after some months. In cases treated mildly for some months an apparent complete cure was obtained. In the treatment of diseases of the scalp and beard by this agent, the good results are chiefly due to its very excellent depilatory effect. In favus and trichophytosis its bactericidal effect is not to be taken into account. In sycosis and folliculitis barbæ, apart from its depilatory action, the ray seems to exert a favorable influence upon the tissues. In mild cases definite cure may follow its use, but in severe ones relapses occur with the return of the hair. In the various forms of acne the treatment was useful, but not more so than those formerly employed. In eczema favorable results were frequently obtained. In all the cases of psoriasis treated the Röntgen ray exerted a remarkable influence upon the eruption. In most patients an almost complete, and in some an absolute, disappearance of the disease took place in a comparatively short time; but relapses were not prevented. In a case of carcinoma of the nose no carcinomatous tissue could be demonstrated with the microscope after treatment for some weeks. The author concludes that this method of treatment is a very interesting and active one in diseases of the skin, and that with improvement in the technique still further advances will be made in its use.

The Treatment of Lupus Vulgaris with Permanganate of Potash.—Hallopeau and Fouquet (*Annales de Dermatologie et de Syphiligraphie*, 1902, No. 1), at a séance of the Société Française de Dermatologie et de Syphiligraphie, presented a patient with a severe and intractable lupus of the leg which had been treated by local applications of permanganate of potash and curettement. Compresses wet with a solution of the strength of 1 : 120 were constantly applied to the affected parts; under the influence of this application the rebellious ulcerations, which had resisted treatment for years, completely cicatrized and the vegetations disappeared. This application was well borne, although in a case of lupus of the face it produced a subacute dermatitis.

Brooke's Paste in Infectious and Inflammatory Diseases of the Skin.—Dreyer (*Dermatologische Zeitschrift*, Band ix., Heft 1), induced by the very favorable results obtained with it in sycosis, has employed the paste recommended by Brooke for various scrofulodermata in a number of other infectious and inflammatory affections of the skin with excellent effect. In five cases of sycosis thus treated results followed more quickly than with any other remedy, the eruption disappearing in from four to five weeks. In furunculosis the effect of the paste was so satisfactory that the author believes it can be employed to the exclusion of all other methods of treatment. The composition of the paste is as follows: Hydrarg. oleat., 28.0; vaselin. flav., 14.0; zinci oxid., amyli, āā 7.0; acid. salicyl., ichthyol, āā 1.0.—M.

A Case of Tuberculous Paronychia from Inoculation.—Dalous (*Annales de Dermatologie et de Syphiligraphie*, 1902, No. 3) reports a case of paronychia

resulting from inoculation. The patient, a medical student, having produced a slight excoriation in the nail furrow of the left ring-finger in cleaning his nails, performed an autopsy next day upon a tuberculous subject, and again scratched his finger in the same place upon a broken rib. Three weeks later a small paronychia occurred at the side of the nail, which was opened, giving exit to laudable pus. Under wet dressings the wound seemed to heal and the pain disappeared. Suddenly the redness reappeared, the epidermis was lifted up along the ungual furrow, and purulent oozing began. Microscopical examination of three whitish points observed in the nail-furrow at this time showed what were thought to be tubercle bacilli. The finger remained tender, and from time to time there was a slight serous oozing. Later the left epitrochlear gland became slightly enlarged; it was then decided that the affection was tuberculous, and the entire lesion was excised. The histological examination of the excised tissues established their tuberculous nature.

Granuloma Annulare.—CROCKER (*British Journal of Dermatology*, January, 1902), under the above title, reports six cases of an affection which he believes belongs to a special type of disease midway between the inflammations and the neoplasms. These cases were characterized clinically by the presence of nodules or papules, which developed slowly, with a tendency to form circles. Through slow involution the circles were broken up into crescents or gyrate patches. The lesions were violaceous red or quite pale. They were firm, some being slightly warty, others flat like lichen planus. They were distributed chiefly on the wrists, the backs of the hands and fingers, and on the neck. They were observed also on the head behind the ears, the upper part of the face, and on the lower extremity over the knee. They seemed to have a preference for the bony prominences, as the knuckles, the radial and ulnar extremities, etc. Microscopical examination of a papule showed that it was composed of a dense mass of cells situated between two hair follicles which were partially included within the cell mass. The horny layer was but little increased, but the prickle cell layer was greatly thickened. In the central portion the papillæ were obliterated, but not at the periphery, where they were broader than normal. A sweat-coil beneath the cell mass showed cell infiltration. Some of the hair follicles in the neighborhood of the papule showed a moderate amount of cellular exudate. Upon the whole, the structure of the papule appeared to be that of a granuloma.

Rheumatic Urticaria with Pigmentation.—BOSANQUET (*British Journal of Dermatology*, February, 1902) reports the case of a girl, eight years old, who had suffered from an eruption of three months' duration, which began as "large white lumps" upon the hands and arms, appearing later on the thighs and legs. The lesions appeared suddenly, and lasted about six hours, leaving dark bluish-black stains. There was slight itching and sometimes actual pain. The patient had had rheumatic pains in the limbs for some years, and the pains became worse during the eruption, the wrists, ankles, and knees swelling. The entire surface of both arms and legs was occupied by slightly raised, dull red patches from a quarter of an inch to an inch in diameter. In addition to these lesions were a few distinct urticarial wheals, and, espe-

cially on the legs, a large number of pigmented patches of varying shades of brown. Under treatment with salicylate of soda the eruption disappeared within a week. Upon the suspension of this remedy a fresh rheumatic attack followed, the knees and ankles being swollen, and urticarial and erythematous lesions appearing upon the extremities. With the resumption of the treatment all the symptoms again disappeared.

[This case seems to us to present the symptoms of erythema multiforme rather than urticaria—Eds.]

Frambœsia Tropica and Tinea Imbricata.—Koch (*Archiv f. Dermatologie und Syphilis*, Band lix., Heft 1), during a journey in the tropics, noted the great number of diseases of the skin prevalent in New Guinea and the neighboring island groups, and gives a brief account of the two most commonly met with, viz., frambœsia and tinea imbricata. He thinks it probable that the disease known in various parts of Africa as frambœsia is not the same affection which is thus named in the South Sea. The South Sea frambœsia is a contagious disease, and can be inoculated from one person to another. One attack confers immunity, and in the regions where the malady is indigenous it is almost exclusively an affection of childhood. The cases which Koch saw occurred in children from one to twelve years old. The legs, arms, the lower portion of the back, the buttocks, and in isolated cases the face and nape of the neck were covered with ulcerations, circular in shape, arranged in groups, and occasionally confluent. They varied in size from a hemp-seed to a five-mark piece, projected above the level of the surrounding skin and appeared like swollen granulations. The newest lesions resembled the pustules of variola, forming elevated nodules covered with epidermis and showing a decided umbilication. The largest nodules had always lost the epidermis, secreted a seropurulent fluid, and were covered with moist crusts, beneath which there was a cushion-like, granulating mass. Some of the largest resembled very closely flat condylomata, especially when they were situated in the region of the anus or the genitalia. Various stages of the lesions were present in one and the same child, the nodules not appearing simultaneously, but new ones arising from time to time until the patient's susceptibility is exhausted.

The duration of the disease is from some months to a year and more. When small children are severely attacked it may prove fatal. When it is introduced into an island where it has hitherto not occurred, adults as well as children are affected; but Koch never heard that Europeans were attacked by it. Concerning the cause of frambœsia, nothing reliable is known.

Tinea imbricata occurs chiefly in the South Sea Islands, and is due to a fungus akin to the trichophyton. Like ordinary ringworm, the disease occurs in circular patches, but, unlike the latter affection, it does not produce rings through healing of the centre of the patches. The diseased epidermis is covered with thin lamellæ which are arranged like the tiling of a roof, a feature which gives the affection its name. It is extraordinarily frequent in adults, almost every inhabitant of some of the villages being affected. The general health is not affected; but chronic swelling of the lymph glands, especially the inguinal and femoral glands, is very frequent.

HYGIENE AND PUBLIC HEALTH.

UNDER THE CHARGE OF

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Causation of Beriberi.—An epidemic of beriberi at Diego-Suarez, in 1900, which included 180 cases, with 37 deaths, was observed by DE SCHUTTELAER (*Archives de médecine militaire*, 1901, p. 470), to whom it appeared that he had to do with a disease of alimentary origin. In a prior epidemic at the same place the addition of an ounce of fat to the day's allowance of food was followed by a rapid disappearance of the trouble, but in this case the same treatment failed to have any effect. The complete elimination of rice from the diet, however, and the substitution of army bread and ordinary bread ended the difficulty, excepting in the case of a number of Chinese laborers, who continued the use of rice, which was old, decorticated, and changed from the normal. Fresh, unhulled rice is believed by him to have no influence in producing the disease. He recommends the disuse of rice and the administration of fat as preventives. [In 1898 A. G. Vorderman, of the Dutch Colonial Medical Service, started the rice theory with the announcement that those who eat white rice are more likely to be seized than those who eat the red sort, in which the pericarp is retained. Inquiry showed that in jails where white rice was used 27.90 per cent. of the inmates were seized, against 0.09 per cent. of those of jails where the red was served. Where both sorts were eaten the ratio was 2.40 per cent. Eijkman has reported an epidemic of polyneuritis in fowls fed on white rice; they recovered when red rice was given. F. Grimm has pointed out that Europeans in Japan are immune so long as they adhere to European diet, and that the disease disappeared from the Japanese Navy when the ration was reconstructed on European lines, and from the Japanese penal institutions after reform in diet and in the preparation of the same. Manson believes that the improvement in the navy could have been no more than a coincidence, and that other hygienic reforms introduced about the same time had a favorable influence. He cites an epidemic in Singapore jail which affected only the male prisoners, whose quarters were damp, while the women, whose quarters were dry, were untouched, in spite of the fact that their food and drink were the same. —C. H.]

Coincidence in the Appearance of Anopheles and of Malaria.—A. BILLET, of the French Army (*Comptes rendus de l'Académie des Sciences*, 1901), observed that the mosquitoes which were first to appear in the vicinity of Constantine toward the end of May, at which time there were no cases of malaria, were all of the genus Culex. Not even in the larval state did he find a single Anopheles. Toward the middle of June he began to find them,

however, and in a number which contained human blood he observed the sporocysts and the characteristic sporozoites of malaria. At about the same time cases of malaria began to present themselves at the hospital from the localities where the Anopheles had been found. [The question arises, If there were no antecedent cases, how did the Anopheles become infected? On this point the experience of the younger Manson, recently deceased, is of interest.

In September, 1900, he allowed himself to be bitten in London by infected mosquitoes brought from Italy, and had an attack of benign tertian. The presence of the parasites in his blood was demonstrated in the usual manner. Recovery under quinine was rapid, and he remained in his normal condition of health until May 30, 1901, when he began to be ill, and then had two paroxysms of tertian fever. Examination of the blood again demonstrated the malarial parasite.—C. H.]

Neutral Red as a Means of Detecting Bacillus Coli in Water.—Several investigators have found that media containing neutral red are changed in color to canary yellow by B. coli communis, but not by B. typhosus. The reaction was found to be constant in an investigation of a large number of races of the organism, but it was shown also that it is brought about by certain other bacteria, including B. tetani, B. œdematis maligni, B. anthracis symptomatici, and B. enteritidis. Most of the aërobic pathogenic bacteria were tested with negative results. In order to ascertain whether the reaction affords a rapid means of detecting B. coli in water and of estimating the number present, R. H. MAKGILL (*Journal of Hygiene*, October, 1901, p. 430) undertook a series of experiments, which led to the conclusion that a water producing a typical canary yellow in neutral red media within forty-eight hours in bouillon, and accompanied in glucose-agar by green fluorescence and gas formation, may be considered to contain B. coli. He found that B. tetani and B. œdematis maligni produce the same appearance as B. coli in glucose-agar, even when the surface of the medium is exposed to the air, but in the bouillon the anaërobes produce the reaction only when oxygen is excluded. B. mesentericus was found to change the red to a dull orange both in bouillon and in glucose-agar.

In bouillon a reaction could be obtained in every instance within twenty-four hours, even with dilutions containing from one to five organisms per cubic centimetres. In extreme dilutions the reaction did not extend to the surface of the fluid in twenty-four hours, and the lower portions had a more orange tint than when the organism was plentiful. With numerous bacilli present the reaction occurred within twelve hours.

W. G. SAVAGE (*Ibid.*, p. 437) finds that it is not a matter of indifference what strength of glucose and of neutral red is used, for if an excessive amount be added it may not be reduced. To determine whether if B. coli is present, it will always give the reaction, and whether it is the only organism which, under the conditions of the test will give the reaction, he instituted a series of experiments which led to the conclusion that, while a positive reaction is not absolutely diagnostic of B. coli, in the vast majority of cases it points to its presence; that while a negative reaction does not absolutely exclude the

organism, it makes its presence highly improbable ; that the test is very easy of application, and is of great value in the routine examination of water.

Growth of Bacteria through Porcelain Filters.—It is generally accepted that ordinary water bacteria can grow through the lacunar spaces of porcelain filters in a few days' time, but that the pathogenic species, which gain access through sewage contamination, cannot multiply, because of the absence of conditions essential to growth. Some observers have held that the chief obstacle is a lack of suitable nutrient material, and that the addition of broth will remove it. Contradictory results published by a number of investigators led Major W. H. Horrocks (*British Medical Journal*, June 15, 1901, p. 1471) to reinvestigate the subject, using Chamberland-Pasteur and Berkefeld candles. Broth, sterilized sewage, sterilized diluted sewage, sterilized ditch water, and sterilized drinking water, all inoculated with the bacillus of typhoid fever, were used in making the tests. With the Berkefeld candles the results were uniformly positive, the organisms appearing as early as the fifth day and at latest on the eleventh. The candles used were cleaned by brushing or by boiling, and then further tested. The one cleaned by brushing yielded the bacillus; the other, as was to be expected, did not. The same tests made with the Chamberland-Pasteur candles gave negative results in every case, even after three weeks. The difference in the two sets of results is attributed to the larger size of the lacunar spaces and to the consequently diminished immobilizing and devitalizing influences. The Pasteur filter, with proper care to prevent passage through flaws or imperfections, ought, therefore, to give perfect protection against water-borne typhoid, but the Berkefeld should be sterilized in boiling water at intervals of three days in order that the bacteria which have already penetrated shall be destroyed.

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PARATYPHOID FEVER; REPORT OF FOUR CASES; ANALYSIS OF ALL REPORTED CASES.

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During the fall of 1901 four cases of paratyphoid fever occurred in the medical wards of the Johns Hopkins Hospital, in Baltimore. In two of these cases a paratyphoid bacillus was isolated in pure culture from the blood, and in two the diagnosis was made upon the ability of the patients' sera to agglutinate Gwyn's "paracolon" bacillus and the organisms isolated from the other two cases. In all four cases the Widal reaction was negative. Gwyn's case, including the temperature chart, which has not been published, is again reported.

Dr. Gwyn's Case.—Louis S., white, male, aged twenty-eight years, carpenter; Baltimore. Admitted October 11, 1897, complaining of fever.

Family History. Unimportant.

Previous History. Unimportant; has been living in Baltimore for the past six years. No similar illness in the neighborhood.

Present Illness. Began September 17th, with sensation of cold, pain in the abdomen, fever and thirst. No epistaxis, bowels constipated the first week. Past two weeks had diarrhœa and continued pain in the abdomen. October 10th, had greenish, watery stool every fifteen to twenty minutes.

Examination. Pale, ill-looking man; eyes sunken, somewhat excited, and talkative. Tongue moist and coated, respiration labored. Breath sounds clear, tubular modification. Heart not enlarged. Sounds clear. Pulse rapid, low tension, dicrotic. Abdomen flat and natural looking. Recti muscles slightly tense. Respiratory movements principally in the epigastric region. General abdominal tender-

ness. Spleen not palpable. No rose-spots. Urine dark colored. Moderate amount of albumin. Abundant granular and hyaline casts. Diazo reaction. No leucocytosis.

October 12*th*. Few dark macular spots on the abdomen; no definite rose-spots. Few moist râles over the right back and axilla. Dark-green fluid stools; 2 c.c. to 3 c.c. of blood from vein in arm, divided among tubes and plates of agar-agar.

14*th*. Delirious most of the night. Spleen just palpable. Few rose-spots over the upper thorax. Thirty-five colonies developed on tubes and plates.

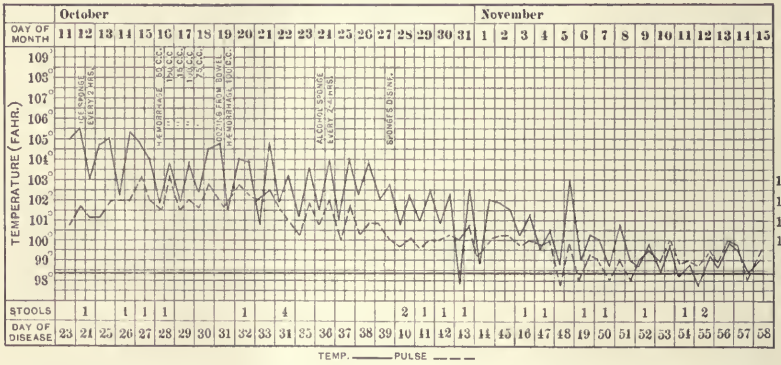
16*th* to 19*th*. Delirious at night. Six hemorrhages from the bowels, in all 500 c.c.

21*st* to 22*d*. Small subcutaneous hemorrhages on the upper right arm and over the left elbow.

November 1*st*. Stools still soft; no diarrhœa.

16*th*. Improving rapidly; left the hospital.

CHART 1.



CASE I.—Badach; Pole, male, aged twenty-eight years; laborer; Baltimore. Admitted September 11, 1901, complaining of headache, pain in the abdomen, and loss of appetite.

Family History. Unimportant.

Previous History. Unimportant. During August, 1901, worked at Curtis Bay, a low, poorly drained suburb of Baltimore.

Present Illness. Began in middle of August, with headache, epistaxis, nausea, abdominal pain, and general weakness. Stopped working during August. Worked during the first week of September; had diarrhœa on day before admission.

Examination. Well-nourished man, face flushed, and expression apathetic; tongue heavily coated, breath foul. Lungs clear on percussion, few fine râles in the right lower back. Heart not enlarged, sounds clear. Pulse slow, full, not dicrotic. Abdomen flat. Respiratory movements present. Spleen not palpable; numerous rose-spots. Urine deep orange color. No albumin, no casts; marked diazo reaction.

September 12*th*. Twelve c.c. of blood from vein in the arm divided among five Erlenmeyer flasks, each containing 150 c.c. of bouillon.

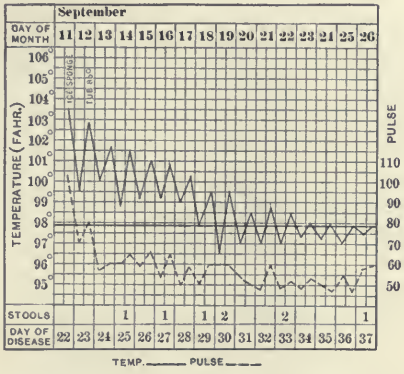
14*th*. Actively motile bacilli in one flask.

18*th*. General condition good. Tongue still heavily coated. Pulse dicrotic. Spleen not felt. Bowels constipated.

26*th*. No fever for three days. Tongue still coated.

October 4*th*. Patient up and about. Convalescence steady and uninterrupted.

CHART 2.



The organism isolated from the patient's blood failed to produce gas in the glucose agar then in the laboratory (possibly ordinary agar was used by mistake), and in spite of its slight agglutination with known typhoid sera, it was considered to be B. typhosus. Later, when its rapid agglutination with the serum of Case II. disclosed its identity, the patient had left the hospital and none of his serum could be obtained.

CASE II.—Milefsky, Russian, male, aged twenty-three years, laborer, Baltimore. Admitted September 23, 1901, complaining of headache, chills, and fever.

Family History. Unimportant.

Previous History. Unimportant. During August, 1901, worked at Curtis Bay.

Present Illness. Began September 17th, with headache, sensation of heat and cold, and loss of appetite. No nausea. September 19th, epistaxis. Slight diarrhœa, followed by constipation.

Examination. Thin, ill-looking man, face flushed and expression apathetic; tongue heavily coated. Lungs clear on auscultation and percussion. Heart not enlarged, sounds clear. Pulse slow, good volume, not dicrotic. Abdomen natural, respiratory movements present. Spleen not palpable. Few suspicious looking spots on abdomen. Urine dark yellow. No albumin, no casts. Diazo reaction.

September 25*th*. Twelve c.c. of blood from a vein of the arm divided among five Erlenmeyer flasks, each containing 150 c.c. of bouillon.

26*th*. Edge of spleen palpable and visible. Well-marked crop of rose-spots. Bowels constipated.

27*th*. Actively motile bacilli in one flask.

October 5*th*. Condition excellent. Spleen not felt. Fading rose-spots.

8*th*. Patient rapidly convalescing.

Case III.—Franklin, colored, female, aged twenty-three years, housewife, Baltimore. Admitted November 6, 1901, complaining of headache, pain in the back and in the abdomen.

Family History. Unimportant.

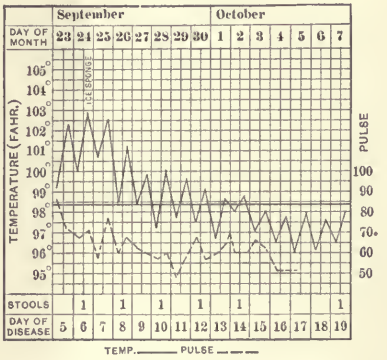
Previous History. Unimportant; has been living in Baltimore.

Present Illness. Began October 29th, with headache, severe pain in the abdomen, and general weakness. No nausea, no epistaxis. Slight diarrhœa. Since the afternoon of November 5th has been unable to void urine.

Examination. Patient dull and apathetic looking, speaks in a hoarse whisper. Tongue furred, breath foul. Lungs clear on auscultation and percussion. Heart not enlarged, sounds clear. Pulse rapid, small, easily compressed, not dicrotic. Abdomen slightly full and tender below umbilicus. Visible peristalsis. Spleen not palpable. No rose-spots visible.

Urine amber colored, a trace of albumin, no casts, marked diazo reaction. Leucocytes, 8000.

Chart 3.



November 8th. Six c.c. of blood from a vein of the arm divided among three Erlenmeyer flasks, each containing 150 c.c. of bouillon. Patient greatly excited during operation, suggesting slight delirium. Blood cultures negative.

11th. General condition good. Tongue slightly furred. Pulse small and rapid, not dicrotic. Leucocytes, 5300. Spleen not palpable. No visible rose-spots.

19th. Spleen just palpable. Leucocytes, 7300.

29th. Temperature still slightly elevated. General condition good. Tongue clear. Abdomen natural, no tenderness. Spleen not palpable.

December 12th. Sitting up, convalescence progressing uninterruptedly.

Case IV.—Ellison, white, male, aged twenty years ("tramp"). Admitted November 29, 1901, complaining of a bad cold and fever.

Family History. Unimportant.

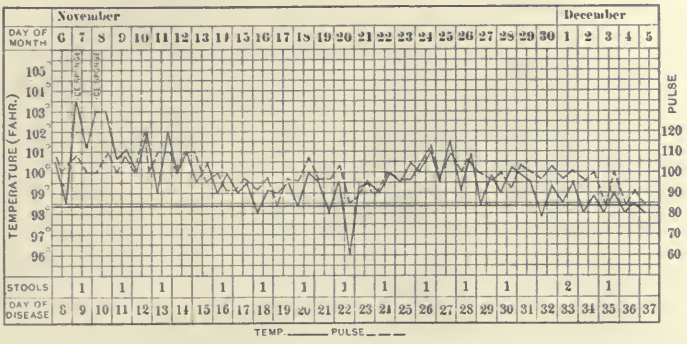
Previous History. Unimportant. For past four weeks has been tramping from Cleveland, Ohio, to Baltimore.

Present Illness. Began soon after setting out from Cleveland, with diarrhœa, five to six watery stools a day. No headache, nausea, epistaxis, or fever. Past two weeks had headache.

November 22*d*. Some fever, chilly sensation, and cough. General feeling of weakness and loss of appetite. Continuation of diarrhœa. No abdominal pain.

Examination. Well-nourished man. Face flushed. Expression dull. Tongue dry and coated. Lungs clear on auscultation and percussion. Area of cardiac flatness diminished. Soft systolic murmur

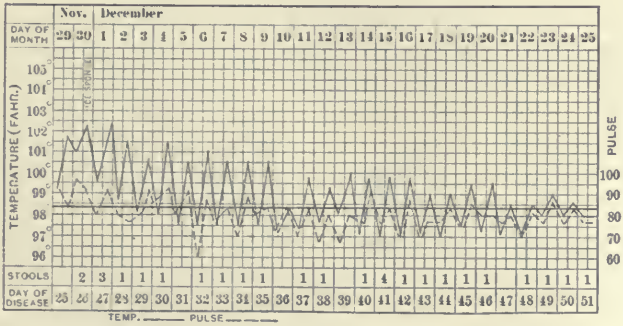
CHART 4.



at the apex. Pulse slightly accelerated, good volume, dicrotic. Abdomen natural. Respiratory movements present. No tenderness. Spleen readily palpable. Numerous rose-spots on abdomen and in flanks. Urine amber colored. No albumin, no casts, marked diazo reaction. Leucocytes, 5500.

December 3*d*. General condition good. Spleen still palpable. No fresh rose spots.

CHART 5.



17*th*. No rose-spots, spleen just palpable. Leucocytes, 8000.

5*th*. Patient sitting up in a wheeled chair. Spleen not palpable. Convalescence progressing uninterruptedly.

As this case was at first regarded as the end of a mild attack of typhoid fever, with, perhaps, a delayed Widal reaction, no blood cultures were made. Cultures from the urine were negative.

Bacteriology ("Milefsky" and "Badach").

1. Morphology, motility, and staining (no attempt made to stain flagella).

   Like B. typhosus.

2. Agar plates and slants.

   Like B. typhosus.

3. Gelatin stab.

   Like B. typhosus.

4. Potato.

   Like B. typhosus.

5. Bouillon flasks and tubes.

   Like B. typhosus; no surface pellicle.

6. Durham's medium.

   (*a*) "Milefsky;" trace of indol after seven days' incubation. Observed on one occasion only.

   (*b*) "Badach;" no indol.

7. Litmus milk.

   Like B. typhosus. The first generation of "Milefsky" produced a terminal alkalinity after three weeks' growth outside the thermostat. Not again observed.

8. Glucose agar.

   Like B. coli; large amount of gas after eight hours' incubation.

9. Fermentation tests.

   (*a*) 1 per cent. glucose bouillon; profuse gas production.

   (*b*) 1 per cent. lactose bouillon; no gas production.

   (*c*) 1 per cent. saccharose bouillon; no gas production.

Parallel cultures of Gwyn's "paracolon" bacillus proved the three to be identical. Cushing's Bacillus "O" differed only in the early alkalinization of the milk, a reaction once observed after seventy-two hours' incubation. When grown in 1900 by Cushing, Gwyn's bacillus produced a terminal alkalinity in from twelve to fourteen days. This reaction was not again noted. Cultures of all the other paratyphoid organisms that could be obtained were made, with special reference to their reaction in litmus milk, and it was found that in this regard they could roughly be divided into two groups.[1]

Group "A." No terminal alkalinity or a long-delayed reaction.

"Gwyn."

"Milefsky."

"Badach."

"Case VII." (Buxton, New York).

[1] Practically the same grouping is made by Brion and Kayser. The final clotting of the milk described by Kurth did not again take place.

" Noonan " (Hewlett, New York).
" Müller " (Schottmüller, Hamburg).
" Barg " (Schottmüller, Hamburg). Not cultivated by us.
" Brion and Kayser " (Strassburg). Not cultivated by us.
Group " B." Terminal alkalinity in one to two weeks.
" Bacillus O " (Cushing).
" Strong " (Philippine Islands).
" Kurth " (Bremen).
" Seeman " (Schottmüller, Hamburg).
" Krenzin " (Schottmüller, Hamburg). Not cultivated by us.
" Thot " (Schottmüller, Hamburg). Not cultivated by us.
" Köcher " (Schottmüller, Hamburg). Not cultivated by us.

Agglutination Tests.

In all tests the hanging-drop method was used. No reaction that at the end of one hour did not show large clumps and absolute cessation of motility was considered " positive." When the New York and European organisms were received, the Baltimore sera, which had been kept in sealed tubes, were two to four months old and had lost about one-half their agglutinative strength. A second series of tests was, therefore, made, and several new organisms which had meanwhile been obtained were introduced. Bacillus " O " and B. enteritidis were tested with the fresh sera, as were also several strains of B. coli; but as the results of both series were the same, they are, for the sake of simplicity, included with the weakened sera tests.

In addition to the failure of our sera to agglutinate B. typhosus, etc., tests with the organisms of Group " B " were also negative. This agrees almost exactly with the results of Schottmüller's agglutination tests. In his table the organisms " Muller " and " Barg," which belong to Group "A," were either not affected or very slightly affected by the sera of the five cases belonging to Group " B," while all the organisms of Group " B " showed a marked interagglutination with the sera of this latter group. On the other hand, however, the sera of the patients Müller and Seeman, Groups "A" and " B," respectively, agglutinated the organisms of both groups; Müller's serum in the same dilution for all, Seeman's serum in higher dilutions for the organisms of Group " B." This would seem to indicate that the separation of the organisms into two groups, which is admittedly based upon insufficient data, is in reality of little significance. It is made merely in the hope of rendering the agglutination tables more intelligible.

TABLE I.

Serum.	Organism.	Race and source of organism.		Dil.	Time.	Result.
	Paratyphoid bacilli.					
Milefsky, Case II.	(Group A),					
	Milefsky,	Isolated from blood during life.	Case II, Johns Hopkins Hospital	1 : 50	1 hr.	+
Franklin, Case III.	Badach,		Case I., Johns Hopkins Hospital.	1 : 50	1 hr.	+
	Gwyn.		Gwyn, Johns Hopkins Hospital.	1 : 50	1 hr.	+
Sera, 2 to 4 months old.	Case VII.,		Buxton, New York	1 : 26	1 hr.	+
	Noonan,		Hewlett, New York.	1 : 26	1 hr.	+
	Müller,		Schottmüller, Hamburg,	1 : 26	1 hr.	+
	(Group B),					
	Seemann,		Schottmüller, Hamburg.	1 : 26	1 hr.	—
	Bacillus "O"	Osteomyelitic abscess.	Cushing, Johns Hopkins Hospital.	1 : 26	1 hr.	—
	Strong,	Spleen, post-mortem.	Lt. Strong, Philippine Islands.	1 : 26	1 hr.	—
	Kurth,	Urine or feces.	Kurth, Bremen.	1 : 26	1 hr.	—
	Typhoid bacilli.					
	Jeeny,	Blood during initial fever.	Johns Hopkins Hospital.	1 : 26	1 hr.	—
	Murray,	Blood during relapse.	Johns Hopkins Hospital.	1 : 26	1 hr.	—
	16 a.	"Blue typhoid," turns milk alkaline in six days.	Pathological Laboratory, Johns Hopkins Hosp.	1 : 26	1 hr.	—
Sera, 2 to 4 months old.	B. enteritidis (Gaertner),	.....	Pathological Laboratory, Johns Hopkins Hosp.	1 : 26	1 hr.	—
	B. choleræ suis,	.....	Pathological Laboratory, Johns Hopkins Hosp.	1 : 26	1 hr.	—
	Colon bacilli.					
	Lisak,	Feces.	Johns Hopkins Hospital.	1 : 26	1 hr.	—
	Caplan,	Blood during life.	Johns Hopkins Hospital.	1 : 26	1 hr.	—

Until a careful comparative study of the morphology, cultural characteristics, and serum reactions of these paratyphoid bacilli is made, no definite conclusions as to their identity can be reached. That they all differ from B. typhosus, B. coli, and B. dysenteriæ is established. That they are closely related to that large group of organisms of which B. enteritidis, B. psittacosis, B. morbificans bovis, and the bacillus of hog cholera are examples, and yet differ from this group, the work of Widal, the accurate and careful descriptions of Cushing and Durham, and these later reports indicate. The work of Cushing and Durham demonstrates not only the delicacy of the lines dividing these groups of closely allied organisms, but the extreme precautions necessary in

TABLE II.

Serum.	Organism.	Dilution.	Time.	Result.
Ellison, Case IV.	Milefsky,	1 : 400	1 hour.	+
	Badach,	1 : 400	1 hour.	+
	Gwyn,	1 : 400	1 hour.	+
Serum, two months old	Case VII.,	1 : 200	1 hour.	+
	Noonan,	1 : 200	1 hour.	+
	Müller,	1 : 100	1 hour.	+
	Seemann,	1 : 26	1 hour.	—
	Bacillus "O,"	1 : 26	1 hour.	—
	Strong,	1 : 26	1 hour.	—
	Kurth,	1 : 26	1 hour.	—
Serum, two months old	Jecny,	1 : 50	1 hour.	—
	Murray,	1 : 50	1 hour.	—
	16 a,	1 : 50	1 hour.	—
	B. enteritidis,	1 : 26	1 hour.	—
	B. chol. suis,	1 : 26	1 hour.	—
	Lisak,	1 : 26	1 hour.	—
	Caplan,	1 : 26	1 hour.	—

TABLE III.

Serum.	Organism.	Dilution.	Time.	Result.
Lane. (B. typhosus isolated from blood and from urine.)	Milefsky,	1 : 26	1 hour.	—
	Badach,	1 : 26	1 hour.	—
	Gwyn,	1 : 26	1 hour.	—
	Case VII.,	1 : 26	1 hour.	—
	Noonan,	1 : 26	1 hour.	—
	Bacillus "O,"	1 : 26	1 hour.	—
Golden. (Typhoid fever with relapse.)	Strong,	1 : 26	1 hour.	—
	Kurth,	1 : 26	1 hour.	—
	Jecny,	1 : 100	1 hour.	+
	Murray,	1 : 50	1 hour.	+
	16 a,	1 : 100	1 hour.	+
	B. enteritidis,	1 : 26	1 hour.	—
	B. chol. suis,	1 : 26	1 hour.	—
	Lisak,	1 : 26	1 hour.	—
	Caplan,	1 : 26	1 hour.	—

establishing their characteristics, and our own observations have shown that in regard to the fermentation of saccharose, a point upon which the earlier observers differed, these precautions must be doubled. For this reason, as well as for those already stated, Bensaude's conclusions as to the identity of his "paratyphoid" bacilli with B. psittacosis can be disregarded.

The extensive comparative study of the organisms described by Shiga, Flexner, and Kruse as the cause of dysentery recently made by Vedder and Duval has proved that these three strains of bacilli, at first described by their several discoverers as possessing slight cultural differences, are identical not only with each other, but with the bacilli which they themselves isolated from dysenteric stools in this country. They very naturally conclude that sporadic, epidemic, and institutional dysentery, whether occurring in Japan, Germany, the Philippine Islands, or in the United States, is always due to the presence of one organism, the B. dysenteriæ of Shiga.

With this completed study as a guide, and in spite of the fact that all the paratyphoid organisms do not as yet appear to be absolutely identical, their very intimate relationship and the sameness of the clinical picture associated with their presence justifies us in considering these cases as a distinct group.

Analysis of Cases.

The association of a thyroid abscess with an attack of typhoid fever occurring twenty-three years previously appears so highly improbable that Widal's case must, for the present at least, be regarded as an isolated observation. There are, however, 26 cases of paratyphoid fever. Buxton and Coleman's case has not yet been published, and the early histories of 2 cases, Cushing's and Strong's, are incomplete, but the remaining cases have been reported in some detail.[1]

The disease has occurred in Paris, in three cities of Germany, in three cities of the United States, and in the Philippine Islands. It

[1] Buxton and Coleman's case, see the June number of this JOURNAL, occurred in a young colored woman, twenty-eight years old, admitted to the Bellevue Hospital, New York City, in October, 1901. It is described as a "mild attack of typhoid fever." The points of interest are: onset with chill, fever, and sweating; frequent attacks of vomiting; two attacks of epistaxis. A tendency to diarrhœa was followed by constipation. Palpable spleen, no visible rose-spots. Duration, seven weeks.

E. H. Hume reports a similar case from the Thompson Yates Laboratories in Liverpool (see vol. iv. Part II. of Laboratory Reports for 1902): Male, aged twenty-nine years, admitted to Liverpool Royal Infirmary in September, 1901. Duration of illness fifty-three days. Relapse: palpable spleen, rose-spots, severe diarrhœa, occasionally involuntary, beginning shortly after onset and continuing into convalescence. Stools mixed with blood; considerable hemorrhage from the bowel. Cystitis in fourth week of convalescence. Widal reaction negative. A paratyphoid(?) bacillus, Bacillus "L," which was agglutinated by the patient's serum, was isolated from the stools three weeks after the disappearance of the fever, and later in pure culture from the urine. Hume regards this bacillus as a member of the B. enteritidis group. It failed to turn milk alkaline after several weeks' incubation.

has appeared in every month of the year except in the months of December, January, and February, the larger number of cases, 21 in all, occurring from July to November inclusive. There have been nineteen males and six females, their ages ranging between seven months and sixty years, about three-fourths being young adults. The duration of the disease has been from twelve to eighty-four days; from twelve to eighteen days, 4 cases; from twenty to thirty-six days, 13 cases; from thirty-six to forty-six days, 5 cases; sixty days, 1 case; eighty-four days, 1 case. 14 cases may be considered as mild, 6 as moderately severe, and 5 cases, 2 of which proved fatal, as severe.

Except in the mild cases and in Gwyn's case the duration of the fever is little indication of the severity of the attack.

The twenty-two available temperature charts are those of mild, moderately severe, and severe typhoid fever. In the 2 cases observed at the onset the rise in temperature was rapid, preceded in one instance by two to three days of subnormal temperature, and the histories of 2 or 3 other cases indicate a like beginning. In one of the fatal cases the febrile paroxysm began with a distinct chill. The chart of Gwyn's case alone approaches that of classical typhoid fever, though in 2 other cases the continued high temperature was accompanied by slight or active delirium. Marked remissions, even in the first weeks of the disease, irregularities unassociated with the occurrence of complications, and in three instances a termination by crisis are especially noticeable. These peculiarities do not appear to have been associated with the severity of the attack, nor with the presence or absence of diarrhœa, and have not been distinctive of the cases belonging to either Group "A" or Group "B." Single relapses have occurred in 3 cases, and one instance of a second relapse is reported. The relapses have been of shorter duration than the initial fever, beginning in one instance with epistaxis, in one with a chill, and in three instances terminating by crisis.

Except in the severe cases the pulse was slow and regular, frequently showing toward the end of the disease a marked acceleration. Dicrotism was noted in 4 of the 12 cases in which the tension of the pulse was described.

Rose-spots varying in numbers from a few scattered over the chest or abdomen to an extensive exanthem involving the hands and face were present in 18 cases. In one instance, a child of seven months, their appearance was quickly followed by a scarlatiniform rash over the back and neck, and in one instance they were present in the first and second relapses only, disappearing in the afebrile period. Small subcutaneous hemorrhages were once noted, and once a slight pigmentation followed the disappearance of the rose rash.

The spleen was palpable in 15 cases, enlarged on percussion in 3, and not enlarged in 4 (2 of which were severe cases), and in 2 cases the condition of this organ was not examined. In only 1 case was the liver enlarged.

In a large majority of the cases the onset was gradual, with headache, weakness, loss of appetite, general malaise, slight bronchitis, and occasionally chilly sensations or abdominal pain. Vomiting occurred in 2 cases; epistaxis in 4 cases. In 10 cases, or 41 per cent., the illness began with diarrhœa, which in 1 case was for four weeks the only symptom, but in only 4 of these cases did the diarrhœa continue throughout the febrile period. Five additional cases, making a total of 62 per cent., had diarrhœa during some portion of the disease. In two instances the fluid stools were mixed with blood; 9 cases, or 37 per cent., were constipated throughout. Except for the fact that 4 of the 5 Bremen cases suffered from diarrhœa, this symptom does not appear to have been characteristic of the disease in any one locality, and it has occurred in mild and severe cases alike. Of the 2 fatal cases 1 suffered with bloody diarrhœa, the other with constipation. The abdominal distention and tenderness which were frequently present bore no definite relation to the condition of the stools.

Blood counts in 10 cases showed, except during the relapse of Hewlett's case, no leucocytosis.

Albumin was found in nine of the twenty-one urine examinations, being present in both the mild and severe types of the disease. Casts were observed but four times, twice in mild cases.

The course of the disease has been complicated by a purulent monarticular arthritis appearing on the thirteenth day, a myositis of the deltoid muscle occurring on the nineteenth day, a femoral phlebitis occurring on the twenty-fourth and fortieth days of the disease, and once with intestinal hemorrhages. Achard and Bensaude's diagnosis of pyelonephritis seems hardly justifiable, and it is much more probable that the pyuria in their case was due to a cystitis in the third week of the illness. Another case of cystitis beginning in the second week of a relapse is reported. Furuncles were present in one of the severe cases, and a small area of bronchopneumonia occurred once during a relapse. The costochondral osteomyelitic abscess developing during convalescence and the case of bacilluria twenty-one days after the disappearance of the fever were the only sequelæ.

The days of disease on which the specific bacillus has been isolated from the blood do not differ from those observed in typhoid blood cultures, but on account of the differences in the methods employed in this country and abroad it is difficult to compare the numbers of paratyphoid bacilli thus isolated with the numbers found in typhoid fever. Our experience here, however, indicates that in this respect the two dis-

eases are similar.[1] The date of the appearance of paratyphoid bacilli in the urine, their estimated numbers, and their occurrence in the rose-spots also agree with the results obtained in typhoid fever. The same can be said of the estimated numbers of paratyphoid bacilli in the stools, but we can find no record of the occurrence of B. typhosus six and seven days after the disappearance of fever.

The pathological anatomy of the disease, which is described by Longcope, is not here considered.

Kurth's 5 cases occurred during an extensive epidemic of typhoid fever, as did 6 of the cases of Schottmüller. Hewlett's bacillus "Noonan" was isolated in a similar series of 26 cases. Gwyn's case was the only one of 265 cases which failed to give a Widal reaction, and Cushing's case was the only instance of paratyphoid infection recognized at the Johns Hopkins Hospital during the season 1899 to 1900. From October, 1900, to the middle of March, 1902, 194 cases of typhoid fever were admitted to the medical wards of this hospital. In 85 of these blood cultures were made with positive findings in from 70 per cent. to 80 per cent. of the cases. During this time the serum of every case in which the Widal reaction and blood culture were negative was tested with Bacillus "O" and Gwyn's paracolon bacillus. The results, excepting the 4 cases just reported, were invariably negative. The serum of 1 such case, a typical case of typhoid fever, was repeatedly tested with all the paratyphoid organisms mentioned in the tables of agglutination. The results were always negative.

Both Kurth and Schottmüller state that they were unable to trace any definite source of infection nor to establish any close relationship between the cases of their separate series, and we must for the present abide by their statement.

Conclusions. 1. There is a type of disease due to infection with the paratyphoid bacilli which in all its variations presents a clinical picture identical with that frequently produced by infection with B. typhosus.

2. Diarrhœa and a termination of the fever by crisis are apparently of more frequent occurrence than in typhoid fever.

3. Myositis and purulent arthritis, rare complications in typhoid fever, have been recorded.

4. Though the disease may be severe it is usually mild, and fatal cases are rare.

5. Absence of intestinal ulceration may prove to be a distinctive feature of the disease.

[1] It is interesting to note that in Gwyn's case and in that described by Brion and Kayser the organism was isolated not by diluting the blood with a large quantity of melted agar or bouillon, a point of technique always necessary to success in typhoid blood cultures, but by spreading a few cubic centimetres of blood over the surface of agar tubes or plates

6. The disease, though wide-spread and occurring in localities where typhoid fever is present, is comparatively rare.

7. Every instance of negative Widal reaction is not due to infection with paratyphoid bacilli.

We are greatly indebted to Dr. B. H. Buxton, of the Cornell Medical School, for sending us his own organism and those which he obtained from Germany.

REPORT OF A CASE OF PARATYPHOID FEVER.

By Albion Walter Hewlett, M.D.,
of the New York Hospital.

Under the title "Infections Paratyphoïdiques," Achard and Bensaude[1] reported in 1896 two cases of continued fever, closely resembling typhoid fever, from which organisms were isolated, intermediate in character, between the typhoid and colon groups. The first case, a young woman, was admitted to the Beaujon Hospital, in Paris, with what at first appeared to be a mild attack of typhoid fever. Though the temperature remained elevated and typhoid in character for forty-six days, no rose-spots were visible, nor was the spleen greatly enlarged. She had no headache, delirium, abdominal distention, or tenderness, but throughout the febrile period there was profuse, often bloody diarrhœa. On the nineteenth day of the disease the left deltoid muscle became inflamed, and for five days the left arm was paralyzed. At this time a large amount of pus was observed in the urine. This persisted for forty-five days, or well into the period of convalescence. On the twenty-fourth day the right femoral vein became inflamed, and on the fortieth day a similar complication appeared on the left side. Throughout the disease there was no leucocytosis, and the Widal reaction was persistently negative.

From a catheterized specimen of urine they isolated an intermediate bacillus. Cultures from the blood were negative, and only B. coli was isolated from the stools. The patient's serum readily agglutinated the organism obtained from the urine, even several weeks after complete recovery. As the urine continued to show a trace of albumin some time after the disappearance of the pus the case was regarded as one of pyelonephritis.

The second case, also seen in Paris, was a child seven months old, who, in June, 1896, had an attack of bronchitis, accompanied by high fever. The few râles which were at first heard soon disappeared, but

[1] Bull. et Mém. de la Soc. Méd. des Hôpitaux de Paris, 1896, vol. xiii. p. 820.

the temperature remained elevated, terminating by lysis on the twentieth day. Throughout the illness the child was constipated, with meteorism and slight abdominal pain. A few days after the onset an extensive crop of rose-spots appeared on the abdomen and was quickly followed by a scarlatiniform rash over the back and neck. No eruption was visible upon the pharynx. On the thirteenth day of the disease a red, painful swelling was noticed over the right sternoclavicular articulation. The following day fluctuation was made out and an incision revealed a small amount of pus apparently originating in the joint. The cartilage and bone were normal, and the wound healed rapidly. Cultures from the pus showed an organism in every respect similar to the one isolated from the first case. No agglutination tests were made with the child's serum.

These bacilli were short rods, with rounded ends, possessing ten to twelve very fragile flagella, and were very actively motile. Their growth in bouillon, in gelatin, and in milk resembled that of B. typhosus. On potato it resembled B. coli. No indol was formed in Dunham's medium. They produced gas in the presence of glucose, but failed to ferment lactose. The sera of immunized animals agglutinated these two organisms, but had no effect upon B. typhosus and B. psittacosis. Their pathogenicity for laboratory animals was much less than that of B. psittacosis.

Achard and Bensaude concluded that their two cases were not similar to those described as due to infection with B. psittacosis, and pointed out the necessity of testing the sera of typhoid fever patients in whom the Widal reaction was absent with these newly discovered organisms. They also advanced the view that when a sufficient number of similar cases should be collected there would be found to exist a type of disease closely resembling typhoid fever, but possessing certain definite and distinguishing characteristics.

Shortly after this Bensaude[1] reported that the organisms first described by him as "paratyphoid" were identical, except in their pathogenicity, with B. psittacosis, and another observer[2] classed these two cases with other instances of psittacosis infection.

The B. psittacosis was isolated by Nocard during an epidemic of "infectious pneumonia," which, in 1892, followed the importation into Paris of several hundred South American parrots. This epidemic made such a deep impression upon the professional minds of that city that for several years many imperfectly reported cases of obscure continued fever, both with and without pulmonary complications, were described as instances of "La Psittacose." The exact nature of many of these cases cannot now be determined. The true disease has, how-

[1] Thesis, Paris, 1897. [2] Millienne. Thesis, Paris, 1897.

ever, been accurately described,[1] and there can be no doubt that, in spite of the similarity between the "paratyphoid" and psittacosis organisms, the clinical picture of the two cases of Achard and Bensaude is similar not to that of "infectious pneumonia," but to that of the rapidly growing group of cases now under consideration.

In 1897 Widal and Nobécourt[2] described an organism isolated from an abscess in the neighborhood of the thyroid gland which also possessed the cultural characters of the B. psittacosis without giving its serum reactions. This "paracolon bacillus" was agglutinated by the patient's own blood in a dilution of 1 to 1000.

One year later Gwyn[3] reported a case from Dr. Osler's clinic which presented a typical picture of typhoid fever, stupor, delirium, continued temperature, rose-spots, palpable spleen, diazo reaction, and intestinal hemorrhage. From the blood of this patient Gwyn obtained a bacillus which was similar in character to Widal's paracolon bacillus. The patient's serum agglutinated this bacillus in a dilution of 1 to 200, but did not agglutinate the typhoid bacillus in dilutions above 1 to 5. Gwyn seems to have regarded this case as one of typhoid fever, with a secondary paracolon infection, although he raises the question as to whether all the symptoms might not have been due to a paracolon infection alone.

In 1900 Cushing[4] described an organism, Bacillus O, isolated from a costo-chondral abscess following a supposed attack of typhoid fever. The Bacillus "O" was agglutinated by the patient's own blood in a dilution of 1 to 800. Culturally the organism showed only minor variations from Gwyn's paracolon bacillus, but the serum of Cushing's patient did not agglutinate Gwyn's organism. In an elaborate study of the characters of these bacilli, Cushing showed their apparently close relationship to the enteritidis group, intermediate in character between the colon and typhoid groups. He summarized the chief distinguishing features of this group as follows:

"*Intermediate Group.* B. Gärtner and B. chol. suis type. Bacilli with the morphology of B. typhosus and possessing an equal or greater number of flagellæ. Actively motile and in many cases having a distinct pathogenicity for both man and animals. Reaction in milk presents an early and terminal strong alkalinity in the presence of air, appearing after a transient acidity. Milk is never coagulated. They

[1] Dujardin-Beaumetz. Official Report, Paris, 1892. Gilbert and Fournier. Etude sur la Psittacose. La Presse Médicale, 1897, vol. v. p. 25.

[2] Séroréaction dans une infection à paracolibacille. La Sémaine Médicale, 1897, vol. xvii. p. 285.

[3] On Infection with a Paracolon Bacillus in a Case with All the Clinical Features of Typhoid Fever. Johns Hopkins Hospital Bulletin, 1898, vol. ix. p. 54.

[4] A Comparative Study of Some Members of a Pathogenic Group of Bacilli of the Hog Cholera or Bac. Enteritidis (Gärtner) Type, Intermediate Between the Typhoid and Colon Groups. Johns Hopkins Hospital Bulletin, 1900, vol. xi. p. 156.

ferment glucose with the production of gas, never lactose or saccharose. Under ordinary cultural conditions no indol is produced.

"Bacillus "O" and B. paracolon (Gwyn) may represent a subdivision of this group, being slower in their action on milk and growing less luxuriantly, and move like B. typhosus in various fluid media and resembling it in their pathogenic action on animals."

Durham[1] later attempted to separate Gwyn's paracolon and Cushing's Bacillus "O" from the members of the enteritidis group, distinguishing them chiefly by their growth in litmus whey and by their inability to form free gas from glucose in a Witte's peptone solution.

In 1900 Schottmüller[2] reported a case similar to Gwyn's, and later, in 1901, he reported five more such.[3] Each patient presented the clinical features of typhoid fever without showing a Widal reaction toward typhoid bacilli. From the blood of each of these cases he isolated bacilli which were identical or closely related and which presented the characteristics of Gwyn's paracolon bacillus. In each case the bacilli were agglutinated by high dilutions of serum from the same patient, while typhoid bacilli were unaffected by dilutions of 1 to 33. According to Schottmüller, the bacilli isolated were not all identical in character, but so closely related as to form a fairly well-defined group. In this group he recognized two types, A and B, depending upon the appearance of the growth upon gelatin and potato, the alkali formation in litmus whey, and the serum reactions. In addition to these six cases, Schottmüller reported a seventh infection which occurred in a doctor who had worked with one of his (Schottmüller's) cultures. Although no organisms were cultivated from the blood of this patient, his serum agglutinated the bacilli obtained from certain of the other cases, and he was believed to be suffering from a similar infection.

Recently, under the name of Bremen gastric fever, Kurth[4] has described five cases with many of the features of enteric fever, but without Widal reactions. From the feces of one of his patients and from the urine of another he isolated bacilli which were agglutinated by high dilutions of the serum of four of the cases. The serum of the fifth, the case showing bacilli in the urine, was unfortunately not preserved, and so could not be tested. Kurth's organisms differed in

[1] Some Theoretical Considerations upon the Nature of Agglutinins, together with Further Observations upon Bacillus Typhi Abdominalis, Bacillus Enteritidis, Bacillus Coli Communis, Bacillus Lactis Aerogenes, and some other Bacilli of Allied Character. Journal of Experimental Medicine, 1901, vol. v. 353.

[2] Ueber eine das Bild des Typhus bietende Erkrankung hervorgerufen durch Typhus ähnliche Bacillen. Deut. med. Wochenschr., 1900, vol. xxvi. p. 511.

[3] Weitere Mittheilungen über mehrere das Bild des Typhus bietende Krankheitsfälle hervorgerufen durch typhusähnliche Bacillen (Paratyphus). Zeitschr. f. Hygiene u. Infectionskr., 1901, vol. xxxvi p. 368.

[4] Ueber typhus ähnliche durch einen bisher nicht beschriebenen Bacillus (Bacillus bremensis febris gastricæ) bedingte Erkrankungen. Deut. med. Wochenschr., 1901, vol. xxvii. pp. 501 and 519.

some respects from Gwyn's, Cushing's, and Schottmüller's. They were very pathogenic to mice and guinea-pigs, producing a septicæmia. A membrane was formed on bouillon, and milk showed a late coagulation. In glucose bouillon gas was produced. No note is made of the action on the other sugars. Indol was not formed after forty-eight hours. Without further study one would be inclined to doubt the affinity of Kurth's bacilli to the group that we have been describing.

Brion and Kayser have reported a case[1] in which an organism having the characteristics of the bacilli belonging to type A of Schottmüller was isolated from the blood, urine, feces, vagina, and rose-spots. The patient was a young girl, who entered the hospital in the third week of her illness. The temperature was slightly elevated and somewhat irregular. There was anorexia, abdominal pain, and constipation. The spleen was palpable, but no rose-spots were noted. A profuse vaginal discharge was found, cover-slips from which showed gonococci. In eight days the temperature reached normal, and six days later the patient was discharged. She returned to the hospital after three days with symptoms pointing to a relapse of the original illness. At this time the spleen was palpable and definite rose-spots were seen over the abdomen. Following this relapse there was a second one, which occurred after an interval of normal temperature for several days. During convalescence symptoms of thrombosis developed in the left leg. The Widal reaction was absent throughout the attack, and the organism isolated from so many different situations reacted positively with the patient's serum in 1 to 1000 dilutions.

A case of typhoid fever with secondary infection by a "paracolon" bacillus has been observed by Sibman.[2] The patient presented the symptoms of cholecystitis, and the "paracolon" bacillus was isolated from the gall-bladder, blood, and urinary bladder during life. This organism agglutinated with the patient's serum in dilutions of 1 to 20, but reaction was also obtained in much higher dilutions (1 to 250) with bacillus typhosus. At autopsy healing ulcers were found in the ileum.

Hume's case[3] presented typical typhoidal symptoms, rose-spots, enlarged spleen, and a relapse. The diarrhœa was profuse and persisted for more than a month after the temperature became normal. Intestinal hemorrhages were present. A cystitis occurred during convalescence, and this led to the cultivation from the urine of an intermediate bacillus which was also isolated later from the feces. The patient's

[1] Ueber eine Erkrankung mit dem Befund eines typhusähnlichen Bacteriums im Blute (Paratyphus). Münchener med. Wochenschrift, 1902, No. 15. p. 611.

[2] Boston Medical and Surgical Journ., 1902, No. 17, vol. cxlvi. p. 443.

[3] A New Pathogenic Bacillus Isolated from a Case Diagnosed as Typhoid Fever. Thompson Yates Laboratories, 1902, vol. iv. p. 385.

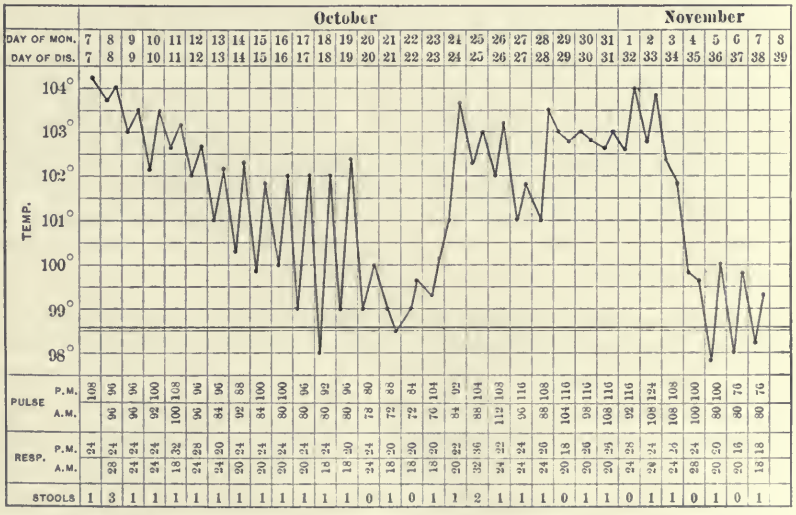
serum agglutinated this organism in a dilution of 1 to 200, but did not affect the typhoid bacillus in a dilution of 1 to 10

Strong[1] has quite recently reported an autopsy forty-two hours after death in which a bacillus similar to Cushing's Bacillus "O" was isolated from the spleen. The spleen was enlarged and soft, and the organs in general showed the lesions common in acute infections. Both large and small intestines were normal throughout. No agglutination tests were made, and Strong himself suggests the possibility that the bacillus might be a post-mortem invader.

Coleman and Buxton's case 7 has recently been reported in this journal.[2]

The following case occurred in the service of Dr. S. W. Lambert at the New York Hospital. Its similarity to many of the above cases justifies it being placed in the same class with them, and it is reported here as adding another to this interesting group.

J. N., stoker, aged thirty-four years, single. Entered the New York Hospital October 7, 1901. Family and past history unimportant. He never had had typhoid fever. He became ill about seven days



before admission, after a heavy debauch. Since then he has had constant vomiting, severe headache, and moderate cough, with white mucus expectoration. He has been continually feverish, and at times chilly, but has had no shaking chills. A mild diarrhœa with two or three passages a day had persisted from the onset up to the time of admission. He was admitted with a temperature of 104.2° F., respirations 24, and pulse 108 per minute. On examination the tongue appeared heavily coated in the centre, with clean red edges and tip. Over both

[1] Paracolon Bacillus. Johns Hopkins Hospital Bulletin, 1902, vol. xiii. p. 107.

[2] THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, June, 1902.

lungs a few sibilant and sonorous râles were heard. The abdomen was distended and tympanitic and showed a few rose-colored spots, which disappeared on pressure. The spleen was not made out. The urine contained a very faint trace of albumin, with occasionally a few hyaline and finely granular casts.

After admission the bowels were constipated, frequent enemata being necessary. The feces presented nothing characteristic, usually being formed and yellowish without the presence of blood or of mucus. The pulse-rate was not increased in proportion to the fever during the earlier period of the disease. The temperature showed a continuous course up to about the thirteenth day, ranging mostly from 102° F. to 104.4° F. After this it became remittent, and on the twentieth, twenty-first, and twenty-second days was normal. It then rose once more, and the second course of fever lasted to the thirty-fifth day. On the twenty-fifth day pain was complained of in the left axilla and over this area loud friction sounds were heard. On the twenty-eighth day the patient had a chill lasting a half-hour. On the next day signs of a small area of consolidation were discovered near the spine of the left scapula. These signs lasted only two days. Leucocytes on the twenty-fifth day, 12,000. No fresh rose-spots appeared during the second course of fever. The abdomen remained rather distended. The spleen was not felt at any time.

The blood serum agglutinated typhoid bacilli fairly well, but not typically, in a dilution of 1 to 10 on the ninth, the nineteenth, and thirtieth days. No agglutination occurred in a dilution of 1 to 50, and no intermediate dilutions were used. Blood cultures were taken on the eleventh day of the first fever, and on the fourth and tenth days of the second course of the fever. The first and last cultures were negative in result. On the second occasion one flask showed a growth of a bacillus which we shall call for convenience Bacillus "Noonan." It was found that the patient's serum agglutinated this organism in a dilution of 1 to 100.

This case, therefore, presented all of the essential clinical features of enteric fever except the presence of a palpable spleen and a Widal reaction toward typhoid bacilli. It is possible that the spleen was enlarged, but was not palpable on account of the distention. The second fever was regarded as a relapse, with a complicating small area of bronchopneumonia. The reasons for not regarding this rise of temperature as due to the bronchopneumonia alone were the limited extent of the signs and their duration of only two days, the lack of an increase in the rate of respirations, and the presence of the B. "Noonan" in the blood at this time.

The B. "Noonan" was found to be a short bacillus decolorizing by the Gram method. In early bouillon cultures the majority of the organisms are motile, the motion being more darting in character than that of typhoid bacilli. The growth in agar, in gelatin, and in bouillon could not readily be distinguished from that of the typhoid bacillus. Milk is at first acidified, but after a period of about three weeks it becomes neutral, and remains so or becomes faintly alkaline.

The amount of alkali developed in plain milk after two months' growth was not sufficient to cause opalization. Indol was not formed after five days' growth in Durham's solution. The bacillus ferments glucose with the production of acid and the evolution of gas, but has no effect upon lactose or sucrose. On the Hiss semisolid "tube" medium there is abundant production of gas, with growth along the stab and out from it in radiating comma-shaped streaks, a typical "colon-growth." The organism differs, therefore, from the typhoid bacillus in that it produces gas in glucose, and does not cause a diffuse clouding of the Hiss semisolid medium. It differs from the colon bacillus in not fermenting lactose, not coagulating milk, and not, at least readily, producing indol.

The agglutination reaction affords a most delicate method for differentiating organisms. Durham has shown, however, that agglutination reactions are by no means absolutely reliable tests of the affinity of bacteria. On the one hand, organisms easily distinguishable, either by their morphology or by their cultural characters, may interagglutinate; that is, the serum derived from an animal immunized with the one will agglutinate the other. On the other hand, organisms which cannot be distinguished with certainty by means of their cultural or morphological characters may show absolutely no tendency to interagglutinate. This is especially true in the colon group, where it is uncommon to find two varieties of colon bacilli giving the same serum reaction. Typhoid bacilli show only minor differences in this respect toward potent typhoid sera.

Gwyn's paracolon bacillus and Cushing's Bacillus "O" illustrate that closely related organisms may show no mutual serum reaction. Thus, Cushing showed that after inoculating a rabbit with his Bacillus "O" and then with B. chol. suis, its serum, while agglutinating these two organisms in a dilution of 1 to 5000, did not affect the paracolon bacillus in a dilution of 1 to 10. On the other hand, Durham states that a Gwyn serum active up to 1 to 20,000 on Gwyn had not the slightest effect upon Cushing's bacillus "O" at 1 to 100 dilution. Schottmüller found that the blood from his patients in each case agglutinated the organism from the same patient in dilutions of from 1 to 100 up to 1 to 10,000. When the serum from one patient was tested with the organism from another, however, the results varied. In the majority of the cases agglutination occurred in dilutions up to 1 to 10,000, but in a few there was no reaction in a dilution of 1 to 33. None of his sera agglutinated typhoid bacilli in the dilution of 1 to 33.

The reaction of B. typhosus, the paracolon bacillus, Bacillus "O" and B. "Noonan" toward Noonan's and toward typhoid sera showed the results tabulated below. As a rule, only two dilutions were made—1 to 10 and 1 to 50.

	Serum of Noonan.	Typhoid sera.					
		1	2	3	4	5	6
B. typhosus	? 1-10 — 1-50	+ 1-100	+ 1-50	+ 1-50	+ 1-50	+ 1-50	+ 1-50
Gwyn	+ 1-100	? 1-10	— 1-10	— 1-10	— 1-10	? 1-10	— 1-10
Cushing	+ 1-50 ? 1-100	? 1-10	— 1-10	— 1-10	— 1-10	? 1-10	— 1-10
B. "Noonan"	+ 1-100	— 1-10	— 1-10	? 1-10	— 1-10	? 1-10	— 1-10

? = a suggestive but not typical reaction.

These results may be summed up in the statement that while Noonan's serum agglutinated typhoid bacilli only fairly well in a dilution of 1 to 10 and not at all in a dilution of 1 to 50, it agglutinated B. "Noonan," Gwyn's paracolon, and Cushing's Bacillus "O" in dilutions of from 1 to 50 to 1 to 100. On the other hand, typhoid sera having a potency of at least 1 to 50 gave only suggestive or no reactions with these organisms in dilutions of 1 to 10. In addition to those tabulated, numerous other agglutination tests were made with typhoid sera on B. "Noonan." but in no case was a positive result obtained.

A guinea-pig was immunized by means of intraperitoneal injections of B. "Noonan" and its serum was used for agglutination tests. In addition to Gwyn's and Cushing's organisms several others, belonging apparently to the same group, were tested.

Organisms.	*Dilution of serum.*	*Result.*
B. "Noonan"	1-5000	Positive.
Gwyn's paracolon	1-5000	"
Johnston's Badach	1-5000	"
Schottmüller's Müller (type "A")	1-5000	"
Cushing's Bacillus "O"	1-5000	Suggestive.
	1-500	Positive.
Johnston's Milefsky	1-5000	Negative.
	1-500	Positive.
Coleman and Buxton's Case 7	1-500	Suggestive.
	1-100	Positive.
Kurth's bacillus	1-20	Negative.
Schottmüller's Seeman (type "B")	1-20	"
Strong's bacillus	1-20	"
B. typhosus (1 variety)	1-20	"
B. coli (2 varieties)	1-20	"

The above serum reactions suggest the close relationship of the first seven of these organisms. To these and to the infections which they caused are especially applicable the names of paratyphoid bacilli and paratyphoid fever. Whether the remaining organisms are only variations from this type or are to be placed in a separate class or classes can only be determined by careful comparative studies of their cultural and agglutinative peculiarities.

PARACOLON INFECTION, TOGETHER WITH THE REPORT OF A FATAL CASE, WITH AUTOPSY.

By Warfield T. Longcope, M.D.,
of Philadelphia.

(From the Ayer Clinical Laboratory, Pennsylvania Hospital.)

Within the last few years careful bacteriological investigations made upon the blood of typhoid fever patients have shown that in a small number of cases, none of which give the Widal reaction, an organism can be cultivated from the blood, during life, which differs in many essential points from bacillus typhosus. This organism was first accurately described by Widal, who called it bacillus paracoli. Recently Schottmüller has substituted the name of paratyphoid bacillus, and proposes to call those cases in which the bacillus occurs "paratyphoid fever," to distinguish them from true typhoid fever. Two of these "paratyphoid" or "paracolon" infections have occurred at the Pennsylvania Hospital, the first of which resulted fatally. For the clinical notes of this case I am indebted to Dr. J. C. Wilson, and for the other to Dr. Frederick A. Packard.

Case I.—Natalie C., Italian laborer, aged twenty-two years. The patient was admitted to the Pennsylvania Hospital March 9, 1902, and entered the service of Dr. J. C. Wilson. The patient spoke only an Italian dialect, and it was difficult to obtain a history of his illness. A friend stated that eight days before admission the patient had had a chill, followed by headache, and pain in the abdomen and right side. He had also had nose-bleed. Physical examination showed a well-developed man, with slightly flushed cheeks and moist-coated tongue. About the upper lip and alæ of the nose were a few herpetic vesicles. The lungs were resonant and free from râles; the heart sounds were clear. Over the abdomen, chest, and back were a few suggestive rose-spots, and the spleen was distinctly palpable. Temperature, 106° F.; respirations, 32; pulse, 120. The urine was acid, of 1026 specific gravity, and contained no albumin, sugar, or casts.

March 10th. Patient is delirious and shows intense excitement during his baths. Leucocytes, 5900. Widal reaction negative.

11th. The delirium still continues, but the patient is less violent. He lies in a semi-stuporous condition approaching coma vigil. Bowels have not moved since admission. At 4 P.M., blood cultures from median basilic vein. In all bouillon flasks, seven in number, an actively motile typhoid-like bacillus.

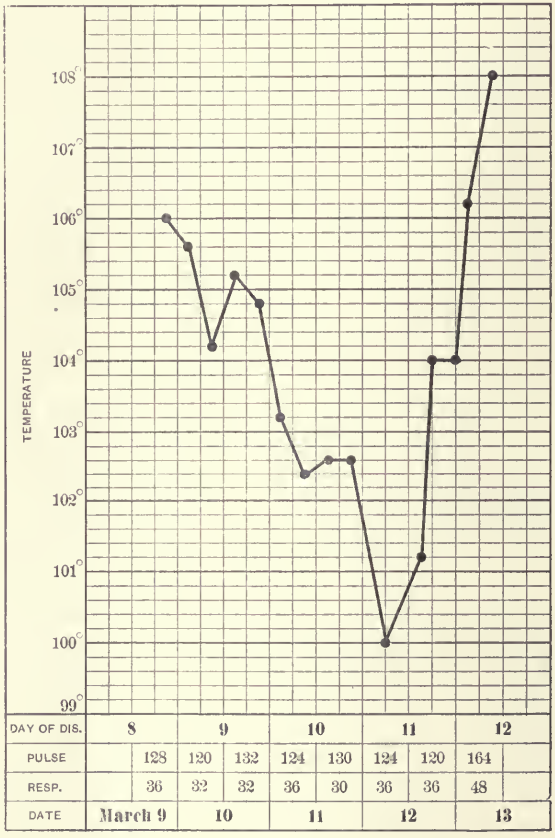
12th. Patient's general condition is much worse; pulse extremely weak; completely unconscious. Immediately before death, on March 13th, at 5.30 A.M., the rectal temperature was 108° F.

The following is an abstract from the notes made at autopsy twenty-eight hours after death:

General paracolon infection; congestion and œdema of lungs; acute splenic tumor; parenchymatous degeneration of liver and kidneys; congestion of brain; ascaris lumbricoides in intestine. The body is that of a well-built man, 175 centimetres in length. No abrasion over the surface of the body. About the lips and alæ of nose are seen herpetic vesicles. There is nothing of note in the peritoneal, pleural, or pericardial cavities.

The heart weighs 345 grammes. The muscle is exceedingly soft, so that when the organ is held up by the apex the entire heart collapses

CHART 1.



DAY OF DIS.	8		9		10		11		12	
PULSE		128	120	132	124	130	124	120	164	
RESP.		36	32	32	36	30	36	36	48	
DATE	March 9		10		11		12		13	

about the hand. The cavities and walls bear normal relations, and all the valves are thin and delicate.

Both lungs present extreme congestion and moderate œdema, but no areas of consolidation are discovered.

The spleen measures 17½ x 12 x 7 centimetres, and weighs 460 grammes. It is much enlarged and exceedingly soft. The capsule is smooth, delicate, and grayish-red in color; on section the pulp is soft, friable, and the general cut surface is of a dull, reddish-gray color. The Malpighian bodies are visible, and scattered through the spleen

pulp are a few small hemorrhages. The trabeculæ do not appear increased.

The liver weighs 1810 grammes and measures 29 x 20 x 10 centimetres. The organ is increased in size, and its consistency is quite soft. Beneath the capsule, which is not thickened, is seen a network of injected vessels. On section the surface presents the brownish-gray appearance characteristic of cloudy swelling.

The kidneys together weigh 270 grammes and are alike. Their consistency is much decreased, the capsule strips readily, and the surface is smooth. On section they show marked cloudy swelling.

Intestines. In the colon the solitary follicles are visible as small gray points, 1 millimetre in diameter. In the small intestines there is no swelling either of the solitary follicles or Peyer's patches, and, with the exception of a few areas in which the mucosa contains gas blebs, the ileum, jejunum and duodenum show nothing abnormal. The appendix measures 10 centimetres in length, its mucosa is apparently normal. Throughout the large and small intestines large numbers of ascaris lumbricoides are found.

The stomach and œsophagus are apparently normal.

The mesenteric glands are not enlarged and appear of normal consistency. A few of them crepitate, and on section are found to contain gas blebs.

The vessels of the brain are deeply congested. No exudate.

The urinary bladder, prostate, seminal vesicles, testes, adrenals, pancreas, and trachea appeared normal.

Bacteriological Examination. At autopsy cultures were made from the heart's blood, lungs, liver, spleen, mesenteric glands, gall-bladder, and cerebral fluid. On plates from the heart's blood, lung, liver, and spleen, numerous colonies developed of a typhoid-like organism agreeing exactly with the bacillus isolated from the blood during life. The colon bacillus was also present in the liver. Plates from the mesenteric glands, gall-bladder, and cerebral fluid gave negative results. This typhoid-like bacillus is a small actively motile organism that does not stain by Gram's method. The morphology is that of bacillus typhosus. On agar plates the surface colonies are small, slightly raised, moist and gray, 1 to 2 millimetres in diameter. Under the No. 3 objective the colonies are pale brown, translucent and finely granular. The deep colonies are small, gray, round, oval or lanceolate bodies, being translucent under the No. 3 objective. The growth appears as a whitish moisture on potato, and in bouillon there is diffuse clouding without pellicle formation. Gelatin is not liquefied. Litmus milk in the first twenty-four hours is slightly acidified, but at the end of forty-eight hours the acidity does not increase, and there is a distinct greenish-blue cream ring. By the third day the milk regains its neutral tint, and after a week there is a faint alkaline reaction, which gradually deepens until by the fourteenth day the color is a dark navy blue. No further changes are noted after five weeks' growth.

Fermentation tests were made in 2 per cent. glucose, detrose, saccharose, lactose, and mannite bouillon. Glucose, dextrose, and mannite are all fermented, but there is no fermentation either of lactose or saccharose. In glucose much less gas is formed with this bacillus than with the colon bacilli, the latter being used for control tests. Indol is not formed.

Histological Examination. The heart muscle presents no special changes besides some congestion and swelling of the muscle fibres, in some of which the striæ are poorly marked.

The lungs show extreme congestion, with a moderate amount of coagulated serum filling the alveoli.

The spleen is much congested, and the Malpighian bodies are somewhat increased in size. There is no endothelioid proliferation, and no red blood carrying cells are found.

The liver shows, besides the general swelling and granulation of the cells, multiple focal necroses. These areas usually occur in the middle zone of the liver lobule, and vary from the size of three or four liver cells to about one-sixth the size of a liver lobule. The smallest foci appear as a granular mass taking the eosin stain; or as two or three necrotic liver cells, which, although their nuclei refuse the stain, still retain their architecture.

Frequently a few leucocytes and fragmenting nuclei are present. The liver cells immediately bordering these areas show beginning necrosis; their nuclei are either contracted and deeply staining or are large and practically refuse the stain. Karyokinesis is often present. In the larger areas necrosis is much more extended, and the central portion is often filled with leucocytes, fragmented nuclei, and a fine interlacing network of fibrils which take Weigert's fibrin stain. In no case, however, is the leucocytic infiltration excessive, and these cells are usually confined to the periphery of the areas. The capillaries lying between these foci contain but few leucocytes and no thrombi. Cells of an epithelioid type are entirely absent. No bacteria can be found in the areas.

The kidney shows swelling and granulation of the tubular epithelium. The mesenteric glands are normal. In a few of them open spaces are seen, which are evidently produced by post-mortem gas formation. The lymphoid tissue is not increased, and no endothelioid proliferation is present.

Intestines. Sections were made through many of the solitary follicles of the large intestine and the agminated follicles of the ileum, but in no section were definite lesions found. In one or two sections the lymphoid tissue was very slightly increased and in the germinal centres of the largest ones, one or two endothelioid cells were found. These cells occurred in no other situations of the intestinal wall.

Case II.—Adolph G., aged thirty-five years; laborer. The patient was admitted to the Pennsylvania Hospital April 3, 1902. The family history was unimportant, and the patient said he had never before had any serious illness. The present attack began three days before admission, with slight chilly sensations, cough, headache, loss of appetite, and abdominal pain. The day before admission he had had nose-bleed. Bowels were constipated.

On examination the man appears well nourished; the lips are dry and the tongue is coated. Heart sounds clear. Lungs show slight impairment of resonance at the bases on percussion, and numerous crepitant râles are heard in these situations. The abdomen is sensitive to pressure. Spleen is not palpable. A few rose-spots are seen upon the back. Temperature, 101° F.; respirations, 28; pulse, 92. Urine is acid, of specific gravity 1015; no sugar, a trace of albumin and a few epithelial casts.

April 5th. Widal reaction negative; leucocytes, 4200.

7th. Râles still present over both lungs; sputum slightly blood tinged.

9th. Widal reaction negative; leucocytes, 4400.

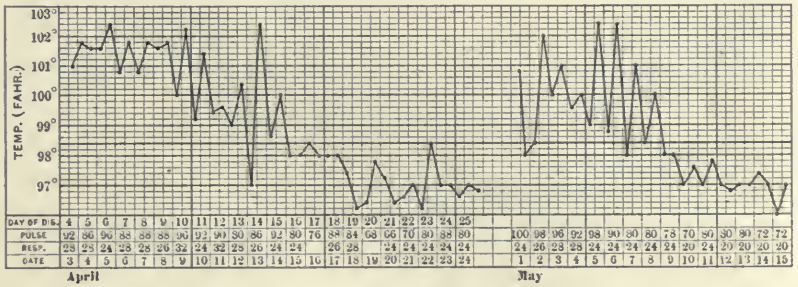
14th. The patient begins to feel better, no tubercle bacilli found in the sputum. Culture from median basilic vein; growth of a small actively motile bacillus which agglutinates with the patient's serum in 1 to 200 dilutions.

15th. Widal reaction positive for B. typhi in 1 to 20 dil., negative at 1 to 50.

23d. Uneventful convalescence.

May 1st. The patient was again admitted to the hospital complaining of the same general symptoms which characterized the first attack; but this time diarrhœa was also present. He had begun to feel sick two or three days after his dismissal, and since then had been gradually getting worse. The patient presents much the same appearance as he did on his first admission, but besides the coated tongue the lips are now covered with herpetic vesicles. The lungs are clear to percussion, but a few râles are heard over both sides. The abdomen is not tender, but the spleen is distinctly palpable, and a few rose-spots are seen over the abdomen. Urine acid, specific gravity 1012; moderate trace of albumin; hyaline and finely granular casts.

Chart 2.



2d. Leucocytes, 3800. Cultures made from vein of the arm gave same actively motile bacillus as in the first culture.

6th. Widal reaction positive for B. typhi in 1 to 20 dil.; negative at 1 to 50.

9th. Patient's temperature reached normal to-day. The convalescence from this time was uneventful.

Bacteriological Examination. On April 14th cultures were made from the median basilic vein and 10 c.c. of blood was distributed among six flasks containing 250 c.c. of bouillon each. Before the culture was taken the skin of the forearm was carefully cleaned according to Cole's method, and the same technique was observed in the first case. In only one flask did a growth develop. This proved to be an actively motile bacillus similar in all respects to the bacillus from the first case, except that milk was not turned alkaline. Litmus milk was faintly acidified, and after two or three days' growth there was gradual return to the neutral reaction, but very slight alkali if any was produced, even at the end of four weeks' time. The growth in all other

media, the gas production in the various sugars, and the absence of indol formation, all corresponded to the characters of the bacillus from Case I. During the patient's relapse the same organism was recovered from the blood for the second time, and developed in five out of seven bouillon flasks. Cultures from the urine made May 10th gave negative results.

The serum from the patient reacted throughout the convalescence of the primary attack, and during the relapse with this bacillus in dilution of 1 to 200; with Gwyn's bacillus at 1 to 500; with Cushing's bacillus at 1 to 200, and with Carlez, Case I., at 1 to 20. The serum agglutinated not only these various strains of paracolon bacilli, but also reacted in low dilution with typhoid bacilli. This positive Widal reaction developed during the convalescence from the primary attack and lasted throughout the relapse. A definite reaction was never obtained in dilutions higher than 1 to 20, but some clumping was noticed even in 1 to 100 dilutions.

Sera.	Time one hour.						Organism.
	1-500	1-200	1-100	1-50	1-20	1-10	
Greenberger, Case I.	—	+	+	+	+	+	Greenberger.
	—	—	—	—	+	+	Carlez.
	+	+	+	+	+	+	Gwyn.
	—	+	+	+	+	+	Cushing.
	—	—	—	—	+?	+	Bac. typhosus.
J. M. Typhoid	0	0	0	—	—	?	Greenberger.
	0	0	0	—	—	—	Carlez.
	0	0	0	+	+	+	Bac. typhosus.
G. C. Typhoid	0	0	0	—	—	—	Greenberger.
	0	0	0	—	—	—	Carlez.
	0	0	0	+	+	+	Bac. typhosus.
N. C. Typhoid.	0	0	0	—	—	—	Greenberger.
	0	0	0	—	—	—	Carlez.
	0	0	0	+	+	+	Bac. typhosus.

0 = No test made at this dilution.

The observations upon the occurrence of the paracolon or paratyphoid bacillus made by Achard and Bensaude, Widal, Gwyn, Cushing and Schottmüller, Kurth, Brion and Kayser, and Coleman, have been thoroughly reviewed by Hewlett; and Johnston in his article upon the subject has discussed the characteristics of the organism as well as its agglutination reactions, and the clinical aspect of the infections.

Brion and Kayser's case is especially noteworthy as illustrating the remarkably wide distribution of the organism throughout the body. In their case they recovered the paracolon bacillus from the blood, urine, feces, vagina, and rose-spots. And the case is of further interest inasmuch as two relapses followed the primary attack, and during the convalescence from the last one symptoms of thrombosis in the left leg developed. Certainly, with these two complications, with the enlarged spleen, rose-spots and diazo reaction, which were all present, the clinical picture of typhoid fever is practically complete. But yet the Widal reaction was absolutely negative and the organism isolated repeatedly from so many different situations, and which the authors identify with the paracolon bacillus of Schottmüller's type "A," reacted in dilutions of 1 to 1000 with the patient's serum. Besides Cushing's case and the second case of the present series, this is the only case reported with relapse.

Most of the cases mentioned by Hewlett have evidently been uncomplicated infections, but it is possible that both the paracolon bacillus and the typhoid bacillus may be present in the body at one and the same time, thus producing a double infection.

In this connection Libman reports a case of cholecystitis in which the paracolon bacillus was isolated during life from the gall-bladder, blood, and urinary bladder. The bacillus reacted in dilutions of 1 to 50 with the patient's serum, but a Widal reaction was also obtained in dilutions of 1 to 250. At autopsy healing ulcers were found in the ileum. From the presence of the Widal reaction in such high dilutions there can be little doubt that the case was really one of typhoid fever with a secondary infection by the paracolon bacillus. It is, nevertheless, interesting to note the point of principal infection in this case, namely, the gall-bladder.

Another autopsy is reported by Strong. The patient had been ill for twenty-six days, and there was continued high temperature. The autopsy, forty-two hours after death, revealed the signs of an acute infection. The spleen was large and soft, the mesenteric lymphatics were swollen, and some along the small intestine were hemorrhagic. Both the large and the small intestine were normal throughout.

From the spleen a bacillus was obtained which resembled Cushing's Bacillus "O." It was not possible to make agglutination tests, and none of the tissues was examined microscopically. Fresh smears from the spleen showed a few crescentic æstivo-autumnal malarial parasites and a fair amount of malarial pigment.

From a study of the cases so far reported it is evident that they represent practically the same affection caused by a bacillus or group of bacilli which differ materially from both the colon and typhoid groups, but have a close relationship to the enteritidis group. The

clinical symptoms are those of a mild infection or more often of typhoid fever. In fact, it is frequently impossible, on clinical grounds alone, to distinguish them from the latter disease. The general malaise, headache, diarrhœa, and temperature curve, together with the enlargement of the spleen, rose-spots, and diazo reaction, form a group of symptoms and signs which would, under ordinary circumstances, render the diagnosis from typhoid fever impossible. Relapse may occur, and even the complications are those common to typhoid fever.

Both of the present cases differ somewhat from those so far reported, in that herpes was present, and epistaxis occurred early in the disease. The first case was ushered in by a chill, a condition noted only in one other case, and the terminal hyperpyrexia which occurred in this patient is unique. The relapse observed in Case II. was likewise unusual. Owing, however, to the positive Widal reaction obtained in this case, it is quite possible that the paracolon bacillus was not the only agent concerned, but that the condition was really one of double infection. Libman's case is certainly to be considered as a double infection. Meltzer in a critical review of the subject is inclined to think such double infections are not uncommon, and further believes the paracolon bacillus is the prime factor; whereas, the typhoid bacillus invades the circulation secondarily and only in sufficient numbers to impart to the blood the power of agglutination. Be this as it may, the persistent occurrence of the bacillus and relatively high agglutination reaction of the serum in the present case make it seem probable that the principal cause of the infection was the paracolon bacillus. It has, therefore, been considered as such.

The first case, on the other hand, was beyond doubt an uncomplicated paracolon infection. Although in certain clinical respects it resembled typhoid fever, still the evidence was not conclusive, and without the aid of the Widal reaction and blood culture it could only be said that the patient was suffering from a severe acute infection. From a study of the pathological findings it immediately becomes evident that this is actually the case. The diagnosis of typhoid fever can certainly be excluded. The absence not only of ulcers, but even of marked microscopical lesions in the intestine, and the normal size of the mesenteric lymph glands without endothelioid proliferation either in them or in the spleen, serve to stamp this condition as one totally different from typhoid fever. Such slight swelling of the lymphoid follicles as was present is readily accounted for by the large numbers of round worms found throughout the lower gastro-intestinal tract.

Doubtless typhoid infections may occur without marked intestinal lesions, or even without intestinal lesions at all; but in these cases the changes in the lymph glands and spleen are still characteristic of the

disease. Opie has recently reviewed this literature, and finds that many of the cases do not bear close analysis. Frequently swelling of the lymphoid follicles or even small ulcers were present in unusual situations, and in the earlier cases the bacteriological records are incomplete. From our present knowledge it seems not unreasonable to suppose that some of the cases of this latter group were really paracolon infections and not typhoid fever at all.

In the pathology of this case specific lesions were entirely wanting. Focal necroses of the liver, as Flexner has shown, are so commonly caused by intoxications of both bacterial and chemical origin that no stress can be laid on their presence in this case. And Cushing, too, produced the same lesion experimentally in rabbits by inoculations of bacilli belonging to the enteritidis group as well as by paracolon bacilli.

Broad conclusions cannot be drawn from one or two cases, but if subsequent pathological findings confirm the results so far obtained, the distinction made on a bacteriological basis by Schottmüller and others between these infections and typhoid fever, will be fully confirmed by anatomical evidence. The wide distribution of the bacillus in the body; its constant occurrence in the circulating blood, and the absence of any localizing lesions all lead to the conclusion that the condition is simply one of general infection. And since it is now fairly well established that typhoid fever is not a local disease, but rather a general infection with localized lesions, it is not surprising that the symptoms in these two affections should be so similar. This is all the more striking when the close relationship between bacillus typhosus and the paracolon bacillus is considered.

It is, of course, possible that further observations will discover a closer connection between these paracolon infections and typhoid fever than the present evidence can show but the fact still remains that the paracolon bacillus is capable of producing a fatal infection distinct from typhoid fever.

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SPONTANEOUS NON-TUBERCULOUS PNEUMOTHORAX.

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By spontaneous non-tuberculous pneumothorax we understand a pneumothorax occurring suddenly in healthy individuals, without the cause being discoverable by physical examination or by the history of the case, and in which there is rarely formation of liquid.

Pneumothorax was, no doubt, known to the ancients; but no clear account has come down to us. It is true that Hippocrates mentions the succussion splash, but this was wrongly interpreted as meaning pus in the pleural cavity; while, in reality, it means the presence of both air and fluid. Apparently the first to appreciate the condition was Riolan, a contemporary of Harvey, although the first exact description of it was not given until a century ago, in 1803, by Itard,[1] a French physician, who coined the term pneumothorax. His studies were made in the post-mortem chamber, and neither he nor his immediate successors seem to have recognized the condition during life. This was reserved for Laennec,[2] whose investigations, particularly of the symptoms and diagnosis of the disease, were so thorough that posterity has been able to add but little to them.

Laennec gave the probable causes of pneumothorax as: (1) tuberculosis; (2) decomposition of pleural effusions; (3) gangrene of the lung; (4) emphysema of the lung; (5) idiopathic formation of air in the pleural cavity. By the latter, Laennec understood a sort of gaseous secretion on the part of the pleura. The second and last of these causes were finally, in the light of many observations, put aside; although the second, decomposition of pleural effusions, has lately been revived on good evidence. Thus, Levy[3] reported a case in which it seemed beyond doubt that a pneumothorax had supervened on a pyothorax, as the result of decomposition by an anaërobic organism, apparently the bacillus aërogenes capsulatus.

May and Gebhardt[4] likewise reported a similar case of pneumothorax due, in this instance, to the bacillus coli communis, and they proposed the name zymotic pneumothorax for one having such an origin. The proteus vulgaris and other undetermined organisms have also been found in cases of this kind, particularly by French writers, who employ the term *pneumothorax par fermentation gazeuse.*

The most common cause of pneumothorax is tuberculosis; this is not alone the experience of individual observers, but is shown to be the fact

by several series of statistics. Thus Biach,[5] in 1880, collected all the cases of pneumothorax which had occurred in three hospitals in Vienna: 918 cases had been observed, which were divided, according to their cause, as follows:

Tuberculosis	715 cases.	Bronchiectasis	10 cases.
Gangrene	65 "	Abscess of the lung	10 "
Empyema	45 "	Emphysema	7 "
Traumatism	32 "	Infarct	4 "
Echinococcus	1 "	Perforated œsophagus	2 "
Thoracentesis	1 "	Abscess of the bronchial glands	2 "
Worms	1 "	Fractured ribs	1 "
Peritonitis	1 "	Fractured sternum	1 "
Ulcer of stomach	2 "	Uncertain	14 "

As regards the frequency with which pneumothorax occurs in pulmonary tuberculosis, the following statistics, quoted from Biach, are of interest: In 58,731 cases of tuberculosis which had been observed, 433—or less than 1 per cent.—developed pneumothorax. Galliard[6] found 36 instances of pneumothorax among 3415 cases of pulmonary tuberculosis, making a percentage of 1.054. These are smaller percentages than those found by Lebert and by West,[7] who give the frequency as 5 per cent. In 1000 cases of phthisis at the Brompton Hospital, there were (Fowler and Goodlee[8]) 65 cases of pneumothorax (6.5 per cent.).

It is seen from these statistics and from others which have been compiled that from 80 to 90 per cent. of the cases of pneumothorax are due to tuberculosis, while the proportion of tuberculous cases that develop pneumothorax is from 1 per cent. to 6.5 per cent. Among the uncertain cases (14) in the foregoing series, there are a few of the so-called spontaneous, idiopathic, or accidental pneumothorax.

When these spontaneous cases were first observed and reported, it was thought that they probably arose from a small tuberculous nodule which could not be recognized by physical examination or by the history. This view is apparently still held by some reporters—notably by West,[9] Delafield (Case 4, this series), Talayrack,[10] and Hamilton.[11] West[12] says: "Experience and experiments seem to show that when pneumothorax has taken place in the apparently healthy, a lesion which may even be of a tuberculous character has really been the cause of the accident." Delafield apparently takes it for granted that his case was tuberculous, although neither physical examination nor the history of the case bears out this conclusion. Hamilton seems to have based his belief largely upon West's great experience. Cases have been observed, however, that have come to post-mortem, which prove that in some instances, at least, tuberculosis is not present; as in the cases of Ranking and Devillier (No. 9, our series). Two other cases, those of Chauffard and Osler (Nos. 40 and 48, our series), were treated by tuberculin, and gave no reaction. The authors have observed

the two following cases, which are certainly cases of spontaneous pneumothorax, and which, they believe, are not tuberculous. The notes are copies of those made at the bedside of the patients.

Case I.—Katherine G., aged twenty-one years; father and mother living; mother the subject of diabetes mellitus; father well. One sister dead of unknown cause. One sister and three brothers living and well. There is no tuberculosis in the family. When the patient was fifteen years of age she had a severe attack of chlorosis, from which she entirely recovered. When nineteen years old she gave birth to a perfectly healthy infant. (This child is living and well at present.) In 1894 she had a rather severe attack of dysentery. Except for the above conditions, she was perfectly well until March 14, 1895. On that date I was called to see her for some ill-defined ailment. A careful physical examination made at the time showed all the organs to be normal. On the morning of March 21, 1895, she was awakened from her night's sleep by a severe stabbing pain in the region of her left nipple, accompanied by distressing dyspnœa. On inspection the left chest was seen to be without respiratory movement. It was distinctly distended. There was no tactile fremitus. There were no voice sounds or breath sounds heard over the left side. The apex-beat of the heart was in the fifth intercostal space on the right side of the chest. There was marked dulness on percussion. She received morphine and was kept in bed. On the next day there were the same physical signs, except that the dull note on percussion noticed over the left chest was found to be replaced by a resonant note.

The next day, March 23d, the note over the left chest was hyperresonant, and there was amphoric breathing over the base. On this day the patient's temperature was normal. She still suffered considerably, and the chest was aspirated. Nothing but air was found. The heart at once resumed its normal position, and the patient speedily recovered. At the end of two weeks she was able to resume her usual duties. She has never been ill since. To-day, seven years after the attack of pneumothorax, she is perfectly well.

Case II.—The patient, P. B., a teamster, aged twenty-seven years, born in Ireland, was admitted to the Philadelphia Hospital on December 16, 1901, in the service of Dr. S. Solis Cohen, through whose courtesy we are able to make this report. His sole complaints were cough and pain in the right side. The family history was exceptionally good. The parents, three brothers, and three sisters, were living and in good health. One sister had died in infancy. The man himself had had the diseases of childhood and typhoid pneumonia. As a teamster he always had been much exposed; he had also drunk considerably.

For a month prior to admission he had had, as the result of exposure, a cough, which did not trouble him greatly. The night before his entrance into the hospital he had a particularly violent fit of coughing, during which he was seized with severe pain in the right side. He had to go to bed, and the next day was brought to the hospital.

On admission he was found to be a tall, robust, well-nourished man, with a flushed and rather cyanotic face. The breath smelled strongly of alcohol. There was no dyspnœa apparent. The chest was large and deep, the intercostal angle obtuse. The right side of the chest was larger than the left, and the intercostal spaces on the former side

bulged slightly. Expansion was deficient over the entire chest, particularly upon the right side, on which the fremitus was also decidedly less than normal, especially toward the base. The right nipple was

Fig. 1.

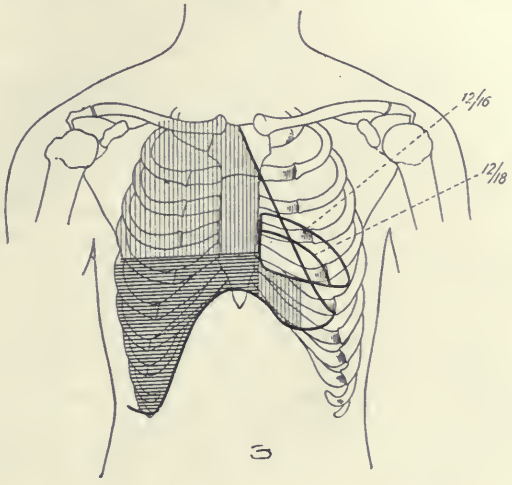
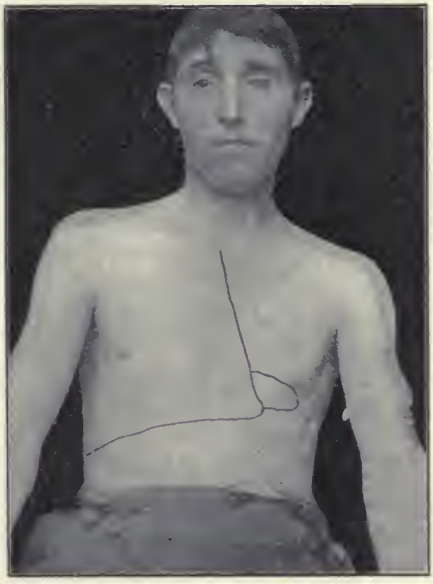


Fig. 2.



half an inch higher than the left, and on inspiration the intercostal spaces retracted less on the right than on the left side.

On percussion the note over the right side was more resonant than that over the left. At the right apex the note had a quality which

could be designated wooden tympany; it was not a clearly tympanitic note. Toward the base, however, the percussion sounds were decidedly and characteristically tympanitic. The liver dulness was entirely obliterated. There was tympany at front, side, and back, down to the edge of the ribs; and the note here in the right hypochondrium, as has been stated, was more tympanitic than over the upper part of the chest. The differences in the percussion note, as well as other features, are shown in the accompanying diagram and photograph. The tympanitic sound extended beyond the left border of the sternum.

Auscultation. On the left side the breath sounds were feeble, the vesicular element being almost suppressed. Expiration could not be distinctly heard in all parts, but where detected was prolonged and low-pitched. On the right side the breath sounds were entirely inaudible over the back. In the axillary region a distant breathing could be heard, the expiration being somewhat harsh. At the extreme apex in front the breath sounds were audible, but faint; below they were absent. Upon expiration an occasional sibilant râle could be heard. The vocal resonance was diminished, but not entirely absent.

The apex-beat was found in the fifth interspace, half an inch outside of the nipple line. The boundaries of the organ were not easily determined. They were on the right side of the left sternal border, above the third interspace; the left border was a finger's breadth outside of the nipple line; the lower at the sixth rib. There was some epigastric pulsation. The first sound was feeble at the base; the second pulmonic was accentuated. The apex sounds were feeble and distant.

On the following day, December 17th, the patient's condition was about the same, except that the cyanosis had increased and the apex-beat and the left heart boundary were a little further to the left than they had been. We strapped the patient's side, and this at once relieved the pain.

On the next day, December 18th, the patient, the notes say, was more comfortable; the cyanosis was less, there was some enlargement of the veins in the right hypochondrium, and the tympany still persisted. The heart, however, had receded fully an inch, the apex being now just within the nipple line, as is shown in the diagram.

On December 19th, three days after admission, an attempt was made to obtain the succussion splash, but without any result. There was evidently no fluid in the pleural cavity. The respiration on deep breathing was somewhat amphoric. The coin-test was tried, but did not yield a characteristic result. There was no bell tympany, although the sound on the diseased side was different from that on the healthy one, particularly just below the angle of the scapula.

Mensuration of the chest on this day showed an expansion of $\frac{5}{8}$ of an inch at the level of the axilla, and $1\frac{1}{2}$ inch at the nipple line. The circumference of the right side just below the axilla was $19\frac{1}{4}$ inches; that of the left, $17\frac{1}{2}$ inches; at the level of the nipples, the right measured $19\frac{1}{4}$ inches; left, $19\frac{1}{2}$ inches; at the level of the ensiform cartilage, right side, $18\frac{1}{2}$ inches; left, $17\frac{1}{2}$ inches.

The urine was acid in reaction and had a specific gravity of 1012. It was free from albumin and sugar, but the sediment contained a few hyaline casts, triple phosphates, and epithelial cells. The sputum was also examined; it contained no tubercle bacilli. Fever was absent throughout.

The patient rapidly improved, and on December 23d, a week after admission, requested his discharge. The signs of pneumothorax were still in part present, and the cyanosis had not entirely disappeared, but there was no cough and no distress. He was seen three months afterward, and was entirely well, the breath sounds being normal and equal over both lungs.

It will be observed that in these two cases a pneumothorax appeared suddenly; in one of them during sleep. In neither of the cases were there any physical signs, symptoms, or history which would warrant a diagnosis of tuberculosis. In both of them recovery was complete. In one of the cases aspiration was resorted to for relief of the symptoms.

In a rather careful search through the literature of pneumothorax we have been able to collect 56 cases which appear to belong to the class of spontaneous non-tuberculous pneumothorax.

An analysis of the tables on pages 233–235 shows the following facts:

Sex. The sex is mentioned in 55 cases. Of these, 45 were in males and 10 in females. The large preponderance of males has long been recognized. West[13] published a series of 24 cases; and Hall,[14] a series of 31 cases, including 21 cases of West's. In Hall's series there were only 2 females, about 1 per cent. In our series there were 2 per cent. of females. Hall believes, correctly, no doubt, that the preponderance of males is due to the fact that men are apt to make greater muscular efforts than women.

Age. There was 1 case under the age of ten years; between ten and twenty years there were 13 cases; between twenty and forty years there were 30 cases; over forty years there were 4 cases.

In 8 cases the exact age was not mentioned, but they were all young adults. The condition, therefore, is distinctly more frequent in young adults than in either the very young or the very old. No cases occurred between the ages of three and sixteen years.

Side Affected. This is mentioned in 50 cases. In one case the left side was the seat of the lesion in one attack, and the right side in the other. (Case 41, Goodhart.) Of the remaining 49 cases, 24 were on the right side and 25 on the left side.

Duration. The actual pneumothorax may last but a few days, though its effects may persist from a few days to eight or ten weeks. One of our own cases was perfectly well at the end of two weeks; the second left the hospital at the end of a week, but was not entirely well then. When examined, about three months later, he was entirely well. Two cases remarkable for their duration have been reported; one is included in this series. The case reported by Whitney (Case 53, our series) appears to be a true case of spontaneous pneumothorax. It had lasted nine years, and was under observation at the time Whitney's article was written. Another case of protracted simple pneumothorax, the

result of a pneumonia, is reported by Adams.[15] This case had occurred two years before it came under the care of Dr. Adams. There were typical signs of pneumothorax, with dyspnœa on exertion. After the case had been under observation three years it gradually cleared up, and all the physical signs disappeared. Both of these cases, however, are marked exceptions. The duration averages, perhaps, six or eight weeks, although all the symptoms may disappear in a few days.

Exciting Causes. The exciting causes are not definitely known. The condition may supervene during sleep, as in one of our cases. Usually some violent exertion has preceded the attack—lifting weights, spasmodic cough, playing foot-ball, etc. It is probable that some such act is the usual exciting cause in most cases.

Symptoms. The symptoms are often slight. The patient of Jochmans (Case 53, our series) worked all the time he was under observation; but pain of marked severity, localized in the affected side, coming on suddenly and occasionally causing syncope, was present in practically all the cases. The pain, however, appears to last but a short time; at the end of twenty-four hours the patient was generally free from distress.

Dyspnœa was absent altogether in the majority of cases. In one of our own it was marked, in the other it was absent. It is of a rather peculiar character; severe and constant in the beginning, later when the patient is lying still he is comparatively comfortable, but any exertion whatever causes him much distress.

Cyanosis was noticed in a few instances. It was present in the beginning of both our cases.

Unconsciousness occurred but once, and then apparently from the great pain and dyspnœa.

Cough usually occurred, but was spasmodic in character and without accompanying expectoration.

Fever was not a marked symptom. In Case I. of our own observation there was a temperature of 102° F. in the beginning, but it lasted for only a few hours. In our second case fever was absent.

Physical Signs. Occasionally, as in the cases of Abeille (No. 10) and Johnson (No. 27) of this series, the physical signs were not marked when the patient was first seen, but they appeared gradually within twelve to twenty-four hours.

Mensuration is helpful in the diagnosis, as by that means a distinct enlargement of the affected side is usually shown. Thus in our second case the right side, which was the seat of the pneumothorax, was $1\frac{3}{4}$ inches larger at the level of the axillæ and of the nipple, and 1 inch larger at the level of the ensiform cartilage. In young individuals a compensatory emphysema on the healthy side may cause that side to be larger than the one affected with pneumothorax. The nipple is likely to be higher on the affected side than on the healthy one.

Inspection revealed enlargement of the affected side and bulging of interspaces in all but one or two of the cases in which it is mentioned. There was also loss of motion on the affected side. The apex-beat of the heart was dislocated to the right or to the left, according to the side affected. In a few instances—Heitler (No. 22), Chauffard (No. 40), and Galliard (No. 33)—the apex was seen in the normal position. In two cases (that of Lundie and Bushby, No. 50) it was not visible. In these cases there may have been pericardial adhesions, retaining the heart in the normal position; or the pneumothorax may have been only partial. In our second case the veins over the affected side were enlarged.

Palpation revealed loss of tactile fremitus on the affected side in all but one case. This appears to be the most constant of all signs. The edge of the liver may also be felt low down in the abdomen, but occasionally the liver cannot be felt in the abdomen, despite the fact that the hepatic dulness is absent from its normal place.

The displacement of the heart is an interesting phenomenon. Most writers attribute it to the effect of pressure, the mediastinum being pushed to the opposite side by the air under pressure. No doubt this is a factor, but another of much importance is the elastic traction of the healthy lung. The heart, as Powell[16] has shown, is held in place by the balanced traction of the two lungs, which, to use Fowler and Goodlee's[17] simile, act upon it like two rubber bands pulling in opposite directions. When one of these bands is divided, as is the case when the lung becomes collapsed, the other band pulls the heart toward its own side. This theory explains the immediate displacement before the pneumothorax has attained a high degree.

Percussion. In all but three of our series of cases the percussion note is described as hyperresonant or tympanitic. In two there was a dull note on percussion. In Case I. of our own and in the case of Waller (No. 35, our series) there was distinct dulness over the affected side. So great was the dulness in our own case that the condition was at first taken for one of pleural effusion. The note changed within twenty-four hours, however, and at the time of tapping there was hyperresonance over the affected chest. The dulness on percussion, which may not be distinguishable from that caused by liquid, is due to the great tension under which the air is held. The note on the unaffected side is more resonant than normal. The heart dulness will be found in an abnormal position, the mediastinum being pushed or drawn toward the healthy side, as is well shown in Figs. 1 and 2. The employment of percussion to locate the heart is not mentioned except in our two cases and in that of Lundie. Care must be taken in locating the heart dulness to recognize the compensatory emphysema on the unaffected side. In many cases absence of liver dulness was noticed when the right lung was affected. As the air gradually disap-

pears from the chest the percussion note becomes normal at the apex, but remains for a time hyperresonant at the base, the bottom of the chest recovering its natural character more slowly.

Auscultation. There may be entire absence of breath sounds and voice sounds, as is shown by one of our own cases. When this is combined with a dulness on percussion there is great danger of mistaking the condition for one of pleural effusion.

Usually there is absence of vesicular murmur, which is replaced by amphoric breathing. The voice sounds are usually amphoric in character. The coin sound was present in many of the cases, but was absent in some. Some discussion has arisen as to whether the "coin sound" may occur in any other condition than pneumothorax. That it does is proven by a case reported by Osler, in which there was a marked coin sound over the apex of one lung, although at post-mortem only a large cavity in the lung and not a pneumothorax was found.

Metallic Tinkling. A musical sound of high pitch, resembling drops falling into liquid confined in a cavity, is of frequent occurrence. As West pointed out in 1884, this phenomenon is not necessarily due to the presence of liquid, the explanation usually given for it, inasmuch as it is frequently present when liquid is absent; in such cases it is probably due to the escape of bubbles of air from the ruptured lung into the distended pleural cavity. In none of these latter cases was there a collection of fluid following the entrance of air, as proven both by physical signs and, in some cases, by exploration with an aspirator.

The opening into the pleural cavity is probably soon closed in many of the cases in such a way that very little air finds its way out after the first escape. This is probable, as is shown by the rapid disappearance of air in most of the cases; and in the patients who had been tapped there was no return of air into the cavity, as there assuredly would have been if the opening had continued patulous. It is, therefore, seen that amphoric breathing and amphoric voice sounds are not necessarily, as has been held, signs of a patulous opening, but may occur when the opening is closed or valvular. That the opening is occasionally valvular, allowing the air to enter but not to leave the pleural cavity, is shown by the decidedly positive pressure of the air in the pleural cavity in some cases, as in the experiments of Aron,[18] made on a case of spontaneous pneumothorax. Hamilton has recognized this fact in his article.

Recurrence of Symptoms. This took place in six of the tabulated cases. In all but one of the instances the recurrence was on the same side as the original trouble. In one (that of Goodhart, No. 41) the recurrence was on the opposite side. In one case there were three recurrences (the case of Gabb, No. 34, in which there were four attacks, with intervals of six, two, and six years). In one instance (that of Finny, No. 51) the recurrence took place eight weeks after the first

attack, when the patient seemed entirely well. In Flint's case (No. 26) there was an interval of four weeks.

A pneumothorax which is simple, that is, not accompanied with the formation of liquid in the chest, occasionally occurs in tuberculosis, and the patient may remain in good health for a long time.

West reports such a case. A man, aged twenty-four years, under treatment for tuberculosis of the lungs, was suddenly seized with severe pain in the chest accompanied by dyspnœa, and with the typical physical signs of pneumothorax. The patient recovered from this attack in six weeks without the formation of liquid in the chest.

Cayley[19] and Hale White[20] give examples of pneumothorax occurring in typhoid fever; others refer to the occurrence of the condition in lobar pneumonia. These cases have not been included in this series because they were due to some sort of inflammatory process in the lung. The cases which we have collected had no inflammatory condition.

One of us (Fussell) has observed a remarkable case of pneumothorax which occurred as the initial symptom of a case of primary sarcoma of the pleura. Though the case is not one which belongs under the heading of this paper, it was thought to be such a case for over three months. It is such a marked example of the difficulty of making a diagnosis that we report it somewhat at length. It is not included in the list.

Case III.—John A., aged three years, and only child of healthy parents. No hereditary disease in either branch of the family. I have been his medical attendant since birth. He has never been seriously ill.

Suddenly in the night of December 14, 1901, he awoke from a sound sleep, crying with pain. During the next day he had a slight cough. I first saw him on the evening of the 15th. I made a cursory examination, but observed nothing especially wrong. At my visit on the 16th I observed that there was much dyspnœa. When not disturbed the child was comfortable, but breathed rapidly. On examination the heart was found in the normal position. There was hyperresonance all over the right side of the chest. There was exquisite amphoric breathing and metallic tingling. There was no succussion splash. Pectoriloquy could be heard over the entire right chest. The right side was motionless during respiration. There was no fever.

December 18th. Physical examination revealed the heart to be 3 cm. to the left of the nipple line. There was no fever. The liver dulness had disappeared.

21st. The amphoric breathing had disappeared from the apex of the chest, although it could be heard at the base. There was still hyperresonance.

22d. Vesicular breathing was heard at the apex of the right lung, to the third rib anteriorly and to the angle of the rib posteriorly. The amphoric breathing was heard only at the base posteriorly. The heart's action was fairly slow.

26th. The heart was almost in its normal position. Breath sounds fairly well heard over the right chest.

February 1*st*, 1902. Patient moving about the house. The temperature had never been above normal. The liver dulness had returned. Breath sounds could be heard over the entire right lung, but they were not as good as over the left lung. The apex-beat of the heart was exactly under the nipple. There was no dulness.

6*th*. During the night following a day of too severe exertion, extreme dyspnœa returned. On examination there was marked hyper-resonance over the right chest. The heart-beat was in the anterior axillary line. Amphoric breathing, pectoriloquy, and metallic tinkling, with a typical coin sound, had reappeared. The liver could be felt on a line with the umbilicus. The patient was rather cyanosed, and the heart's action was rapid. The temperature was 102° F.—the first fever during the illness. There was evidently a re-opening of the old rupture of the lung, or a rupture in a new place. The patient's condition gradually grew worse, and on February 11th he was almost in extremis. The chest was aspirated under local anæsthesia. Much air, with a small quantity of bloody froth, escaped. Immediately the heart returned to its normal position, dyspnœa disappeared, and good breath sounds were heard over the right chest. The child fell into a quiet sleep, and when he awoke asked for nourishment.

13*th*. The patient still pale, but not cyanosed. Good resonance over the right side to the liver dulness, which was in the normal position. Heart dulness was of normal size and in the normal position. Breathing was slow, regular, and full.

24*th*. There was good respiratory movement on both sides of the chest. Breath sounds not quite so loud on the right side as on the left. Heart and liver in normal position.

March 3*d*. The child appeared well. The breath sounds were still not quite so loud over the right chest as over the left.

Patient was sent to Florida March 1st. Was improving steadily until April 8, when suddenly, in the middle of the night, he was seized with pain and seemed to be trembling and cold. There was some shortness of breath. From that time on he became gradually more dyspnœic; breathing rate about 60. Various diagnoses were made until Charleston was reached, and liquid was diagnosed in the chest.

April 16. *Physical Examination.* The patient lies quietly on the right side; but when disturbed he cries. He is not cyanosed. Crying does not cause cyanosis at first. After crying has continued and a little exertion is made, cyanosis is present. Bulging of the right side posteriorly. There is but little motion on that side. The apex-beat of the heart is not plainly seen, but it can be felt half an inch outside of the nipple line. Right chest measures 10½ inches; left, 12 inches. No fremitus on the right side. Large rhonchi are heard over the right side, possibly transmitted from the left. No coin sound; no metallic tinkling; no amphoric breathing. On quiet breathing, fairly good breath sounds are heard over the entire right side, but nothing to compare with those on the left. Percussion shows flatness over the entire right side posteriorly, resistance below the ribs on the right side, and good resonance over the right and left flank on lying down.

17*th*. The dulness still persists on the right side; no fremitus; distinct breath sounds on the right side; blowing breathing at extreme apex of the right side; left border of the heart dulness at the anterior axillary line. The patient was tapped in the mid-axillary line. There

was practically no fluid present; only a small amount of blood and water that was in the tube at the time of operation. A hypodermic needle was entered in two other positions, but no liquid was found. After the operation the patient's left chest was almost tympanitic in character. Breath sounds were present. The patient could lie in comfort on the back—a thing not possible before.

18*th*. Patient breathing rapidly; lying on the right side; pale, but not cyanosed; abdomen distended. On the right side of the abdomen there is very much more resistance than on the left. The interspaces on the right side are still bulged. There is epigastric retraction, the exterior jugular vein is filled There is tympanic resonance over the right side anterior to the margin of the ribs, and there is dulness posteriorly of the right side below the fourth rib. No tinkling, no amphoric breath sounds. The exterior jugular fills on crying. The heart dulness is almost in the anterior axillary line.

21*st*. Breathing is more labored than yesterday, there is resonance over the right chest as far as the sixth rib anteriorly and posteriorly. Dulness below that position. The dulness is not movable. The left border of the heart is one inch to the left of the nipple.

22*d*. The patient passed a restless night, is cyanosed, the heart action rapid and weak. Physical signs about as yesterday except the position of the liver, which seems to be on a decidedly lower line that it was yesterday. In the afternoon the patient was suffering so extremely, and apparently was in such imminent danger of death, that ether was administered, a portion of the sixth rib excised, and the following conditions found:

There was a cavity lined with pleura which extended above the point of opening as far as the finger could reach. It contained 60 c.c. of bloody liquid. The whole lower chest was filled with a semisolid substance.

The patient bore the operation badly, but revived under stimulation, and was in good condition two hours after the resection.

24*th*. A sudden cardiac dilatation after a good night's rest.

26*th*. Death occurred. At the autopsy the right chest was found filled with a primary new-growth of the pleura. Rupture of the lung had occurred as the first sign of the disease.

A study of our own cases and of those we have collected from the literature shows that pneumothorax occasionally occurs in persons in apparent good health. This has been observed as the cases we have collected testify, but the tendency of writers has been to ascribe such cases to an unsuspected tuberculous lesion that had remained and continued to remain unrecognized by physical and rational signs. We desire to emphasize the fact, however, that there is a spontaneous pneumothorax which is not due to tuberculosis of the lungs. What is its cause? The most reasonable view, it seems to us, is that the rupture of the lung occurs through an emphysematous vesicle. This presupposes the existence of an emphysema; hence, it might be said, a disease of the lungs. As we have tried to exclude from our tabulation all cases of pneumothorax occurring in advanced chronic emphysema, our list comprises only cases in which emphysema if it existed was moderate and

not possible of diagnosis. Now a moderate degree of emphysema in adults cannot be considered a sign of disease. It is extremely rare to find an adult lung in which there are not a few enlarged vesicles along the anterior margins or at the apices. As this condition is not recognizable clinically, and as it is not considered a sign of disease post-mortem, it is not necessary to do so when explaining spontaneous pneumothorax. Our conclusion, therefore, is that pneumothorax can occur, with a practically healthy lung, from rupture of an emphysematous vesicle.

The possibility of its occurrence as the result of emphysema is undoubted. A number of cases of pneumothorax are on record in which the autopsy showed advanced emphysema and no tuberculosis.

In Ranking's case, quoted in our series (No. 9), there was a spontaneous pneumothorax, with recovery. Some time after the patient died of an unsuspected dissecting aneurism. At the post-mortem a small superficial area of the lung that had been affected with pneumothorax was found to be the seat of emphysema. Ranking believed that the pneumothorax occurred because of the rupture of one of these vesicles. There was no tuberculosis. Devillier (the first case of our table) was unable to find at the post-mortem any signs of tuberculosis, and believed the pneumothorax was due to rupture of an emphysematous vesicle which was found.

Cnopf[21] has observed several cases of diphtheritic croup which developed pneumothorax before death; at autopsy an emphysema, local in character, was found, rupture having taken place through one of the vesicles.

Zahn[22] reports six cases of pneumothorax caused by exertion in individuals suffering from some grave pulmonary lesion. He found either a rupture through a local emphysema or to a tear of the pleura due to old pleuritic adhesions.

That pneumothorax may occur with a practically healthy lung is clearly demonstrated by the cases in our table; the histories show that the individuals were perfectly well before the occurrence of the pneumothorax. The after-history is likewise one of perfect health. No severe inflammatory reaction followed the entrance of the air into the pleural cavity. In tuberculous cases the simple pneumothorax is soon followed by the formation of liquid in the chest. Tuberculous cases die in the great majority of instances or become chronic invalids.

In three of the cases in our list (Osler, Chauffard, and Jochmans) tuberculin was used without any reaction following. This would go to show that in these cases at least there was no tuberculosis.

Diagnosis. With the symptoms as described above, sudden severe pain in the chest, dyspnœa, faintness, cough, and the physical signs of hyperresonance, amphoric breath and voice sounds, metallic tinkling, coin sound, dislocation of the viscera, all suddenly appearing, there can be no possible difficulty in making a diagnosis of pneumothorax. All these

signs, however, are rarely present at the same time in the same case. In the very rare cases in which there is dulness on percussion, together with loss of tactile fremitus and voice sounds, the pneumothorax may readily be mistaken for a pleural effusion, as was done in our first case. The sudden appearance of the symptoms and signs in the course of a few minutes or hours will usually serve to mark the case as one of pneumothorax. Puncture of the chest with a long hypodermic needle should always be resorted to when the question is in doubt.

In the cases in which there is hyperresonance with absence of breath sounds, together with loss of tactile fremitus and voice sounds the thought of emphysema will arise. In emphysema, however, the physical signs are generally bilateral, in pneumothorax one side alone is affected. In the very rare cases of unilateral emphysema there may be more difficulty in arriving at a conclusion. There will be displacement of the viscera in pneumothorax, none in emphysema; the presence of vesicular murmur in emphysema, none in pneumothorax.

There may be great difficulty in the diagnosis from diaphragmatic hernia. In this condition the abnormal percussion note, as a rule, does not extend over so great a surface as it does in pneumothorax; gurgling over the affected side will be present in hernia, absent in pneumothorax. Auscultatory percussion—percussion over the abdomen, auscultation over the chest, reveals distinct transmission of the percussion note; and when the patient swallows water there may be splashing and gurgling noises. If strangulation is present the symptoms of this condition will help in the diagnosis. Attention to the same physical signs will aid in the differentiation of pneumothorax from an abnormally high position of the diaphragm on one side, with the consequent apparent presence of the stomach and intestines in the chest cavity.

The non-tuberculous cases will have to be distinguished from the extremely rare tuberculous cases which recover without the development of effusion. The history of the case and the absence of tuberculosis in any portion of the body will help. The use of tuberculin will cause a reaction in the tuberculous cases, none in the non-tuberculous.

The great difficulty in distinguishing these benign cases from malignant disease of the pleura with pneumothorax is well illustrated by the case we have reported. The final outcome is the only distinguishing feature in such a unique case.

In certain rare instances of extremely large tuberculous cavities all the signs of pneumothorax may be present, except dislocation of the viscera, which will serve to point the way to a correct diagnosis.

Case 56, by Jochmans, is of especial interest, because the X-ray was used to confirm or make the diagnosis. The collapsed lung could be seen as a shadow above a clear zone below. As the lung expanded its shadow was seen further down.

Treatment. The great majority of patients were put to bed and received an opiate to control the pain. No other treatment was necessary, as they soon began to improve. In our second case (No. 55 of table) strapping of the chest with adhesive strips proved effective in controlling the pain. Nine of the cases were aspirated, with instant relief of all symptoms and without return of air into the chest cavity.

Aspiration is certainly a safe procedure; it is entirely under the control of the operator, so that it can be stopped if untoward symptoms occur. If the symptoms are urgent the case should be aspirated, and aspiration should also be performed if the air is not spontaneously absorbed in a few days.

It is wise, however, to delay aspiration for a few days after the rupture, in order that the seat of the opening may be firmly closed with lymph, otherwise the opening will rupture and the air re-accumulate.

Result. All but one case recovered (Case I., 1826), but the true nature of this case was not realized until autopsy.

Conclusions. 1. Spontaneous non-tuberculous pneumothorax occurs in healthy individuals. It is rare. It is most common in young men.

2. The pneumothorax is simple—*i. e.*, there is no formation of fluid.

3. There is rarely any febrile reaction, except, perhaps, in the very beginning.

4. There is probably a moderate amount of emphysema in the lung which is not recognized during life and is not incompatible with health.

5. Aspiration is a certain and safe means of relief and should be resorted to in severe or prolonged attacks.

6. This form of pneumothorax is benign. All but one of the reported cases recovered, and there was only once formation of fluid.

Bibliography.

See also list of cases.

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11. Hamilton. Montreal Medical Journal, 1898, xxvii. p. 885.
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13. West. Clin. Society Trans., 1884, xvii. p. 56.
14. Hall. Ibid., 1887, p. 153.
15. Adams. Boston Medical and Surgical Journal, 1886, p. 397.
16. Powell. Diseases of the Lungs and Pleura, 4th ed., 1893, p. 152.
17. Fowler and Goodlee. Loc. cit.
18. Aron. Deutsche med. Woch., 1896, p. 257.
19. Cayley. Clin. Society Trans., 1884, xvii. p. 52.
20. Hale White. Ibid., 1896, p. 905.
21. Cnopf. Münch. med. Woch., 1893.
22. Zahn. Virchow's Arch., 1890, vol. cxxiii.

List of Cases.

Reporter.	Sex and age.	Side affect'd	Duration.	Cause.	Symptoms.	Treatment.	Result.
1. Devillier. Thèse, Paris, 1826.	M. 18	Right	Several days.	.....	Dyspnœa; pain.	None.	Death.
2. Ferrari. Gaz. Méd. de Paris, 1856, No. 11.	M. 16	Right	Few days.	Over-exertion.	Resonance over chest, pain, dyspnœa, fever, cyanosis, no respiratory sounds, distention of chest.	Aspiration.	Recovery.
3. Brunnicke. Dublin Hospital Gazette, 1856, p. 111.	M. 31	Right	Few weeks.	.....	Perfectly well three months after.	.....	Recovery.
4. Dowell. Ibid., September, 1856.	M. 23	Left	3 to 4 weeks.	Severe cough.	Pain; slight cough.	.....	Recovery.
5. Thorburn. British Medical Journal, 1860, vol. i. p. 413.	M. 32	Right	2 mos.	24 hours after hard rowing.	Few: only dyspnœa, resonance, metallic tinkling, amphoric breathing.	Rest; iodine externally.	Recovery.
6. Thorburn. Ibid.	M. 37	Right	2 mos.	After gardening.	Same as above.	Rest.	Recovery.
7. Wipham. Proc. London Med. Soc., vol. ix. p. 247.	M. 31	Right	1 mo.	No exertion, had been sitting in draught.	Pale, anxious; amphoric breathing; metallic voice sounds; resonance on percussion good; fremitus.	Rest.	Recovery.
8. Ricker. Wien. med. Woch., 1860, No. 28.	M. 18	Left	2 mos.	During coughing	Pain; dyspnœa.	Aspiration; patient relieved at once.	Recovery.
9. Ranking. Ranking's Digest, 1860, No. 11, p. 96.	M. 19	Left	2 mos.	.....	Pain, dyspnœa, distention of side, dislocation of heart, amphoric breathing; metallic tinkling.	No treatment.	Recovery.
10. Abeille. Gaz. Méd. de Paris, 1867, No. 1.	M. 29	Right	7 wks.	Hard work.	Pain, dyspnœa, no phys. signs at first, three days later amphoric breathing, tympany, metallic tinkling.	Morphia for pain; rest.	Complete recovery.
11. Vogel. Deutsch. Arch. f. klin. Med., 1867, vol. xi. p. 244.	F. 29	Right	4 wks.	Over-exertion.	Pain, dyspnœa, dislocation of heart.	Opium; rest.	Recovery.
12. Rilliet and Barthez. Malades des Enfants, vol. i. p. 614. Quoted by Galliard.	... 3	Right	30 dys.	Unknown.	Pain, dyspnœa, amphoric breathing; no metallic tinkling.	.....	Recovery.
13. Oppolzer. Allg. Wien. Med. Zeit., 1868, No. 52.	M. 17	.....	Few days.	.....	Sharp pain, dyspnœa, dislocation of organs, resonance, bell tympany.	Opium; rest.	Recovery.
14. Forster. Archiv f. klin. Med., 1869, vol. v. p. 545.	M. 28	Right	3½ mos.	During walking.	Pain, dyspnœa, tympanitic dulness, metallic tinkle, breath sounds weak, distention of side.	Morphia for pain; rest.	Recovery.
15. Mackenzie, Lancet, Aug. 19, 1871.	M. 50	Right	3 wks.	Exertion.	Pain, dyspnœa, lividity, amphoric breathing, metallic tinkling; well in a few days.	Aspiration.	Recovery.
16. Wilks. Brit. Med. Journ., 1874, p. 770.	M. y'ng	Left	Few days.	Exertion.	Sudden onset, gasping, pain, tympany over chest.	None.	Recovery.
17. Wilks. Ibid.	M. eld'ly	.....	Few days.	Exertion.	Intense dyspnœa.	None.	Recovery.
18. Wilks. Ibid.	F. 30	Left	3 mos.	Walking.	Eight months pregn't, delivered at term; dyspnœa, cough; no breath sounds, no voice sounds.	Aspiration.	Recovery.

Reporter.	Sex and age.	Side affect'd	Duration.	Cause.	Symptoms.	Treatment.	Result.
19. Church. Edinburgh Med. Journ., June, 1875.	M. 39	Right	3 wks.	Walking.	Pain, dyspnœa.	Aspiration.	Recovery.
20. Bozasinsky. Canst. Jahr., 1876, vol. xi. p 168.	M. 30	.....	26 dys.	.....	Attack occurred during sleep.	.....	Recovery.
21. Bull. Ibid., 1877. vol. xi., p. 171. Quoted by Biach.	F. 29	Left	Short time.	Playing, inst. conversation.	Two attacks, one after playing piano, another after talking.	.....	Recovery from both attacks.
22. Heitler. Wien. med. Woch., 1879, No. 17.	M. adult	Right	2 mos.	While dressing.	Dyspnœa, no fever; tympany, distention of side; heart in normal position?	.....	Recovery.
23. Delgrange. Journ. des Sci. Méd. de Lille, in Brit. Med. Journ., 1881, p. 196.	M. 18	Left	8 dys.	Inflating chest.	Pain, dyspnœa.	.....	Recovery.
24. Fraentzel. Ziemssen's Encycl., vol. iv. p. 746.	M. 19	.....	6 wks.	Rolling barrel.	Tearing in chest; dyspnœa.	.....	Recovery.
25. Biermer. Würzburger Med. Zeit., vol. i. p. 385.	M. 18	Left	7 wks.	Dancing.	Sensation of oppression, dizziness.	Some liquid formed.	Recovery.
26. Flint. Practice of Medicine, 1881.	M. 29	Left	7 wks.	Carrying a pack.	Pain, tympany, dyspnœa, amphoric breathing, metallic tinkling.	Morphia.	Recovery.
27. Johnson. Clin. Soc. Trs., 1882, p. 159.	M. 17	Left	2 mos.	Playing.	Pain, dislocation of viscera three days after onset of pain.	Rest.	Recovery.
28. Rix. Quoted by Hall.	M. 39	Left	7 wks.	While sweeping.	Pain, faintness, hyperresonance, metallic tinkling, no cough.	None.	Recovery.
29. West. Clin. Soc. Trans., 1884, p. 56.	M. 24	Right	5 wks.	?	Pain, dyspnœa, displaced heart and liver, bell tympany, amphoric breathing, metallic tinkling	Aspiration.	Recovery.
30. Symonds. New York Med. Record, 1886, vol. i.	M. adult	Left	8 wks.	Riveting.	Pain, dyspnœa, dislocation of organs, no respiratory murmur.	None.	Recovery.
31. Vinay. Lyon. Méd., Jan. 30, 1887.	M. 19	Left	2 mos.	?	Pain, no movement on affected side, no fremitus; tympany, amphoric breathing, metallic tinkling, dislocation of heart.	Morphia for pain.	Recovery.
32. Hall. Clin. Soc. Trans., 1887, vol. xx.	M. 24	Left	1 mo.	Unknown.	Temp. 100°, resonance, metallic tinkling, a second attack with no apparent cause.	Quiet.	Recovery.
33. Galliard. La France Méd., 1887, vol. iii. p. 1617.	M. 33	Right	Short time.	Exertion.	Pain, tympany, no fremitus, silence over chest.	Rest.	Recovery.
34. Gabb. British Med. Journ., 1888, vol. xi. p. 178.	F. 56	Right	Each attack 2 or 3 months	Strain.	Pain, dyspnœa, amphoric breathing, at first low down, later above resonance; four attacks well recorded, 1874, 1880, 1882, 1888.	Morphia.	Recovery
35. Waller, Lancet, 1890, vol. i.	M. 16	Right	2 mos.	Jumping.	Pain, faint breath sounds, slight fever, slight dulness.	Tapped with instant relief.	Recovery.
36. Lundie. Edinburgh Med. Journ., 1891, p. 220.	M. 20	Left	1 mo.	Thinks an old pleural adhesion torn.	Pain, dyspnœa, hyperresonance, no heart dulness, no breath sounds, heart was dislocated backward.	None.	Recovery.

Reporter.	Sex and age.	Side affect'd	Duration.	Cause.	Symptoms.	Treatment.	Result.
37. Glaeser. Zeit. f. klin. Med., 1892, p. 394.	M. 32	Left	1 mo.	Unknown.	Sudden onset, dyspnœa, pain, tympany.	Tapped, with instant relief.	Recovery.
38. Klemperer. Deutsche med. Woch., 1893, p. 602.	M. 21	Left	2½ wks	Screaming.	Pain, dyspnœa, unconsciousness, cyanosis, no breath sounds; dislocation of viscera.	Rest; opium.	Recovery.
39. Galliard and Barbe. Gaz. des hôp. de Paris, 1896.	F. 63	Left	6 wks.	Cough.	Pain, dyspnœa, tympany, coin sound, dislocation of viscera.	Rest.	Recovery.
40. Chauffard. Semaine Méd., 1896, vol. xvi. p. 156.	F. 20	Left	2 mos.	Exertion.	Pain, dyspnœa, tympany, amphoric breathing; no sign of tuberculosis, no dislocation of heart.	Tested with tuberculin, no reaction.	Recovery.
41. Goodhart. Clinical Society Transactions, 1896, p. 29.	M. 24	Right and Left	Short time.	Jumping.	Pale, dyspnœa, metallic tinkle, displaced heart.	Rest.	Recovery.
42. Aron. Deutsche med. Woch., 1896, vol. iii. p. 257.	M. 34	Right	6 wks.	.....	Cyanosis, hyperresonance, metallic tinkle, no respiratory sound, positive pressure in chest.	Tapped.	Recovery.
43. Gibson. Edinb. Hosp. Reports, 1896, vol. iv. p. 237.	M. adult	Right	.....	Exercising.	Partial coin sound, no breath sounds, no vocal resonance.	Rest.	Recovery.
44. West. Lancet, 1897.	M. 46	Left	.....	Unknown.	Pain, dyspnœa, metallic tinkle.	Rest.	Recovery.
45. West. Ibid.	M. 24	Right	6 wks.	Cough.	Pain, dyspnœa, bell sound, amphoric breathing, no tuberculosis.	Rest.	Recovery.
46. West. Ibid.	M. 24	Right	8 wks. 4 wks. 2 wks.	Foot-ball.	Three attacks; pain, dyspnœa.	Rest.	Recovery.
47. West. Ibid.	M. 15	Right	2 mos.	Dancing.	Pain, usual sign.	Rest.	Recovery.
48. Osler. Maryland Med. Journ., 1897-98.	M. adult	Right	5 wks.	Walking.	Pain, dyspnœa, cough, bell tympany, metallic tinkle.	Rest; tested with tuberculin, no reaction.	Recovery.
49. Atkinson. Ibid.	M. adult	.....	Few weeks.	Lifting.	Pain, faintness, amphoric breathing	.....	Recovery.
50. Bushby. Liverpool Med. Chir. Journal, 1898, p. 97.	M. adult	Left	3 wks.	Cough.	Pain, heart not located, hyperresonance, no voice or breath sounds.	Rest and opium.	Recovery.
51. Finny. Dublin Journ. Med. Sci., Apr., 1898.	M. 18	Left	8 wks. and 5 wks.	Exertion.	Two attacks two mos. apart, pain, dyspnœa, hyperresonance, metallic tinkle.	Rest.	Recovery.
52. Delafield. Interstate Med. Gaz., 1899, vol. vi. p. 14.	M. adult	Right	3 mos.	3 months, when dismissed	Sudden pain, amphoric breathing: dislocation of heart, author thinks it is tuberculous, but gives no reason.	None.	Under observation.
53. Whitney. Philadelphia Med. Journ., June 1, 1899.	F. 35	Left	9 yrs.	Brisk walk.	Dyspnœa, cough, resonance, dislocation of heart, no fluid.	None.	Under observation.
54. Fussell. This paper.	F. 21	Left	2 wks.	During sleep.	Pain, dyspnœa, dulness on percussion, absence of breath and voice sounds and of fremitus.	Tapped.	Recovery.
55. Riesman. This paper.	M. 27	Right	1 wk.	Cough.	Pain, no dyspnœa, resonance, dislocation of viscera, no breath sounds.	Rest; strapping of chest.	Recovery.
56. Jochmans. Deutsch. Arch. f. klin. Med., 1902, Band iv., Heft 1 and 2.	M. 22	Right	4 wks. 6 wks.	.....	Pain; patient always able to work. Tuberculin used with no effect.	X-ray showed collapsed lung.	Recovery.

A CASE OF HYPERPLASTIC TUBERCULOSIS OF THE VERMIFORM APPENDIX.

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Tuberculous appendicitis is a well-recognized and often observed pathological condition. By reason of its being only a small part of a more or less generalized infection, and not giving rise to independent clinical symptoms, it is, however, a disease seen much more often in the autopsy-room than upon the operating-table, and in either case is usually due to direct extension of a tuberculous typhlitis.

Statistics compiled by Fenwick and Dodwell[1] show that about 85 per cent. of intestinal tuberculosis begins in the cæcum or ileocæcal region, and in confirmation of their conclusion other investigators are quoted. They do not mention its ever beginning in the appendix proper or being strictly limited to that organ. Eisenhardt[2] does not mention such a limitation in 1000 tuberculous subjects examined. In a little more than 99 per cent. of those with intestinal tuberculosis it was found to be secondary to lung tuberculosis. The obvious reason for this is the frequent swallowing of tuberculous sputum. Weigert[3] is quoted as saying that 90 per cent. of the cases of lung tuberculosis are followed by intestinal infection.

Tuberculosis of the bowel usually results in destructive ulceration beginning in the lymph follicles of the mucosa and gradually extending to the deeper coats. Healing by cicatrization, with stricture, may result. Now and then there are seen cases in which connective tissue hyperplasia is the predominant anatomical feature of the lesion, giving rise to a mass often indistinguishable from a true tumor by the naked-eye examination. Such cases are comparatively rare, and such changes nearly always involve the ileocæcal region. About two years ago the writer[4] published reports of two such cases, with a review of the more important literature up to that time. Simultaneously prepared and since published is a valuable contribution to the pathology of the condition with the report of a case by Lartigau,[5] of New York. More

[1] Lancet, 1894, vol. ii. p. 133.

[2] Ueber Häudfigkeit und Vorkommen der Darmtuberculose. Inaug. Diss., München, 1891. Abstract in Baumgarten's Jahresbericht, 1891, p. 824.

[3] Quoted by Herxheimer, Deutsche med. Woch., 1895, p. 891.

[4] A Contribution to the Pathology of Chronic Hyperplastic Tuberculosis of the Cæcum. The American Journal of the Medical Sciences, 1900, vol. cxix. p. 668.

[5] A Study of Chronic Hyperplastic Tuberculosis of the Intestines. Journal of Experimental Medicine, 1901, vol. vi. p. 23.

recently a report of three cases falling well within the class has been made in this country by E. W. Andrews,[1] and a fairly typical unpublished case was recently presented, with demonstration of the specimen, to the Medical Society of Rush Medical College by C. C. Rogers.[2]

Of this form of intestinal tuberculosis more than one hundred cases are now to be found in the literature. In all but a very few of them the appendix has been uninvolved in the hyperplastic process, though Routier[3] describes a case in which it had undergone changes similar to those in the cæcum. I have been unable to find any report in which hyperplastic tuberculosis was confined to this organ. The following case would, therefore, seem to be of unusual interest. It occurred in the private practice of the late Prof. Christian Fenger. Through his kindness I was enabled to obtain the clinical history of the case and to study the appendix at the operation which he performed.

Clinical History. A. G., male, aged forty-seven years, and a merchant by occupation, entered the Passavant Memorial Hospital, Chicago, May 31, 1900. His father died of pulmonary tuberculosis at the age of forty-one years; mother, three sisters, and one brother all living and well. The patient had measles at the age of nine years, rheumatism at thirty years, and has been troubled with asthma since the age of fifteen years. About fifteen years ago he had a mild attack of specific nephritis, lasting but a short time and unattended by complications. Three years ago he developed a left inguinal hernia, and eight months ago a right.

The present illness began about five weeks ago. While working he felt a griping pain in the abdomen, which lasted but a few minutes and passed away. (This was attributed to the hernias by the patient, and considered to be of little consequence. Closer questioning brought out the fact that similar sensations had been felt now and then for some months.) Similar attacks recurred about half a dozen times a day. They became gradually more severe and more frequent, and were accompanied by nausea and once by vomiting, so that after about ten days he entered a hospital and was put to bed. There was pain and localized tenderness in the right iliac region. Hot applications relieved the pain, and he became well enough to undertake a long trip from his home to Chicago a few days before applying to Dr. Fenger for treatment. During this trip the pain redeveloped.

Upon entering the hospital the patient had a tender swelling in the region of the appendix reaching down to near Poupart's ligament. Physical examination was otherwise negative. He was put to bed and an alcohol dressing applied. On the day after admission he had an afternoon temperature of 100° F. Thereafter the temperature remained normal until after the operation. By June 8th all spontaneous pain had disappeared, the swelling was much reduced in size, and pressure gave only an indistinct sense of tenderness.

On June 15th an operation was performed by Dr. Fenger under

[1] Annals of Surgery, 1901, vol. xxxiv. p. 787. [2] Meeting of December 2, 1901.
[3] Referred to by Caussade and Charrier, loc. cit., No. 9.

ether anæsthesia, and the enlarged appendix, including a portion of the cæcal wall, which was moderately thickened, was removed. There was no evidence of peritoneal tuberculosis to be found at that time. Healing took place without complications. There was moderate elevation of temperature for a few days succeeding the operation, and now and then a rise of one or two degrees for about a week.

Two weeks after the operation the patient developed an acute painful orchitis on the right side, and the temperature mounted to three or four degrees above normal, where it remained, with some irregularity, for about a week. The orchitis was treated by local applications of cold, and the swelling gradually disappeared, leaving, however, a certain amount of enlargement and induration in the testicle and epididymis. On September 6th the patient was again anæsthetized, and an exploratory incision was made, bisecting the right testicle and epididymis, with the expectation of finding evidence of local tuberculosis, the appendix in the meantime having been proven to be affected with that disease. Such evidence failing to appear, the organ was sutured and left after removal of small portions of both testicle and epididymis for microscopical examination. An uneventful recovery took place, and the patient was discharged in good health on October 9th, without showing any clinical signs or symptoms of tuberculosis.

On March 15, 1902, I had an opportunity to examine and talk with the patient. He reported perfect health during the eighteen months since he left the hospital. There was no sign or symptom of local recurrence in the bowel and no physical evidence of tuberculosis in any other part of the body. The right epididymis was a little thickened, but the testicle and spermatic cord appeared to be practically normal. Beyond a slight asymmetry of the prostate gland, the left lobe being the larger, no abnormalities could be detected by rectal examination. The patient wears a double truss, and the hernias occasion no distress. The urine was found to be normal.

The appendix came under my observation some months after removal and preservation in alcohol. The following description refers to the condition found at that time:

Gross Examination. The part removed includes the appendix and a small portion of the cæcal wall surrounding its base. The cæcal wall shows some thickening, but no other recognizable change in its present condition. The appendix is 6 cm. in length and curved upon itself, so as to form two-thirds of a semicircle. It varies in diameter from 18 mm. to 20 mm. in its thickest part, near the middle, and is 10 mm. at its base, near the cæcum. The distal end is rounded and smooth. It is very firm and hard. It shows on its concave curve the remnant of a meso-appendix throughout its whole length. The surface is in general smooth, and is covered by what appears to be a nearly unaltered peritoneum, with a few ragged, torn adhesions. The color varies from yellow to dark brown, the variation being apparently due to differences in the amount of subperitoneal blood. The surface is marked by smooth, rounded, projecting masses of firm subperitoneal fat, which invade the wall to a considerable distance. Section in both longitudinal and transverse direction shows the lumen to be practically obliterated. Its original location is, however, still visible in all places. The mucosa is from 2 mm. to 3 mm. in thickness, and is sharply demarcated from the fibrous wall surrounding it. In places there is a

distinct line of cleavage between them, presumably from the greater contraction of the softer mucosa during the process of hardening, thus forming two concentric rings. This thickened mucosa appears smooth and finely granular on the cut surface. The outer wall is made up of firm, whitish fibrous tissue of almost uniform appearance, and varies in thickness from 6 mm. to 10 mm. A few small yellow spots are seen in the subserous layer. It is invaded by the fat masses before referred to, which extend inward from the peritoneal covering. Microscopical tubercles or caseous areas are not seen in the hardened specimen, though in parts of the wall near the serous surface the somewhat more yellowish tinge of certain small areas suggests changes of that character.

Microscopical Examination. Sections were cut, after embedding in celloidin, from various parts of the appendix and the cæcal wall, and in various directions. They were stained with hæmatoxylin and eosin. Complete transverse sections were made through the middle, showing all the coats in their natural relations. Examination with the naked eye and an ordinary hand lens shows a thick, pink-stained wall containing minute blue dots, and a few larger areas nearer the serosa staining a paler blue. The central portion lying next to the lumen forms a blue-staining zone, and is from 2 mm. to 3 mm. in thickness. Irregularities in the depth of color are here very apparent. The low powers of the microscope show this zone to be made up of densely aggregated small round cells filling the mucous and submucous layers. Higher powers show the small cells to be mostly mononuclear, with deeply staining nuclei, making up the picture of ordinary tuberculous granulation tissue. Many giant cells are present, some of them large and containing large numbers of nuclei. Surrounding the giant cells are areas of pale epithelioid cells, with large, well-preserved nuclei. Microscopical tubercles of fairly typical appearance are numerous. In no place is there complete necrosis or caseation. The nuclei of practically all cells are distinct.

The epithelial lining of the appendix is in a fair state of preservation. Its cells stain quite well and show mucoid degeneration. In a few small places there is no layer of epithelium covering the submucous granulation tissue and tubercles. The glands of the mucosa are comparatively scarce. Now and then a little group in a fair state of preservation is seen penetrating the deeper layer; in other places there are found mere remnants of scattered glands embedded in the granulation tissue and apparently off from the surface. The epithelial cells of such glands resemble those superficially placed. Where glands are entirely absent the single layer of epithelium passes smoothly over the submucous tuberculous tissue.

The whole of the submucosa is densely packed with small cells and tubercles, and the line of demarcation between this and the muscularis is, as a rule, definite and distinct.

The muscularis is greatly thickened and largely transformed into connective tissue of the adult type. There is, however, a considerable excess of muscle cells—a highly sclerotic muscularis. The direction of the fibres is uniform enough to permit of an indefinite distinction between the circular and longitudinal layers in some parts. In places, however, we find oblique bundles of fibromuscular tissue following neither plane in a normal way. In certain areas a dense connective

tissue only is to be made out. Studding the whole of this thick layer are a few microscopical tubercles. Some of these are of typical form, with centrally placed giant and epithelioid cells and a surrounding

FIG. 1.

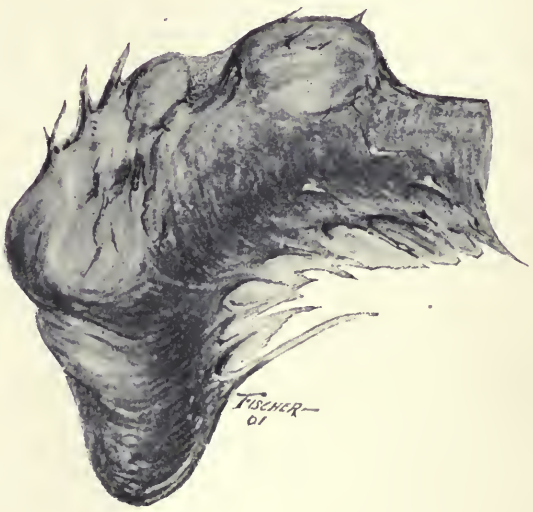
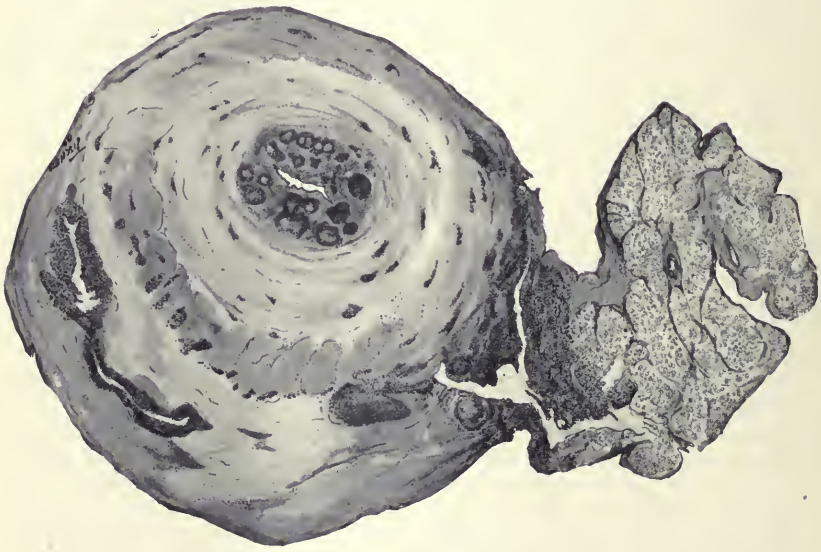


FIG. 2.



zone of lymphoid cells. Others are entirely of the lymphoid type—only minute collections of closely packed lymphoid cells.

The subserous coat is greatly thickened, in places more than equal-

ling the muscularis. It contains a great excess of adult connective tissue and many microscopical tubercles. Some small areas are present in which a considerable degree of degeneration has taken place, though none to the extent of complete necrosis and obliteration of structure. All areas contain many cells with well-stained nuclei. Masses of fat are found in this layer in portions where it was recognized in the gross examination. In the thickest part of the appendix this fat is absent.

The meso-appendix contains much fat, and is of ordinary appearance. It contains tubercles near the appendicular attachment.

Some of the vessels of the appendicular wall show no noticeable changes, and are filled with red blood cells. In others the vessel wall is distinctly thickened.

Sections of the small portion of the cæcal wall removed show the mucosa and submucosa to be filled with tuberculous granulation tissue of ordinary form and containing many typical and atypical tubercles without caseation or necrosis. The wall throughout contains an excess of round cells, but is not thickened more than is to be accounted for by reason of this infiltration. Its epithelial layer is intact, but shows much diminution of glandular elements.

Bacteriological Examination. Sections were stained in the ordinary way with carbol-fuchsin for tubercle bacilli; hæmatoxylin, methylene blue, and picric acid were used as counter-stains. Many sections were examined, with negative results.

Microscopical Examination of the Epididymis. A few prepared sections of this organ were found in the hospital laboratory. The connective tissue of the epididymis is considerably increased. The epithelium is practically unaltered. Here and there in the stroma are found little areas of small round cells containing single deeply staining nuclei. These are not sharply marked off from the surrounding tissue, as a rule, the edges blending gradually with the stroma. None of these areas contain epithelioid or giant cells, hence they do not conform to the typical picture of tuberculosis. In none of the areas is there any necrosis, nor are any of them made up of or infiltrated with polymorphonuclear leucocytes. They are made up entirely of lymphoid cells. Search for tubercle bacilli in these areas was made by the hospital house officer at the time of the original examination, and was negative. Dr. Fenger interpreted the small celled areas as being most probably lymphoid tubercles. He was not, however, in possession of the fact of an old specific urethral infection.

Unfortunately, the piece removed from the testicle was lost before sections had been made.

This case is of pathological interest because of its comparative rarity and the unusual results of infection with tubercle bacilli. It is of further interest to the surgeon because of the slow progression and amenability to operative treatment of such forms of tuberculosis in the intestinal tract.

Our knowledge concerning the etiology of tuberculosis as a distinctly hyperplastic process is still unsatisfactory. The disease is essentially a chronic inflammation of low intensity and slow progress. These elements have been explained in various ways. Practically all tuber-

culous cæcal tumors are poor in tubercle bacilli, and this fact may in a measure account for the chronicity of the process, though in a typical case reported by Caussade and Charrier[1] they were numerous, and Tchistovitsch[2] has shown that caseation does not depend so much upon the number of tubercle bacilli present as upon their virulence. Attenuation of the organism is the explanation advanced by Lartigau[3] and others. It is not easy to explain how this attenuation is brought about. Infection with an originally attenuated organism has been assumed by some.

Hartmann and Pilliett[4] advance the opinion that secondary infections induce some of the changes met with in this class of cases and contribute in some measure directly to the production of the hyperplastic process, and perhaps also indirectly by causing attenuation of the tubercle bacilli present. In this connection a series of experiments by Raymond and Ravaut[5] is of interest and importance. They demonstrated quite conclusively that tuberculous dissemination and destruction in the lower animals proceed more rapidly in the presence of either pathogenic or non-pathogenic secondary infections. In case of the non-pathogenic infections the reason for this is not directly apparent, but where a pathogenic secondary infection occurs the explanation is logically based upon the fact that injured tissue becomes less resistant. In the more usual forms of tuberculosis it is a matter of common observation that secondary infection adds to the rapidity of the destructive process and increases the gravity of the disease.

Since the tissues of various animals and individuals and organs have a wide degree of variation in susceptibility to a given organism, it may be that not enough stress has been laid upon individual and local resistance. The toxins of a given tubercle bacillus might be able to produce only slight irritation when growing in the tissues of one appendix, thus determining a conservative process of hyperplasia, while in another they might produce rapid necrosis. It is decidedly unusual to find in any part of a body with hyperplastic tuberculosis of the cæcum any rapidly progressive or destructive lesion. It is, on the other hand, frequently found that an old healed or latent tuberculosis of the lung exists. Again, it is not infrequent to find an acute process developing in the lungs late in life, when the general nutrition has been brought to a low condition by the prolonged incomplete intestinal obstruction so often existing, or has been similarly reduced

[1] Un cas de tuberculose ileo-cæcale de form hypertrophique. Arch. Générales de Méd., 1899, N. S., Tome i., No. 4.

[2] Annales de l'Institut Pasteur, Tome iii. p. 209.

[3] Loc. cit.

[4] Notes sur une variété de typhilite tuberculeuse simulants les cancers de la region. Bull. de la Soc. Anat. de Paris, 1891, p. 471.

[5] Action des microbes sur le development du bacille de la tuberculose. Arch. de Méd. Expérimentale, 1899, Tome xi., No. 4, p. 494.

by other causes. Such a change need not be attributed to an infection with a new and more virulent organism or to the taking on of new qualities of virulence by the original infection, but rather to a decreasing individual resistance, which finally becomes so low as to be of no avail as a protective influence. This quality of individual resistance may be looked upon as only one of several or many elements in determining a hyperplastic tuberculous process. The question of the attenuated organism is probably the most important, and the scarcity of organisms so often found is perhaps of some slight importance.

In concluding we may summarize as follows: 1. Secondary tuberculosis of the vermiform appendix is a frequent condition, and usually occurs by extension from the cæcum. 2. Primary tuberculosis of the appendix is a rare disease. 2. The tuberculous appendix may undergo hyperplastic changes similar to those occurring in other parts of the bowel, chiefly the cæcum. 4. Hyperplastic tuberculosis may be limited to the appendix, but such limitation is very rarely met with. 5. The etiology of tuberculosis as a distinctly hyperplastic process is not well understood.

SOME OF THE DIFFICULTIES AND ERRORS IN THE DIAGNOSIS OF APPENDICITIS.

By Charles Greene Cumston, M.D.,
of Boston, Mass.

There are few organs which have such varying anatomical situations as the vermiform appendix, but this structure only follows the law applicable to all residuary organs without definite functions, and which are the remains of an embryonal state. In the embryo the appendix is found in the prolongation of the large intestine, and first appears underneath the liver. When the interstitial development of the ascending colon takes place, the organ migrates downward, and is found on the internal aspect of the cæcum.

In the adult it is to be found in the internal half of the iliac fossa, at the boundary of the superior strait of the pelvis, and is held in this position by a peritoneal fold derived from the mesentery, commonly called the meso-appendix.

The direction of the appendix in relation to the cæcum may be internal, ascending or descending. Its length is extremely variable.

From this we can see how different may be the relationship that the organ may acquire. When it is long and ascending in direction it may reach the right kidney or the under aspect of the liver. When descending it is in close relationship with the organs contained in the small pelvis, such as the uterus, adnexa, ureters, or bladder. When

its direction is internal it is in relation with the terminal portion of the ileum, and may even extend across the median line of the abdomen. When it takes an external direction it is in relationship with the psoas muscle, and this is the most frequent descending situation, according to Testut. From this great variability in the anatomical relationship of the organ it is easy to conceive how difficult a diagnosis of appendicitis may be made under certain circumstances.

We may conveniently divide the abnormal anatomical situations of the appendix into three classes, basing them on the various causes of ectopia of the appendix. (1) In this class we have those anomalies due to adhesions occurring during fœtal life. These adhesions may exist between the organs contained in the right hypochondrium, where before birth the cæcum is found along with the liver, the gall-bladder, the kidney, and the duodenum. They give rise to intraperitoneal or extraperitoneal appendicitis, to subhepatic peritonitis, or to perinephritic or to perihepatic abscesses. The appendix may adhere to the testicle or to the ovary, which during their descent draws the appendix downward, thus producing an inferior ectopia. From this fact we can explain those cases of appendicitis occurring in hernia sacs in the male, and those cases of pelvic appendicitis in the female which are easily mistaken for a salpingitis, perimetritis, or hæmatocele, as is well illustrated by two of my cases, which will be detailed further on. (2) The anomalies due to a malformation or a migration of the cæcum have for cause an arrested development of the cæcal ampulla, which may remain in the right hypochondrium in the region of the liver, or to a displacement of the cæcum in the abdominal cavity. These displacements are generally due to a very great laxity of the mesocæcum. The cæcum and the appendix in a state of migration have been found in most every part of the abdominal cavity, in the right or left iliac fossa, the pelvis, or even in the left hypochondrium. (3) Abnormal appendicitis, on account of a change in the relationship between the appendix and the cæcum, is by far the most frequent. The appendix may be extremely long and very movable, and it may be found in the midst of the loops of the small intestine, where, when it becomes inflamed, there will result an encysted peritonitis. These purulent peritoneal pockets may be multiple. When the inflamed appendix does not contract adhesions with the neighboring parts, it may set up a sudden generalized peritonitis which rapidly ends in death.

The appendix is sometimes found in a state of retrocæcal ectopia—that is to say, folded under the cæcum outside of the peritoneum—and when an inflammation of an appendix thus situated arises, the pus may make its way toward the kidney or into the pelvis.

The mere examination of a possible situation of the appendix gives us an idea of the great difficulty of making an accurate diagnosis in a

certain number of cases, and I would warn the general practitioner to be very wary of the famous McBurney point, and the symptomatic trio, namely, pain, muscular rigidity and cutaneous hyperæsthesia to be found in this region.

I will now rapidly enumerate the classical symptoms of appendicitis, and will endeavor to ascertain if there are any that may be truly called pathognomonic. These symptoms are objective and subjective. The first class consist of tumefaction and an elevation of the temperature.

The tumefaction may be present either in the form of a localized induration seated in the right iliac fossa, varying in size from a walnut to a hen's egg, or it may be found in the form of a small movable, elongated tumor the size of the finger, while by percussion a little dulness may be elicited. But I would say that, at least as far as my experience goes, palpation of an enlarged appendix is a very difficult matter, and I believe that when a well-defined mass can be palpated, it is due more particularly to the tumor formed by a peri-appendicial inflammatory exudate than to an enlarged appendix itself. The presence of adhesions of the appendix to the neighboring parts will also give rise to the formation of a tumor. Unfortunately, the cases where satisfactory palpation can be accomplished are very infrequent, and this for several reasons, namely, on account of the thickness of the abdominal walls and the muscular rigidity due to the hyperæsthesia.

The temperature in appendicitis, according to my experience, has nothing characteristic about it, and I have seen patients with several ounces of pus and a ruptured appendix in their abdomen, who had a perfectly normal temperature, with a pulse of 80. Then, again, certain cases of appendicitis produced by anaërobic organisms run an apyretic course.

The subjective signs consist in pain localized to one point, muscular rigidity, and cutaneous hyperæsthesia. The pain may assume various types, being sharp or dull, continuous or occurring in paroxysms; but what seems to be the most important point in the mind of the general practitioner is that this pain and muscular rigidity are to be found at a point in the middle of a line drawn from the umbilicus to the anterior superior iliac crest. That in an ordinary every-day attack of appendicitis this classical situation will be found present in a large number of cases I do not deny, but when they do not exist the fact that we are dealing with a case of appendicitis cannot be excluded. When we have a patient whose abdomen is painful over its entire extent, it is certainly a difficult matter to exactly localize the starting point and the maximum point of the intensity of the pain. I have seen so many cases of appendicitis where the pain was localized around the umbilicus exclusively that I have come to regard it as of almost as much diagnostic value as McBurney's point, and in one case of a little girl, six

years of age, I opened the right iliac fossa after having made my diagnosis of appendicitis exclusively on the condition of the pulse, temperature and localized pain in the region of the umbilicus only, and removed a greatly enlarged and inflamed appendix. I am glad to see that in a recent issue of the *London Lancet*,[1] Mr. Roper calls attention to pain around the umbilicus as symptomatic of appendicitis.

Muscular rigidity will always be found wherever inflammatory lesions exist within the abdomen, and as to cutaneous hyperæsthesia I can only say that it varies greatly with each individual.

The concomitant symptoms, such as constipation, diarrhœa, mucomembranous colitis, or former attacks of appendicitis, may occasionally aid in the diagnosis, but they do not go very far in helping us, excepting, perhaps, in the matter of constipation.

The other symptoms which may be observed simply form a part of the symptom complex of peritonitis. They arise when infection has become generalized throughout the peritoneum, and consequently have nothing of certainty about them. Most important of all is to discover the starting point of these symptoms, because they may be just as well due to an acute salpingitis, an intestinal perforation, or to any other septic condition of the abdominal or pelvic organs.

Bilious vomiting, a rise in temperature, symptoms of intestinal obstruction, a small, thready pulse, all have nothing that is characteristic, and consequently we may say that in a certain number of cases there is not a single infallible sign in the presence of which we may say this is a case of appendicitis. Those symptoms on which up to the present time surgeons have based their diagnosis, for want of something better, are the subjective symptoms, that is to say, those which offer nothing constant and which change their physiognomy in each individual case. Consequently, the diagnosis of appendicitis can only be made after taking into consideration all the symptoms presented by the patient and the evolution of the affection; but I think that we will all be humble enough to say that in some cases the correct diagnosis was not made until the abdomen had been opened.

I make no pretention to throw any new light on the diagnosis of appendicitis, and my only point has been to report a few cases occurring in my practice, as they demonstrate fairly well how circumspect one must be in giving his opinion as to the nature of the case, and how difficult it is to arrive with certainty at a correct diagnosis.

Case I.—The following case I saw in consultation with Dr. W. Herbert Grant, to whom I am indebted for the following notes: The patient was delivered of her first child February 22, 1900; the labor was easy and the perineum only slightly ruptured, requiring two stitches. On March 24th, that is to say about a month after the labor,

[1] Arthur C. Roper. When to Operate in Perforative Peritonitis, Lancet, April 20, 1901.

the patient, who had done very well up to that time, began to complain of a slight flow from the uterus every day, and a backache. Examination showed the uterus somewhat enlarged. Ergot was ordered.

On the next day she complained of considerable pain occurring during the night. She had vomited and fainted. She also complained of pain in the region of the stomach. The abdomen was tender on palpation, especially in the region of the appendix. There was no flow, and a large hot douche was ordered, with fomentations. Temperature was 38.5° C.

On March 26th the temperature was both normal in the morning and afternoon, and the patient said she felt much better. The bowels had moved twice from the salts which had been ordered the day before. The patient was ordered to remain quiet in bed and continue the hot douches.

On April 4th she was seen again in considerable pain, and the same treatment was ordered. By April 11th she was up and about, looking fairly well, but there was still some pain in the right side. On the 14th she complained of severe pain through the entire abdomen, but more especially in the right groin at a point consequently too low for McBurney. The uterus was movable, but manipulations caused pain. The temperature was 38.8° C. On the next day her temperature was 39° C., and as she was not gaining she was admitted to the Baptist Hospital.

At six o'clock of the same day I saw the patient in consultation with Dr. Grant. By bimanual palpation a large mass could be discovered in the posterior cul-de-sac; it was tender on pressure, and might have been the size of an orange. From the history, I was more inclined to believe that we were dealing with a case of appendicitis, probably adherent to the right tube and ovary, which were prolapsed in the cul-de-sac of Douglas, and advised immediate operation, which was performed by Dr. Grant at 8 P.M.

The abdomen was opened in the median line, and the mass was found to be composed of the appendix and right tube, which was considerably enlarged and œdematous, the whole being bound in a mass of fresh adhesions. In attempting to tie off the tubes the ligature cut through, and the stump was sewed over with kangaroo tendon. The appendix, which was very long and dipped directly down into the pelvis, was dug out of the fresh adhesions and removed. The patient made an uneventful recovery, and is, I am told by Dr. Grant, about to be confined with her second child, the pregnancy so far having been perfectly normal.

CASE II.—Patient, aged twenty-eight years. Married; one child five years ago. The patient had been under my care two years previously for endometritis, for which she was curetted, and had been discharged cured.

When asked to see her two years later, I found her in bed with severe pain in the hypochondrium and an anxious facial expression. The entire abdomen was distended, but the pain appeared to be generalized over the hypogastrium, more marked on the right-hand side. The patient had vomited several times during the night. Temperature, 39.5° C.; pulse, 110.

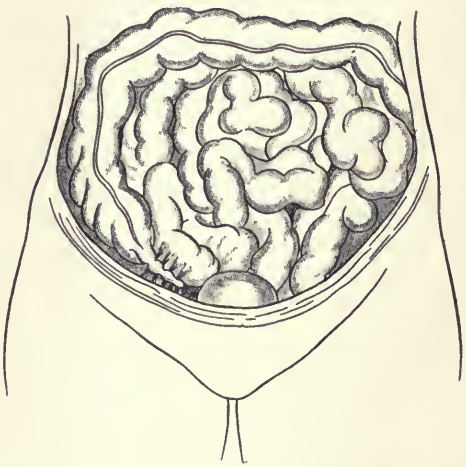
Bimanual examination showed that the uterus was immobilized by a mass on the right side, which appeared to be the broad ligament. Pal-

pation was very difficult, on account of the intense pain it produced, as well as the distention of the abdomen, but I thought I could make out pretty distinctly an enlarged tender tube and ovary.

The next day the patient was worse; she had had a severe chill and the temperature had reached 40.5° C.; pulse, 125. The mass on the right-hand side of the uterus which I had felt the day before was more distinct, and the local symptoms were decidedly limited to the right iliac fossa. Bimanual examination showed that the tumor and the uterus were adherent, and the diagnosis of pus in the right tube and broad ligament appeared to be evident. The slight uterine secretion was examined microscopically and revealed the presence of numerous gonococci.

Operation by the vaginal route was advised, but the family refused, and consequently a medical treatment, consisting of ice-bags to the abdomen and hot vaginal irrigations were ordered along with morphine to relieve the pain.

FIG. 1.



Three days later these severe symptoms began to decrease in intensity, and the temperature fell to 38° C., and the pulse to 90. The patient suffered much less. The abdomen became soft, and palpation allowed me to feel the mass, which was adherent to the uterus and practically filling up the right iliac fossa. In about a fortnight all the symptoms had cleared up and the patient was in full convalescence.

Three months later bimanual examination revealed only a slight induration in the right iliac fossa, the uterus being quite movable.

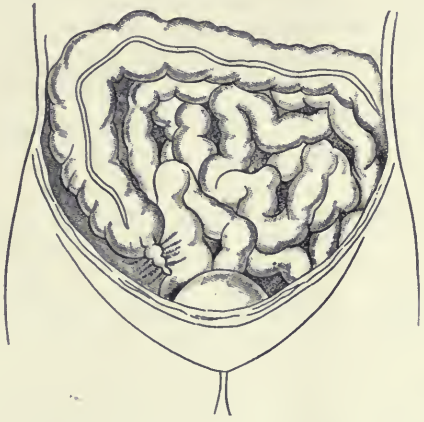
About one year after this attack the patient was suddenly taken with similar symptoms, only much more severe. Examination revealed a mass in the right iliac fossa, but which seemed to be situated higher up because it could easily be reached through the anterior wall of the abdomen. The family this time accepted surgical interference.

On account of the nearness of the mass to the anterior abdominal wall, it was decided to attack it this way rather than through the vagina. Ordinary incision for appendicitis was made, although I still

thought that I was dealing with a diseased tube and ovary. Upon opening the peritoneum I found a long appendix reaching down into the iliac fossa and adherent to some coils of small intestine and to the iliac fossa. The adnexæ were perfectly normal. The adhesions were broken down and the appendix removed after a difficult dissection. The abdomen was closed, and recovery was uneventful. A good idea of the condition of the appendix in this case may be obtained from the accompanying figure. (Fig. 1.)

Case III.—Patient, aged thirty-six years; married, with two children. For some time past she has complained of pains in the right iliac fossa. For the last three weeks the pain has increased in intensity, and vomiting has been frequent. A tumor in the right inguinal region has been present for the last three days. Bimanual examination showed an enlarged uterus in physiological anteversion. The left adnexa are apparently normal. On the right-hand side a large, hard, and only slightly painful mass can be felt. By rectal examination

Fig. 2.



seemed to indicate a parametritic infiltration which extends to the pelvic wall.

By hot irrigation and rest in bed the symptoms improved, and three weeks later bimanual examination showed that the infiltration had considerably decreased, and a small painful tumor, about the size of an orange, could be made out in the region of the ovary.

The abdomen was opened a few weeks later, when a considerably enlarged appendix, forming a cyst and adherent to the coils of small intestine and anterior abdominal wall, was removed. The tube and ovary were perfectly healthy. The patient made a rapid recovery. The condition of affairs in this case is well represented in the figure. (Fig. 2.)

Case IV.—Patient, aged forty years. Mother of several children. Had a miscarriage about the third month, four weeks before we saw her in consultation with Dr. Drew. The doctor had been called in because the patient had been complaining of chills and pain in the abdomen for the past week. The tongue was heavily coated, the tem-

perature was 39.7° C.; pulse, 115. The bowels had been constipated for several months, and the patient could only relieve them by large doses of aperient medicine.

Bimanual examination showed the uterus enlarged and diverted, and pressed up against the pubis by a large retro-uterine mass about the size of a grape-fruit, and which extended upward, reaching the anterior abdominal wall in the median line. A diagnosis of a pelvic abscess following a septic miscarriage was made and immediate laparotomy advised on account of the marked septic condition of the patient.

The abdomen was opened in the median line, the peritoneum was cautiously opened, when a large amount of dirty, greenish, stinking pus was evacuated, about a pint coming away. The cavity thus left was carefully explored and found to be made up of the uterus anteriorly, by masses of small intestine agglutinated together, while the right wall was composed of a greatly inflamed cæcum, with the appendix starting off from it and dipping directly down into the small pelvis. The appendix had perforated at about its middle, and was gangrenous. It was peeled off and removed. The opening into the cæcum could not be closed by sutures on account of the great friability of the gut, and consequently a long glass drainage tube was inserted and the cavity lightly packed with iodoform gauze.

For four days after the operation the temperature chart was one of profound sepsis, the mercury registering 38° C. in the morning, and from 40° C. to 40.5° C. in the evening; but after that time it suddenly dropped, and the patient made an excellent recovery, and was discharged in three weeks.

Case V.—A young unmarried girl, aged twenty years, complained of pain low down in the right iliac region. Bimanual examination made per rectum revealed a tumor about the size of a lemon and apparently adherent to the uterus. There was some tenderness in the left iliac region as well. At no time had there been any acute symptoms, nor elevation of the temperature. Exploratory laparotomy was advised and accepted.

After the abdomen was opened the right tube and adnexa were found bound down in a mass of exudate, and were adherent to a large appendix chronically inflamed. The right ovary, being in a state of total sclerocystic degeneration, was removed along with the tube, and the appendix resected. Examination of the latter organ showed evidences of a chronic catarrhal condition; it is probable that had this organ been allowed to remain for any great length of time a typical acute attack of appendicitis would have resulted.

Case VI.—At one o'clock in the morning I was asked to see a boy, aged seven years, with his family physician, a gentleman in whom I have the highest confidence as regards diagnostic ability, and upon my arrival the following history was given:

The child had always been well since its birth. He was well nourished and an intelligent boy. Three days previously, while playing with some little friends, he complained of pain in the right iliac region, which by evening had reached great severity. The child slept little, and complained of severe pain during the night. The next morning when the doctor saw him he found the abdomen distended, and upon percussion obtained resonance everywhere excepting a line of dulness in the region of the cæcum. Palpation over McBurney's point was extremely

painful, and the pain extended down toward the inguinal canal. A diagnosis of appendicitis was made, and the patient was treated by ice-bags to the abdomen and paregoric in sufficient dose to relieve the pain. The pulse at this time was 110 and the temperature 39° C. For the next forty-eight hours the condition of affairs remained practically the same, but the pain and tympanism increased, and, becoming alarmed about the patient's condition, I was requested to come with all haste with a view of operating.

Upon my arrival I found what would be called a pretty sick boy. The features were sunken, the pulse hardly to be counted, and a respiration of 40. The abdomen was so distended that not much of anything could be made out excepting a severe pain in the right lower half of the abdomen. The boy was lightly etherized and the abdomen was opened as the only chance, small as it was, of saving him. When the peritoneal cavity was opened a dark-blue, turgid tumor presented itself in the region of the cæcum, to which it had contracted some adhesions, as well as with coils of the small intestine. After breaking these adhesions down and freeing the mass, it was found to be an undescended testicle, with two twists in the spermatic cord which had caused the blood supply to the organ to be cut off and was in imminence of gangrene. A pedicle was formed and the testicle and part of the spermatic cord removed.

Here was a case where we were sadly led astray by the symptoms, but to do justice to my excellent friend who called me to the bedside of this patient, I will say that he had only attended this family for about a year, and the errant testicle had never been referred to by the parents of the patient.

Case VII.—As this case has already been recorded in extenso in an article that I published with Dr. Vander Veer in the *Annals of Surgery*, I will be very brief, and I only allude to it here as a case entering under the head of those discussed in this paper.

The patient, a woman, aged about forty years, complained of pain in the right iliac region on several occasions during the winter, and was attended by a gentleman of excellent repute, through these attacks, which he diagnosed as catarrhal appendicitis. After the third attack he advised the removal of the appendix, which was done with great ease, and after its removal the organ upon examination did not present any manifest lesion; but this is usually the case, I think, in simple catarrhal appendicitis when the organ is removed before a severe attack has taken place.

After the appendix had been removed the patient still complained of her right iliac fossa, later vomiting ensued, with distention of the abdomen, and, in fact, all the symptoms of chronic intestinal obstruction. By palpation a small mass could be indistinctly made out in the region of the cæcum, and believing that we were dealing with some inflammatory condition of the latter organ, to which the symptoms of intestinal obstruction were due, I advised opening the abdomen, which was done two days later, when the patient was in a worse condition than when I had seen her two days previously.

The cæcum was found greatly dilated and bound down in the right iliac fossa, where a small hard tumor could be made out, firmly adherent

to the surrounding parts. After a long and difficult dissection, the cæcum with the neoplasm was finally freed and brought up into the abdominal wound. The growth proved to be annular carcinoma of the cæcum. Resection of the gut was deemed imprudent to attempt on account of the bad condition of the patient at the time, and an artificial anus was made. The patient, however, did not rally, and died a few hours later. The differential diagnosis between carcinoma of the cæcum and appendicitis has been alluded to by Mr. Tubby in his lectures on "Abdominal Affections," which were published a short time ago in the *Clinical Journal*, of London, and he is to my knowledge the only author that has brought this important point before the notice of the profession.

CASE VIII.—In August, 1900, I was asked to see a boy, aged six years, and obtained the following history from the attending physician: Three days previously, on returning from a walk with his nurse, the child was suddenly seized with pain in the right iliac fossa and vomiting. His physician saw him about two hours later, when he found great tenderness in the iliac region, and by palpation what he took to be a mass about filling the right side of the pelvic cavity. The temperature was 38.5° C.; pulse, 110; respirations, 28. The child had been in very good health, excepting that a very slight diarrhœa had been present for about six weeks, but as it presented no intensity no medical advice had been demanded.

On the next day the child appeared better, the vomiting had subsided, but considerable pain was still present in the right iliac fossa. The temperature was 39.2° C., but the pulse had dropped to 100. The general condition was good, and the expression of the face was not changed; the tongue was somewhat coated; a liquid diet and ice-bags applied loco dolienti was the treatment carried out. But as the pain in the iliac fossa did not abate in the next twenty-four hours, and as the temperature still remained about 39° C., surgical advice was called for.

Upon examination I found a fairly well-nourished child, somewhat tall for his age and very intelligent. By inspection the right side of the abdomen appeared slightly bulging, but there were no enlarged subcutaneous veins to be seen. A satisfactory exploration by palpation could not be obtained on account of the rigidity of the rectus, and the boy would cry out with pain if any pressure was made over the right iliac fossa. The bowels were rather distended, but I was pretty well satisfied that I could detect a mass in the right iliac fossa and filling up the right side of the pelvic cavity. The temperature at my visit was 38.8° C.; pulse, 99; respirations, 24.

My diagnosis was gangrene of the appendix, with probable perforation, but I believed that the abscess cavity was walled off. Operation was advised and accepted, and was done at 8 P.M.

The usual incision for appendicectomy was made, but when the peritoneum was opened out gushed about 200 c.c. of a lemon-colored liquid, and by inspection the serous membrane was found studded with miliary tubercles. Numerous soft adhesions covered the cæcum down in the pelvis, but after these had been carefully broken down the cæcum with the appendix was brought out of the abdominal incision. The cæcum and ileum were studded with tubercles and were in a highly hyperæmic condition. The appendix was bound down to the ileum by a band of

adhesion about 1 cm. wide, which strangulated the tip of the viscus, but perforation had not taken place, although the end of the organ below the constriction was gangrenous.

The abdominal cavity was carefully explored, but the numerous adhesions between the coils of intestine were respected; the cavity was wiped out with gauze sponges, while the right iliac fossa received particular attention. The abdominal incision was then closed with buried layers of catgut for peritoneum, muscle, and fascia, with silkworm-gut for the skin.

The after-history is short; the temperature soon reached the normal, and the patient recovered his health very rapidly. It is now nearly two years since the operation was done, and no pelvic symptoms have occurred The thoracic viscera are apparently in good condition, and the boy is making flesh. Microscopical examination of the appendix showed the lesions to be tubercular. The specimen was covered with numerous tubercular follicles containing a number of giant cells. The vessels of the meso-appendix showed thickening of their walls, and the lumen of some was obliterated.

I could cite a number of other instances where lesions of the adnexa were taken for appendicitis, but the cases that I have already reported appear to me to be good examples of various conditions which may lead one to make a diagnosis of appendicitis when some other condition is present, or *vice versa*. There are many other cases in which an appendicitis may be mistaken for other diseases, or where various abdominal affections have been diagnosed as an inflammation of the appendix. In the early stages of typhoid fever a mistake of this nature may be committed, because oftentimes pain in the region of the cæcum, with a rise in pulse and temperature, and certain disturbances of the gastro-intestinal tract, simulate appendicitis in some cases closely, and Tuffier opened the abdomen of a typhoid fever patient thinking he was dealing with appendicitis. Another interesting case is one reported by Monod, who found an appendix contained in a retro-uterine hæmatocele.

The differential diagnosis between a psoas abscess due to disease of the vertebral column and appendicitis is sometimes exceedingly difficult, and quite a number of cases have been reported where an appendicular abscess has formed over the psoas muscle, or even burrowed into it, giving rise to symptoms which were very misleading and completely shadowing the true nature of the purulent collection. Movable kidney has been mistaken for a relapsing appendicitis, and the cases that I have reported in this paper certainly show the possible confusion in the diagnosis that may arise between appendicitis and parametritis.

No symptoms which are found in the classical writers as typical of appendicitis are constant, with a very distended or painful abdomen, McBurney's point may be impossible to find, and in some cases throughout the course of the disease it may be entirely absent, or will be found in various points in the right iliac fossa according to the

anatomical situation of the cæcum, which, as I have already pointed out, varies considerably. On the other hand, a sore spot may be completely wanting in certain cases of appendicitis having a torpid development. The other inferences which may be drawn from the temperature, the pulse, or the cutaneous hyperæsthesia have nothing which will aid the diagnosis particularly.

A large number of abdominal affections may be mistaken for an appendicitis, and this is nearly of every-day occurrence. Pyosalpinx, intestinal occlusion, strangulation of the colon, or pyelonephritis, pylophlebitis, hysteria, psoitis, enterocolitis, lead colic, typhoid fever, intestinal tuberculosis or peritoneal tuberculosis, have all been diagnosed appendicitis in certain cases. On many occasions the physician or the surgeon will be exposed to these errors in differential diagnosis, and for this reason I think it well to bear in mind that the diagnosis of appendicitis is not always the simple thing that many would make us believe.

Another thing to be borne in mind is that the reaction of the peritoneum varies greatly from one subject to another, such, for instance, as occurred in the case of a patient operated on by Quénu, who walked about all day and danced all night with a perforated appendix. This winter I operated on a boy with a perforated appendix and about a half pint of pus in his abdomen, who had attended to his work in his shop for five days with this condition of affairs present in his abdomen. On the other hand, a simple appendicular colic may take on a very severe and serious aspect in a nervous patient, although the lesion found in the appendix will not amount to much of anything.

It is very evident that a large number of cases do not offer the diagnostic difficulties that I have enumerated, but it is quite sufficient to know that they exist, so that all precautions may be taken in order to make a good diagnosis. For want of a correct diagnosis, a hysterical or typhoid fever case might be operated on for appendicitis if care be not taken, and although the operation may not be dangerous, even if the lesion is not an appendicitis, the operative technique may be different, and the surgeon might open a psoas abscess through the abdomen when he would have acted otherwise if the correct diagnosis had been made; or he might open a pyelitis without being aware that a plastic appendicitis compressing the ureter was the true cause of the pus in the kidney.

Appendicitis is relatively a new pathological finding, and its history dates back only a few years, so that its pathogenesis and etiology are not as yet sufficiently known. The disease has been attributed to mucomembranous colitis, foreign bodies lodged in the organ, or as a secondary affection depending on an inflammation of the cæcum, and *vice versa*. In gangrenous appendicitis I believe from what I have seen

that these cases are due to a torsion of the organ and its mesentery which cuts off its blood supply, and I suspect that on account of the few and discrete symptoms to which this type of appendicitis gives rise renders it most dangerous, because much intraperitoneal damage may have already taken place before the patient comes to operation. I would also point out that in young lymphatic children an attack of acute gastro-enteritis may be mistaken for appendicitis and simulate it very closely, so much so that I have been asked to operate under these circumstances, but a careful medical treatment and attention to the alimentary canal will cause all apprehension to disappear as the little patient starts on the road to recovery. Much has been written on grippal, rheumatic and pneumococcic appendicitis. All this simply makes the question more obscure. It is probable that the truth of the matter is much more simple, and that bacteriology and pathological anatomy have not had their last word. The theory that appears to me the most plausible is this: The appendix, as we know, is chiefly composed of lymphoid tissue, and has been called by certain French writers the abdominal tonsil. Now, just like the tonsils, it reacts in all those general infections, such as rheumatism, pneumonia, grippe, or scarlet fever.

The tonsil is an organ of defence, but when the invading infection is an intense one, the organ becomes tired, and is consequently in a *condition of lessened resistance*, and it is at this moment that it itself becomes infected at the beginnng or at the end of acute general diseases. This infection is still further favored by the presence of bacteria in the numerous crypts, where they usually live a saprophytic life; but under the influence of the swelling and hyperæmia of the organ they become enclosed within the crypts, and thus the "closed sac" is realized.

Appendicitis is exactly comparable to a tonsillitis as far as the mechanism of infection is concerned, and we can thus explain why grippal, pneumonic and rheumatismal appendicitis have been described, although the only pyogenic organism found was the bacterium coli, which is nothing extraordinary, since this organism inhabits the large intestine just as certain staphylococci live in the mouth.

All these facts are naturally still hypothetical and need demonstration, although they appear nearer the truth, and they better explain all the facts thus far put on record. When these points shall have been definitely settled it is quite probable that the diagnosis will be benefited.

Whether or not an enlightened pathology will change our methods of treatment is, I suspect, doubtful, and for the present I believe that the surest way of bringing our patients forth from danger is by immediate operation where the symptoms are sufficiently marked to justify the opening of the abdominal cavity. In the fulminating type of appendicitis, that is, where the appendix is gangrenous and has ruptured, the

escape of its contents infecting the peritoneal cavity either locally or generally, no time should be lost in giving exit to the septic material. But these cases when operated on often do badly, unless the pus has become thoroughly walled off, and the reason is simply this: they have not been operated on in time. The appendix has been undergoing changes slowly for several days previous to rupture, and the symptoms during this time are very indefinite. The pulse and the temperature will oftentimes be normal, the patient only complaining of a sensation of fulness or a slight indefinite pain in the right iliac region. But when a patient comes complaining of these symptoms, indefinite as they are, the surgeon should be on his guard, and carefully inquire into the patient's life during the previous week or ten days, when in almost every case he will find that the patient has taken some violent form of exercise, which has produced a torsion of the appendix. In several cases I have operated for no other reason than that the patient had complained of more or less pain or a dragging sensation in the right iliac fossa after having taken unusually active exercise, and in each case the appendix was found dark in color, swollen, and almost on the point of perforation. In some few cases I have seen patients go through several attacks of acute appendicitis of a mild type, and when operated on later I have found and removed what upon microscopical examination appeared to be a perfectly normal appendix, a condition of affairs which perplexed me very much, and led me to believe that my diagnosis of appendicitis was erroneous. But finally, after having operated upon several such cases, I examined a couple of these appendices microscopically, and found that there was ulceration of their mucous membrane to such an extent that in certain parts of the lumen the mucosa was completely absent, and that direct infection from bacteria within the lumen could take the place by direct penetration into the lymphoid follicles, and which would ultimately result, after several attacks, in a peritonitis with or without perforation of the organ. Ample proof of what I have just said will be found in Mr. Lockwood's most excellent work on appendicitis which has recently appeared, and to those desirous of a clear idea of the pathology of this affection I would strongly commend this book for their perusal.

The symptoms of left-sided appendicitis are due to one of two causes: either from an abnormal position of the cæcum and appendix on the left, due to either a total inversion, or to an elongation, or an abnormal laxity of its ligaments, or we may have an appendix normally located on the right side, but whose exaggerated length causes it to lie over in the left iliac fossa, and may or may not be bound down in this position by adhesions which have been previously formed.

Symptoms of appendicitis arising in the left iliac fossa are rarely as typical as when the affection occurs on the right, and this is due to the

anatomical conditions found in those instances where the cæcum and the appendix are congenitally displaced, and their study demonstrates why certain phenomena are present when an inflammation of the appendix occurs under these circumstances. In one case reported by Legueu, a child was admitted to the hospital for typhoid fever, and in the left renal region was found a tumefaction extending from the left iliac fossa up toward the abdominal wall. Autopsy showed a perforated appendix, which, with the cæcum, lay in front of the left kidney.

Hernia of the cæcum of the inguinal variety on the left side has been well studied by Pujol, and he has collected quite a number of cases. Nové-Josserand has reported the case of a patient who had a left inguinal hernia for eighteen years, which had been painless and was easily reduced, but which suddenly, after a traumatism, increased in size, became irreducible and was accompanied by many symptoms closely resembling those of strangulated hernia. At the operation the cæcum and the appendix were found in the sac, along with a loop of small intestine. The appendix was hard and filled with a soft substance resembling very closely fecal matter.

Another case has been recently reported by Schwarz:

A man, aged forty-five years, had had two years previously a strangulated inguinal hernia on the left side, about the size of a child's head. The operation, performed on the sixteenth day, showed that the contents of this hernia were composed of the ileum, ascending colon, cæcum, and a perforated appendix.

As to the causes which give rise to displacement of the cæcum to the left, I would first call attention to an arrest of its migration. When this occurs it may become localized in the umbilical region, or be placed slightly to the left of the median line, or may become situated distinctly in the left side of the abdomen. Under these circumstances the appendix would be in relation to the posterior aspect of the left rectus abdominis, and from there could easily extend into the hypochondrium or even into the left iliac fossa. If the mesocolon should be extremely short the cæcum would be naturally fixed in this position, as in the following three cases reported by Fowler.

Case I.—A boy, aged sixteen years, was seen two days after abdominal pain, nausea, and vomiting had set in. The abdomen was distended by a tumefaction, which was somewhat more marked on the left. A painful point, about three inches in area, was discovered on the left, beginning in the region of the umbilicus and extending downward. Percussion gave dulness in the left iliac fossa, but the pain was more particularly marked in the left lumbar region. A diagnosis of left-sided appendicitis was made, and a large quantity of purulent serum was let out from the peritoneal cavity. A large suppurating cavity situated to the left of the median line was found and corresponded to the dulness

found on percussion. The caput coli and the cæcum were deviated from their normal position, and were bent to the left and upward toward the umbilicus and lost in a mass of dense adhesions. The patient died on the third day, and the autopsy showed a perforated gangrenous appendix. The cæcum was situated to the left of the median line at the level of the umbilicus. Beside the peritoneal abscess, a second purulent cavity was found communicating with the first, which extended upward and backward in the retroperitoneal cellular tissue.

Case II.—A man, aged nineteen years, who after seven days' illness presented all the symptoms of a septic peritonitis. Two days before his physician had noticed a tumor underneath the left rectus muscle. Upon opening the abdomen a large quantity of purulent serum was let out from the peritoneal cavity. The cæcum was found exactly behind the umbilicus, and pointed to the left. The appendix was situated just below the umbilicus, under the left rectus. The appendix was not removed on account of the bad condition of the patient, who died one hour after the operation. The autopsy showed a perforated gangrenous appendix in the situation above described.

Case III.—A female, aged twenty-five years, who was suddenly taken with violent colics, accompanied by nausea and vomiting. The abdomen was very painful, but the pain seemed somewhat more pronounced over the external border of the left rectus muscle. Forty-eight hours after the patient got out of bed to urinate, and was seized with a sharp pain to the left of the umbilicus, which was soon followed by generalized pain and collapse. She died in seven hours. The autopsy showed a perforating appendicitis, and the cæcum was held down by a short mesocolon almost directly above the sacral promontory. The appendix was curved upward and outward underneath the left rectus, and was thickened, infiltrated, and perforated at its middle. Generalized peritonitis.

Beside an arrest of development we can also admit as a cause of displacement of the cæcum an abnormal elongation of its ligaments and suspensory apparatus, which would result in a very great mobility of the organ, and which would naturally be all the greater if its ligaments should be entirely wanting. Excessive length and mobility of the meso-appendix and the ilio-appendicular fold can also be considered as a very important cause of displacement of the appendix to the left and of the cæcum consecutively. Pujol says that the ligaments of the appendix allow that organ a very great degree of mobility, while the cæcum has little, and it might be admitted that in some cases the appendix was the first to enter the hernia, and afterward the cæcum might follow it, and the following case reported by Gessler would seem to demonstrate this theory.

The patient was a cachectic female, aged seventy years, presenting a double inguinal hernia. On the right the hernia was small and reducible, while on the left it had an hour-glass shape and extended into the left labium majorum. The lower part of the left hernia was the size of a walnut, while the upper part was the volume of a pigeon's egg. The abdomen was painful, especially on pressure; it was distended

and diarrhœa was present. The left hernia could be imperfectly reduced into the inguinal canal. The patient died in three weeks. Autopsy showed that the appendix, with thickened walls and a stricture in its middle, was located in the left inguinal canal. The cæcum was found behind the pubis and extended toward the umbilicus. It had contracted dense adhesions with the anterior abdominal wall and small intestines. It was greatly increased in size.

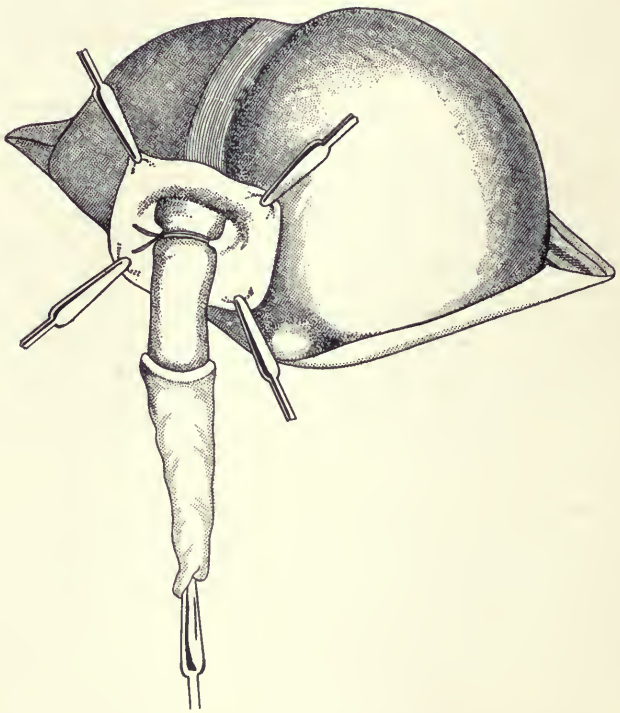
Bonn and von Arx have reported two cases of displacement of the cæcum and appendix due to entirely different causes. In point of fact, they were cases of kyphosis, the vertebral column being carried to the left while the pelvis was deviated to the right, from which consequently a considerable decrease arose in the distance normally separating the cæcum from the left iliac fossa. One of the cases may briefly be reported as follows:

It was the autopsy of a male, aged eighty-two years, who presented a very pronounced kyphosis. The lower border of the ribs was nearly in contact with the upper border of the pelvis. There was a double scrotal hernia, which extended down as low as the lower third of the thigh, and formed a tumor the size of an adult's head. In the left hernial sac was found all the small intestines, and behind it the cæcum and appendix, as well as the beginning of the ascending colon, which, with the cæcum, measured 20 centimetres in length. The cæcum and ascending colon were perfectly free and movable in the sac and presented a very long mesocolon. The remainder of the ascending colon passed over the bladder in the direction of the right inguinal ring, where it formed the contents of the right hernia, along with a portion of the omentum, about the size of a fist. There were no adhesions in the sac. On both sides the testicles were situated behind the contents of the hernia.

It now remains for me to say a few words regarding those cases of left-sided appendicitis which occur in subjects having an appendix arising on the right side, but which, on account of the length of the organ and its direction, cross the median line and may even extend into the left iliac fossa. In some instances the appendix may be lost in the midst of loops of the small intestine, but in order that an inflammatory process of the appendix having this situation may give rise to symptoms on the left-hand side, it is essential that one of the conditions above mentioned must be fulfilled, or the organ must be extremely long, or fixed at its tip to the left of the median line by adhesions. Anatomical studies have shown that the mean length of the appendix varies from 6 to 12 centimetres, but this organ is subject to very great variations. Gegenbauer has seen an appendix measuring 20 centimetres, Ribbert one of 21, Cruveilhier and Lannelongue one of 22, and Luschka one measuring 23 centimetres. It is evident that appendices having such an exaggerated length would have a decided tendency to become displaced in almost any direction.

Cases in which the appendix is situated in its normal position on the right, but extends across the pelvis into the left side, where it is bound down by adhesions, are not of infrequent occurrence, and all infectious inflammatory processes which have attacked the peritoneum, including the serous membrane of the appendix, can by adhesions bind the appendix, either to the sigmoid flexure, or to other abdominal viscera situated in the left-hand side of the abdomen. From this fact it can be readily understood that an inflammatory process located in the apex of the appendix may produce symptoms in the left iliac fossa.

FIG. 3.



When the symptoms presented by the patient are distinctly located in the left iliac fossa they can be due only to one of two conditions, either a complete displacement of the appendix and cæcum or else a localized inflammatory process situated in the apex of an appendix which is bound down in the left iliac fossa. Those cases where the symptoms are observed in both iliac fossæ are due to an inflammation of the entire organ bound down by its tip in the left iliac fossa. This last class of cases I believe should be included in those instances of extension of the peritoneal inflammation to the left, ending in suppura-

tion, which gives rise to a perisigmoiditis, a condition well described by Obratzoff. It should also be borne in mind that a generalized peritonitis following the perforation of an appendix in its normal position on the right, or to rupture of an abscess, may present the maximum of symptoms on the left, although the starting point of the process was in the right iliac fossa.

In closing I would say one word regarding the removal of the appendix. The technique surely is in no way novel, but I believe that on the whole it is the best one to follow in the large majority of cases.

When once the appendix has been brought to light with its peritoneal covering, the first thing to be done is to find the base of the organ. This is accomplished by following one of the longitudinal bands of the cæcum, as they all converge at the base of the appendix. When this has been found a circular incision, only including the peritoneum, is made in the appendix about two centimetres above the insertion of the appendix in the cæcum.

The peritoneum is then separated from the appendix and turned back, and a ligature is placed around the base of the organ, which is then snipped off with scissors. A peritoneal covering remains which is brought over the stump, and is either simply tied off or closed by a few catgut sutures. The figure here given will illustrate the technique.

The mesentery of the appendix should, of course, be ligated and treated in the ordinary way.

This method of removal of the appendix may occasionally be difficult when the operation is undertaken during the attack, but this is not due to adhesions between the organ and its peritoneal covering as might be thought. In reality the difficulty arises from the friable condition of the appendix, the walls of which may be altered by gangrene or ischæmia, which naturally favor rupture of the organ during manipulations.

Under these circumstances, instead of removing the appendix at once part of the organ only should be removed below the point of the gangrenous or ulcerating process. To recommence the operation at the point of rupture might be, perhaps, in some instances, useful, but I believe it is the most prudent to abstain and drain.

BOTHRIOCEPHALUS LATUS; REPORT OF A CASE OF DOUBLE INFECTION, WITH A DISCUSSION OF THE CAUSATION OF PRIMARY AND SECONDARY PERNICIOUS ANÆMIA.*

By Robert N. Willson, M.D.,
of Philadelphia.

Although several cases of infection of human beings by the bothriocephalus latus have been reported in the United States, the number is still very limited and the condition evidently rare.

It is commonly met with in certain parts of Europe and Asia, so that its failure to appear in this country must be ascribed to two main causes, the first and foremost of which is the fact that the custom of eating fish raw or half-cooked is indulged in only by those who have learned the habit in another land. And even were the fish of the American fresh waters eaten raw it is not certain that they would transmit this form of infection; nor has it ever been determined that American fish are themselves susceptible to infection by the bothriocephalus. An inquiry sent to the Bureau of Animal Industry in Washington as to whether bothriocephalus measles had been noted up to the present time in any species of fish taken from the American fresh waters, elicited the information that it was "not acquainted with any cases where the larvæ of bothriocephalus latus have been found in American fish."

It must be admitted that while this is only negative evidence it still carries considerable weight. Moreover, so few instances of human infection have appeared, or at least been recognized and reported, even in our foreign population, that the list is completed by cases noted by Walker[1] and Leidy,[2] Packard,[3] Hagelstam,[4] Riesman,[5] Stengel,[6] and McFarland,[7] five of which writers observed their cases in Philadelphia. This one fact suggests not only a large foreign population, but one that retains to a large extent its native manners and customs. Both conditions are literally present in certain sections of the city, where not only will the visitor not hear a word of English spoken, but where English is not understood by the mass of the people. My own case I believe to be the third of multiple infection by the bothriocephalus latus reported in this country, and, perhaps, the first in which this was certainly the state of affairs. Packard considered his case one of multiple infection, and Hagelstam describes a case of so-called bothriocephalus anæmia in a Finnish woman, aged twenty-nine years, and says of her that after

* Read before the Germantown Medical Society and (in part) before the Pathological Society of Philadelphia

his treatment "quite a number of tapeworms" were expelled. He offers the information, however, that he saw neither the eggs nor the segments; and as a consequence his case can hardly be accepted as certainly one of bothriocephalus anæmia, since both the multiple infection and the picture of pernicious anæmia may be caused by the tæniadæ as well.

The first case noted in this country was probably that studied by Drs. J. T. Walker[1] and Joseph Leidy,[2] in 1879. The patient was a Swede, aged twenty-eight years, and had been three months in this country. He had passed a few inches of segments at irregular intervals for over five years. His symptoms were those of distress in the epigastrium. He stated that he had been treated unsuccessfully by two physicians in his own country. He was put under anthelmintic treatment by Dr. Walker, and passed three hours later fifty feet of the worm, this portion being thrown away. Fourteen hours later he passed the remainder, measuring over one hundred feet, and weighing 6.5 ounces. Dr. Leidy notes of the case that the character of the segments indicated that they were portions of several worms, and that the largest segments (preserved in alcohol) measured 4 mm. by 10 mm.; also, that he had seen no other specimen from a person in our country. No head was obtained.

Dr. F. A. Packard[3] had under his care in the Pennsylvania Hospital in 1891 a Finnish sailor who had been suffering from diarrhœa for several weeks. He had at this time a profuse diarrhœa, with greenish-brown, semifluid movements. The specimen, ejected after a dose (f℥ss) of castor oil, consisted of "evidently parts of two worms, as manifested by the appearance of the size of the links." The heads were not obtained, although the smallest segments were minute specks. The course of the diarrhœa remained unchanged after the voiding of the portions of the worms.

Hagelstam,[4] a Finnish physician, while visiting in this country in 1895, saw, with several other physicians, a young boy, aged twelve years, who had been seven years in this country. All of his family had had tapeworms, and he himself, one year previous, had attacks of dizziness, vertigo, headache, anorexia, nausea, etc., all of which symptoms now reappeared. At last he was unable to rise from his bed. His stools showed the ova of the bothriocephalus latus. He was given an anthelmintic, but no segments were passed. After a serious illness he recovered, and at no subsequent time could parasitic ova be discovered in the stools.

This case, although offering more evidence than the others cited by Hagelstam, offers as the only diagnostic symptom the presence of the ova, which, as in Dr. Riesman's case, may not be altogether characteristic. The failure to expel any portion of the worm at any time, and

a total recovery notwithstanding, court the conviction that not only was the case not one of bothriocephalus latus anæmia, but that there may have been some error as to the finding of the ova.

Riesman's[5] case occurred in a Russian woman, who seemed to be in good health, and who had been in this country for a number of years. Altogether about three yards of segments were obtained, the links being exceedingly tiny, though the head was not discovered.

Stengel[6] stated in the discussion following the last-named report that he had noted a case in a Scandinavian sailor several years before, the patient being entirely free from symptoms. He had also a second case in still another foreign sailor.

McFarland's[7] case was noted in a Russian Jew, who, sixteen years ago, passed segments of the bothriocephalus on two occasions. Six or seven years later, and while in this country, he again passed a considerable piece of the worm, and since that time at regular intervals of six months or more. He has never had any unpleasant symptoms. The last portion of the worm was passed after an interval of one and one-half years. His blood count showed hæmoglobin, 80 per cent., erythrocytes 4,760,000, leucocytes 86,000.

The specimen was presented without any statement as to the clinical history. The portion exhibited was a few feet in length. The smallest segments of this specimen appeared to be those of the square type, in which the size of the worm rapidly diminishes and the length and breadth are approaching one another.

I wish to report a case that first came under my care in the receiving ward of the Pennsylvania Hospital in 1899, and was seen shortly after this time at her home in private practice.

She was first examined on March 7, 1899, when she brought with her a small pailful of material passed from the bowel that day. It consisted of twenty-six feet five inches of tapeworm segments that were recognized at once to be those of bothriocephalus latus. The segments were broad and short, and exhibited the peculiar rosette uterus of that parasite, as well as the characteristic ova.

The patient was a Russian Jewess, aged forty-six years, from the eastern part of Germany, and in her home had been a fish-vender. There was no history of tapeworm infection in any other member of her family as far back as the grandfather and grandmother on both sides; although all have lived freely on a fish diet, especially herring and sea-trout. She would not admit eating raw fish. Eight children and a husband are living and well. In the fatherland she was always a healthy girl, has had no serious illness in her life apart from her present trouble. While still in Germany (time indefinite) she noticed that she was often dizzy, faint, easily tired, and for five or six years previous to her immigration she had headache and frequent cramps. She has been in America seven years, and only fairly well during that time. Fifteen years ago, for the first time, she noticed the links of the

tapeworm in the stools, but has never been treated for the condition. Often she has been so weak that she could hardly walk, or even stand, and often has fainted away. Bowels fairly regular, no diarrhœa. At intervals of a week or more she would pass from a few feet to two or three yards of the segments. Between the fainting and weak attacks, which terminated with the passage of a portion of the worm, she felt quite well, though never strong. She had been growing much weaker in the last few months, and her appetite was entirely lost.

The patient presented a number of symptoms that might have been present in but certainly were not typical of a severe anæmia. She was fairly well nourished; her skin dusky, though it had none of the color (waxy or lemon tint) of pernicious anæmia. Her mucous membranes were pale, but not more so than was natural in a woman who had had less than her fair share of nourishment for many years. Her gums were in good condition; there was no bruit in the cervical veins; cardiac and hæmic murmurs not present; and the spleen and liver only slightly if at all enlarged. The abdomen was tense and rigid. The dusky hue of the skin extended over the whole body. The tissues were firm, and there was no excessive deposition of fat in any portion of the body. The bones were not tender. The temperature was 98.5° F.; pulse, 80; respirations, 20. The urine showed no abnormality. She was placed in bed, and after a purge deprived of food for twelve hours. At 8 P.M. on March 7th she received chloroform (10 ♏), and calomel (5 grains), resulting in one small bowel movement containing a short ribbon of continuous and attached proglottides. At 8 A.M. she received chloroform (10 ♏) and oleoresin aspidii (fʒss), followed in one hour by magnesium sulphate (ʒj). Two large liquid stools followed this procedure, each containing about ten feet of the worm. The segments were large, and no head was present. All stools were carefully strained through gauze. At 3 P.M. of the same day the patient received Tanret's pelletierine (fʒj), followed by tr. jalap. comp. (fʒj) in an hour. A free movement of the bowels followed in two hours, accompanied by agonizing cramp-like pains during the passage of nearly twenty feet more of the worm.

Up to this time over sixty-seven feet of segments had been discharged, including the portions obtained before and after the medication. During the night intense cramps were again experienced, and at this time it was noticed that a considerable quantity of the worm or worms was protruding from the anus in two ribbons of segments of nearly equal size, and diminishing at nearly an equal rate as they approached the bowel. The projecting segments exhibited a curious expansile or squirming motion, and the ribbons were evidently firmly attached well up in the bowel, and were resisting expulsion. Upon the slightest traction they retired and re-entered the anus as fast as they were drawn down by the fingers. There was only one further bowel movement during the night, though there was much nausea, some vomiting, and great abdominal pain. About six feet of segments were discharged with great difficulty, and evidently at the expense of only one of the worms, as one ribbon now projected much further than the other, and its segments were larger, though both showed a diminished size as the anus was approached.

On the 9th the patient was much stronger and brighter and thought that the entire worm had been passed. With persuasion she received

liq. pelletierine (f℥j), and one hour later tr. jalap. comp. (f℥ss). Two hours elapsed before the passage of a large movement containing ten feet of segments. Again the two bands appeared, nearly equal in length and seemingly distinct. The patient seemed so prostrated at this time that she was given milk in small quantities through the day, one cup of coffee, and brandy at regular intervals. Later in the same day about two feet of segments were passed. Neither band of projecting links suggested by its size proximity to the head, and for this reason it was considered advisable to continue the treatment. The segments of one string were now wide and short, with a very small, closely bunched uterine rosette, black with eggs, those of the other were less wide, longer, with a rosette of greater length than width, which was perfectly white and contained few eggs. Both sections continued their curious motion until expelled from connection with the chain in the bowel.

March 10th. No medication was employed during this day, and the patient refused all food excepting a few ounces of milk and a half ounce of brandy every three hours. No bowel movement until 10 P.M., when about one foot of each string was passed, with much pain. The segments of both strings were now markedly smaller, but still far from their terminal size.

11th. As the patient felt much stronger and insisted on going home a last attempt was made to expel the remainder of the worm. At 8 A.M. liq. pelletierine (f℥j) was given and followed in an hour by an ounce of tr. jalap. comp., with the result of expelling only about two feet of segments in the same double ribbon, which now disappeared from view. Three bowel movements followed during the forenoon and afternoon, consisting mostly of mucus and slime, with a few curds of milk, and no segments. There was no pain after the first of these passages. The patient's general condition was so markedly and rapidly improved that she walked home in confidence and with evident relief from the fear of a perpetual purgation. Owing to the fact that she was not admitted to the wards of the hospital, but remained in the receiving ward, there had been no blood examination, and this was first made shortly after her last medication and before her departure. The hæmoglobin was 60 per cent., erythrocytes 5,120,000, and leucocytes 16,000. There were present many nucleated red cells, mainly of the smaller forms. No myelocytes were noted.

The patient was under my care for several days after this time, and recovered health and strength so far as to seem perfectly well. The worm had certainly not been completely discharged, but it was hoped that it had perhaps been destroyed and would eventually come away.

I have been able through the kindness of Dr. Morris J. Lewis to obtain two subsequent clinical notes of the patient that are of interest in showing all our attempts to have been futile.

She was admitted to Dr. Lewis' wards in the Pennsylvania Hospital on May 22, 1899, with the same symptoms as when first seen by me. The urine was 11,012, acid, lemon color; sed., flocculent, no albumin, no sugar; microscopical examination negative. May 28th she passed eight feet of the worm, no anthelmintic being given. On June 1st she was starved for twenty-four hours, then Tanret's pelletierine (f℥j) was given, followed by castor oil and a large enema. In the afternoon she passed thirty-four feet of segments, the smallest of which measured about ⅛ inch in width. No head was found.

June 3*d*. She complained of some abdominal pain and dizziness, some nausea. Much better than before, however, and out of bed. Temperature at this time was constantly subnormal. Respirations and pulse normal. The only rise of the temperature was that following the administration of the pelletierine (99°).

5*th*. Discharged at request, in greatly improved condition.

She was again admitted to the hospital on October 14, 1899.

The patient at this time was thin, and her skin dark and muddy. The tongue pale and slightly coated. The heart showed a soft systolic, basic murmur. The lungs were negative. The liver extended 2½ inches below the costal margin; the abdominal muscles were rigid. The patient complained of pain in the centre of the chest, low down, and radiating to both shoulders. She was given calomel (3 grains) in fractional doses, sod. phosph. (ʒij) before breakfast daily, and liquid diet.

October 16*th*. She was given calomel, ¼ grain hourly for eight doses, followed by magnes. sulphate, ℥ss. October 17th she passed six and one-quarter feet of the worm, the segments measuring about ⅜ inch broad. October 18th she passed three feet of worm, ½ inch broad (evidently segments from another worm, though not surely so).

18*th*. At noon she was given chloroform 10 ♏; at 1 P.M. and 1.30 P.M. the following mixture, half at each dose—pomegran. root, ℥j; powd. ergot, ʒj; pumpkin seed, ℥j; add aquæ bull., f℥x; add extr. aspid. eth., ʒj; ol. tiglii, ♏ij.; acacia, q. s.; chloroform, ♏ x.

No note is found in the history of any bowel movement following this medication. (Evidently no worm was passed from the continuance of the treatment.)

19*th*. Urine negative. October 21st, no tapeworm passed to-day. October 21st., one dose of Tanret's pelletierine at 10 A.M., chloroform (10 ♏) at 6 A.M. and at 10 A.M., pulv. jalap. comp. (ʒj) at 11 A.M Passed 18 inches of tapeworm during the afternoon. (By mistake only a portion of the pelletierine was given).

25*th*. Full dosage of pelletierine, etc., given to-day as above. Passed 24¾ feet of bothriocephalus segments, which seem to indicate the presence of two worms, traced to a width of ⅛ inch. No head was found. One portion of the worm was passed completely knotted and twisted in a ball. Castor oil (f℥ss) was given with ol. tiglii (gtt. ij), but with no further result.

31*st*. No further treatment. Patient doing well. November 1st, discharged.

An attempt to learn the subsequent history of the patient was rewarded not only by full information, but by a most interesting confirmation of the diagnosis of multiple infection made years before from the character of the segments, while the parasites were still in the body. The patient stated that two years ago (about a year after leaving the hospital) she consulted a worm specialist in this city and was given at 9 A.M. a tumblerful of pleasant tasting liquid, after fasting for two meals only, according to instructions. At 5 P.M. she passed an enormous quantity of tapeworm, after which she felt perfectly well. There was no pain and no prostration connected with the treatment as in previous attempts. She claimed to have been shown four heads of the fish tapeworm by the operator. One month later she gave birth to a healthy boy at term, and has since that time been absolutely well.

Her appearance at this time is that of a healthy woman. I then consulted the specialist, and was shown the specimen removed from the patient, which is now exhibited, together with the specimens removed by me at an earlier date. I have examined the mass of segments with great care, and fail to discover more than two heads. The segments seem to indicate the presence of three worms, but certainly there are not three heads present, and still less four. The specialist claims also to have measured the segments and to have found over 200 feet. I have not had the opportunity to confirm or refute this statement, but am inclined from the gross appearance to doubt the accuracy of his measurement.

There are several interesting points in the study of this case apart from the rarity of the bothriocephalus in this country. Not the least among these is the undoubted presence of two bothriocephali, either of different sizes or in different stages of growth. Not only the enormous lengths (82 feet 3 inches), but the total number of segments (about 12,000) far exceeds that of any specimen observed up to the present time. Both these facts, as well as the steady diminution in the size of both bands as they approached one another, establish beyond question the certainty that more than one parasite was in evidence. In both the uterine rosette was very distinct, and the stained specimen exhibited clearly the genital apparatus as well as the tubular formation of the uterus, and the many ova. Both series of segments showed to a marked degree the abnormalities and monstrosities of development so common to the worm, as well as many twin seminal orifices. The latter have been noted by other observers as peculiarities of the bothriocephalus latus.

Allowing, then, that only two worms were present and of approximately equal length, both must have measured considerably over 35 feet. Neither could have been under this length without conceding to the other a length of over 50 feet. Allowing them equal lengths, both may have measured over 40 feet, without considering the portion left in the intestine, nor that which had been lost previous to our seeing the patient.

With regard to the patient herself, the general impression given by her appearance, though evidently anæmic, was rather that of a cachexia dependent upon lack of nourishment and unhealthy living than the lemon-yellow color of a typical pernicious anæmia. The blood examination also failed to confirm the expectation of an anæmia of pronounced type, giving as it did rather a suggestion of chlorosis than of pernicious anæmia. The hæmoglobin was considerably reduced, the red cells were probably somewhat low for this case, and there was a decided leucocytosis. Possibly the constant purgation extending over four days had much to do with the condition of the blood, furnishing a concentrated solution in place of the usual one, and thus increasing

the number of erythrocytes per cubic millimeter. There was a decided increase in the percentage of the polymorphonuclear leucocytes, and many eosinophiles were present. There was also a considerable number of nucleated erythrocytes, mainly normoblasts. The rather low percentage of hæmoglobin bears out the theory that the concentration of the blood disguised somewhat an anæmia that was probably of a more advanced degree than the count showed, though this fact could only have been demonstrated by a knowledge of the previous condition of the blood.

Typical bothriocephalus anæmia certainly was not present, however, either in the blood picture or in the symptom complex.

The question in such a light becomes most interesting as to the causation and origin of all forms of pernicious anæmia, and especially with respect to the appearance of the anæmia in certain individuals that are infested by the bothriocephalus and its absence in others. Discussion of this point will be taken up at a later time.

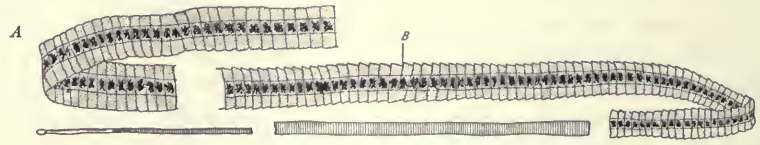
Although Bremser[8] first accurately described the bothriocephalus latus in 1819, and gave it the name by which it is now generally known, the credit of its first differentiation from the tæniadæ belongs to F. Glaser (Huber, *Twentieth Century Practice of Medicine*),[9] who wrote with regard to the tænia lata in 1603. Many writers called attention to its peculiarities during the next century, and among these were Clericus, Linnæus, Pallas, etc. Not only, however, was Bremser's description the first full and accurate one, but his also was the first drawing (Taf. II.) that resembled to any great degree the object of his efforts. The plates published in his monograph are not only accurate, but highly creditable in their artistic finish. Sommer and Landois,[10] with others, worked out the anatomy of the bothriocephalus in 1872, and Max Braun[11] described its life cycle in his well-known monograph at a later date.

Linnæus first named the parasite tænia. Later it was known as bothriocephalus latus (Braun);[11] and it has still more accurately been characterized as dibothrium latum (Rudolphi).[12] The last two names refer both to the width of the segments as compared with the length, as well as to the furrow that is to be seen on each lateral surface of the head. The parasite belongs to the lowest order of the cestodes; not so much because of an anatomic degeneracy of its organs as owing to a lack of individuality in the several parts that make up the body. A distinction is often wanting between them altogether. The head is very small and simple, and often presents no more than an attaching surface or end. The neck is very short, if it exists at all, and passes at once into the body segments. Adjacent segments can often be distinguished only by means of the recurrence of the sexual apparatus, which appears regularly in spite of the imperfect individualization of the segment.

The accompanying cut (Fig. 1), which is roughly adapted from Bremser, represents a rather more regular and distinct arrangement of the individual parts of the worm than is usually noted.

The bothriocephalus has been found mainly in certain parts of Europe, and especially along the shores of the Baltic, in the east and west of Germany, in Russia, as well as in Switzerland, and nearly all of the sea-coast countries. It has seldom been seen in middle Germany. In Ireland it is so common that Cobbold[13] named it the "Irish tapeworm." It is also the commonest tapeworm in Japan, and Ijima[14] states that the reason of this frequency is to be found in the habit of the people of eating the onchorrhyncus perryi raw, or dressed only with sauce. Among other notes as to its distribution it is stated that the Athenians "were free from tænia, but harbored bothriocephalus." (Histor. Plant IX., 20: quoted by Huber.) The bothriocephalus latus is also the largest species of tapeworm seen in the human being, and most authors give it a length of 2 to 5 metres. Riesman suggests 2 to 9 metres for the adult; Wood and Fitz, 15 to 27 feet; Osler, 25 to

FIG. 1.



A, B. Twin segments.

30 feet or more; von Jaksch, 5 to 8 metres; Kaufmann, "can be 8 metres;" Klemperer, 3 to 15 metres; Strümpell, 6 to 8 metres; Sahli "up to 8 metres," etc. Undoubtedly, Klemperer's statement more nearly approaches the outer limit than any other, and it is safe to say that even a greater length can be attained, and, perhaps, was exemplified in the case reported in this paper. Bremser quotes Goeze in describing a specimen seen by Bloch, measuring 60½ elle (the German ell in the different States measured between 22 and 30 inches), and Boerhaave as seeing one that had been expelled from a Russian, and measuring 300 elles. Probably both of these comprised segments from several worms.

The bothriocephalus has occurred singly or in company with others of its kind, and has been noted in human beings at the same time with tapeworms of other varieties. Boettcher[15] notes a case containing 100 bothriocephali, Roux[16] one carrying 90, Heller[17] one with 38, Eichhorst[18] one with 90, and many others of the same nature are on record. When more than one worm is present the growth of the individuals is, of course, hindered, and, as a rule, small specimens (3 to 5 feet or more)

are seen. In my own case, however, both must have been considerably over 35 feet in length.

The head, already mentioned, is 2 to 3 millimetres long by 1 millimetre broad, and is described by various writers as ovoid, almond, or spoon-shaped. (Figs. 2 and 3.) Macroscopically it appears less than the size of a small pinhead, and is often entirely colorless. It carries neither hooklets nor suckers, the former having been lost long before the stage of complete development, and the nearest approach to the latter being the two lateral grooves already referred to. These grooves probably form the only means of attachment between the head and the folds of the duodenal wall, and theoretically the parasite should not be a difficult one to remove. Cutaneous glands are to be found in the head, but are absent in the body. Muscle fibres and two distinct nerve cords are also noted, the latter appearing like " two roundish or

Fig. 2.

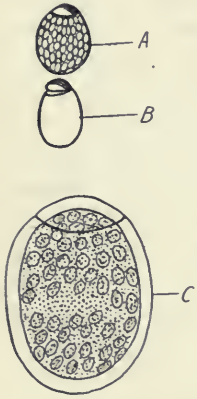
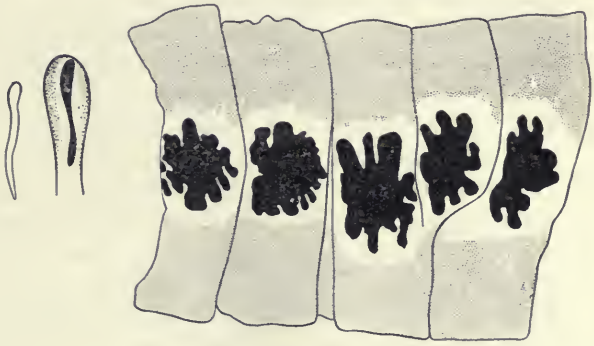


Fig. 3.



kidney-shaped spots of granular appearance, which gradually approach one another toward the anterior end of the head, and are finally united in a loop by a transverse connection." (Leuckart.) A number of fine vessels extend beneath the cuticle.

The segments as stated are separated from the head only by a pretence at a neck, and are reproduced by a continual segmentation of the latter. They are very tiny at their point of origin, but soon increase in size and begin at once to develop the regularly recurring sexual apparatus. At first they are slightly longer than broad; then nearly square, while still very small: and soon the characteristic appearance is noted, the width being from two to four times that of the length. The fully developed segments average 2.5 to 4.5 millimetres in length, and 8 to 14 millimetres in width, varying in number from 3000 to an almost indefinite number. Each segment contains at its centre a dark, bluish-gray spot, which, on examination, appears in the form of an irregular

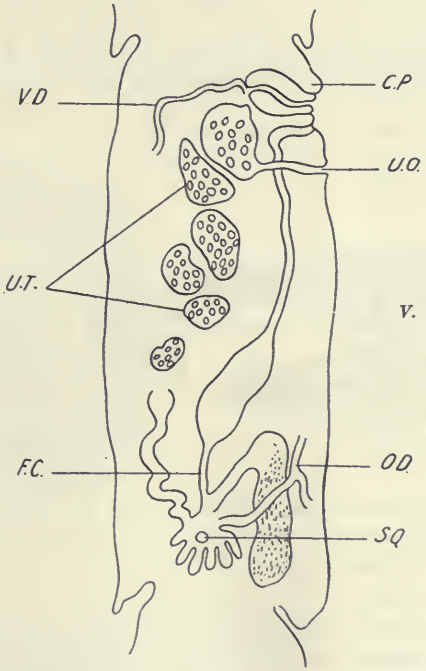
rosette, marking the recurrence of the segments. This rosette never fails of appearance, though the segments as already stated may run together, be partially divided, or show no demarcation whatsoever. The frequent occurrence of imperfect and abortive types of twin segments may be considered an almost distinctive feature of the bothriocephalus family, although seldom or never mentioned in the text-book descriptions. I have noted its absence in none of the specimens that have been examined by me. (Fig. 3.) The segments may also be split, either at the free edge or in the parenchymatous lateral portion of the body. I do not look upon these irregularities as always due to traumatism or pressure, but consider them, especially the imperfect and twin segment formations, as typical malformations.

The rosette deepens in color macroscopically in proportion to the number of ova contained, and toward the tail of the parasite, from the segments of which many or all of the eggs have been discharged, the rosette tends to become light in color, and may even appear whiter than the surrounding parenchyma. The uterus comprises the simplest arrangement of any noted in the segmented parasites. Anatomically it is composed of a single tube folded upon itself so as to appear in the form of a group of radiating pouches. Apart from the uterus there is also a rather simple arrangement of the organs, which consist principally of the genital apparatus and its excreting and receptive passages. The terminal segments contain the uterus and its eggs only, the other sexual organs undergoing a gradual process of atrophy as the tail is neared. The first mature rosettes and ripe ova are seen about 500 to 600 millimetres behind the head, and the number of eggs at this point is small. Further on toward the centre of the body the uterus becomes overcrowded with ova, and the centre of the segment is accordingly raised into a tiny protuberance. Early in its history the uterus is coiled up in the centre of the segment, in the form of a single tube. Later on, and as the ova are produced and stored away, the organ becomes longer than the segment itself, and must arrange itself accordingly in the rosette or branching form, with radiating projections numbering four or five, or sometimes six on each side. The anterior loops always enfold the generative apparatus and the excretory organs. The uterine aperture from which the eggs are discharged can be seen 0.2 to 0.4 millimetres posterior to the genital openings, which are found in the anterior middle of the segment, the male anterior to the female. This opening of the uterine pouch upon the flat surface of the segment renders the discharge and escape of the eggs much more easy than by means of a lateral opening at the adjacent margins of the segments as in the tæniadæ.

The reproductive orifices as already stated are to be found in the central line toward the anterior portion of the segment, and on its

ventral surface. They are in close apposition, the male slightly anterior to the female, and decidedly larger. From the centre of the male opening protrudes a tiny knob or projection that comprises the cirrhus or organ of copulation. Behind and around this is the cirrhus pouch, the function of which is to protrude the cirrhus, bringing about the act of copulation. Around both the male and female openings is a row of tiny papillæ. The female opening, as stated, is the smaller of the two, and leads into a vagina that runs laterally for a large portion of the width of the mid-part of the segment. The anatomical

FIG. 4.



V.D. Vas deferens. *C.P.* Cirrhus pouch. *V.* Vagina. *U.O.* Uterine opening. *O.D.* Oviduct. *S.G.* Shell gland. *F.C.* Fertilizing canal.

features may be clearly comprehended by reference to the accompanying suggestive figure roughly drawn from Leuckart.[19] The yolk sacs appear macroscopically as dark spots in the otherwise clear parenchyma. The testes are arranged laterally in a line, extending to each side of the cirrhus pouch and the uterus, and are connected with the cirrhus pouch and the cirrhus by the vas deferens, which is also noted in the diagram. The testicles are in the middle layer of the segment and arranged in columns; they average about 300 to 400 (Landois and Sommer[10]) or 600 to 700 (Leuckart[19]) in number for every segment.

The vas deferens is seen on the dorsal surface of the uterus, following the coils of the latter to a certain extent. It is surrounded by a sheath of circular fibres which, by contracting, force on the current of spermatozoa. Before its entrance into the large cirrhus pouch the vas swells into a semen sac, a duplicate of which is found at the posterior extremity of the vagina. The ovaries are found one on each side of the extreme lower end of the uterus, in the form of fan-shaped bodies, including the so-called shell gland and knotted gland between them.

The excretory system forms an elaborate network that is distributed all over the body. It does not follow the rope-ladder arrangement noted in the tæniadæ, but can be seen in the form of many fine tubules extending close under the surface of the body, and ending in small goblet-shaped enlargements. These openings hold a large cell, and to this is attached a cilium that hangs down into the funnel.

FIG. 5. FIG. 6.

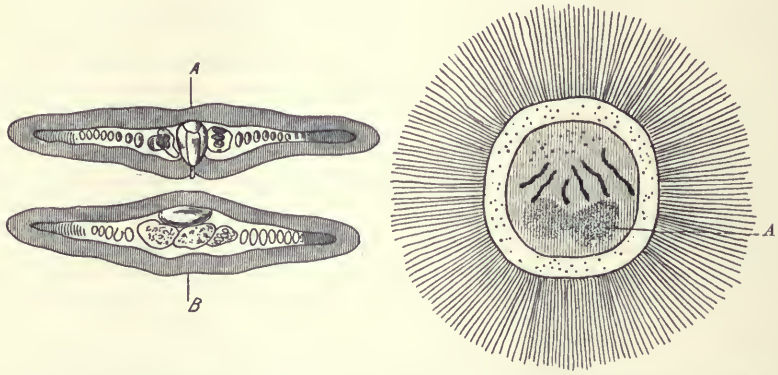
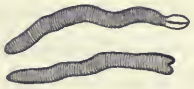


FIG. 5.—*A*. Transverse section at level of cirrhus pouch. *B*. At level of female genital organs
FIG. 6.—*A*. Bundles of muscle fibres. Embryo with cilia and hooklets. (After LEUCKART and BRAUN.)

Nourishment undoubtedly takes place by osmosis, through the substance of the segment, and doubtless is maintained at the expense of the host. The fresh-water fish has been conclusively shown to be the link in the life cycle between the egg and the tapeworm, and particularly such fish as the pike, trout, turbot, perch, salmon, etc., all of which have been noted as containing the bothriocephalus cysticerci. Braun[11] has clearly demonstrated the cycle of development to be the following: The segments or ova are discharged into fresh water from the bowel of some carnivorous animal, such as man, the dog, cat, and even the seal, and some water-birds. Both the ova and segments are capable of living some time after their discharge from the bowel. The ovum lies for weeks or months in the water, and during this time of incubation gradually develops into the onchosphæra, a ciliated larva with six hooklets, empowered by the tiny bands of muscle fibres. (Fig. 6.)

The larva is soon liberated from the ovum by passing through the lidded end (Fig. 2), and by means of its cilia moves rapidly through the water. The cilia gradually lose their motile power, and the embryo sinks to the ground and dies. Sometimes the ciliated covering is completely shed, whereupon the embryo dies at once. Occasionally, however, the motion of the cilia brings the onchosphæra into the vicinity of the fish, and with its ingestion the typical life cycle begins. That this event occurs is demonstrated by the number of infested human beings in certain localities of the world, and from the fact that twenty to thirty cysticerci have been found in a single measled fish. The onchosphæra now passes into the intestine of the fish, and thence into the muscles and organs, boring its way by means of its hooklets, and probably sometimes carried by the lymph or blood stream. It then develops at once into the typical bothriocephalus measle, the plerocercoid, which has both head and tail and is not a true larval form. (Fig. 7.) The flesh of the fish is then eaten raw or half-cooked by man, digestion of the plerocercoid capsule takes place, and the plerocercoid itself is thus liberated in the intestinal canal. Braun has demon-

FIG. 7.



Plerocercoid. (After BRAUN.)

strated this cycle in the dog and cat, as well as the human being, three students presenting themselves to him voluntarily for the experiment. Grassi and Parona have also confirmed his investigations by like experiments upon themselves. In a careful search of the literature I have failed to find a single reference to the occurrence of the bothriocephalus cysticercus in man, and Riesman mentions the same experience. Braun has, however, demonstrated their presence in the muscles and in nearly all the organs of the fish. In his experiments upon the three students already mentioned he obtained in each of all the stools thirty to forty bothriocephalus ova one month after administering the freshly removed plerocercoids in milk, sausage, and bread. He also caused the expulsion from one student of two bothriocephali, from another three, and from the third portions of several worms. Eight days previous to this time all had slight intestinal pains. During his experiments the ova were found constantly in the stools, and appeared to him to furnish an infallible and diagnostic sign. They vary from a dirty white to a brownish color, and are elliptoid or oval in appearance. Their length is from 0.06 to 0.07 millimetres, and their width slightly over half as much. In most cases a lid can be seen, either

closed, only the line of closure then being evident, or often open; in the latter event there is no difficulty in recognizing the variety. In some specimens the lid is much more definite than in others, and Riesman notes with regard to his case that the lid was rarely to be distinguished. He also notes, however, that the segments were very tiny, and the youthful stage of both segments and eggs undoubtedly will account for this fact. It may be laid down as a general rule that the younger the egg the less distinct will be its lid, either owing to its imperfect formation, or because it is still at the extreme tip of the ovum. When the ovum is ripe, however, there will always be found a certain number that will show distinctly the tiny cover, and if they at first appear few in number more can be demonstrated by exerting a definite pressure over the segment and the eggs by means of a glass slide. The lid will then be seen to open up, and in some cases the embryo will be expelled. So long as the ovum retains the embryo it is of a brownish color. When empty it is opaque, but almost colorless. It has three shell coverings, and at the lidded end there is usually to be seen a tiny knob or projection that will help in directing the attention in the search for the lid. (Fig. 2.) The best method for examining the fecal mass for the eggs is to mix a small portion thoroughly with water and centrifugate for a few minutes in the ordinary hand or water centrifuge. The sediment may then be pipetted out and examined with the low lenses on the glass slide, as in the case of urinary deposits. The ova are usually but not always found in the feces, however, and the diagnosis is at such times extremely difficult, as the segments in certain cases may not appear for a long interval, amounting at times to over a year (*vide* McFarland's case). When found the diagnosis is certain, as no other parasitic ova approach these in size and are accompanied at the same time by the presence of a lid. On the other hand, if absent the evidence is only a partial one, and the worm may still be within the intestine, von Jaksch and others to the contrary notwithstanding. As already mentioned, the discharge of the ova from the uterus directly on the flat surface of the segment explains the frequent appearance and recognition when the eggs are sought after. The bothriocephalus like the other cestodes will reproduce itself in toto, provided any portion of its length from the head down be left attached within the intestinal canal. Braun notes the growth of the segments at a rate of 20 to 30 a day, and the production or reproduction of the whole worm in from four to five weeks or longer. The eggs may be demonstrated by a very simple method. The segment should be held firmly in a large drop of glycerin on a glass slide by means of a pathological needle, and with a second needle the eggs are teased out from the uterus and set free in the glycerin. This can be readily done under the low-power lens. A still better method is to clear the segment for

an hour or two in oil of bergamot or cloves, after thorough dehydration in alcohol. The oil should then be nearly removed by means of absorbent paper and the segment mounted in balsam. It may also be stained without difficulty in a dilute solution of hæmatoxylin, and subsequently dehydrated and stained in absolute alcohol tinged with eosin. The segment is then quickly dried between layers of absorbent paper and cleared as before and mounted in balsam. Sections may be made in paraffin or celloidin. As previously mentioned, all that is necessary for the diagnosis is the flattening of the proglottid—of whatever variety—between two ordinary glass slides, whereupon the typical rosette uterus can plainly be seen. The worm may live in the intestinal canal for an indefinite time, one having been reported by Mosler and Peiper[20] that was known to have been in the host fourteen years, one quoted by Wood[21] for thirty-five years, and in the case under immediate consideration having been known to be present over fifteen years and probably for a still longer time. The age of the host, as well as the sex, seems to exert an influence upon the occurrence of the bothriocephalus in the intestinal tract. This is true of tapeworms generally; they are as a class also rarer in women than in men, possibly owing to the greater quantity of food ingested by the male sex. They are also more common during the middle third of life, though frequently found in children. Mensinga[22] found a tapeworm in an infant ten weeks old, and Osler refers to a case in an infant five days old. W. Y. Plant (quoted by Osler) cites many cases of tapeworms in children. The parasite may exert the most vicious influence upon the health and happiness of his host, or may hold possession of the intestinal canal for years without making known its presence by any sign. The latter is less true of the bothriocephalus than the tæniadæ. Often there is a vague symptom complex, centring itself in a discomfort in and about the digestive tract. This forms the frequent picture, and the first suspicion of the cause of the trouble is had when the strings of segments are found in the bowel movements. Single segments are seldom if ever found, owing to the difficulty with which the poorly individualized proglottids are separated from one another. In rare instances even months and years may pass without a single passage of segments, when suddenly, for some unknown cause, the bowel delivers itself of a portion of its uncanny burden. Strümpell suggests that this discharge occurs most frequently in the spring or fall, but a study of the cases that are at my command does not lead me to think that the parasite has any respect for any definite time or season, being affected more, perhaps, by the condition of the host and the character of the food ingested.

When definite symptoms occur they are usually in the form of pain or uneasiness around the umbilicus, and sometimes the severest colic. The appetite is occasionally enormous, while the patient, notwithstand-

ing the ingestion of large quantities of food, emaciates progressively. Sometimes there is complete anorexia. Nausea, vomiting (occasionally of the segments), and extreme salivation have all been noted. The bowels are often constipated, though more rarely may diarrhœa be present. Moreau[24] (quoted by Pepper) has reported a case of tapeworm attached to the fossa of Vater in which there was jaundice and painful enlargement of the liver. Letulle[25] has reported a case presenting ascites and an icteroid tingeing of the skin. Vertigo, convulsions (usually epileptiform), pruritus, itching of the nose and anus, headache (especially migraine), hiccough, syncopal attacks, inequality of the pupils, transient palsies, chorea, and rarely delirium, have all been seen and definitely ascribed to the intestinal parasite. The severe nervous symptoms are more often noted in children, while those of a vague and uncertain nature are more often seen in strong and otherwise healthy adults. Hypochondriasis and mania are rare conditions that have been noted in the course of tapeworm disease. This varied picture is by no means different in bothriocephalus infection. The tendency, however, being rather to severe than to mild manifestations. Quite characteristic of certain cases of bothriocephalus infection is still another picture that has now become classic, the so-called bothriocephalus anæmia. This feature was absent in the case observed by me, and may be said to occur in only a certain percentage of cases, the occurrence following no apparent rule. When it is present the patient presents the typical symptom complex of pernicious anæmia, and many cases have been looked upon as such until by chance the ribbons of segments have been found in the stools. There is gradual emaciation, with marked anæmia, tending toward the pernicious type, the erythrocytes averaging between 1,000,000 to 2,000,000 per c.mm., and the color index high. There are the usual signs of regeneration and degeneration in the erythrocytes, many megaloblasts, poikilocytes, and all the variations in staining quality and basic granulation. Huber credits bothriocephalus disease with a mortality of 16 per cent., almost entirely due to the pernicious type of anæmia.

Usually there is intestinal derangement, such as diarrhœa, nausea or vomiting, vertigo, palpitation, cardiac distress, œdema of the extremities (or of the whole body in extreme cases), with fever and marked prostration. The skin presents the typical lemon-yellow color, and the underlying tissues are often infiltrated with fat. Unless the worm is removed in such cases the termination is a fatal one, and in some cases the system has seemed totally unable to react from the depressed condition, even after the discharge of the parasite. The autopsy shows the typical marrow and bone changes and fatty metamorphosis in the organs. This picture has rarely been produced by the tænia saginata, E. Becker[26] having recently reported such an instance in which

two tæniæ saginatæ were found. It has also been ascribed to the anchylostoma, as in the case of the workers in the St. Gothard tunnel, and to other intestinal parasites. The occurrence is so much more frequent, however, in the course of bothriocephalus disease that it is now mainly associated with that parasite.

Reyher[27] has reported nine deaths in the Helsingfors Hospital from pernicious anæmia, "in most of which" the bothriocephalus latus was found in the intestine only at the autopsy. He states that in every case of pernicious anæmia at the present time the stools are examined for the ova and also for the more rare segments. In all of the autopsied cases the typical lesions of pernicious anæmia were found.

As the worm is not a blood-sucker the search for a cause for this pernicious blood condition has not been easy to determine, and it has been only within the last few years that there has appeared even a plausible explanation of the riddle. Schapiro[28] held, in 1887, that some toxic substance was excreted by the bothriocephalus, or that a poison was formed by the decomposition of the links before or after death. He denied Botkin's[29] theory that the symptoms are reflex and due to irritating action upon the mucous membrane of the bowel, also Reyher's belief that they are due to the abstraction of blood as in anchylostoma infection, there being no such wounding of the membrane as in the case of the anchylostoma. It was a different matter, however, for Schapiro to show why in one person the anæmia is present and not in others. In fact, it has not been explained up to the present time how certain individuals can harbor several of these worms and show no influence of the same upon the red corpuscles, while others exhibit the most profound anæmia with only one as the cause. Individual resistance must, of course, play its part; but whatever toxin the worm contains or manufactures is there in both instances, and yet its effect varies more decidedly than in the case of any like influence that we know. This will be referred to at a later point in the discussion. Reyher has seen cases with one or two parasites in the intestinal tract with severe anæmia, while Heller has noted one sailor at whose autopsy seventy-eight bothriocephali were found, and yet there had been no marked anæmia. Reyher then claimed to have demonstrated small granules in the circulation that appeared singly or in clumps, actively motile, equipped with flagellæ (*vide* Frankenhauser, quoted by Schapiro), and that these granules exerted a destructive influence on the red corpuscles. This theory was not borne out by the prompt therapeutic effect of an anthelmintic therapy, as pointed out by Schapiro, who claimed that it was much more likely that a toxic chemical substance is secreted and excreted by the parasite with such effects as were exemplified by the experiments of Silbermann, in which, following the administration of small quantities of pyrogallic acid by injection, or of

hæmoglobin solution or glycerin, the blood of animals took on the appearance of pernicious anæmia.

A still more plausible theory was offered in 1894 by Schaumann,[30] who studied seventy-two cases personally observed by himself, as well as thirty-nine cases gleaned from the literature. Of the seventy-two cases he made a careful study of the blood in thirty-eight and found the average number of corpuscles to be 1,311,000 in men, and 1,273,000 in women. The leukocytes showed little or no change, varying from 3000 to 12,000. The erythrocytes were nucleated in all of the cases in varying numbers, and usually more than half of these were megaloblasts. Only two cases showed mitoses, and both of these proved fatal. The poikilocytes were of the usual types, the color normal. Rouleaux formation was much diminished. In 80 per cent. of all cases the bodily temperature was elevated, the fever often being remittent, varying between normal and 40.2° C. (104.1° F.). In twenty-two cases there was constipation, in twenty diarrhœa. Ova were absent from the stools in only two cases. The urine was usually normal, though indican was present in large quantities. The gastric juice was very faintly acid, and only in one case gave the reaction of free acid.

In concluding his paper Schaumann suggested the presence of a toxic substance, either in or secreted by the worm, that acted directly upon the erythrocytes. This, he claimed, was not certain, but seemed to be borne out by all the facts at our command. In 1898 Schaumann and Tallqvist[31] supplemented the claim of four years previous by a second paper in which they reported the result of a series of experiments. Up to this time Vlajeff[32] (quoted by Schaumann and Tallqvist) had been the only one to investigate the question by an attempt to extract (chemically) poisonous substances from the bothriocephalus latus, though without success. Schaumann and Tallqvist carried their experiments still further. They used segments from the worms obtained from persons showing no anæmia, feeling certain that whatever blood-destroying substances came from such specimens were not inherent in the patient from whom they had come, and must, therefore, be original in the parasite. Dogs were fed and also subcutaneously treated with an extract prepared from the segments (*a*) with trypsin, (*b*) rubbed up with physiological salt solution, and (*c*) a certain number were fed with small pieces of the segments. As a result of the subcutaneous use of the extract, there was no local irritation of any note. In seven dogs there was a more or less marked reaction on the blood, as the result of all methods of administration of the bothriocephalus extract. With the first dose, as a rule, there was a diminution of 1,000,000 to 1,500,000 in the number of erythrocytes. On pushing the test further the diminution became slighter and slighter. Sometimes there was a complete halt in the decrease, or even an actual increase begun. This has

also been observed in similar experiments made with pyrogallol, and probably indicates an immunity established at a certain point against any deleterious drug or toxin. The most marked fall in the erythrocytic count was obtained from a dog (3,400,000) the blood count of which was previously 7,200,000; this was made two weeks after the beginning of the administration of daily doses of the extract. Schaumann and Tallqvist suggest that dog's and human blood would be likely to act differently toward the toxin. This dog showed typical clinical signs of anæmia, pale mucous membranes, hæmic murmurs, and died of exhaustion. The other dogs could not be experimented with to the end, as the material gave out. All, however, showed a less marked type of anæmia. Guinea-pigs that were given the saline solution of the extracts showed little reaction; one died with atypical symptoms, the other two exhibiting no change. Defibrinated blood from both dogs and guinea-pigs was tested in reagent tubes, with tapeworm extract, which had no effect upon the hæmoglobin of the guinea-pig. There was marked decoloration of the dog blood. In conclusion, the writers suggest two possibilities not yet considered: (1) That the anæmia was caused by bacteria in the worm, and (2) that the small quantity of male fern retained in the worm acted as the toxic substance in the subjects experimented upon. The latter possibility was excluded by feeding a dog with large doses of male fern, with no untoward effect. The former they considered far less probable than that of a toxic substance peculiar to the worm and exerting its primary influence upon the erythrocytes.

Jawein[33] has recently reported a case of bothriocephalus anæmia and claimed that the latter is due to the absorption of some toxic substance or substances produced by the parasite, with a primary influence upon the bone marrow, and interfering with the performance of its function.

Messiner and Calamida[34] have still more recently injected extract of tapeworm and obtained constant and characteristic symptoms, such as tremor, depression of spirits, paresis of the posterior and lower extremities, somnolence, etc. Control experiments proved that the symptom complex was not dependent upon simple proteid influence, but was caused by some substance in the tapeworm itself. All species of tapeworm gave similar results in the human body.

In concluding a study of which the interest grows as the connection is gradually established between such a local condition as the presence of a tapeworm and such a general one as pernicious anæmia, it occurs to the writer to suggest still another possible explanation for the bothriocephalus anæmia, and, indeed, of all pernicious anæmias. Certainly, there are many cases studied, both at the bedside and at the autopsy, in many if not all of which the clinical and post-mortem findings are similar, whether the cause be recognized or not. It need not be said

that a far greater number of cases of the so-called primary pernicious anæmia occur in this country than of the acknowledged secondary form. Formerly there was no belief in a secondary pernicious anæmia. We must now account, not only for the resemblance between a primary and secondary condition, but for what is, to my mind, an undoubted identity of two conditions seemingly caused by different influences—one supposedly known, the other absolutely unknown. In this light it would appear strange that we should search for any one toxic substance in the tapeworm, when we know that the picture can be produced in part or in whole entirely independently of that worm and by processes carried on entirely within the human body. It seems much more rational to assume that the intestines are assigned a certain function in the general economy, and that when this function is interfered with through abnormal bacterial working, or malnutrition, or improper food, or nervous derangement, or through the presence of a living, absorbing, hungry organism, or through any other cause—that then there ceases the manufacture of substances usually produced by the glands of the digestive tract that are necessary to the nourishment of the blood-making and blood-preserving organs, or that certain toxic substances always found in the intestinal tract take on new virulence (when the resisting power is depressed), and can no longer be successfully combated. There seems to be no doubt that this influence is noted first clinically in the anæmic exhaustion, the pallor, and in the reduced number of erythrocytes. The fact that most cases of the bothriocephalus type recover absolutely when freed from the parasite indicates even more surely that the intestines have been allowed to reassert themselves and resume their functions than that a certain toxic influence has been removed. Moreover, it is not fair to assume that a parasite that has resided within the intestinal tract for weeks, months, or years, and produced its symptoms by means of a toxin, will cease the production of that toxin simply because a portion of its length has been removed. And yet, in the case reported in this paper, the symptoms disappeared for a time when even a small portion of worm was discharged. The patient then remained well for weeks or months until it became time for the discharge of another portion. At once there was relief, and long before a reaction from a toxic influence could have been obtained. The inference must be that the intestine is once more enabled to carry on its functions and to contend against the influence that has been undermining the vitality of the system. Nor do the experimental injections of tapeworm extract and their results rightly lead us to such a conclusion as that drawn by Schaumann and Tallqvist. A parasite that has absorbed the juices and toxic substances of the bowel for months and years, as adult bothriocephali must have done, inevitably becomes saturated with the juices and toxins produced by the host. Nor need

such substances have produced active symptoms in their producer to render them toxic to another individual or to animals of a different species when introduced by ways and means not natural even to the original holder. Even the blood of a healthy person is no longer believed to introduce and re-establish a healthy supply in the anæmic arm of another, but to deteriorate and destroy a portion of what remains. In the same manner, the extract of one man's intestinal contents (even providing, for argument's sake, that the latter are not rich in bacterial and decomposition products), will be likely to act as a toxic influence upon another, just as pyrogallol and certain other drugs may do, producing destruction of the erythrocytes, but without furnishing any suggestion that the toxin originates in the bothriocephalus itself. In order to indicate that the toxin originated in the bothriocephalus, experiments such as were executed by Schaumann and Tallqvist, and Messiner and Calamida must be carried out with the plerocercoid or its extract; and even then it is possible that substances toxic to man may be carried from the fish. All that they have proved by their series of experiments is the fact that they introduced a toxin and that this produced a partial picture of pernicious anæmia. On continuing the experiment immunity was produced, as is also the case with pyrogallol and similar poisons, *but it is not true of the toxin that produces pernicious anæmia;* for if its influence is allowed to persist, not only does no immunity appear, but the end is fatal. The absence of hæmoglobinuria indicates the absence of a toxin whose influence is primarily a destruction of the erythrocytes. In fact, the probability appears to be strong that there is no immediate connection between the presence of the bothriocephalus and the pernicious anæmia apart from its mechanical influence upon intestinal function and as the results of such preventive action, together with the absorption of nourishment much needed by the human host. That there is a toxic substance in evidence must remain unquestioned; but that it originates elsewhere than in the man's intestinal tract seems highly probable. There seems also no doubt that, in addition to the toxic influence upon the blood, there is also a marked reflex influence upon the general system, and that, together with these, are at work the gradual exhaustion of an exaggerated peristalsis maintained through years, and the inanition consequent upon the loss of the nourishment necessary to maintain the tapeworm. As to whether the supply of a natural secretion of the bowel is diminished below the necessary quantity, or wholly cut off when the parasite is present, or whether the resistance is lost to toxic substances usually handled without difficulty by the intestine, are questions to be answered only after such careful investigation and animal study and experiment, as the writer has, up to the present time, had neither leisure nor opportunity to devote to the subject. It seems

established, however, that the day of primary anæmia is gradually passing by, and that behind all diseased processes, whether of the blood or of any other organ, there is an active potent cause that is possible to discover and prevent, if not cure.

The treatment of bothriocephalus disease comprises a series of prophylactic measures, as well as those for the disease itself. The important and only effective method of prophylaxis is the thorough cooking of all fish foods before ingestion. As this furnishes almost absolute protection against infection, arguments need hardly be adduced in favor of extreme care in this regard. We cannot exercise such care, however, over our pet dogs and cats, and as these animals can also harbor the bothriocephalus and scatter its ova and proglottides in every direction, there is still a danger which, while not great, can hardly be avoided under certain unfortunate circumstances. When a patient is known to be infested with any form of tapeworm, not only the segments, but all bowel passages should be burned, as the most certain and effective manner of destroying both the ova and proglottides.

As regards the active treatment of the patient, the prompt expulsion of the worm offers the hopeful and only possible means of cure. Contrary to the common opinion the bothriocephalus is one of the most difficult of the cestodes to destroy and expel from the bowel, as is exemplified by nearly every case cited in this paper. Thymol, administered in doses of 10 grains t. i. d., for several days, and after twenty-four hours of starvation, followed either by aspidium, koosso, pumpkin seed, or pelletierine, and later by a purge, seems to be the form of treatment that has yielded the most successful results. I have had no opportunity to use thymol, though the drug has been praised by many writers. In the treatment of my own case, and in the subsequent handling by others, pelletierine was always found to be the most efficient drug, though none was completely successful. Caution must be exercised in its use, however, as a number of cases have been noted of serious collapse as the result of its administration. Most treatments fail, either through lack of preparation of the patient or through a too timid administration of the anthelmintic. Probably the latter reason explains the frequent lack of success in general practice and the almost uniform success of the so-called worm-specialist or quack. The suggestion has also been made that morphine (1 to 3 grains) may be injected hypodermically into the projecting segments in certain cases prior to purgation. This suggestion seems, on the face of it, dangerous, to say the least, and there will be few experimenters rash enough to subject their patients to the possibility of absorbing a large quantity of a powerful poison while in a weak and susceptible condition. Most cases of infection by whatever variety of tapeworm, provided the patient is properly prepared by fasting, if the drugs are intelligently given, will

furnish a successful outcome, and the growth will not recur, even if the head be not found. The latter is undoubtedly often destroyed, and then discharged at a later time. An enema will often assist in delivering the worm when free. Some cases seem, for a time at least, practically invulnerable; and where the pernicious anæmia accompanies such a type the prognosis is a bad one, indeed. On the other hand, the recovery is usually so prompt upon the expulsion of the entire worm that no effort is too great, nor can it be repeated too often (after the worm is full-grown) until at last the attempt is completely successful.

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ECTOPIA OF THE ADRENAL.

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The object of this paper is to give a brief résumé of the cases on record and a short sketch of the histology and embryology of this gland so far as they bear upon ectopia of the organ.

Histologically, the adrenal is composed of cortex and medulla, the former consisting of zona glomerulosa, zona fasciculata, and zona reticularis. The capsule surrounding the organ is composed of elastica in the outer part and white fibrous connective tissue in the deeper portion. In the latter Joesten and Rauber found involuntary, non-striated muscle fibres. Besides these, bloodvessels, nerves, ganglia, accessory adrenals, and bands of cells of the zona glomerulosa are also found. The capsule does not strip and is thinner in children than in adults. In the outer part of the zona glomerulosa the cell groups are elongated, while in the lower part they are globular. These cell groups are surrounded by connective tissue and capillaries. The nuclei are large and the protoplasm of the peripheral cells less in amount than that of the deeper cells. Extra nuclei are sometimes found in these cells. This zone is quite irregular, and in children may even be wanting. The cells of the zona fasciculata are arranged in strands or columns between which are found the connective tissue, bloodvessels, and lymphatics. The cells are more regular and paler than those of the preceding zone and stain less readily. They contain, except in children, fat globules. The nuclei are smaller, granular, and situated in that part of the cell nearest the capillaries. There are usually, in these columns, two cells side by side. In the deeper layers of this zone the cells are less sharply defined and the nuclei central. The zona reticularis consists of cells arranged in a network, the continuation of the columns of the zona fasciculata. The cells are small, nuclei large, and the protoplasm pigmented with a yellowish-brown substance. In old age this zone is irregular, and in places wanting.

The medulla is separated from the above by a layer of large, smooth cells. It contains a network of connective tissue bundles, within the meshes of which are fragmented chains or groups of cells which stain

deeply with chromium compounds. The nuclei are large, and often there is but little protoplasm.

Nerves and ganglion cells are abundant. The vessels are numerous and large, especially the veins. The adrenals of the newborn and young children are rich in furrows. This is of importance in the formation of accessory adrenals. In youth and adult life they are smooth.

Reviewing briefly the embryology of the adrenal we find that it has a double origin. According to Hertwig,[1] Balfour, Braun, Kölliker, and Mitsukuri, the medulla is derived from ganglionic outgrowths of the sympathetic system. The cortex, however, has a greatly disputed origin. Balfour, Braun, and Mitsukuri hold that it is developed from mesodermic cells just anterior to the mesonephros in a concavity of the cardinal vein. Hertwig, Minot, Janosik, Weldon, Milhalkovics, Semon, Hoffman, and Hans Rabl consider it of epithelial origin. Janoski and Milhalkovics hold that it is developed from the head end of the genital ridge, or epithelial cells in that region, while Weldon, Hertwig, and Minot believe that it arises from the head end of the mesonephros. (See also Aichel.[13]) The cortex as it develops surrounds the medulla and finally almost completely encloses it.

According to Chiari[2] the adrenal is developed from the peritoneal cells at the head end of the sexual gland anlage. As it consists of the same tissue as the latter it remains in intimate relation with it until the development of bloodvessels and the permanent kidney breaks up this relationship. At or about this time small parts or collections of cells may become detached, such fragments or even the whole gland becoming ectopic structures.

In an embryo of the second or third month the adrenals lie in close proximity to the inferior vena cava. Later, with the descent of the testis or ovary, small cell-groups or detached portions of the developing organ may be drawn away from their former positions and deposited at various places along the path of descent of the developing organs and especially through the necessary lengthening of the spermatic veins.

At this time the adrenals are comparatively large, enclosing nearly the whole kidney. The two are separated by connective tissue, the future capsule of the kidney. As the kidney is lobulated in the fœtal condition it is easy to understand how small detachments of cells could be enclosed in the interlobular connective tissue at this stage, and so account for the presence of adrenal tissue in the columns of Bertini and other parts of the adult kidney.

Mention of accessory or misplaced adrenal occurs as early as 1568, followed by that of Morgagni, in 1740, and Duvernay, in 1751. Rokitansky found bodies of various sizes in the region of or upon the normal adrenals, in the solar and renal plexuses, and even the cortex

and medulla of the adrenal body itself. Klebs, in 1876, states that, in addition to the above places, accessory organs may be found upon the kidney, beneath the capsule, and even within the kidney substance itself. Since then such structures have been found in the region of the internal abdominal ring, in the inguinal canal, upon the spermatic cord, between the epididymis and testicle, in the broad ligament, and in structures neighboring to those mentioned. They have also been found in the liver and within the capsule of the adrenal.

Marchand,[3] in his article of 1883, was the first to give a detailed description of these bodies. All his cases occurred in infants and children, and from this he drew the conclusion that in youth they disappeared and so were not met with in adult life. In his cases the bodies occurred in the broad ligament and in the region of the kidney.

In the first case the main body was found in the broad ligament, and smaller ones in the right adrenal. On section the larger one exhibited the cortex only.

The second, third, and fourth cases showed the accessory bodies in the broad ligament. The second one, on section, showed a yellowish-white edge and a yellowish-gray centre. It was, according to his conclusions, the only one to be found that exhibited anything like a true medulla. Its cortical cells contained fat globules. The other two were practically the same as case one.

The fifth case exhibited a small body just behind the right kidney.

The sixth case showed a number of small ball-like masses on the kidney and to the median side of the adrenal. On section these showed only cortex.

The fallacy of Marchand's conclusion, that accessory adrenals were to be found in children only, was soon proven by the findings of Schmorl.[4] His cases were adults, and he found a wider distribution of the accessory structures.

His first case, a man, aged thirty years, exhibited a small body just outside of the external abdominal ring. It lay upon the spermatic cord in close relation to the artery and the vein. It was yellowish-brown, smooth, pea-sized, and upon section showed a peripheral zone and a grayish-white centrum. In the latter the lumina of many small vessels were to be seen. The cortex showed adrenal substance, while the medulla consisted of delicate connective tissue and many bloodvessels.

D'Ajutolo[5] found such a body on each spermatic cord, just within the internal ring, of a newborn infant. In Schmorl's second case he found a small mass 2.5 mm. by 1.5 mm. in the right lobe of the liver. This was sharply defined and consisted of a dark yellow periphery and a brownish, not well-defined centrum. The cortical cells were in groups surrounded by delicate connective tissue and thin-walled bloodvessels. The zona fasciculata showed fat globules and in some cells

yellow pigment. In a woman, aged thirty years, he found three small bodies in the liver, and in another case two in the right lobe. In his next case the accessory adrenal structure occurred (in the liver) as a well-defined mass, about the size of a hazelnut. The cell protoplasm was pigmented, while some of the columns of cells showed hyaline degeneration. The centrum contained many bloodvessels.

The liver, no doubt, makes an effort to dispose of these foreign cells, and in some cases is successful, while in others the cells persist, multiply, become encapsulated and produce masses such as that just mentioned. (See also Noyes.[14])

Schmorl demonstrated a wide distribution of ectopic adrenals and also that such malposition occurred in adults, both male and female. Chiari,[2] in 1884, reported several cases. In his first case a small body was found posterior to the right kidney. It was about the size of a pea, yellowish-brown in color, and on section showed only cortex. The centrum consisted of bloodvessels and delicate connective tissue, and just external to these structures pigment cells were noted. Beyond this was the rest of the cortex. All three zones were distinct and all contained fat, the zona glomerulosa being richest in this element.

The second occurred in the broad ligament of a woman. Here the pigment zone was well marked, and the centrum especially so. The cells of the zona reticularis were pigmented and the whole mass encapsulated.

The third showed a small mass beneath the right kidney, near the adrenal, and the fourth also beneath the right kidney. Here the general characteristics were the same.

Ulrich[6] reported an adrenal in the kidney, another upon the upper pole of the right kidney, separated from the renal tissues by the capsule of the kidney. The same observer noted two other instances, both in children, one fourteen days and the other three years old. His third case showed all three zones, no medulla, no fat, and no pigment.

Dagonet's[7] first case showed a pea-sized body in the broad ligament just below the ovary. In the second there were two, one lying between the testicle and epididymis, and another on the spermatic cord. Of these the first showed the zona glomerulosa and zona fasciculata and a centrum rich in capillary bloodvessels. The cell stained deeply, but contained neither fat nor pigment. He made the observation that in children the centrum was red and the vessels filled with blood, while in the adult the centrum was usually pigmented and dark.

Kelly[8] reported a case in which there was union of the adrenal and kidney and a displaced mass of the former, irregular in shape, in the cortex of the latter. The little adrenal islets had portions of kidney cortex enclosed within them. Besides these, there are the cases of Rossa (quoted by Warthin[15]), four in the broad ligament, and of these two in newborn children; those of Meyer, seven in children and fœtuses; and

Gottschalk's, one in an adult. Wahneau reported a case in which an ectopic adrenal was found in the cœliac ganglion.

The occurrence of ectopic adrenals is not so infrequent as might be supposed. Imbert[9] states that they occur in about 92 per cent. of all autopsies, and they are found in the kidney in 6 per cent. to 8 per cent. of cases. Eastwood[10] calls attention to the malignancy of the neoplasms, developing from adrenal rests. His paper takes up those occurring in the pelvis in connection with the spermatic and ovarian veins and broad ligament. He found a large malignant tumor in the fundus uteri. It consisted of a large, encapsulated mass the cells of which resembled those of the zona glomerulosa. Imbert[9] experimented on dogs with the view of producing tumors composed of adrenal tissue. He detached the left adrenal and inserted it into a longitudinal incision in the kidney, and studied the results in the animals that recovered. In one dog three and a half months after operation the tumor resembled the so-called pseudolipoma of the kidney. He considers this an experimental pseudolipoma of the kidney. In another case he produced a cystic condition.

The importance of ectopic adrenals is not their frequency, but the frequency with which they give rise to neoplasms. Their importance is being more fully realized as tumors supposed to be lipomas and adenomas are found to consist, histologically, of adrenal rests.

Grawitz[11] first directed attention to the fact that certain tumors of the kidney were composed of adrenal tissue, adrenal rests, and Kelly[8] in an exhaustive review of hypernephromas has fully summed up the various views as to their origin and general character.

Ectopic adrenals respond to the following tests:

1. *Histological.* The peculiar, indeed, quite characteristic architecture of the organ as a whole as well as its component layers.

2. *Chemical.* Gives the reaction for glycogen. The specific brown coloration in chromium fixed preparations, said by Böhm and Davidoff not to be observed elsewhere except in certain cells of the hypophysis.

3. Presence of fat globules in the cells, especially in the zona glomerulosa.

4. *Staining reaction.* By the use of Weigert's fibrin and Russel-fuchsin stains, Lubarsch[12] found that the nucleus and nucleolus of adrenal cells stain differently. No other tissue responds to this test.

After this brief résumé of the occurrence of accessory adrenals and the histology and embryology of the normal gland, I desire to report the following case:

The patient,* J. L., male, aged twenty-nine years, was admitted to the Jefferson Medical College Hospital, the diagnosis being gumma or tumor of the brain; although the previous history yielded no satisfac-

* For this brief abstract of the history the writer is indebted to Dr. Spencer. Other features of the case will be reported elsewhere.

tory data, it was believed that the lesion was syphilitic. Had recurring convulsions that at the time of admission were uncontrolled by usual remedies, and occurred every fifteen minutes. He was trephined for the purpose of reducing pressure and as an exploratory procedure. Death occurred on the following day.

Autopsy by Prof. Coplin, to whom the writer is indebted for the use of the autopsy record, the material, and suggestions in the preparation of this report.

Pathological Diagnosis. Numerous hemorrhages in subcutaneous fat, spleen, and subserous tissues; cloudy swelling in the heart, liver, and kidneys. Hypostatic congestion and pulmonary œdema; lobular atelectasis. Ectopic of adrenal; intense meningeal congestion; gumma in left frontal lobe.

Only so far as bearing upon the matter at hand, will it be necessary to give a summary of the autopsy notes.

The kidneys were about normal in size, but somewhat flabby. Internally they showed but little abnormality. Upon the anterior superior surfaces of both kidneys a thin yellowish body was noticed. This covered an irregular area about 3 cm. in diameter, and approximately 1 mm. thick. The peripheral portion was yellowish, while that toward the cortex of the kidney was dark. They were beneath the capsule in each instance, and in places dipped into the cortex. One adrenal of normal shape, size, and location was present on the right side.

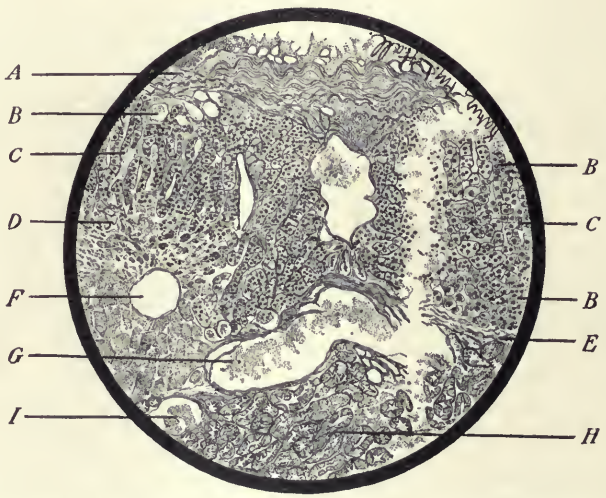
Upon the under surface of the liver near the transverse fissure, a small, thin mass was noticed. It resembled that upon the kidney. It was approximately 1 cm. in diameter and 0.2 cm. thick, tapering at the ends like a small adrenal. Upon section it had the appearance of normal adrenal tissue. Pieces of these masses were placed in Heidenhain's solution and Müller's fluid, dehydrated in ascending strengths of alcohol, cleared in turpentine, and embedded in paraffin.

Adrenal in the kidney. (See Fig. 1.) Upon histological examination the adrenal, in connection with the kidney, showed the following structure: The capsule was rather thick and composed of white fibrous connective tissue. In the deeper layers were apparently some involuntary non-striated muscle fibres. Between the groups of cells of the zona glomerulosa and capsule were many red blood cells. These were also noticed scattered between the glomeruli. The groups of cells of this zone were large and small; in places these were wanting, the zona fasciculata reaching nearly to the capsule. In others the glomerular zone was five or six groups deep. The edge of this patch of adrenal tissue tapered, and at the extreme margin the capsule was seen separating it from the kidney cortex, but for only a short distance. Here the zona glomerulosa followed the capsule to its end. Over this area the regular capsule was quite thick and apparently laminated. Between the lower layers were extensive but narrow spaces containing large numbers of red blood cells. Beyond the area of true adrenal tissue this capsule extended as a thick mass of connective tissue in which were great numbers of erythrocytes. Here also were found fat and elastic tissue, the latter continued from over the area of adrenal substance. Within the capsule were also groups of cells resembling those of the zona glomerulosa and separate cells, which took the nuclear stain quite deeply. These latter cells were arranged in a band in the middle of the capsule, and as the adrenal substance was reached the band became broader and ended abruptly.

At one place a beam of tissue, apparently involuntary non-striated muscle fibre at its inner end, passed in at an acute angle, cutting off a triangular portion of the adrenal cortex. Large and small bloodvessels were present in abundance and nearly all filled with blood cells.

Just beneath the capsule was a single row of cells that extended quite a distance. They appeared the same as the rest of the cells of the zona glomerulosa. Beneath this the groups were large and irregular. The number varied from two to six in depth. The cells and nuclei of those nearer the capsule were small, with outlines usually indistinct. Most of the remaining nuclei, however, were large and prominent and took all stains deeply. They were circular in outline and mostly eccentrically placed. The nuclear membrane was sharply outlined, and in those cells less deeply stained the nuclear fibrils were

FIG. 1.



Section of cortex of kidney containing ectopic adrenal. (Fixed in Heidenhain's solution paraffin, hæmatoxylin, and Van Gieson. Obj. 16 mm., oc. compensation, and reduced ⅓.) *A.* Capsule of kidney extending over adrenal. *B B B.* Zona glomerulosa. *C C.* Zona fasciculata. *D.* Zona reticularis. *E.* Capsule projected between adrenal and kidney cortex partly separating the two structures. *F.* Cavity surrounded by Bowman's capsule, external to which is adrenal tissue. *G.* Large vein. *H.* Kidney cortex. *I.* Imperfectly developed Malpighian body.

seen in various arrangements, apparently karyokinetic figures. The nuclei vareid from six to thirteen microns in diameter, the average being about eight to nine. The cell protoplasm stained but faintly and irregularly, giving the appearance of fat globules. The outlines were usually indistinct, and the diameter varied from eighteen to thirty microns. A few had two or three nuclei. Between the groups, beneath the capsule, were noticed red blood cells scattered and grouped.

Zona fasciculata. The columns were long and parallel as in the normal structure, and separated by connective tissue. The cells were larger than those of the zona glomerulosa, and the nuclei averaged ten to twelve microns in diameter. These were placed eccentrically toward the centre of the columns and showed karyokinetic figures. The protoplasm stained more deeply and more regularly than in the above zone,

and the cell outline was also more distinct. The cells in the lower portion of this zone were of a peculiar olive-green color, the nuclei deeply stained, and the whole somewhat hazy.

Zona reticularis. Here the cells were smaller and the nuclei comparatively large, averaging ten microns. Frequently two were seen in a single cell. The nuclei were irregularly placed; no matter what stain was used the cells were of a peculiar olive-green color and somewhat hazy. They were indiscriminately scattered and not arranged in definite chains, groups, or network. The cell outlines were more distinct than in the other zone. Some of the nuclei were quite distinct, showing peculiarities of those of the other zones. Here also a great many red blood cells were noticed scattered and in groups. A number of tubules, about eleven, were noticed here. These were lined by simple squamous epithelial cells and two contained imperfect Mal-

FIG. 2.

Section of ectopic adrenal beneath the peritoneum and intimately attached to the capsule of the liver. *A A.* Capsule of Glisson. *B B.* Zona glomerulosa. *C C.* Zona fasciculata. *D D.* Zona reticularis. *E E.* Peritoneal surface.

pighian bodies. This zone passed directly into the cortex of the kidney, except at the outer edges of the patch. At this portion the zona reticularis was absent. Between this zone and the cortex at places larger spaces were visible, apparently cystic in character, perhaps greatly distended capsules of Bowman, as they were lined by simple squamous epithelial cells.

Mass under the liver. (See Fig. 2.) Here apparently the order of the zones was reversed. Separating this mass from the liver was a thick layer of loosely arranged connective tissue containing oval masses of cells apparently adrenal glomeruli, pigmented as those of the zona reticularis.

The zona glomerulosa was only two or three cell groups in depth. The cells were smaller than those in the foregoing specimen and stained more deeply. The nuclei averaged nine to ten microns, were eccen-

trically placed, and stained intensely. Blood cells were found between the groups. In the zona fasciculata the cells were also smaller than those in the kidney, but the nuclei were larger. The latter averaged twelve to fourteen microns, were eccentrically placed, and stained deeply. The cells were darker than those of the third zone. The columns were quite long and well separated in places. The zona reticularis stained well, the nuclei were prominent, and the cell protoplasm was less hazy than in the kidney specimen. The cells were as large as those in the zona reticularis of the above, but deeper in color, containing, apparently, more pigment. The network was closely meshed, especially in the deepest part, where the cells formed an almost solid mass the extent of the section. Here the color was an olive-green.

Over the greater extent of this mass was a band of tissue, apparently representing the peritoneum. In places the strands of this tissue were separated, and the spaces contained an abundance of red blood cells. For quite a distance it gave way to several layers of large polygonal epithelial cells. The nuclei were prominent and eccentrically placed, but the cell walls were indistinct. The cells were deeply colored, like those of the zona reticularis, but separated from them by connective tissue and bloodvessels in places.

From the above it will be seen that the zona reticularis was external, a very unusual condition.

Conclusions. 1. Ectopic adrenals are found in both sexes and all ages. 2. Their occurrence is far more frequent than formerly supposed. 3. Although they vary in size, most of them conform to the general description of yellowish, oval, or globular bodies, which on section show a light periphery and a dark centrum. 4. Microscopically these bodies consist of two or three zones of the cortex of the adrenal, but seldom of the medulla. (Marchand's second case was the only exception, and no complete histological description was given.) May,[16] however, found both cortex and medulla in two out of ten of his cases. 5. The separation of the masses occurs early, before the inclusion of the medulla by the cortex of the normal gland. 6. The distribution varies greatly, the usual location being some point between the kidney and the descended sexual gland; to this is to be added the unusual location, the under surface of the liver, and also within the organ.

Note.—While this paper has been in the hands of the printer, Joseph C. Ohlmacher (*Journal of Medical Research*, May, 1902, vol. vii. No. 4, p. 421) has reported a malignant medullary hypernephroma of the kidney.

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A CASE OF HEMORRHAGIC EXUDATIVE ERYTHEMA (HENOCH'S PURPURA).[1]

By Herbert Swift Carter, M.D.,
of New York City.

The case here presented is one of a modified form of Henoch's purpura, in which the abdominal symptoms were as severe as they were interesting.

The entire subject of the etiology of most of the purpuric conditions is so hopelessly obscure at the present time that no discussion of it will be attempted. Whether in this or in other cases it is due to changes in the blood cells, plasma reaction, coagulability, or the presence of the ever possible toxins in it, derived from uneliminated excrementitious matter, is simply a matter of speculation, there being nothing positive in this instance to point to, the intestinal canal, however, not being above suspicion.

History. Mrs. S., American, aged twenty-nine years.

Family History. Her sister has had attacks of what has been called "gastric neuralgia," characterized by very severe abdominal pain (not associated with an eruption), lasting from a few hours to the greater part of the day; often associated with obstinate constipation. The mother also suffers from facial neuralgia.

Previous History. As a child she had a very severe attack of measles. She has never had rheumatism in any of its regular manifestations. Not alcoholic. No menstrual irregularities. She has always been an exceedingly healthy woman, with no hæmophilic tendency whatever.

Present Illness. On March 6th the patient had a late supper consisting of sweetbreads and coffee. The following evening she complained of a moderate sore-throat, and noticed a few scattered, bright red spots about both elbows. There had been considerable constipation for several days previously. As she felt perfectly well otherwise, no attention was paid to the spots until the next day, when it was noted that the eruption was more profuse, and had appeared on the legs above the ankles. She was seen first on March 9th by the writer, and the following notes taken:

Physical Examination. At 10 A.M. temperature was 98.6° F.; pulse, 84; respirations, 20. The patient is slightly anæmic. Tongue moist and very slightly coated. No enlargement of superficial glands.

[1] Read before the New York Society of Internal Medicine, April meeting, 1902.

Skin. Over the extensor surface of both arms to the shoulders, and to a much less extent over the flexor surfaces of the forearms, over the legs from the ankles up, including buttocks, there is a profuse eruption of small, bright red, purpuric spots, associated here and there (particularly about the elbows and just above the ankles) with areas which are rather larger, slightly raised, and less red in color (purpura exuditivum). None of the spots disappear on pressure, and the purpuric ones are very characteristic. (I mention this fact, for in the relapses they were less so.) The joints are generally tender, but none are swollen or red. The trunk and face are entirely free from the eruption, as are also the hands and feet.

Heart, lungs, liver, spleen, and stomach are of normal size and position.

Abdomen. The patient complains of a feeling of "indigestion" in the stomach and some pain in the upper half of the abdomen, which is also moderately tender to palpation. The skin, too, over this area being slightly hyperæsthetic.

Throat. Very slight redness; is not sore. Pupils and knee-jerks normal.

Urine Examination. Clear. Specific gravity, 1020; very acid. No albumin or sugar. Indican in very great excess (Jaffe's test).

Microscopical Examination. Amorphous urates. No blood.

The patient complained of nausea, but had not vomited. The bowels had moved freely after a large dose of cascara. Strontium salicylate and an alkali were ordered, together with fluid diet.

I was called at 8 P.M. and found that the patient had vomited twice and was then tossing about the bed and groaning from severe pain, limited to the upper half of the abdomen, which had been steadily increasing all day, and was now unbearable.

Examination. Temperature, 99° F.; pulse, 80; respiration, 20. Eruption more profuse, but of the same character.

Abdomen. There is very marked tenderness all over the upper half, apparently most intense over the stomach area, as obtained by percussion. Muscular rigidity on attempted deep palpation; no one spot more tender than another could be made out, and no masses could be felt. There was no distention, and the lower half of the abdomen was soft. Palpation was easy. Appendix region normal.

As there was no positive evidence of peritoneal inflammation, and the suffering was intense, morphine was given hypodermically. This relieved the pain, and the next morning when seen the subjective pain had almost entirely disappeared, and the abdominal tenderness was much less; the eruption had faded very markedly during the night, was much less red and profuse, and was brownish in places; the joint pains were insignificant.

For the next three days the eruption continued to fade, the tenderness to disappear, and the general condition improved, but only slightly.

March 13th. Patient feels fairly well, but a new crop of the eruption is coming.

The next day the eruption had increased, and she complained of beginning abdominal pain and feeling of "indigestion" again, besides being generally miserable. The pain steadily increased, and by 2 A.M. March 15th morphine had to be resorted to again on account of its severity. The physical examination was precisely as it was in the first

attack, except that the eruption was more profuse and involved the trunk, hands, and feet to a slight extent, and was more exudative in character. The left hand was also puffy and the carpal joints very tender. The abdominal condition was as before, but in addition there was tenderness along the upper part of the descending colon. Temperature, 98.6° F.; pulse, 80.

The eruption and abdominal pain and tenderness began next day to subside together, and after three days both had almost disappeared.

During this attack there was only a faint trace of indican present in the urine. Blood examination: red cells, 4,340,000; leucocytes, 9000 per c.mm.

A similar relapse occurred ten days later, the pain and eruption reaching their height in forty-eight hours from the onset, although in this instance the pain was most severe just before the eruption on the body was greatest. In both the original attack and the first relapse the height of the eruption and the greatest intensity of pain were exactly coincident, increasing together to this point, and then, as it were, receding hand-in-hand. In this relapse the eruption was at times almost wholly of the exudative type, and at others, both exudative and purpuric. The vomiting was also a more marked feature, and continued about eighteen hours, although it may in part have been due to the morphine. Leucocyte count again 9000 per c.mm. Examination of vomitus contained no free HCl, no lactic, butyric, or acetic acids, and the urine showed only a faint trace of indican as in the first relapse.

After the subsidence of the pain and eruption the patient said she felt much better than she had after the first two attacks, and improved steadily. After each attack the stools contained undigested food and mucus, but it was only after the third attack that taking food gave any gastric discomfort, and then only slight and for twenty-four hours.

The special points for consideration are:

1. At first apparently an ordinary attack of rheumatic purpura, with typical eruption and joint symptoms, preceded by sore-throat.

2. Excessive amount of indican in the urine at first, later never more than a trace.

3. Temperature, pulse, and respiration never above the normal.

4. No hemorrhage from visible mucous membranes.

5. Very severe abdominal pain limited to the upper half of the abdomen and usually most marked over the stomach area, which began shortly after the appearance of the skin eruption and increased in intensity, reaching its climax when the eruption was most marked, except for the slight modification in the last relapse, as already noted.

6. Relapses three to ten days apart. Entire illness three and one-half weeks.

7. No hyperleucocytosis.

8. Course of the disease and relapses and pain uninfluenced by salol, salicylates, ergot, gelatin, acetanilid, iron, bismuth, alkalies, aqua, chloroform, calx chloride and poultices, all tried in various ways. Pain only relieved by morphine.

Of course, the interest here centres entirely about the abdominal symptoms associated with the purpuric eruption on the skin, and the question of what it might or could be is of decided interest.

Nearly thirty years ago Henoch[1] published his observations on four cases "Concerning a Peculiar Form of Purpura," with gastro-intestinal symptoms—all of the cases being characterized by the following facts:

1. All occurred in children.
2. Purpura with colic, abdominal tenderness, vomiting, and accompanied by intestinal hemorrhage (usually from transverse colon).
3. Rheumatic pains and swelling of the joints.
4. Relapses in three to eight days—the course of the disease lasting in all three to seven weeks.
5. Fever moderate or none at all.

In discussing these cases of Henoch's, Strümpell[2] says that the gastro-intestinal disturbances may occur also in adults. There may be intestinal ulceration, with perforation and consequent peritonitis. The spleen may undergo acute enlargement.

In 1895 Osler[3] published a series of eleven cases of apparently much the same character, and again in 1900 seven additional cases, all of which he groups under the general head of "Exudative Erythema," in an article entitled "Visceral Lesions of the Erythema Group."

In all of these cases there was a skin lesion, sometimes of a simple exudative erythema, at others of a true purpura, associated with attacks of epigastric pain, usually very sudden in onset and with an abrupt termination, but in others the pain lasting seven to ten days. He brings out also the relationship between this combination of symptoms and angioneurotic œdema and urticaria, and says: "A point of special interest is the relationship of certain forms of purpura to the erythemas. Schönlein's peliosis rheumatica may be regarded as a hemorrhagic type of an exudative erythema, and Henoch's purpura, which is characterized especially by the occurrences of gastro-intestinal crises, belongs to the same group."[4]

Taking into consideration this chain of evidence, it seems fair to place this case among the exudative erythemas associated with purpura and gastro-intestinal crises (Henoch's purpura). The intestinal hemorrhages in Henoch's series were presumably due to the purpuric eruption on the intestinal mucous membrane, and although in the case here reported there was no intestinal hemorrhage and only a slight streak of blood in the vomitus during the second relapse, still, it seems to the writer that the intra-abdominal symptoms were in all probability due to an eruption, either purpuric, exudative, or both, into the gastric or intestinal mucous membrane.

[1] Berl. klin. Wochenschrift, 1874, vol. xi. p. 64. [2] Strümpell, p. 745.
[3] The American Journal of the Medical Sciences, December, 1895.
[4] Jacobi Festschrift, p. 446.

TRAUMATIC POTT'S DISEASE, FOLLOWED BY SPASTIC PARAPLEGIA.

By Henry M. Fisher, M.D.,
of Philadelphia.

Henry F. had always been well until the year 1868. He was a bricklayer by trade, and while working on a scaffolding fell backward and was picked up unconscious. When he regained consciousness he was found to be suffering from a severe contusion of the thorax, and he complained also of intense girdle pains. Some weeks later posterior angular curvature of the spinal column was noted.

After remaining in bed four months the patient was able to return to work, though he suffered at times acutely from the girdle pains. These pains, however, gradually subsided and finally entirely disappeared.

Eight years after the accident, that is, in 1876, he had to all appearances recovered entirely from all effects of the accident, except for the angular curvature, which persisted, and for ten years he felt as well and strong as ever.

In 1886 he observed that his legs were becoming weaker, that there was a constant dull aching in the muscles of his legs, and that he was easily fatigued.

Nine months later he found that he was unable to walk without staggering.

From January to April, 1888, he was under treatment at the Episcopal Hospital, and was discharged unimproved.

After this he went West to superintend the building of a furnace. He became, however, progressively weaker, and finally had to be conveyed to and from his place of employment every day. Returning to Philadelphia, he continued to work with increasing difficulty, and on February 16, 1891, he was admitted to the Orthopædic Hospital. He was at this time able to get about the ward with the aid of two canes. His treatment at the hospital was as follows: 1. Absolute rest in bed. 2. Suspension while in the sitting posture three times daily for an hour at a time. 3. After two months a plaster jacket was applied and he was allowed to sit up in a chair.

The extension with the jury-mast was then continued for three months longer. The plaster jacket was then removed and the treatment by extension was discontinued. He remained nearly nine months at the Orthopædic Hospital, and was discharged November 10, 1891.

About a month before leaving the hospital the muscles of both lower extremities were faradized daily, and complete extension was practised daily for four minutes at a time. He also received massage during his whole stay at the hospital. He thought that the massage and electricity had been of much benefit to him, at least so far as the relief from the symptoms of muscular rigidity and aching was concerned.

After leaving the Orthopædic Hospital he went at once to the Episcopal Hospital. There various drugs were administered without any result, with the single exception of nitroglycerin, which appeared to relieve somewhat the spastic condition of his muscles. When he was

admitted this rigidity of the muscles of the lower extremities was extreme. The patellar reflexes were markedly increased, and ankle clonus and "clasp-knife rigidity" were noted. No impairment of the muscular power in his arms was observed.

February 15, 1893. Since last March the patient has observed impairment of power in his left hand, associated also with some anæsthesia, and there has been much awkwardness in using this hand. Three or four months later the same symptoms were observed in the right hand. There was now some wasting of the left interossei and of the left adductor pollicis. No marked wasting of the muscles of the lower extremities had so far been noted.

July 13, 1895. Patient has been having mild galvanic current applied to his legs for the past two months, and he says that he can move his legs better and with less pain after the electricity has been applied.

September 25*th*. Patient had a chill to-day, and his temperature rose to 103.5° F. He developed at the same time a distressing cough, attended with much dyspnœa, and his respirations increased to 36 to 40.

His temperature from this time until his death was constantly two or three degrees above normal, sometimes rising as high as 103° F. in the evening, and his pulse-rate varied from 104 to 140. For the above clinical notes I am indebted to Dr. W. W. Ashhurst, late resident physician at the Episcopal Hospital.

October 1*st*. On resuming my service at the hospital I found that the patient had complete paraplegia, with paralysis of the bladder and rectum, and that there was marked wasting of the muscles of both upper and lower extremities. Cough and dyspnœa were marked. Examination of the lungs anteriorly showed the presence of very numerous subcrepitant and submucous râles, but there were no marked evidences of consolidation, at least anteriorly. The patient was, however, too weak to submit to a very thorough examination. His dyspnœa increased, and he became rapidly weaker, and finally died, November 21, 1895, a little over four years after his second admission to the hospital, nine years after the first marked development of the symptoms of involvement of the cord, and twenty-seven years after the injury was received. The autopsy showed that death had been caused by an acute miliary tuberculosis; tubercular granulations being thickly scattered through both lungs, the spleen, and the kidneys, and also in the peritoneum.

There were distinct evidences of disease (caries of one, or possibly both) of the lower dorsal vertebræ, and the membranes over the bodies of these vertebræ were markedly thickened and adherent. The brain, at least to the naked eye, showed no evidence of disease, and sections of it were unfortunately not preserved for microscopical study.

The medulla and the spinal cord, however, through its entire length, showed in the parts stated marked evidences of degeneration. The cord and medulla were removed, hardened in alcohol and Müller's fluid, and sections were embedded in celloidin and stained by the Weigert-Pal method.

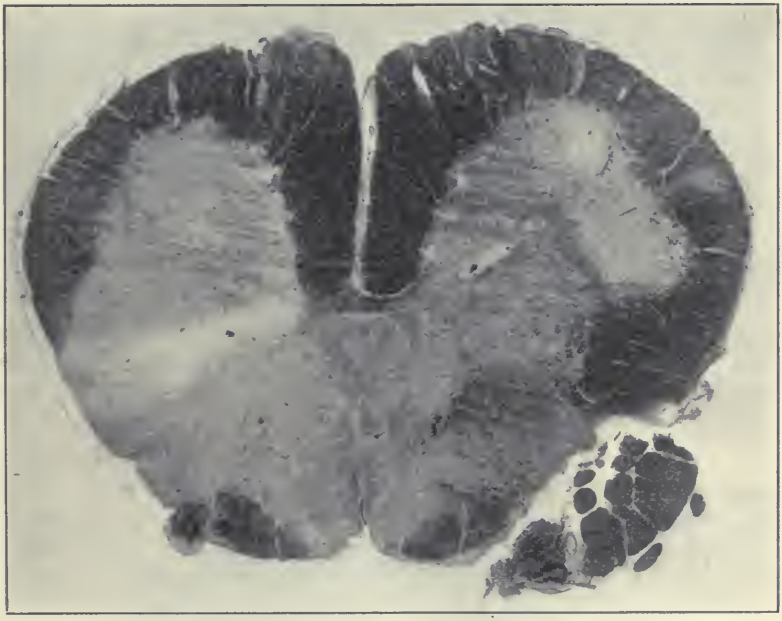
The photomicrographs used in illustrating this article were made for me by Dr. James Wallace.

For the following account of the distribution of the lesions in the

cord and medulla my thanks are due Professor Simon Flexner, of the University of Pennsylvania:

"*Lumbar Segment.* (Fig. 1.) The degeneration affects in the main the postero-lateral and posterior columns. There is complete degeneration of the posterior columns, and the degeneration extends into the gray matter, taking in all that portion of it posterior to the commissures, and, in the side to be described, extends for a short distance into the anterior gray matter immediately anterior to the commissure. On the side showing least degeneration there is an irregular extension into the white matter of the postero-lateral tract; whereas, on the other

FIG. 1.



side the posterior tract is invaded diffusely as far as and extending into the lateral group of cells of the anterior horn.

"There is a small island of white matter which has escaped, this island being located laterally to Goll's column and reaches to the periphery of the cord. Its position suggests that it is a portion of the posterior root fibres entering at this level.

"The anterior columns and the antero-lateral columns, excepting as indicated, are undegenerated.

"*Lower Dorsal Segment.* (Fig. 2.) The posterior columns are intact. The same is true of the anterior columns and of one lateral column. The opposite lateral tract shows complete degeneration extending from the entrance of the posterior roots to the anterior median fissure. There are no medullated fibres preserved in this area.

FIG. 2.

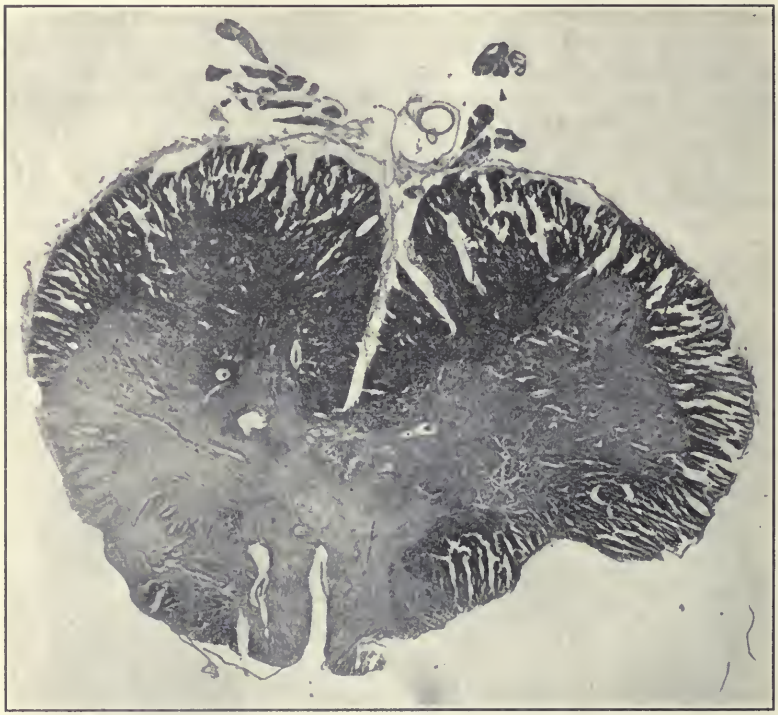
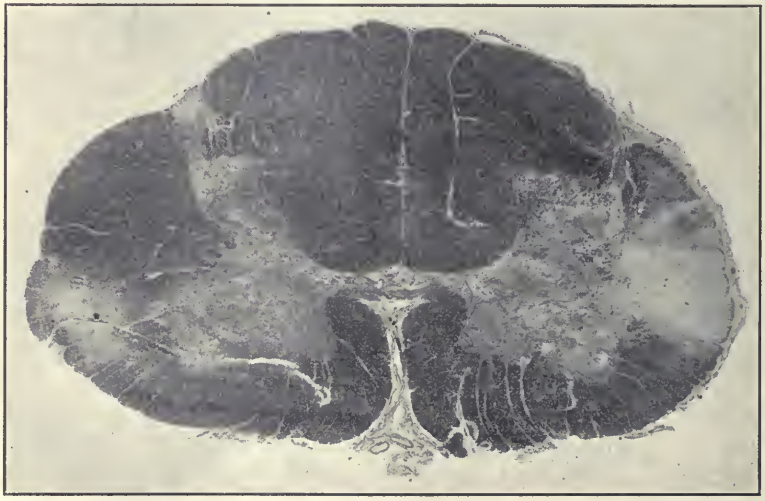


FIG. 3.



"Viewed under high power this material is made up of a fine network, in which there are innumerable round refractive bodies which are slightly tinted with a yellowish-brown stain, and which appear to be remains of nerve fibres which have lost their medullary sheaths.

"*Upper Dorsal Segment.* Appearances here differ from those in the lower only in the further encroachment anteriorly of the area of degeneration.

"*The cervical cord* (Fig. 3) shows two distinct areas of degeneration. A large one starts almost at the posterior horn and extends laterally to the margin of the cord, and anteriorly beyond the anterior median fissure. The smaller occupies the region of the lateral tract, but does not reach the lateral margin of the cord. The gray matter appears uninvaded. The posterior columns are probably normal, although the column of Goll in its central portion stains more palely than the rest.

"*Medulla.* This section, which appears to be just above the decussation of the pyramids, shows two areas of degeneration in the posterior columns almost equal in size, both being imperfect in that there are remains of medullated fibres and stained sheaths fragmenting and showing varicosities. The lesser lateral degeneration corresponds to that of the smaller area of the cervical section, but is somewhat larger. The larger of the lateral degenerations extends through to the periphery of the cord, and is just posterior to the anterior horn. An occasional degenerated medullary sheath remains."

The most interesting feature of this case clinically was the entire quiescence of all symptoms that might be referred to the disease of the cord for fully ten years after the receipt of the injury, and then the rather sudden lighting up of symptoms of spastic paraplegia. It seems fair to suppose that there was a very gradual interference with the nutrition and blood supply of the cord, in consequence of the slight compression at the seat of the injury.

The sclerosis was ascending and by no means absolutely symmetrical. It will be observed, however, that in the main the degeneration has involved the lateral and postero-lateral columns, and in this respect the lesions do not differ so greatly from those described as characteristic of spastic paraplegia.

As might be expected, the lesion is most extensive below the original seat of injury. The girdle pains of which the patient complained soon after the accident, and the intensely spastic condition of the muscles of the lower extremities, appear to have been satisfactorily accounted for, first, by pressure on the posterior nerve roots, and ultimately by the almost total degeneration of the cord, at least upon one side, in the region of the posterior and postero-lateral columns. The degeneration having been very much more pronounced upon one lateral half of the cord than upon the other, one would have expected that the symptoms (spastic contraction) would have been more pronounced upon the side of the body corresponding to the more degenerated portion of the cord. This may have been the case; but if so, the fact was not recorded.

CONGENITAL ABSENCE OF THE ENTIRE ŒSOPHAGUS, WITH REPORT OF A CASE.

By James P. Marsh, M.D.,
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The condition of congenital malformation of the œsophagus is very rare. Mackenzie, in a very complete survey of the literature, found but fifty-six cases reported up to December, 1880. Solis-Cohen, writing in 1888, in *Ashhurst's System*, says that there had been reported between sixty and seventy cases, including four from the United States.

Taking in view, in a general way, the histories of these sixty to seventy cases, it would appear that the following conditions may obtain:

1. A congenital fistula of the neck, due to a want of closure between the second and third branchial arches and involving the œsophagus.
2. The œsophagus may be completely absent.
3. The œsophagus may be obliterated in only certain portions of its extent.
4. There may be stenosis not amounting to complete obstruction.
5. There may be dilatation or diverticula.
6. There may be a fistulous communication with the trachea. In two cases this communication occurred with a bronchus.
7. There may be double œsophagus with reunion at the cardiac end.

I shall confine my attention to the second division of complete absence of the œsophagus, as my own case comes under this head.

Of the fifty-six cases collected by Mackenzie, he gives five as being cases of the entire absence of the œsophagus. These are the cases of Sonderland, Lozach, Mellor, Heath, and the *Netley Catalogue*. It is manifest that Mackenzie did not carefully read the history of these cases, for the case of Lozach is the history of the dissection of a monstrosity, one of twins born at a little more than the seventh month of gestation. This infant had many anomalies, and it does not seem to me should be included in this class of cases. A search for Heath's case, referred to by Mellor, shows that Mackenzie was in error in including this case among the cases of œsophageal malformation, as it was a case of absence of the duodenum. The number of Mackenzie's cases is, therefore, reduced to three. To these I may add that of Steel's and my own case, which make in all five cases.

Mackenzie's own case, in which the lower end of the œsophagus communicated with the trachea, occurred in the child of a man who had had a previous child, born of a different mother, die under the

same circumstances. There is no case on record where the same condition has occurred twice in the offspring of the same mother. I think it fair to consider the double occurrence to the same father as a coincidence or rather as a faulty observation, as the evidence rests entirely upon the father's testimony.

The most acceptable theory for the explanation of this anomaly is that based upon the embryology of the œsophagus. Minot says that the œsophagus is developed from the *vorder daum*, between the pharynx and the stomach; that during the fourth week it begins to lengthen out, and by the end of the fifth week has become a cylindrical tube of considerable length; and that of its further history we have but little reliable information. It is certain, however, that in birds, reptiles, and fishes, the œsophagus is for a long time an impervious cord. W. Opitz maintains that the lumen is closed for a while in the human embryo. A reference to Fig. 441, page 753, of Minot's *Embryology* —Reconstruction of Fol's Embryo— will show the œsophagus as being practically closed. By a glance at Fig. 438, page 752—Reconstruction of His' Embryo B.—one can readily understand how there might occur an impervious œsophagus, or that there might occur a communication with the trachea or a bronchus. In fact, it is rather strange that this anomaly does not occur more frequently.

In passing, I may say that it is a somewhat remarkable circumstance that Sonderland's case, Mellor's case, and my own case were born during the month of August.

The diagnosis, provided that one carries the possibility of this condition in mind, is easy. There is a notable sameness to the symptoms existing in all cases. The child is like any other child until it begins to nurse. After taking a mouthful of milk or water, the child, in swallowing, is taken with a severe attack of strangling, and becomes cyanotic, and, by a supreme effort, throws out the ingested fluid through the mouth and nose. Suffocation seems imminent, and Mackenzie says that Porro's case did actually suffocate during one of the attacks. As a rule, the cyanosis passes away, and the child is apparently all right until the next attempt at nursing is made, when the same process is repeated. The bowel movements become gradually less in amount, and the secretion of urine becomes diminished. The child rapidly emaciates, and finally dies of starvation. Toward the end inspiration pneumonia occurs in quite a proportion of the cases.

There is no other condition that in any way resembles this one. However, to absolutely confirm the diagnosis, two expedients have been resorted to. Some observers have given the child a measured quantity of milk and water, and during the expulsive coughing induced have recovered the exact amount of the fluid given. Others have passed a soft catheter.

The minimum diameter of the œsophagus of the newborn child is 4 millimetres, and the distance from the border of the gums anteriorly to the cardiac orifice of the œsophagus is 17 centimetres. Hence, if an introduced catheter of this size cannot be passed the distance mentioned, it is evidence of occlusion of the œsophagus. Although not so stated by any observer, it seems to me that this procedure is not without danger, as the parts being malformed, there is considerable liability of passing the instrument into the trachea or bronchi.

The prognosis has been a fatal termination in all cases, although it would seem that with the modern methods of doing gastrostomy the life of these individuals might in the future be saved without rendering them an unbearable burden to themselves.

All medical treatment is worse than useless, and all that can be done for these cases must come from the surgical side of the house. This was recognized by Mr. T. Holmes. He suggested that the following procedure be adopted: "The object would be to cut down upon the point of a catheter passed down the pharynx, and then to trace the obliterated œsophagus down the front of the spine until the lower dilated portion is found. A gum catheter should then be passed through an opening made in the upper portion, and so into the stomach through the lower portion. If the two portions are near enough to be connected by silver sutures over the catheter, and if the latter can be retained until they have united, permanent success might possibly be obtained." Mr. Holmes seems to have never had the opportunity to carry out this procedure.

Both Solis-Cohen and Richardson seem to think this suggestion of Holmes to be feasible and worthy of trial. It is possible that there are cases in which this procedure might be successful, but in my case it would have absolutely failed and the child would have undoubtedly died in the attempt.

In all cases of absolute absence of the œsophagus, and, in fact, in all cases of the second, third, and sixth class mentioned above, which include all cases demanding immediate relief, the only operation to be considered is that of gastrostomy. The only case thus treated is that of Charles Steel, who performed gastrotomy in a child twenty-four hours old, and by means of retrograde catheterization found complete occlusion of the œsophagus. A full description of this case will be found in the list of cases.

Owing to the rarity of the condition, and the considerable difficulty in finding the old references, it has been thought best to add a short résumé of each case so far reported, the author's case being the last one detailed:

Case I. (Sonderland)—The title of this case is as follows: "The remarkable case of a child which, with a total absence of the œsophagus was born and lived eight days."

The child was born apparently complete and healthy. It was noted that at the birth there was a considerable amount of amniotic fluid discharged, and that the placenta was two or three times larger than usual. Soon after birth, sugar-water was given to the child, which it swallowed eagerly, but it was immediately seized with an attack of suffocation, and the ingested fluid was thrown out again through the mouth and nose. This process was repeated every time the child attempted to take nourishment. A malformation of the œsophagus was suspected. The child lived eight days, and died of starvation. During his life he had regular defecation and urination, but on account of the want of nourishment it was not so copious as is normal.

At the autopsy the liver was noted as being of large size and covering over the bowels as far as the navel. It was of normal color and development. The gall-bladder was full of bile. After removing the liver the stomach and intestines were found to be of natural form and in their normal place. The œsophageal opening into the stomach was wanting, and in the words of the reporter, "It was in this place through the cellular tissue, with the diaphragm attached." In the thorax was the right lung, light red in color and dilated (inflated). The left one, on the contrary, was throughout of a dark color and of firmer consistency; therefore, it was inferred that the child had only used the right lung in breathing. The heart was regular in form and normal in structure. The œsophagus was entirely wanting and the pharynx ended blind in a sac.

Case II. (Mellor).—"In the month of August, 1839, Mrs. P., the mother of four healthy children, was delivered of her fifth child, a fine, well-formed infant, after a perfectly natural labor of a few hours' duration. When in due time the infant was put to the breast it was observed that the nipple was scarcely retained in the mouth beyond a minute, when the little creature became apparently convulsive, and almost instantly rejected the nutriment which it had taken. On my subsequent visit I was made acquainted with the above particulars, when I felt disposed to assent to the opinion expressed by the mother, that flatulency might be the cause of the symptoms, and accordingly prescribed a simple carminative. This was almost immediately rejected, as the milk had been, the infant, notwithstanding manifesting the greatest eagerness to supply its instinctive wants."

Mellor inferred an obstruction to the œsophagus, and attempted to pass a bougie, which proceeded for a short distance and then became curved upon itself. Matters went on in this way until the seventh day, when the child died.

At the post-mortem examination it was found that the pharynx ended in a blind pouch at the level of the cricoid cartilage, no trace of the œsophagus being visible beyond this part. The stomach presented no deviation from its ordinary form and dimensions, with the exception of the cardiac orifice, where there existed a slight bulging at the part corresponding with the termination of the gullet, and which was firmly united to the diaphragm. Further, a probe introduced at the aperture could not be made to pass into the stomach. Between this point and the sternum not the slightest trace of the œsophagus, or any band of connections whatever with the pharyngeal portion, existed.

The stomach contained nothing but air (?) and a little mucus; the other viscera appeared perfectly normal.

Case III. (*Netley Catalogue*).—This case, after a long and careful search, I have been unable to locate. Mackenzie refers to it as: *Catalogue of the Museum Army Medical Department*, 1845, p. 385.

A personal search in the library of the College of Physicians of Philadelphia failed to find it. A careful and painstaking search of the library of the Academy of Medicine at New York, made by myself and the librarian, Mr. John S. Browne, failed to find it, and the librarian of the Surgeon-General's Office at Washington informed Mr. Browne that the work was not in that library. So I will have to let the case stand for what it is worth upon Mackenzie's reference.

Case IV. (Steel).—The child was twenty-four hours old, and seemed to be well in all respects, excepting when he had taken a little nourishment "he became very livid, had difficulty in breathing, and then returned the food and appeared no worse." The attendant introduced a sound five inches and encountered an impassable obstruction. Steel was called and met the same obstruction. He advised operation by opening the stomach, with the idea that if the obstruction were simply membraneous he might puncture this and restore the continuity of the tube. His description of the operation and the after-history is as follows: "On the following afternoon I was asked to perform the operation. The infant took chloroform well. I opened the abdomen above the umbilicus in the middle line, exposed the stomach, and stitched it at four points to the skin, having some difficulty to keep the liver from protruding. The stomach was then opened, which was perfectly healthy, and, of course, empty. A bougie was passed down the œsophagus as before, and another upward from the stomach for a short distance; but they did not approach each other by what we judged to be an inch and a half. I then cut a gum-elastic catheter in half, and passed it from below, introduced up it a long, slender steel probe, and pressed it upward as far as was justifiable, in case the lower part of the tube might be twisted or narrowed and capable of being rendered pervious. All was of no avail, however; so the stomach wound was closed with sutures, also the abdominal wound, and we felt sure that the œsophagus was deficient for about an inch and a half. The infant slept for some time, and died twenty-four hours afterward. The next afternoon we made an examination and found that the œsophagus terminated above and below in blind-rounded ends an inch and a half apart, and there was no cord or connection between the parts. All of the wounded portions were quite healthy, and the appearances led to the conclusion that had there been only a membranous occlusion a happy result might have been hoped for."

Case V. (Marsh).—This child was delivered by a normal labor following a perfectly normal pregnancy. He was born at 8.45 P.M., August 22, 1896. The placenta showed evidences of calcareous degeneration. The family history is negative, and all other children born of the same parents have been properly formed. The child was apparently all right up to 4.30 A.M. of August 23d, when he was put to the breast and nursed a trifle, when he suddenly became black in the face, and, after considerable choking and gasping, he raised a little bloody mucus and the milk which he had nursed. These phenomena followed all attempts at nursing, which were occasionally persisted in until the death of the child, August 29th, at 7.30 A.M. Irrespective of rectal alimentation he emaciated rapidly. From 4 P.M. to 12 mid-

night of August 27th he had a series of convulsions. These were followed for three hours by a marked rigidity of the body. At 10 A.M. of the 27th a marked area of consolidation was noticeable over the lower lobe of the left lung. This was accompanied by large mucous râles and fine crepitant râles. Defecation and urination were at first normal, but laterally the bowels ceased to move. He died quietly of exhaustion, and markedly cyanotic, on August 29th at 7.30 A.M.

Autopsy at 9.30 A.M., August 29th. Body emaciated. No rigor mortis. The bloodvessels of the brain are very much engorged with blood, and the brain tissue is unusually dry. All of the internal viscera are in their normal position. The heart, the lungs, blood-vessels, the liver, the spleen, intestines, kidneys, and pancreas are all normal. The urinary bladder contains about one drachm of urine. The lower lobe of the left lung is irregularly consolidated, and there are several disseminated areas of consolidation in the lower lobe of the right lung, but not as extensive as in the left lung. The œsophagus ends blind at the level of the suprasternal notch. The stomach has attached to it an œsophageal termination of normal calibre, which extends as far as the diaphragm and ends blind at that point. Between these two points can be traced a few very fine fibrous bands. In other words, the œsophagus for about two inches is absent.

Measurements of the Stomach. Tip of cardiac end to pylorus, 5.2 cm.; from œsophageal outlet to opposite wall, 2 cm.; diameter of pylorus, 1.1 cm.; length of blind œsophageal outlet, 1.2 cm.

Anatomical Diagnosis. Congenital absence of the entire œsophagus. Aspiration pneumonia of both lungs.

Bacteriological examination of the small amount of mucus in the stomach showed it to be sterile.

Previous to death a diagnosis of obstruction to the œsophagus was made, and gastrostomy was offered and rejected by the parents.

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OBSERVATIONS ON VEGETABLE PROTEOLYTIC ENZYMES, WITH SPECIAL REFERENCE TO PAPAÏN.

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Scientific interest in enzymes of vegetable origin which have the power of dissolving proteids was probably first aroused by observations on the so-called insectivorous or carnivorous plants. It has been estimated that there exist about five hundred of these forms which have the capacity of deriving their nitrogenous intake in part through dissolution of animal organisms or organized albuminous substances.[1] The better known of them belong to the genus Drosera (including the fly catcher), and the genus Nepenthes (pitcher plants). The precise nature of the proteolytic action here involved still remains to be investigated. It is known, however, that the plants can live without utilizing these peculiar digestive processes which have been put at their disposal.

The discovery of proteid-dissolving enzymes in seeds was of greater importance to the physiology of plants. In the vegetable diastatic enzymes the botanist had learned to recognize substances by the agency of which the insoluble reserve carbohydrates could be rendered soluble and portable during the growth of the plants. The detection of proteolytic enzymes in seeds, and the study of the changes which can be inaugurated by them, leaves little doubt that they play an important rôle in the proteid metabolism incidental to the germination processes.[2] Through them the proteid reserve materials are rendered active; and various typical products of proteolysis have already been isolated from seedlings. The investigations in this field, to which E. Schulze and his coworkers have contributed no small share, make it quite probable that proteolytic enzymes are widely—perhaps universally—distributed in plants. They occur in bacteria, in fungi, and in various parts of fully developed higher vegetable forms, as well as in seeds. But it is in a few cases only that the enzymes of plants have as yet received any careful study.

The proteolytic enzyme present in the fruit and various parts of the melon tree (Carica papaya) has attracted particular attention. It was investigated by Wurtz in 1879, and later by S. Martin, Chittenden and others.[3] This enzyme, called papaïn or papayotin, was introduced

[1] A. L. Gillespie. The Natural History of Digestion, 1898, p. 42.

[2] The literature of this subject is in part presented by Butkewitsch, Zeitschrift für physiologische Chemie, 1901, vol. xxxii. p. 1.

[3] The literature is referred to in detail in a recent paper by Mendel and Underhill, Transactions of the Connecticut Academy of Arts and Sciences, October, 1901, vol. xi., from which most of the data presented in this article are reproduced.

into medical practice several years ago; and commercial preparations of the papaw containing it have at various times met with considerable favor under different names, such as "papoid," "caroid," etc. A similar enzyme has been detected in the latex of the common fig (Ficus carica) and from the fruit of the pineapple (Ananassa sativa) there can be isolated a proteolytic enzyme which has been carefully studied by Chittenden,[1] who named it bromelin. Papaïn and bromelin will form the special topic of this paper, not because they are exceptional in nature, but rather because they have received more extensive investigation than other known vegetable enzymes. Quite recently, however, the proteolytic enzymes of yeast[2] and of barley[3] have become the subject of considerable scientific discussion.

The development of more recent researches in physiological chemistry has brought out many new facts regarding the proteolytic enzymes of animal origin. A better acquaintance with the products of proteolytic changes and the study of autolytic or auto-digestive processes in various organs have modified older views. But all of this knowledge has only tended to emphasize more than ever before the importance of enzymes for the functions of living organisms. In an interesting lecture on the chemical make-up of cells, Hofmeister[4] has pointed out that our growing acquaintance with the wide distribution of enzymes in organisms and with their manifold functions leaves little doubt that sooner or later there will be discovered a specific enzyme appropriate for every vital chemical reaction.

It has been customary to classify proteolytic enzymes into pepsin- and trypsin-like groups, according to the conditions under which hydrolysis proceeds most favorably. The extensive researches of Kühne and Chittenden made it clear that in proteolysis we have to deal with a whole series of cleavage products, and that solution is not synonymous with peptonization. They isolated the substances which are now distinguished under the general names of proteoses and peptones, to the more careful analysis and differentiation of which many other investigators, notably Hofmeister and his pupils, have since contributed valuable data. All of this work has tended to show that the chemistry of digestive proteolysis is by no means as simple as was once assumed. Peptic digestion has long been supposed to hydrolyse proteids only to the stage of peptones, and thus to be clearly distinguished from the far-reaching proteolysis by trypsin. But recent observations have made it probable that under favorable conditions non-proteid products

[1] Journal of Physiology, 1894, vol. xv. p. 249.

[2] Hahn und Geret. Zeitschrift für Biologie, 1900, vol. xl. p. 117. Kutscher, Zeitschrift für physiologische Chemie, 1901, vol. xxxii. p. 419.

[3] Weis. Zeitschrift für physiologische Chemie, 1900, vol. xxxi. p. 79.

[4] Die chemische Organisation der Zelle, Braunschweig, 1901, p. 14.

may be formed in gastric digestion.[1] How far these more profound changes are actually due to the enzyme pepsin itself, rather than to the newly described "pseudopepsin,"[2] or to autolytic (auto-digestive) enzymes of the tissues,[3] remains to be demonstrated. The pancreatic gland has been found to split up proteids completely into non-proteid compounds during the self-digestion of its tissue.[4] Here, too, evidence is still wanting that this result is brought about by the enzyme which has been isolated under the name of trypsin, and which forms the characteristic part of the secretion of the gland—and that the cleavage is not due to distinct autolytic tissue processes.

The near future will bring new contributions toward the solution of these problems. It is quite possible that they will demonstrate a closer identity between the processes provoked in the one case by pepsin, and in the other by trypsin and the tissue enzymes; and that as our knowledge of the chemical details of these processes increases, more attention will be directed to the products formed and less to the environment of the reaction. For the present, however, we can distinguish types of enzymes only by (*a*) the nature and reaction of the media in which they unfold their activity, and (*b*) the specific products formed. For example, pepsin acts only in an acid medium, and so far as I am aware, tyrosin and tryptophan[5]—two characteristic, easily recognized, and readily formed derivatives of trypsin proteolysis—have never been detected among the products of its cleavage of pure proteids.[6] If the criteria outlined above are applied to some of the other enzymes of animal origin more carefully studied it will be found that pseudopepsin, a specific enzyme described by Glaessner[7] as occurring in the gastric mucosa, forms tryptophan. It differs from pepsin and trypsin in that it can unfold its action in both acid and alkaline media, each of which in turn would suffice to destroy one of the other two enzymes. Jacoby's[8] liver ferment, to which the self-digestion of the liver under antiseptic conditions is attributable, closely resembles trypsin in its action, as do the various similar enzymes[9] described. It is characterized by forming simpler end-products with relative ease,

[1] Lawrow. Zeitschrift für physiologische Chemie, 1901, vol. xxxiii. p. 312.

[2] Glaessner. Hofmeister's Beiträge zur chemischen Physiologie, 1901, vol. i. p. 26.

[3] The wide distribution of these enzymes capable of dissolving the tissues in which they occur is suggested by the paper of Hedin and Rowland, Zeitschrift für physiologische Chemie, 1901, vol. xxxii. p. 531; also T. Smith, New York Medical Journal, 1894, p. 590.

[4] Kutscher. Die End-produkte der Trypsinverdauung. Habilitationsschrift, Marburg, 1899; Levene, American Journal of Physiology, 1901, vol. v. p. 298.

[5] The chemical nature of this compound which has long interested physiological chemists has lately been made clear by Hopkins and Cole, Journal of Physiology, 1901, vol. xxvii. p. 418.

[6] Pfaundler. Zeitschrift für physiologische Chemie, 1900, vol. xxx. 90.

[7] Glaessner. Hofmeister's Beiträge zur chemischen Physiologie, 1901, vol. i. p. 26.

[8] Zeitschrift für physiologische Chemie, 1900, vol. xxx. p. 163.

[9] Salkowski. Zeitschrift für klinische Medicine, 1890, vol. xvii., Supplementband, p. 77; Schwiening, Virchow's Archiv, 1894, vol. cxxxvi. p. 444; Hedin and Rowland, loc. cit.

and by transforming compounds in which nitrogen exists in the molecule in firm combination into bodies from which nitrogen is easily split off. Moreover, the autolytic liver enzyme is selective in its action, so that only certain tissue proteids are broken down by it. In this respect it recalls the newly described enzyme erepsin, discovered in the small intestine by Cohnheim,[1] which splits up peptones and proteoses, but does not act upon native proteids. Finally, Kutscher[2] has pointed out the presence of a proteolytic enzyme in the thymus which shows specific peculiarities in the self-digestion of this gland.

The preceding considerations, which give a hasty review of some of the peculiarities of unorganized ferments occurring in the animal kingdom, make it probable that we have to deal with proteolytic enzymes of varying types. It is important to emphasize this before entering upon a discussion of the enzymes of plants, for the plant physiologists have been accustomed to turn to the animal ferments in making comparisons. Thus, Vines[3] has recently suggested "that all known proteolytic enzymes of plants are tryptic, though some of them, such as that of Drosera, still await further investigation. This suggestion," he adds, "gains in interest when it is borne in mind that tryptic digestion is of general occurrence in the animal kingdom, and is apparently the sole process in many invertebrates. It is not improbable that it may be expanded into the proposition that tryptic digestion is a property of all living organisms, and that it is the more primitive form of the digestive process." J. R. Green[4] writes: "It is uncertain whether pepsin is represented in the vegetable kingdom. All the proteolytic enzymes which have been fully investigated have been found capable of carrying the hydrolysis beyond the stage of peptone. The work of the earlier observers did not include a careful examination of the products of the decomposition, and hence, for the present, it remains uncertain whether or no some of the ferments belong to the peptic category." In another connection the same author says: "On a review of all these vegetable proteolytic enzymes, it will be seen that our knowledge is not at present sufficiently definite for us to say whether we have to do with one or many. Some of them may be peptic only, though it seems probable that they are all tryptic. Those which have been at all exhaustively examined undoubtedly carry the proteolysis to the stage of crystalline amides. We do not yet know, again, whether there is one enzyme only, varying somewhat in its features according to the conditions of its secretion, or whether the different plants discussed yield different varieties of trypsin. Bromelin

[1] Zeitschrift für physiologische Chemie, 1901, vol. xxxiii. p. 451.

[2] Ibid., vol. xxxiv. p. 114; also Conradi, Hofmeister's Beiträge zur chemischen Physiologie, 1901, vol. i. p. 147.

[3] Annals of Botany, 1901, vol. xv. p. 572.

[4] The Soluble Ferments and Fermentation, 1899, pp. 195, 219.

and papaïn certainly show very little difference in their behavior, and one is tempted to pronounce them identical. For the present, however, it is perhaps advisable to leave this question undecided."

Papaïn has usually been regarded as closely related to the trypsin of the pancreas.[1] A review and criticism of the data upon which this conclusion was based have been presented by the writer in another place.[2] Several years ago it was demonstrated[3] in this laboratory that not only are true albumoses (in Kühne's sense) formed by various commercial papaïn preparations acting in different media, but, contrary to the statements of several writers, peptones—*i. e.*, compounds giving the biuret reaction and not precipitable by ammonium sulphate—are also formed in considerable amounts. The latter were separated from digestive mixtures and their physiological action was investigated. Our more recent attempts to isolate three characteristic products of tryptic digestion, namely, leucin, tyrosin, and tryptophan, failed; although relying upon such statements as have been introduced into the literature of this subject, we had expected to find a marked resemblance in character between the products formed by trypsin and those resulting from papaïn proteolysis. As we were not fortunate enough to secure specimens of the papaw fruit itself for study, four widely used commercial preparations were employed. They will be referred to as Papaïn A, B, C, D, and were bought under the names of "Papoid," "Caroid," Papaïn (Lehn and Fink's), and Papaïn (Merck's), respectively. The results obtained with these preparations were fairly concordant and characteristic.

Observers have by no means been agreed regarding the conditions of reaction under which papaïn proteolysis proceeds favorably. It is admitted that weakly alkaline fluids favor the solvent action of the enzyme; but there has been great diversity of experience regarding the influence of acid reaction. Our own experiments confirm the results obtained by Wurtz, the earliest careful investigator of the enzyme, and by Chittenden, who has made the most exhaustive study (with "papoid"). Proteids are dissolved readily in digestive mixtures with various reactions, both acid and alkaline. The details of the experiments are given elsewhere.[4]

The following summary of one series taken from our protocols is typical. In each trial 10 grammes of moist proteid were digested, at 37° C., for four hours with 100 cubic centimetres of the digestive solution containing papaïn and 1 per cent. of sodium fluoride, to prevent

[1] Oppenheimer. Die Fermente und ihre Wirkungen, 1900, p. 135, where the references to the earlier literature are given.

[2] Mendel and Underhill. Transactions of the Connecticut Academy of Arts and Sciences, October, 1901, vol. xi.

[3] Chittenden, Mendel, and McDermott. American Journal of Physiology, 1898, vol. i. . 255.

[4] Mendel and Underhill. Loc. cit., p. 6.

bacterial action. The control solutions and the boiled portions (in which all enzyme action was, of course, excluded) indicate the extent of the solvent action of the various media employed.

PAPAÏN DIGESTION OF COAGULATED EGG-ALBUMIN.

(The figures indicate the percentages of proteid dissolved.)

Medium.	Papaïn A.		Papaïn B.		Papaïn D.		Controls without papaïn solution.
	Unboiled.	Boiled.	Unboiled.	Boiled.	Unboiled.	Boiled.	
0.1 per cent. HCl . .	8.7	2.3	14.5	2.9	40.6	5.4	6.0
1.0 " $HNaCO_3$	24.0	8.7	54.0	1.2	66.7	2.1	4.2
Water	16.6	0.8	41.7	4.0	72.7	6.1	2.4

In numerous qualitative tests with various papaïn preparations, acting on fibrin, casein, boiled and unboiled muscle tissue, in the presence of 2 per cent. sodium fluoride and in media acid with 0.1 per cent. hydrochloric acid, or alkaline with 1 per cent. sodium bicarbonate, or 0.5 per cent. sodium carbonate, or in approximately neutral fluids, vigorous solvent action was always observed. The relatively weak solvent action noted in the acid mixtures above is doubtless attributable to the strength of acid used; and by the selection of more appropriate conditions the solvent power could doubtless have been considerably increased.[1]

When trypsin acts upon ordinary proteids, leucin, tyrosin, and tryptophan (proteinochromogen) are speedily formed in considerable quantities. In peptic digestion, on the other hand, these compounds do not arise in appreciable amounts under ordinary circumstances. Tryptophan, in particular, has been regarded as a typical product of the tryptic enzymes. Malfatti[2] has recently noted that it may be formed by extracts of the stomach mucosa—an observation which the writer has verified. This reaction has, however, been attributed by Glaessner[3] to the presence of traces of trypsin and of pseudopepsin already referred to. R. Kingsley, who has examined a number of active commercial pepsin preparations at my suggestion, has found evidences of tryptophan-forming enzymes in very few instances. Great precaution must be taken to exclude the formation of bacterial enzymes which readily produce tryptophan.[4] In this respect many earlier investigators of vegetable enzymes have apparently been neglectful;

[1] Chittenden. Transactions of the Connecticut Academy of Arts and Sciences, 1892, vol. ix. p. 307.

[2] Zeitschrift für physiologische Chemie, 1900, xxxi. p. 43.

[3] Hofmeister's Beiträge zur chemischen Physiologie, 1901, vol. i. p. 28.

[4] Malfatti. Zeitschrift für physiologische Chemie, 1900, vol. xxxi. p. 44, foot-note.

and this applies, perhaps, to a recent study by Vines[1] of nepenthin, the enzyme of the pitcher plant. Vines was unable to isolate leucin or tyrosin from the products formed by it; he succeeded, however, in obtaining the well-known delicate tryptophan reaction with chlorine water. There is no evidence in the description of the experiments that any antiseptic was employed to exclude the formation of bacterial enzymes. The author merely states that "in the absence of all signs of putrefaction, such as the odor of indol and skatol, it must be concluded that the production of tryptophan was due to the presence of an enzyme, and that nepenthin digestion is tryptic in nature" (p. 570). The experiments of Vines seem inconclusive, as were the similar observations of Martin on papaïn. Thus a mixture of Witte peptone, citric acid, and Nepenthes liquid, kept at incubator temperature for nearly a day, was found to give the tryptophan reaction. No bactericidal precautions were employed, although the author states that blank experiments with boiled Nepenthes liquid were carried out. The only occasion for critical comment by the present writer, upon observations which he has not attempted to repeat experimentally, lies in the following further statement by Vines: "I have also found," he writes, "that pineapple juice and papaïn, under similar conditions, produce tryptophan from Witte peptone. . . . My results make it apparent that the three enzymes, nepenthin, bromelin, and papaïn (or papayotin), have essentially the same proteolytic action, which is tryptic; although, as I have already pointed out, they seem to differ in activity, bromelin being the most active, nepenthin the least. There is, however, a further difference between them as regards the media in which they are capable of acting. Nepenthin is only active in an acid liquid, and digests when as much as 0.25 per cent. HCl has been added."

We have searched for leucin, tyrosin, and tryptophan among the products of papaïn digestion under a variety of conditions. In over sixty trials with the four enzyme preparations already mentioned, where bacterial decomposition was avoided by the use of sodium fluoride or thymol, we have uniformly failed to detect them. They are, therefore, in our opinion, not normal products of proteolysis by papaïn under usual conditions. The observations, in solutions of differing reactions, on casein, fibrin, coagulated egg-white, muscle tissue (boiled and unboiled), and Witte peptone were so concordant in this respect that it is scarcely necessary to enumerate the variations in the time of digestion, the reaction of the digestive media, the quantity of enzyme used, and other details. Comparison with control trials always indicated a vigorous digestion in each case. In some experiments the

[1] Annals of Botany, 1901, vol. xv. p. 563.

digestion was allowed to continue at 35° C. for over a month without altering the results noted. Only with fresh muscle tissue were the tryptic end-products obtained. Since boiled tissue failed to digest similarly, the results point to the self-digestion (autolysis) of the muscle,[1] and refer to the tissue itself as the active agent in the production of tryptophan in this case.

An investigation of the character of the digestion products formed by the action of papaïn on a typical proteid—casein—has indicated that they closely resemble those which arise from this substance in gastric digestion.[2] Caseoses and casein peptones were separated under conditions quite comparable with those described by Alexander[3] in his study of the gastric digestion of casein. The differences between the action of papaïn and of bromelin under similar conditions were striking. O. H. Schell, who undertook, with the writer, the experiments with pineapple juice, was able to isolate large quantities of leucin and tyrosin from casein digestions in the presence of thymol. Harlay[4] has also lately pointed out that the products of papaïn digestion differ from tryptic digestion products. According to him, oxidizing enzymes, like the tyrosinase of fungi, do not turn either papaïn or pepsin mixtures black, as they readily do the tryptic products which contain tyrosin.

The failure of papaïn to conform exactly with any of the standards set in the past for other proteolytic enzymes need not surprise us. The more carefully such enzymes—especially from vegetable sources—are being examined, the more varied are found to be the manifestations which characterize and distinguish them.[5] The observations recorded above indicate that papaïn belongs to a class of enzymes which apparently differs somewhat in type from the two proteolytic enzymes that have received most careful investigation in the past, namely, pepsin and trypsin. While the products of the papaïn digestion of proteids resemble quite closely those of pepsin, so far as they have been examined in detail, the enzyme differs from ordinary animal pepsin in that it acts readily in both neutral and alkaline media. On the other hand, although papaïn is comparable with trypsin in exerting a solvent action in fluids of various reactions, the failure to form leucin, tyrosin, or tryptophan in appreciable quantities—at least under

[1] Schwiening. Virchow's Archiv, 1894, vol. cxxxvi. p. 444.

[2] Mendel and Underhill. Loc. cit., p. 10 et seq.

[3] Zeitschrift für physiologische Chemie, 1898, vol. xxv. p. 411.

[4] Abstract in the Journal of the Chemical Society of London, Part I., July, 1900, p. 419. Harlay's experiments were made with the related species Carica hastifolia.

[5] Thus Pfeffer writes: "Plants evidently produce several kinds of proteolytic enzymes, but direct experiments are required to show whether vegetable pepsins produce peptone with albumoses as intermediate products, whether vegetable trypsins carry the digestion as far as the formation of leucin, tyrosin, etc., and whether only the latter ferments are able to digest nucleins." (Ewart, Pfeffer's Physiology of Plants, 1900, vol. i. p. 509.)

conditions in which they are readily formed in large quantities by the other tryptic enzymes—places it in a class of its own for the present. Possibly the enzymes of Drosera and Nepenthes belong here also.[1]

The existence of rennin, or milk-curdling enzyme, in the vegetable kingdom appears to be wide-spread.[2] Its presence has been indicated in the juice of the papaw and the pineapple, and there is some evidence that it exists independently of the proteolytic enzymes, papaïn and bromelin. Regarding the function of rennin in plants nothing has been known; nor has the occurrence of this enzyme in the animal kingdom met with any very satisfactory explanation. Its use in the fishes and birds is scarcely less obscure than in mammals. A. Danilewski and his pupils[3] have discovered that rennin extracts exert a clotting or precipitating action on solutions of albumoses. Clear solutions of the latter, when mixed with rennet, soon deposit flocks or large masses of proteid-like substances which Danilewski terms "plastein," and which resemble in some respects the anti-albumid of Kühne and Chittenden. The reaction is apparently due to an enzyme, since boiled rennet loses this peculiar property. It has been suggested that the "plasteins" play an important rôle in the synthetic formation of proteids, and that rennin is the agent concerned in the regeneration of proteid from proteoses in the alimentary canal. To make this observation more general, and to assume a synthetic importance for the enzyme rennin which is so widely distributed in both animals and plants, is at present nothing more than an interesting speculation. Kurajeff has recently demonstrated that commercial papaïn preparations also act upon solutions of Witte peptone in the manner indicated above.[4] Whether this reaction is due to the proteid dissolving papaïn or to a distinct enzyme has not been definitely ascertained. Further experiments promise to throw light on the function of these clotting enzymes.

[1] Since the above was written, Emmerling has succeeded in obtaining from one kilo of fibrin one gramme of tyrosin, together with small quantities of leucin, aspartic acid, glycocoll, alanine and phenylalanine by E. Fischer's new method for the isolation of amido acids from digestive mixtures. This represents the entire yield after digestion for weeks at 37°, with large quantities of a papayotin preparation of Merck. Emmerling remarks that even after this prolonged reaction the cleavage is very incomplete, the digestive products consisting for the most part of albumoses and peptone. (Berichte der deutschen chemischen Gesellschaft, 1902, xxxv. p. 695) In another recent paper on tryptophan in proteolysis, Vines has repeated his experiments with various vegetable products and obtained positive results. (Annals of Botany, 1902, xvi. p. 1.) I have also lately found a single imported preparation labelled "Papayotin, E. Merck," which gives a tryptophan reaction with proteids. The experiments ought to be repeated with papaïn preparations made in the laboratory directly from the fresh fruit.

[2] Green. The Soluble Ferments and Fermentation, 1899, p. 244.

[3] Sawjalow. Archiv für die gesammte Physiologie, 1901, vol. lxxxv. p. 171.

[4] Kurajeff. Hofmeister's Beiträge zur chemischen Physiologie, 1901, vol. i. p. 121. C. B. Ingraham, Jr., has repeated these experiments in our laboratory, with similar results.

THE RELATION OF CARBON TO NITROGEN IN THE URINE, WITH A METHOD FOR THE ESTIMATION OF CARBON.

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The quantity of carbon taken into the system with the food during the twenty-four hours is very large, the greater part being eliminated by the lungs as CO_2, and the remainder by the urine and feces. The number of carbon metabolism experiments is not large, owing to the difficulties in estimating the elimination from the lungs. The most complete experiments have been made by W. O. Atwater, recorded in Bulletin No. 44 of the United States Department of Agriculture; he finds that with a daily intake of 234.0 C, 219.0 C, or 93.6 per cent. are eliminated by the lungs, leaving only 6.4 per cent. to be eliminated by the urine and feces. As the percentage eliminated by the urine is so small, it seemed probable that pathological conditions might make a variation in the relation of carbon to nitrogen.

The estimations of carbon in the following analyses are made by a modification of the ordinary wet method:

The urine was decomposed in an ordinary 500 c.cm. fractional distilling flask by means of a mixture of sulphuric and chromic acids, the carbon dioxide evolved passed through iodic acid, silver nitrate, and biniodate of sodium into a flask containing ammonia; the CO_2 is precipitated from the ammonia carbonate with $BaCl_2$, filtered, the precipitate dissolved in normal nitric acid and titrated back with semi-normal caustic potash; the amount of nitric acid required multiplied by 0.006 gives the amount of carbon.

In order to test the accuracy of the method, a solution of oxalic acid was made, containing 1.48 per cent. carbon, and the carbon estimated with the following results:

5 c c. of the solution contained by calculation	0.074 C.	= 1.48 per cent. C.
Found in 5 c.c. of the solution	0.075	= 1.5 per cent.
" " "	0.0744	= 1 488 "
" " "	0.0738	= 1.476 "
" " "	0.0741	= 1.482 "

The following estimations were made with various specimens of urine, with the following results:

I.	5 c.c. urine contained (*a*)	0.0351 C.	= 0.702 per cent.
	5 " " " (*b*)	0.0348	= 0 696 "
II.	5 " " " (*a*)	0.0525	= 1.05 "
	5 " " " (*b*)	0.0507	= 1.014 "
III.	5 " " " (*a*)	0.0606	= 1.212 "
	5 " " " (*b*)	0.0594	= 1.188 "
IV.	5 " " " (*a*)	0.0498	= 0.996 "
	5 " " " (*b*)	0.0504	= 1.008 "

The variations in the above analyses come within the limitations of error, and I, therefore, consider the method reliable for the estimation of carbon in urine.

The relation of carbon to nitrogen is the point which has to be considered. In order to obtain a basis for the normal factor $\frac{C}{N}$, the following analyses were made from the twenty-four hours' urine of presumably healthy subjects. In every case two analyses were made and the mean taken.

Total quantity of urine in 24 hours.	Total carbon.	Total nitrogen.	$\frac{C}{N}$
I. 1170 c.cm.	9.9333	10.1965	0.97
II. 1750 "	16.0125	20.335	0.78
III. 1750 "	12.582	11.3662	1.1
IV. 1050 "	9.009	8.967	1.0
V. 940 "	11.844	18.7859	0.63
VI. 1170 "	15.3738	15.1047	1.01
VII. 680 "	7.616	10.224	0.74
VIII. 870 "	9.396	12.0338	0.78
IX. 900 "	9.855	11.8692	0.83

The variations in the above $\frac{C}{N}$ factors are from 0.63 to 1.1; of those of the two extremes, Nos. V. and III., No. V. had a gouty diathesis, and No. III. had a hypochlorhydria, so that the actual variations of those who were presumably healthy were from 0.74 to 1.01, giving a mean of 0.875, or about the same as the respiratory quotient.

A metabolism experiment was made extending over five days: the first three days the subject spent quietly in his room, the last two days he took strong exercise on his bicycle. The analyses of the food were all made with the exception of those marked (*), which were estimated.

TABLE A.

	Dec. 29 to 30.			Dec. 30 to 31.			Dec. 31 to Jan. 1.			Jan. 1 to 2.			Jan. 2 to 3.		
	Food taken	N	C	Food taken	N	C	Food taken	N	C	Food taken	N	C	Food taken	N	C
Eggs	140.0	2.9	20.16	135.5	2.84	19.5	208.5	4.37	30.02	120.0	2.52	17.28	133.0	2.79	19.15
Steak	357.0	12.49	44.44	316.0	11.0	38.8	172.0	6.02	23.32	350.0	12.25	44.1	357.0	11.62	43.55
Crackers	221.0	3.221	63.25	185.5	2.7	53.0	132.0	1.84	39.46	182.5	2.73	52.19	142.5	1.99	40.95
Butter	53.0	.....	34.76	36.0	.....	23.95	39.0	.....	25.54	47.5	.....	31.16	41.0	.....	26.89
Sugar*	77.5	.....	20.06	86.5	.....	23.06	75.0	.....	15.7	82.5	.....	21.8	101.0	.....	26.3
Milk	261.5	1.307	12.00	350.0	1.75	16.06	400.0	2.0	18.4	300.0	1.5	13.8	340.0	1.7	15.86
Rice	.....	.....	.....	70.0	0.95	21.09	60.0	0.78	18.1	0.5	0.68	15.06	50.0	0.68	15.06
Total	.....	19.91	194.67	.....	19.31	195.48	.....	15.01	170.54	.....	19.68	185.59	.....	18.18	187.96
Feces	20.0	1.21	8.38	20.0	1.21	8.38	20.0	1.21	8.38	20.0	1.21	8.38	20.0	1.21	8.38
$\frac{C}{N}$ of food	9.78	.....	.....	10.11	.....	.....	11.36	.....	.....	9.42	.....	.....	10.32		
$\frac{C}{N}$ of urine	0.88	.....	.....	0.75	.....	.....	0.73	.....	.....	0.85	.....	.....	0.73		

During rest the intake was 54.23 N and 560.69 C, giving a factor $\frac{C}{N} = 10.32$; the elimination of the urine and feces was 47.43 N and 58.08 C, giving a factor $\frac{C}{N} = 1.22$. The body gain of nitrogen was 6.8 N (42.5 protein), while the body gain of carbon plus that eliminated by the lungs was 502.08. During the two days of exercise the intake was 37.86 N and 373.35 C, being a factor $\frac{C}{N} = 9.6$, while the elimination was 33.39 N and 40.98 C, giving a factor $\frac{C}{N} = 1.23$, showing a body gain of 4.47 N, equal to 27.93 protein, and elimination of the lungs and body gain of carbon was 332.73 C. The average daily intake of carbon during rest was 186.89, and the average daily elimination of urine and feces was 19.36, leaving an average lung elimination of 167.53 C. During the two days' work the average daily intake of carbon was 186.6, and the daily elimination of urine and feces was 20.98, leaving 165.62 eliminated by the lungs.

From the above it appears that under normal conditions the proportion of carbon eliminated by the lungs, urine, and feces is practically the same on the same diet during rest and during a reasonable amount of exercise, and also that the factor $\frac{C}{N}$ in the urine is the same within narrow limits in a healthy subject.

In order further to test the difference between exercise and rest, the urine secreted during sleep and that excreted during the waking hours was collected from three healthy subjects. In these analyses the carbon was estimated in inorganic combination as well as the total carbon. Normally about one-third of the CO_2 in the blood is in loose combination with the hæmoglobin, while the other two-thirds are either free or in combination with alkalies. The quantity of CO_2 in combination with hæmoglobin eliminated by the lungs will be fairly constant, while any variation would presumably rest with that in inorganic combination and would be eliminated by the urine as carbonate.

TABLE B.

	I.		II.		III.	
	Slecp.	Awake.	Sleep.	Awake.	Sleep.	Awake.
Total quantity of urine	310 c.c.	1135 c.c.	215 c.c.	780 c.c	230 c.c.	660 c.c
Number of hours	7	17	7	17	8½	15½
Total nitrogen	3.236	8.262	2.683	7.677	4.991	11.08
Nitrogen per hour	0.462	0.486	0.383	0.452	0.587	0.765
Carbon in organic combination	2.901	8.781	2.342	5.945	2.717	6.343
" " " per hour	0.414	0.516	0.334	0.35	0.32	0.409
" in inorganic combination	0.0688	0.1975	0.0318	0.1404	0.0472	0.1504
" " " per hour	0.0098	0.0116	0.0049	0.0052	0.005	0.0097
Total carbon	3.889	8.979	2.3768	6.085	2.76	6.494
" " per hour	0.513	0.528	0.339	0.358	0.324	0.411
$\frac{\text{Total C}}{\text{Total N}}$	1.2	1.08	0.88	0.79	0.57	0.58
$\frac{\text{Organic C}}{\text{Inorganic C}}$	62.7	45.51	67.3	42.2	63.6	42.1

In every case the total carbon and nitrogen eliminated per hour is less during sleep than while awake, while the factor $\frac{C}{N}$ is higher during sleep than waking. The inorganic carbon is less per hour during sleep, and the factor $\frac{\text{organic C}}{\text{inorganic C}}$ shows marked regularity.

Fr. Tangl, in *Arch. f. Anat. u. Physiol.*, 1899, has shown that in the dog the factor $\frac{C}{N}$ is the same both at rest and at work, but that diet makes a difference. He found that on fat diet $\frac{C}{N}$ was 0.691, while on a carbohydrate diet it was 0.944.

As the factor $\frac{C}{N}$ under normal conditions is constant within narrow limits, and is unaffected by rest or exercise, it follows that any great deviation from normal must be the result of some pathological condition. When the factor $\frac{C}{N}$ is high the patient may be on a carbohydrate diet, or he may be assimilating his carbohydrates and not assimilating his fats and proteids in proportion, or vice versa ; if his factor is low he is either on a proteid fat diet or he is not assimilating his carbohydrates. There is also a possibility as to the condition of the blood making a variation in the factor. The carbon in acid carbonate combination is eliminated by the lungs with the formation of carbonate, and, therefore, the alkalinity of the blood must have an effect upon the carbon elimination. Waller, *Arch. Exper. Path. u. Pharm.* Bd. vii., found that in rabbits poisoned with HCl there was only from two to three volumes carbon dioxide in the blood. Geppert and Zuntz observed that the alkalinity of the blood in rabbits was diminished by the acid formed during tetanic convulsions, and at the same time the carbon dioxide of the blood was decreased. During diabetic coma the alkali of the blood is in part neutralized by the β-oxybutyric acid.

Minkowski found only 3.3 volumes of CO_2 per cent. in the blood of a patient suffering from diabetic coma. A diminished alkalinity of the blood causes a greater elimination of CO_2 of the lungs, and consequently a reduced elimination by the urine. An examination of the condition of the stomach in relation to the factor $\frac{C}{N}$ showed no constant variation ; in a case of hyperacidity, with 84° free HCl, the factor $\frac{C}{N}$ was 1.5, while in cases where free HCl could not be detected in the stomach contents $\frac{C}{N}$ ranged from 1.0 to 1.2.

I have observed in gouty conditions that the factor $\frac{C}{N}$ is very low ; in the twenty-four hours prior to a very severe attack it was 0.58, and in the same patient when fairly free from pain the factor $\frac{C}{N}$ was 0.63 ; in another case observed in the institution it was 0.61. From the results of several hundred urinary analyses in patients at the retreat and outside, I have come to the conclusion that when the $\frac{C}{N}$ factor is 0.7, or below, strong alkaline treatment is indicated.

CÆSAREAN SECTION.[1]

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One of the most trying ordeals to which an obstetrician is exposed is deciding in a case of difficult labor whether one should persist in trying to deliver "per vias naturales," or resort to other measures. For this reason if no other, every case of Cæsarean section should be reported. In the last five years there has been an almost complete change in opinion as to this operation, which was formerly only resorted to after all other means had failed.

The first case of Cæsarean section recorded was done by Jakob Nufer, of Switzerland, in 1498, who operated on his own wife, and the first case operated on by a physician was by Trautmann, of Wittenberg, in 1610. These were both cases of deformed pelves.

The case I present was one of deformed pelvis, funnel-shaped, in which the conjugate diameter was decidedly lessened. Mrs. G., aged twenty-seven years, born in the United States, married, primigravida, entered Bethesda Maternity Hospital May 28, 1900. Her family history is negative. At the age of four years she had an acute illness, which was followed by a complete paralysis of the extremities. She lay in bed one year, and then gradually regained use of her arms and right leg, so that she was able to move about on crutches. The spinal deformity was then noticed, and gradually increased until she reached maturity. The menstrual function was established at the age of nineteen. It has always been painless, and occurring every four weeks and lasting seven days. She was married in 1898. Her last menstruation began September 1, 1898. During October, November, and December she had morning sickness and vomiting. In March she was confined to her bed with an attack of pneumonia, lasting nine weeks. She does not know when she first felt fetal movements. May 25th she had a few colicky pains, during which she passed a large quantity of clear, greenish fluid, which had no odor. She believes it was passed by the rectum. After this her abdomen seemed less tense, and she felt more comfortable.

On examination she presents a marked scoliosis, the curvature being to the right. There is considerable rotation, with consequent deformity of the ribs. In addition, there is a moderate degree of kyphosis. The lower dorsal region is chiefly affected. Both legs are undeveloped, the left more than the right. There is talipes equinus of the left foot. On standing the weight is thrown on the right leg, owing to the shortening of the left one. Her heart and lungs are negative. Her height is 5 feet, weight 110 pounds. On abdominal palpation the small parts are felt to the front, the breech in the right

[1] Read before the Alumni Association of the Medical Department of the Washington University, February 13, 1902.

hypochondrium, the head in the left iliac fossa. The fetal heart is heard in the lower left quadrant. The pelvic measurements are: circumference, 75 cm.; spines, 26 cm.; crests, 28 cm.; trochanters, 25 cm.; right oblique, 20 cm.; left oblique, 21 cm.; external conjugate, 16 cm.; tubera ischia, 6 cm.; pubo coccyx, 8 cm.

The right ischiopubic ramus corresponds to the middle of the body, the left diverges, but the pubic arch is very narrow, and does not permit of palpation of the interior of the pelvis. On standing the left crest of the ilium is 8 cm. higher than the right. The pelvis is kypho-scoliotic, funnel-shaped, with a narrow outlet. Subtracting 1.5 cm. from the pubo-coccyx measurement, the anterior posterior diameter of the outlet is found to be 6.5 cm., the transverse 6 cm.

The patient was seen by Dr. S. E. W. Saunders and A. Derivaux, in consultation, on May 29th. Cæsarean section was advised and acceded to. In view of the history of the passage of a large quantity of fluid on May 25th, which was followed by a decrease in the size of the abdomen, and which was undoubtedly liquor amnii, it was determined to operate as soon as possible in the interest of the child.

Incision was made in the median line, and before opening the uterus it was lifted out of the abdominal cavity and pressure made about the neck with the hands; at this time, also, a hypodermic injection of aseptic ergot was given. The uterus was opened by longitudinal incision, first having protected the abdominal cavity with gauze; the fetus was removed feet first, cord clamped in two places, cut, and the child passed to an assistant. The placenta was removed as quickly as possible, and the cervix dilated, by which time the uterus was thoroughly contracted and the incision closed by three rows of sutures, loose twisted silk being used. Pressure about the cervix was kept up until the uterus was thoroughly contracted. The abdominal incision was closed in the usual manner. There were not more than eight ounces of blood lost during the whole operation.

The child weighed six and one-quarter pounds. On the second day the child was placed to the breast. The lochia was scant throughout the puerperium, and ceased on the afternoon of the fifth day, but reappeared on the morning of the tenth, lasting but one day.

On the sixteenth day some of the sutures were removed, and on the twenty-sixth day the patient was out of bed. On July 12th the fundus was found to be 6 cm. above the symphysis pubis on examination. It was apparently held suspended by adhesions to the abdominal wall. Involution was about complete.

The temperature ranged from normal in the afternoon of the first day to 99.2° F. in the morning of the fourteenth day; the pulse from 70 in the afternoon of the first day to 88 in the afternoon of the eleventh day; respiration from normal in the afternoon of the first day to 32 in the morning of the eighth day.

In the spring of 1901 I had a letter from her saying her physician had informed her that she was pregnant, and she wanted to know what to do. I explained to her the choice between a premature labor and a Cæsarean section, with the chance of having another live child; she preferred waiting until full term and undergoing an operation a second time.

In the early part of December, 1901, I had her enter the hospital, and, reckoning the time of maturity as nearly as possible—she was

nursing her first baby at the time she conceived, and had no idea when she first felt fetal movements—had her prepared for operation on December 27th. The mother and husband had requested at this time that she be made sterile; at the former operation the question had not arisen.

The incision was made at the site of the first operation, and on cutting through the peritoneum but few adhesions were found. The line showing the uterine incision was quite marked, but there was apparently no thinning of the walls and no bulging or tendency to hernia. Some of the sutures were intact, with little or no change in their structure. Ergot (aseptic) was given several times hypodermically. Before closing the uterus the finger was inserted and the cervix well dilated. There was but little bleeding. No difficulty in removing the child or the placenta. The uterus was closed with several interrupted sutures, loose twisted silk again being used, and the peritoneal covering approximated with fine continuous silk suture. To render the mother sterile, the tubes were ligated, each in two places, divided, and all ends covered with the peritoneum, so there would be no possibility of a restoration of the canal. The abdominal wound was closed in the usual manner. There was a slight vaginal discharge for three days following the operation. There was only a slight elevation of temperature, 99.2° F., on the second day. In three weeks the stitches were removed, and in twenty-four days mother and child left the hospital. The child weighed six pounds.

The indications for Cæsarean section are either absolute or relative: the first when there is no other alternative and delivery "per naturales" is impossible, and relative when there is a choice between this and other procedures. The absolute indications are when the conjugate diameter is 7 cm. and less and child living, and diameter 4.5 cm. or less and child dead; when long growths exist, obstructing the outlet, tumors, pelvic and uterine, which cannot be removed at the time; extreme atresia of the genital tract, congenital or acquired; ruptured uterus, sudden maternal death, and carcinomatous degeneration of the cervix or vagina.

Relative when Cæsarean section enters into competition as an alternative to craniotomy or symphysiotomy, in the interest of the child when there is a moderate degree of contraction, forceps on a movable head and version abandoned, if the head shows no signs of moulding and descent after one hour of the second stage of labor, rigidity of the cervix extending as high as Bandl's ring.

The two operations in vogue are the classical Sänger and the Porro.

The Porro operation is indicated when infection of the uterus has taken place, extensive adhesions of the vagina preventing discharge of the lochia, in carcinoma of the cervix, although in this condition panhysterectomy is undoubtedly the operation indicated, atonia uteri, dangerous hemorrhage, rupture of the uterus when suturing is impossible, myoma blocking the pelvis, bilateral ovarian tumors, and when sterility

is required. Leopold considers gonorrhœal infection and serious cardiac or nephritic disease as indications for the Porro operations.

The Sänger or classical operation is performed as follows: The abdominal incision is made in the median line, and the peritoneal cavity opened as in all abdominal operations, all adhesions carefully ligated and freed, the uterus lifted out of the cavity, and the parts well protected by gauze. Uterine contractions should now be induced, if they are not already present, either by manipulation or hypodermic injection of aseptic ergot, or both. Location of the placenta made, if possible, and incision in the uterus carefully made after the uterine arteries are well under control, either by an assistant firmly grasping the uterus as low down as possible, encircling it with the hands, or encompassing it with an elastic ligature, which procedure is not as good as controlling the arteries by hand, as uterine atony may follow. The incision is made large enough to deliver the child, and down to the membranes. The membranes opened, child delivered at once perfectly by grasping the feet, clamping the cord with two forceps, cutting between, passing the child to an assistant, and removing the placenta as soon as possible; dilating the cervix, if necessary, by passing the fingers into the cavity; suturing the uterus with material that will not tear the tissue or be too readily absorbed; passing the stitches to but not through the decidua; the peritoneal covering is then approximated with a fine continuous suture; the omentum brought down, covering the uterus as far as possible. It is undoubtedly better surgery to place the omentum back of the uterus, as adhesions when in front may take place, and intestinal strangulation may arise; some advocate placing it thus, so that if any leakage occurs it can the more readily be taken care of. The abdominal incision is closed in the usual manner. If there has been any soiling of the peritoneum with blood and amnion it should be thoroughly cleansed with normal salt solution, otherwise the parts are merely wiped with dry gauze. Some leave the uterus in the abdominal cavity, but hemorrhage is not so easily controlled or the adjacent parts as thoroughly protected. In suturing the uterus plain sterile catgut should not be used, as there is danger of hernia due to too early absorption. Sippel advocates catgut in preference to silk, because the latter acts through the capillaries upon the intra-uterine fluid, and may thus carry germs to the outer surface. McDearmid, in speaking of the modifications, says Müller's method of first turning out the uterus is open to the objections that are attached to a long abdominal incision, great exposure of viscera, and enormous cicatrix, which increases the liability to ventral hernia, while the uterus is not even then always removable. I think his objections are more than overbalanced by the advantages of having the uterus out of the cavity. The liability to ventral hernia is not so great, as the abdominal incision is usually

higher, and danger, as a rule, is when the incision is low, for then there is more pressure. The vagina should always be thoroughly douched and scrubbed.

The incision in the uterus may be done in several ways: Cohenstein recommends it to be made on the posterior surface; Kehrer on the anterior surface, also in transverse lower segment; Sänger, longitudinal middle third; Fritsch, transverse fundal; Müller-Caruso suggested fundal; Bar, longitudinal from fundus to Bandl's ring.

Fritsch claims delivery of the child is much easier, less dangerous to subsequent hernia, hemorrhage less, sutures more easily applied, less danger of leakage, also not so apt to wound the placenta. Braun and Everke oppose these views and claim intestinal adhesions are more frequent, while others say uterine atony is more likely to follow this incision. The Bar incision is undoubtedly the one most frequently used. In making the incision, the wounding of the placenta should be avoided if possible. Olshausen lays great importance on locating the site of the placenta.

When the question of sterility enters into the question of the kind of operation, the modified Sänger is preferred to the Porro. The mere ligation of the tubes for sterility is not absolutely certain, as restitution of the canal is possible. Krossmann suggests dividing the tubes with the thermocautery. Braun suggests resection of a portion of the tube and covering divided ends with the peritoneum. Neumann divides the tubes close to its insertion, and excises a V portion of the uterus in which is located the interstitial part of the tube.

The advantage of the operation done on this case, of ligating, cutting, and covering the divided ends of the tubes with peritoneum, lies in the fact that not only does it render the woman sterile, is easily and quickly performed, and does not create any of the nervous disturbances which so often follow the removal of the ovaries, but also at a future time restoration of the canal by plastic operation can be taken into consideration if so desired.

The advantages of the Sänger over the Porro are not only in its being the easier and quicker, and, therefore, of less risk to the mother, but it does not interfere with menstruation or destroy the sexuality of the woman, does not destroy the sexual feeling which is so great a cause of marital unhappiness, nor is it followed by the nervous symptoms of the menopause which may follow the Porro. Daland gives the mortality of the Sänger method at 8 per cent., that of the Porro at 37 per cent.

There are three points to be taken into consideration in the question of making the mother sterile. First, the desire of the mother and husband. Second, the good of society at large, as in the criminal. Lastly, the child, when the mother is suffering from a disease which there is a

probability of being transmitted. In the last two cases it should be the operator's duty to induce sterility

As early as 1892, Ford, of St Louis, and later J. Palmer Dudley, of New York, and G. M. Boyd held that Cæsarean section and the Porro operation are not only justifiable, but in reality indicated in complete and central ectopic implantation of the placenta.

Boyd says later: "Cæsarean section is so frequently performed and with so low a mortality that the day, he believes, is not far off, if it does not already exist, when, for the child's interest, it will be elected in some cases over high forceps, version, induction of premature labor, and symphysiotomy."

Reynolds advocates Cæsarean section in all cases in which a mechanical obstacle renders the delivery of an otherwise healthy woman by the usual obstetrical operations more than ordinarily difficult and dangerous. Zinke says Cæsarean section and the Porro operation are perfectly legitimate and elective procedures in all cases of placenta prævia, central and complete, and especially when the patient is a primipara, when the os is closed and the cervix unabridged, when hemorrhage is profuse and cannot be controlled by tampons, and when separation of the placenta around the internal os is difficult or impossible.

The statistics of ten cases of Cæsarean section for placenta centralis show that seven mothers and six children lived. Ehrenfoest makes the mortality in the children greater, adding the case of a child which died ten hours after the operation, due to imperfect closure of the foramen. Botallo adds one which died on the tenth day, which he does not admit as a successful operation. He opposes, and I think justly, the operation for this condition.

Gillette advocates the Sänger operation in cases of placenta centralis, and the Porro operation when much blood has already been lost.

Reynolds says when the mother's vitality has been seriously lowered by septic infection or prolonged labor, craniotomy is to be preferred to Cæsarean section. If the life of the mother only is to be taken into consideration, craniotomy should be performed, according to Bretschneider. He cites 132 cases with a mortality of *nil.*

The reports of Leopold, Pinard, Zweifel, Olshausen, and others show that Cæsarean section is less dangerous than craniotomy. Pinard declares that craniotomy on a living child should never be performed. There are several stand-points from which craniotomy should be regarded in comparing it with Cæsarean section: the religious, whether the child should be sacrificed, the sentimental, the humanitarian, and the sociologic. Then, again, can we tell what the condition of the child will be? What if the child by Cæsarean section should be a monster, an idiot, or deformed? In Prague an anencephalic monster was delivered by Cæsarean section. Then, again, the station of life,

the rich, the poor. When Napoleon was asked concerning a tedious labor of the Empress Marie Louise, he said, "Treat her as you would a shopkeeper's wife in the Rue St. Denis, but if one must be sacrificed, save the mother."

Who is to decide these questions, the physician, the family, society at large, or who? Let the moralist answer.

The operation suggests itself at two periods: early in pregnancy, when a prognosis of a difficult or obstructed labor is made, and at labor, when it is difficult or obstructed. In the first case, the question is whether to allow the woman to go to term and operate, or to induce premature labor. In the second case several questions present themselves. Can the woman be delivered of a living child should craniotomy be performed? Is the woman in good condition? Is the child in good condition?

The operation should be done as near the end of gestation as possible. The importance of an early operation before any intra-uterine manipulation and lowered vitality from prolonged labor exists cannot be too earnestly insisted on. The high mortality is due, to a great extent, in putting off the operation until all other means have been exhausted.

Freund agrees with Olshausen, that the scope of Cæsarean section should be widened to include many cases of eclampsia and contracted pelvis in which perforation otherwise would have been performed. In some cases a combination of circumstances, rather than a single abnormality, render Cæsarean section necessary. Olshausen advocates Cæsarean section in serious cases of eclampsia coming on before the onset of labor. Himmel recommends it when the uterus is inactive, cervix undilated, and the mother's condition so urgent that time cannot be lost. He cites forty cases—mortality: maternal, 51.3 per cent.; fœtal, 43.9 per cent.

Loewenstein advocates it when the condition of the mother is hopeless, the child living, and quick delivery in any other way is hopeless.

Lately there have been a number of Cæsarean sections reported, being performed on account of ventral fixation. This operation (ventral fixation) cannot be too quickly or too urgently opposed; there is not only danger of intestinal trouble arising, but under no consideration should it be countenanced during a child-bearing period.

Numa Pompilius is said to have enacted a law requiring all women who should be pregnant to be delivered of the child before burial. Anton Prokiss states that Cæsarean section done after death gives very poor results, while those done in the moribund have almost always resulted in saving the child. There is one case on record when Cæsarean section was performed twenty-four hours after maternal death and the child delivered alive. In Austria it is forbidden to bury a woman

dying in the second half of pregnancy without first performing Cæsarean section.

In comparing Cæsarean section with symphysiotomy, Burnes, at the Amsterdam International Congress, in 1899, gives the mortality from 3 per cent. to 7 per cent. lower, and convalescence is decidedly more rapid than is symphysiotomy.

Cæsarean section has been performed twice several times. Boyd reports a case operated upon three times, the last two operations being done by himself. Michaeles, Oettler, and N. Charles, of Liege, have each operated four times on one case. Webster reports a case of Cæsarean section on a child thirteen years of age.

A CLINICAL LECTURE ON THE RADICAL CURE OF INGUINAL HERNIA, AND ON A CASE OF ANAL FISTULA, WITH REMARKS ON ANÆSTHESIA.

By William L. Rodman, M.D.,
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This boy, colored, aged eleven years, has a reducible hernia on the right side. He has with it a marked phimosis. Trusses have been tried, and have not influenced the hernia at all. Therefore, I take it that we are more than justified in doing a radical cure operation. Such operations in children were formerly not looked upon favorably on account of the difficulty of keeping the wound aseptic; but these disadvantages were overrated, and undoubtedly some of the very best results that we now get are in children. Dr. Coley, of the New York Hospital for the Ruptured and Crippled, demonstrated this several years ago, so we do not now hesitate to operate on children when a cure has not been effected by means of a truss.

Naturally, the question will come up as to how much this extreme degree of phimosis has influenced the hernia. Of course, it is impossible to say definitely, but the chances are that it has had much to do with it, because phimosis is one of the principal causes of hernia in children. Then, again, those of you who heard my didactic lectures on hernia, naturally may think that this might be some developmental error, being upon the right side, where developmental faults are most likely to occur. In truth, this may prove to be what is so common, a congenital hernia on the right side, due to the vaginal process of the peritoneum which passes down the inguinal canal remaining patent. The testicle at the time of its descent passes through the inguinal canal

and ring before reaching the bottom of the scrotum. The lower portion of the peritoneum thus drawn through the canal becomes later on the tunica vaginalis of the testis. That portion between the external and internal rings in normal cases becomes obliterated. When this obliteration does not take place the canal remains patent and a portion of intestine may slip into the opening, traverse the canal, becoming what is called a congenital hernia.

It is impossible to tell until the hernia has been cut down upon whether or not it is of the congenital variety. A man well advanced in years may develop a congenital hernia, but the conditions leading to the hernia are congenital, not the hernia itself.

I would be glad to explain the several varieties of hernia from an anatomical stand-point, but I have not the time, as the patient is now under the anæsthetic.

We shall perform in this case the operation that we prefer, namely, the Bassini operation. The incision should be begun just inside the anterior superior spinous process of the ilium one-half inch above Poupart's ligament and carried well down to the external abdominal ring. There is no advantage in a small incision in doing Bassini's operation. In the subcutaneous tissue we encounter several large veins, and these we clamp before cutting, so as to minimize hemorrhage.

We have now exposed the aponeurosis of the external oblique muscle well down to and slightly below the external abdominal ring. I now introduce the grooved director beneath the aponeurosis and lay it open as far up and slightly beyond the internal abdominal ring. I frequently cut without the grooved director as a guide, but would not advise you to do this until you have done many Bassini operations.

I could never understand why Treves speaks of the grooved director as "that most dangerous instrument." I think it one of the safest instruments we have. Having split the aponeurosis of the muscle, we dissect it above until we see clearly the margin of the rectus muscle. We dissect the lower flap downward until we approach the deep shelving of Poupart's ligament. We next isolate the sac and cord en masse. The cord is usually found behind the sac. Having now isolated sac and cord en masse from the surrounding tissues, it becomes necessary to separate sac from cord.

As I rather anticipated, this is one of those congenital herniæ. They are always more or less tedious to operate upon, as I have said, for it becomes necessary to make a sac. In a child of this age we must use great care in separating the small vas deferens from the sac. In the adult it is large, hard, and stands out like a whip-cord, and is easily detected. Those of you who are near can see the very small vas deferens. In making the blind dissection at this stage of the operation I know of no better instrument than a pair of curved scissors. Re-

member your anatomy always, and do not imagine, as some have done, that the cord is inside of the sac in a congenital hernia. Such a condition of things is impossible. The cord never is and cannot be inside of the sac. I find it difficult for students to understand this, and yet it is simple enough. The testicle is behind the peritoneum, and when it descends keeps behind it always. I was once amused to see a professor of surgery at a Bassini operation vainly look for the cord inside the sac of a congenital hernia. He was two and a half hours in finding the cord, because he did not look for it in the right place.

The sac having been isolated from the cord up to the internal ring, it is pulled upon, twisted, and ligated. It is then cut, and a tunica vaginalis is made from the lower end of the sac. The sac should never be ligated until it is first opened. One can never be positive that the sac is empty unless this is done. A number of mistakes have resulted with different operators from failure to do this. You can look into the sac now and see that it is entirely empty.

Now, gentlemen, many operators differ at this point. The management of the sac is perhaps one of the most important steps in a hernia operation. The first operations for the radical cure of hernia simply contemplated the high ligation of the sac. Then others advocated twisting of the sac so as to bring the peritoneum lower down. This, undoubtedly, was a step in advance of high ligation. Then Macewen anchored the sac at the internal ring, making, as he called it, a living stopper to the internal ring. Afterward, Kocher, of Berne, transfixed the muscle, brought the sac out and laid it down upon the aponeurosis of the external oblique. Bassini removes the sac entirely.

Having disposed of the sac, we now begin the suturing and transplantation of the cord, first advocated and popularized by Bassini. Halsted, of Johns Hopkins, soon afterward also insisted upon transplantation of the cord. The vast majority of surgeons all over the world at the present time believe this a judicious step. Some, however, do not. To be perfectly candid, I should have to say that there is a growing tendency not to transplant the cord. Yet, as I have said, the vast majority still believe it the safer plan.

The first suture is placed through the internal oblique muscle, or, rather, the conjoined tendon near the edge of the rectus muscle, and before placing it, of course, one should feel for the pulsation of the deep epigastric vessel, as it would not be a pleasant thing to puncture it. The choice of suture material is also of the utmost importance. Bassini used silk and had the best of results with it. Others prefer absorbable sutures, such as the kangaroo tendon or chromicized gut, because they abide sufficiently long in the tissues to do the necessary work of suture material and then pass away. At the Johns Hopkins

Hospital, Halsted and his excellent coworkers generally prefer silver wire in herniotomy. Absorbable sutures have the greater number of advocates beyond any doubt. I, myself, generally employ the absorbable suture, either kangaroo tendon or chromicized gut, though I not infrequently use silk and silver wire. The disadvantage in the metallic and silk sutures is that they do not always remain as harmless tenants in the tissues, but cause irritation, and may in time be extruded. It is unpleasant to have a patient come back to you within six months or a year with a sinus resulting from the use of non-absorbable sutures. The frequency with which this occurs has, in my opinion, been overrated by the partisans of absorbable sutures. I have used silk and silver wire in many herniotomies and have seen but one such case. Usually about five sutures should be placed below the cord. It is my practice also to place one above the cord, recognizing that this is a weak point, where recurrence is most likely to take place, and which therefore should be protected. I have followed this practice for at least five years, and have not, so far as I know, had a single recurrence after a hernia operation. Some surgeons have been content to use ordinary gut. This, in my judgment, is a great mistake, as it does not abide sufficiently long to ensure union between the muscle and tendon. You cannot expect firm union between such structures in less than a fortnight or three weeks, even in young patients with good reparative powers.

We have now transplanted the cord, and, as you see, it rests upon a new bed entirely. It now becomes necessary to close the aponeurosis of the external oblique over the transplanted cord. This is best done, in my judgment, by continued suture of chromicized gut. The advantage in the continuous suture is that it is more rapidly applied, and, if properly placed, does not strangulate tissue. I now feel the cord below the external ring, and am certain that I have not interfered with its circulation. We now close the wound in the skin by the subcuticular stitch of silver wire. This avoids the danger of stitch abscesses, and we find that a large percentage, practically all of our cases, unite per primam. All considerations in radical cure operations should give way to the important one of primary union, as a larger percentage of cases will remain cured if suppuration does not occur. The subcuticular stitch takes a little time, but the end justifies it. We now see the wound closed entirely by the subcutaneous suture without drainage. The silver wire is not tied, as you see. It will be removed at the end of a fortnight, and the line of incision will scarcely be seen.

I show you the case operated upon two weeks ago. The silver wire has been removed and the line of incision is very dim.

We will now perform another operation upon this child, namely, circumcision. It may be of interest for you to know at this point that phimosis is a common condition in the colored race. In a boy of this

age sutures are unnecessary; therefore I shall bring this skin and mucous membrane closely together and maintain them in apposition with iodoform gauze dressing. I have operated upon a number of boys in this way without suturing, and have had no reason to regret it. In children it is certainly better to use absorbable sutures if any are to be used, so as to avoid the necessity of removing them, which both frightens the child and causes pain. It has been many years since I have used sutures after circumcision in children. We will now apply a plaster-of-Paris dressing, so as to prevent infection of the hernia wound. It is an excellent plan, one that has for many years been carried out at the Hospital for the Ruptured and Crippled, in New York. Professor Halsted also uses the same dressing after breast operations.

The next case is that of a man, aged fifty-five years, with the history of acute suppuration around the rectum. Such cases frequently occur after exposure to cold. The man gets into a perspiration, perhaps sits down on a cold stone. The more chronic cases are painless in nature, and in this respect resemble chronic abscesses elsewhere. All abscesses in this region should be opened very early, because there is a tendency for them to break into the rectum and cause anal fistula.

This abscess has been opened and drained well for the last four or five days, and we hope there is no internal opening in the rectum; in other words, that it is a blind, external fistula. We will examine it carefully, lay it open, curette it thoroughly, and pack the wound if such is the case. If the fistula communicates with the rectum, it will then be necessary to cut the sphincter ani muscle, place it at rest, and facilitate healing. The chronicity of anal fistula is due to the fact that the parts are constantly in motion and cannot heal. There is little tendency on the part of anal fistula to heal spontaneously. In the chronic or tubercular varieties of ischiorectal abscess, it is necessary to act promptly, curette away all diseased tissue, and in this way prevent general infection and a prolonged drain on the patient. Time was, many years ago, when the surgeon hesitated to stop a drain of this kind in tubercular patients. In a case of consumption accompanied with anal fistula, it was thought better to let the fistula alone. This view is now held by only a few, the majority of surgeons believing that the safe thing is to stop the discharge as soon as possible. Such abscesses are treated exactly as non-tubercular ones. The same reasons which obtain in ordinary cases do so with much greater force in tubercular subjects, because they are less able to stand a prolonged suppuration than patients in better health.

It may be asked if injections could cure anal fistula. Possibly, yes, in a very small percentage of cases, yet no one thinks of wasting time with such treatment. The operative treatment is very satisfactory. A few years ago it was advised that fistulous tracts be dissected out entirely, the wound brought together by sutures, the aim being to get

primary union. This is only attainable in a very few cases. It was an attempt at ideal surgery, for which there is little place. In small recent fistulæ in young subjects in good health such an attempt may be proper, but will rarely succeed. There is one point about which I would like to caution you, namely, finding the internal opening in complete anal fistulæ. The mistake is apt to be made of looking for the internal opening too far up the gut. The point of the finger should just enter the anus. The sinus is then followed carefully down to the gut with a grooved director when it will usually, if there be an internal opening, pass into the rectum. The opening, I repeat, is nearly always within half an inch of the verge of the anus. There may be many external openings, but there is rarely more than one internal opening.

I digress long enough to point out that this patient is showing marked excitement from ether. You know that I have just taught you that such is the case with drunkards and athletes. In such cases the ether should be withdrawn for half a minute, the patient given plenty of air, and, as a rule, the excitement will cease. I would, moreover, impress upon you again that this is a dangerous state in ether anæthesia, and that the vapor should be withdrawn and not pushed, as so often happens. I have repeatedly seen the greatest excitement at once relieved by withdrawing the vapor and allowing the patient to breathe pure air for a half minute or a minute. My anæsthetists have from time to time been impressed with this teaching, and all have admitted to me that they have seen nothing but good come of the practice. Struggling under either ether or chloroform is dangerous. It increases the intravascular tension and seriously interferes with both the action of the respiratory and heart centres. Ether, as you know, practically always kills through the respiration. It may in rare instances do so through the heart. Chloroform, generally killing through the respiration, may more frequently than ether kill through the heart. I decidedly dissent from the teaching of some who assert that chloroform invariably kills through the heart. The experiments of the Hyderabad Commission were thorough and satisfying to the unprejudiced, and leave little room for doubt that the usual cause of death in chloroform anæsthesia is from paralysis of respiration. You may ask how this can be proven. It is done by what is called cross-circulation experiments. The blood from dog A would feed the brain of dog B, but not go to any other part of the second animal. A is then chloroformed, and his blood passes into the brain of B, but not to his heart. Acting upon the brain alone of B, all the symptoms of chloroform narcosis were produced. Per contra, when the blood passes to the heart alone of B, none of the effects of chloroform are produced so long as the brain receives none of the vapor.

In the rare cases of death through the heart during chloroform narcosis, the result is usually due to previous disease of the organ, such as

fatty degeneration, dilatation, myocarditis, valvular disease, but especially myocardial disease.

The state of excitement having subsided, the ether being better borne, we now return to the operation. With my finger in the rectum I will attempt to follow the sinus and detect an internal opening if one exists. The apparent escape of gas possibly indicates an internal opening. Sir Benjamin Brodie many years ago taught that the internal opening should be looked for with great care, and that an opening should not be made on account of one's impatience. The internal opening must be found, otherwise relapse is reasonably certain. After patiently searching, I have found the internal opening and now bring out the end of the grooved director through the anus. It only remains to cut all superlying tissues with a sharp knife. The sphincter should be cut at right angles because there is less liability to puckering and scarring. Having laid open the main channel, it now becomes necessary to search for secondary or minor ones. They should all be laid open and made to communicate with the main channel. The sphincter, however, should not be cut in more than one place, as there may be too great relaxation, even incontinence of feces. Such a result in the beginning of your career may cost you a great deal in professional repute.

I do not know any disease which will require more careful surgery than fistulæ. Many relapse if not properly operated. Piles, on the contrary, rarely do so. Fistulæ do relapse, because in the hurry or want of care, some little sinus has escaped detection, and not been laid freely open.

The best dressing is iodoform gauze packing. The bowels are kept locked for seventy-two hours, possibly four or five days. There is here also a small internal pile. We will treat this as we generally prefer to do, by means of the ligature. The last case I operated was by the clamp and cautery. I do not, however, prefer this plan of treatment in the majority of instances. In very small internal piles, stretching the sphincter will effect a cure. Injection of carbolic acid is a most dangerous practice, and embolism may result and destroy life. If the injection method is practised the hypodermic syringe should be inserted well into the tumor and the solution carried well down into its centre. If the acid is introduced just beneath the mucous membrane, sloughing is likely.

The only advantage of this method is the ability to treat patients on their feet, that is, without going to bed. I do not wish to condemn it altogether, as I have myself practised it in a few well-selected cases where I had the best of reasons for doing so. It can be done without an anæsthetic, and this itself will be enough in certain instances to call for its employment rather than the ligature, clamp, and cautery, either of which necessitates general anæsthesia. Its field of usefulness, however, is limited, and I wish to state emphatically that it is more dangerous than any other treatment of internal piles.

REVIEWS.

MODERN MEDICINE. By JULIUS L. SALINGER, M.D., Demonstrator of Clinical Medicine, Jefferson Medical College; Chief of the Medical Clinic, Jefferson Medical College Hospital; Attending Physician to the Philadelphia Hospital; and FREDERICK J. KALTEYER, M.D., Assistant Demonstrator of Clinical Medicine, Jefferson Medical College; Hematologist to the Jefferson Medical College Hospital; Pathologist to the Lying-in Charity Hospital, Philadelphia; Assistant Pathologist to Philadelphia Hospital. Pp. 801. Philadelphia and London: W. B. Saunders & Co.

THE aim of the authors has been to bring within the compass of a single volume not only clinical medicine but what they are pleased to term "a number of specialties, such as physical diagnosis, bacteriology, the examination of the gastric contents, the urine, the blood, the feces, etc.," for which the student is usually obliged to procure separate books. For this reason the first one hundred and seventy pages are occupied with an introduction proper, symptomatology and semeiology, which includes much that should be found in the next division—physical diagnosis—clinical bacteriology, and, finally, laboratory methods. Of this little need be said; it is fairly complete and should be a good guide for the student, although we are of the opinion that he will still prefer his little book for his pocket in the clinic or for his desk in the laboratory. Here as elsewhere some peculiarities of expression are found which obscure the interpretation, "atmospheric pressure," as in a pneumatic cabinet, decreases the pulse-rate. Rarefied air, as in mountain regions, on the contrary, increases the pulse-rate (p. 38). Again, we find such an important omission as a statement in reference to the changes in sphygmographic tracing which arise from the varying weights upon the artery when the Dudgeon instrument is employed (p. 43). The remainder of the volume is devoted to the consideration of the subjects grouped together to form internal medicine, and is divided as follows: Infectious diseases, diseases of the circulation, of the respiratory system, of the digestive tract, and of the kidneys, constitutional diseases, diseases of the blood and ductless glands, of the nervous system, and of the muscles, intoxications and sunstroke, and, finally, diseases due to animal parasites. Of the book this much can be said: it is systematically developed and evenly written, and while there are no chapters of startling brilliancy there are none of painful inadequacy; the latter is much the less rare in the modern text-book. The claim of the authors that the main facts are considered from a modern and generally accepted stand-point is, to a remarkable degree, true. Yet instances can be pointed out where the opposite holds. In the section on septicæmia (page 283 *et seq.*) no mention is made of soluble silver, which is certainly modern and quite generally accepted. In so-called croupous

pneumonia (p. 237) the mechanical and minor problems receive attention, while treatment based on its essential character—infection—is not presented. In various parts of the work the brilliant results obtained in internal antisepsis do not receive by any means adequate recognition. Often after an inadequate presentation of the treatment of a particular disease there comes out an involuntary admission of its inefficacy. For instance, in typhoid fever, after a brief exposition of the method of Currie-Jürgensen, commonly known as Brand (p. 185), comes the curious admission: "Management of convalescence—the process is long and tedious." Nothing is said about the methods which treat both patient and disease and have produced such remarkable reductions in mortality. Of minor matters many might be criticised. Too frequent resort to opium or morphine in respiratory diseases when codeine is preferable and much more efficient; peculiar descriptions, as that of mountain fever (p. 290); singular classification, as that of infective endocarditis (p. 327) into septic or pyæmic, typhoid, cerebral, cardiac or malarial type; indiscriminate mingling of suffixes, morphia and morphin, atropia and atropin, when neither is correct if the Pharmacopœia is the standard, for that gives morphine and atropine.

The illustrations and tables are excellent, the type and binding satisfactory, and in the main the text has been well done, even if the size of the book necessitates condensation and may suggest the adjective "sketchy." With minor defects corrected, with the present as a basis, an excellent text-book can be made. The greatest fault which we find lies in the inadequate treatment. In this respect the authors are in good company, for it is a defect of nearly every text-book which we have read in recent years. But with the wide-spread revival of interest in therapeutics, with the enormous increase of knowledge, both of old remedies and recent additions to our resources, the authors had the opportunity to make this the most useful of all works of its class. We trust that the next edition will show a careful sifting of therapeutic material rich in facts which are the most important for the alleviation of human suffering. R. W. W.

THE PRACTICAL MEDICINE SERIES OF YEAR-BOOKS. Under the general editorial charge of GUSTAVUS P. HEAD, M.D. Vol. III., The Eye, Nose, and Throat. Edited by CASEY A. WOOD, C.M., M.D., ALBERT H. ANDREWS, M.D., and T. MELVILLE HARDIE, A.M., M.D. Chicago: The Year-book Publishers, 1901.

THE publishers of this series of year-books are to be heartily congratulated on the great practical value of the plan which they have pursued.

The present little volume presents excellent abstracts of the most important current literature on those branches with which it deals. The various editors have performed their work in a most satisfactory manner, the abstracts, while short, containing the gist of those articles which they represent.

The illustrations which accompany the text are hardly worthy of mention, and the book is inartistic in its whole get-up, both paper and

binding being cheap in quality. However, these books are necessarily ephemeral in their value, and their inexpensive price probably justifies the cheapness of their make-up. F. R. P.

A Text-book of Obstetrics. By Barton Cooke Hirst, M.D., Professor of Obstetrics in the University of Pennsylvania, etc. Third edition, 8vo., pp. 873. Philadelphia and London: W. B. Saunders & Co., 1901.

This volume has been designed by its author as a text-book for students and a guide for physicians in active practice. It is one of the few text-books by one author now in common use.

The arrangement of the volume is that usual in medical text-books. Anatomy, physiology, and embryology are briefly reviewed. Embryonal and fœtal circulation are described, but not as completely as in many works, and attention is not especially directed to the ready occurrence of partial asphyxiation of the blood through leakage in cardiac valves.

An excellent discussion of the pathology of the placenta is given, a subject frequently neglected.

The diagnosis of pregnancy is fully described, and a copious series of illustrations, showing abdominal tumors other than the pregnant abdomen, is added. We question the value of these illustrations in a text-book, as the tendency in diagnosticating pregnancy is to make too rapid and superficial examination in each case. If the student or practitioner forms the idea that by the contour of the abdomen and the appearance of the abdominal tumor he can detect the presence or absence of pregnancy, he may be misled. Pregnancy complicated by abdominal tumor is not exceedingly rare, and the tendency would be to miss such a diagnosis were undue attention given to the shape of the abdomen. In discussing the pathology of pregnancy, stress is laid upon the kidney of pregnancy and upon nephritis. The toxæmia of pregnancy is not thought of special importance. The quantity of albumin is considered a guide for the induction of labor. Our experience has led us to rely more upon the quantity of urea and solids excreted, as shown by specific gravity and urea percentage than upon albumin. The most dangerous cases which we have seen are those in which the kidneys gave no warning until too late to materially influence the condition of the patient. The writer retains the term "miscarriage," and applies it to the expulsion of the product of conception after the placenta has been formed. This seems an unnecessary division and liable to create confusion, in view of the fact that patients rarely speak of abortion because of the criminal association often connected with the name, but almost invariably of miscarriage.

The section upon Extra-uterine Pregnancy is full of interesting matter and illustrated abundantly. Some of the illustrations, however, are more pictorial than illustrative, because photographs of specimens without color and without the accentuation of important points by drawing are not always satisfactory. In operating for tubal abortion the writer employs drainage by both gauze and a glass tube. This is more practical than logical. If the operator's technique is perfect, drainage is unnecessary. Unless gauze packing is employed to check oozing hemorrhage, its use as a drain may be justified by experience,

but not by theory. In our experience there is in these cases a considerable oozing of blood and serum from the tissues about the sac of a ruptured ectopic gestation, and we have employed drainage as much to check this oozing as to remove foreign matter from the abdomen.

The description of labor is graphically given and the usual phenomena of parturition are clearly described. The illustration which represents a bed ready for use during confinement is misleading, as the chair for the physician is so placed that the student cannot easily reconcile this illustration with others, showing the protection of the pelvic floor and the management of the head during its escape. We fail to find a clear statement of the posture which the patient should take in a case of spontaneous or normal labor, nor do we find distinctly stated the necessity for cleansing the eyes and mouth immediately after the birth of the child. The nurse is advised to apply the obstetric binder sooner than seems to us prudent, in view of the danger of relaxation and possible hemorrhage.

The writer expresses skepticism as to the value of ergot in promoting involution during the puerperal period. We agree with him if this be limited to considerable doses of ergot only, but small doses of ergot combined with tonic doses of strychnine have given us most excellent service in many cases when subinvolution might have been expected. We prefer a more careful technique in the management of the nipples during the puerperal period, using borated dressings with a retentive bandage in all cases in which the patient will allow such dressings. We have found it necessary to describe more definitely than does the writer the field of cleansing the genital organs during the puerperal period. His consideration of this subject is given in the section under the preventive treatment of puerperal septic infection.

In discussing the mechanism of labor, he adheres to the old usage of four distinct positions, and to the old view, which ascribes considerable importance to the contour of the pelvic walls in influencing anterior rotation. The evidence in favor of the pelvic floor as the most important agent in rotation has always seemed to us conclusive.

Contracted pelves receive full consideration with abundant illustrations. Schauta's classification is adopted. In treatment, if the internal antero-posterior diameter is 9.5 cm., labor should be induced at the thirty-sixth week. If this diameter is reduced to between 7 and 8 cm., labor is still to be induced at the same time, the operator trusting to forceps or version to deliver the patient. This is scarcely reasonable and not in accord with the most recent results in the treatment of labor in contracted pelves. The indication for the Cæsarean operation has recently been advanced to 8½ or 9 cm., and if labor is to be induced in a pelvis as small or smaller than this, it should be done not later than the thirty-second week in the interests of the mother. Our present knowledge would indicate that the question of the induction of labor before the thirty-sixth week, or even at any time, should be left to the decision of the parents of the child. If they wish to throw the risk upon the child, then labor is to be induced; but if the mother is willing to assume risk in a pelvis whose true conjugate is between 7 and 8 cm. the induction of labor should be declined. The author occasionally sanctions the application of the forceps above the brim of the pelvis, but is more distrustful of the performance of version. Our experience leads us to believe that without engagement the forceps should not be

applied, and that in cases where it is permissible to try one of the less radical operations, version is better than forceps. Our experience coincides with the author's in the value of Walcher's position, but only in cases in which the head enters the pelvic brim and partly engages.

Under the complications of labor are considered placenta prævia and post-partum hemorrhage. This is again a reversal of the customary classification, but such liberty is permissible and forms an example of the constantly changing character of medical literature. In placenta prævia, the writer speaks with delightful assurance of the success attending the use of the tampon accompanied by partial separation of the placenta with the fingers. For accidental separation of the placenta during pregnancy, he would empty the uterus as soon as possible. In post-partum hemorrhage the time-honored resources, ice and vinegar, are given prominent place. In our experience a hot douche and the intra-uterine tampon of iodoform gauze have proven most reliable. The author does not recommend the use of strychnine. We have found this drug superior to ergot in securing permanent contraction of the uterus.

In discussing the use of forceps the time-honored limit of two hours for spontaneous expulsion is still accepted. While this may serve as a guide for those comparatively inexperienced, the better plan is to interfere so soon as the head has left the cervix and progress ceases. The author prefers celiohysterectomy to any other form of Cæsarean section. This is undoubtedly the more satisfactory operation for the operator, but if a patient distinctly elects to undergo a possible second operation this choice must be given. It is still a question whether the operator has the right, in ignorant and vicious patients illegitimately pregnant and sent to hospitals, to permanently prevent the power of reproduction. While there can be no question that such is the desirable course for the public good, it is possible that an operator might be seriously embarrassed with the charge that he had exceeded his rights and privileges in so important a decision.

The volume closes with an account of the diseases of the newborn child. In the treatment of asphyxia, Schultze's method is preferred, while the more simple and, in our experience, efficient method of folding and unfolding the infant with the head lowest does not receive mention.

As a whole, this book presents an interesting and clear statement of modern obstetric science in its application to practice. It is abundantly illustrated by reference to literature and pictorially. Whether in the practice of others the same results will follow the methods of treatment described, the experience of each reader must determine. The author is sanguine and positive in his statements, and some of his readers will not agree with his deductions or with his lines of reasoning; but all will admit the merit and value of the volume, and those interested in obstetrics will read and refer to it with pleasure and with profit.

E. P. D.

THE PRINCIPLES AND PRACTICE OF MEDICINE. DESIGNED FOR THE USE OF PRACTITIONERS AND STUDENTS OF MEDICINE. By WILLIAM OSLER, M D. Fourth edition. New York: D. Appleton & Co., 1901.

A REVIEW of the last edition of Dr. Osler's book seems hardly necessary in view of the fact that everyone knows from past experience with former editions that each one has been a most satisfactory and complete

exponent of the condition of the practice of medicine at the time of appearance. Since the third edition appeared, in 1898, some extremely important steps have been made in medicine, all of which, so far as we can see, have been incorporated in this recent edition. A few of these advances might be mentioned, most of them being pointed out in Dr. Osler's preface. Since 1898 our knowledge of the etiology of dysentery, its various types, and their different dangers and sequelæ, have been more thoroughly studied. The characters of Shiga's bacillus are still being carefully determined, and not only a method of carrying out the agglutination test, but also, which is more important, the production of an antitoxic serum have been already accomplished. In yellow fever great advance has been made, not only in the purely scientific study of the disease, but in its prevention in places where it is indigenous and its transmission to other points. The summary which Dr. Osler gives of the recent work done in connection with the contagion of yellow fever is, it is hardly necessary to say, fully up to date; and it is, indeed, remarkable in this particular section how Dr. Osler seems to have obtained in time for incorporation in his book the results of work that was only completed after the greater portion of his manuscript must have been in the hands of the printer. The same thoroughness is seen in the statements made regarding the so-called pneumonia antitoxin, which is certainly proven to be not an antitoxin. In the paragraph relating to immunity and the serum therapy of pneumonia, which is in itself very brief, he gives the data at hand with sufficient detail. Bubonic plague is also a disease in which so much work has lately been done that rearrangement was necessary, and in accomplishing this Dr. Osler has so condensed what he wished to say in regard to facts brought out since the third edition was published that the space occupied by the article is almost to a line exactly the same as that occupied in the former edition. This rearrangement of facts, without adding to the size of the text of the former edition, and without omitting mention of any important advances, is one of the most remarkable features of this new edition. A few only of the differences between the two editions have been mentioned, yet all through the book one sees small alterations which cause the volume to contain descriptions of all the main features of the various diseases from the most recent view-point.

The reason for the continued popularity of Dr. Osler's *Practice of Medicine* is not far to seek. There is through the whole book evidence of careful thought as to the matter to be presented and the manner in which it is stated, while one is impressed constantly with the thorough medical honesty of the author. The fairness of presentation of the subjects and the completeness of the discussion of each disease are undoubtedly the main causes for the continued popularity of the work.

F. A. P.

A Manual of the Practice of Medicine. By George Roe Lockwood, M.D., Attending Physician to Bellevue Hospital, New York. Second edition, revised. 847 pages, with 103 illustrations, many of them in colors. Philadelphia and London: W. B. Saunders & Co., 1901.

In its second edition this manual is much larger than it was in the first. Many portions have been rewritten, especially those dealing with

malaria and certain diseases of the digestive system—gastritis, dilatation of the stomach, gastric atony, ulcer of the stomach, gastric neuroses, enteritis, colitis, etc., and some new subjects have been introduced, of which bubonic plague, gastroptosis, gastric analysis, and Reichmann's disease may be mentioned. While some may question the utility of such books, it must appear evident that in the present state of medical education, especially in view of the increase of the system of compulsory recitations, a good manual is of much service to junior students. Of the many manuals on the subject, Lockwood's is one of the best. In the main, it is accurate; its subject-matter is arranged after the classification of Osler, and it contains but little obsolete matter. As a preliminary to the study of the more extended and complete text books, it may be recommended to junior students for use under the guidance of a competent instructor. A. O. J. K.

Simon's Clinical Diagnosis. A Manual of Clinical Diagnosis by Means of Microscopical and Chemical Methods, for Students, Hospital Physicians, and Practitioners. By Charles E. Simon, M.D. Fourth edition, revised. Illustrated. Philadelphia and New York: Lea Brothers & Co.

The task of the reviewer is rendered at once easy and more difficult by the fact that the book has met with almost unexampled popular success. Dr. Simon's text-book appeared at the psychical moment. The medical profession had been prepared by von Jaksch's work on the same subject, and yet that work did not appear to be absolutely adapted to American needs. Dr. Simon's book, however, seemed to meet the requirements perfectly; it was scientific in tone, and yet sufficiently elementary to enable its user to understand not only what he was doing, but why he was doing it, and it was and is sufficiently thorough to give not only the details of the various clinical investigations, but also their rationale and significance. Moreover, it includes valuable discussions upon such important subjects as albuminuria, glycosuria, and a host of kindred subjects, all within the scope of the clinical diagnostician. Not the least important feature of a medical text-book is the style in which it is written. It has not been our good fortune to read a book on this subject—and we are familiar with many—in which the style adds so much to the matter as in the present volume. There is, perhaps, nothing more difficult in literary composition than the accurate and clear description of a scientific method. So many of the procedures seem to come almost at once, and to be inextricably combined with one another, that it is almost impossible to give a clear, consecutive, and satisfactory account. And yet Dr. Simon has accomplished this nearly impossible feat perhaps one hundred times or more in reference to some of the most complicated and difficult of the laboratory methods. There will of necessity be a difference of taste regarding what should be selected to comprise such a book. There is no question that it could readily have been made twice as large as it is, and yet not have covered the field entirely. In fact, the enormous amount of work that has been done on this subject, properly abstracted,

would fill a system rather than a volume. It might have been advisable to introduce a brief discussion of Talqvist's method of estimating hæmoglobin. The Widal reaction is given a rather scant description when one considers its extraordinary importance in the diagnosis or exclusion of typhoid fever. No mention is made of the confusion which may exist between infection with the paratyphoid and the true typhoid bacillus; nor is mention made of the alleged fact that in cases of jaundice the blood gives a typhoid reaction. We think it would be well to mention some of the extensive experiments that have been made upon the serum reaction of the tubercle bacillus and the fact that agglutination of the pneumococcus has also been obtained. The description of the introduction of the stomach-tube and the withdrawal of the stomach contents is careful and accurate. It might have been mentioned that very frequently the withdrawal of the contents is greatly facilitated by having the patient lie down. Dr. Simon is unqualifiedly in favor of Töpfer's test for free hydrochloric acid. Other investigators are by no means so positive, and it might have been well to suggest that on this subject there is considerable difference of opinion. Of course, as the clinical results are chiefly comparative, it makes really very little difference what method is employed so that it gives fairly constant results. The description of the examination of the feces is perhaps less satisfactory than other parts of the book. It is a subject that is generally shirked by investigators. Presumably the most important constituent from the stand-point of diagnosis is the fat and its derivatives. We could have wished a more accurate method for its estimation. Nothing is said concerning the investigations of Schmidt upon the early and late fermentation of the feces and its significance, although this is a very easy method to employ, and Schmidt occupies a sufficiently distinguished place in clinical medicine to render his statements worthy of consideration. In the section on the urine Dr. Simon is thoroughly at home. It is one of the most satisfactory and thorough articles that has ever been written on this subject. Not the least valuable and interesting part of the book are the brief chapters appended upon transudate and exudate, the examination of cystic contents, of the cerebro-spinal fluid, and of the secretion of the sexual organs.

In conclusion, it gives us pleasure cordially to recommend the book as the best extant on this subject. J. S.

Syphilis: A Symposium. New York: E. B. Treat & Co., 1902.

This little volume presents in a compact form the contributions of seventeen well-known syphilographers. They were originally written for the *International Medical Magazine*, and, as the writers are all well known in their special line, the articles are all of some value. It is, moreover, interesting to have in a handy form the latest expressions of opinion concerning the subject from so many writers, each of whom treats the subject as he sees it in his own special line of work.

H. M. C.

PROGRESS

OF

MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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On the Stokes-Adams Syndrome.—JAQUET (*Deutsches Archiv für klinische Medicin*, 1902, lxxii., 77) enters into the history and literature concerning these interesting manifestations in connection with the report of an extremely interesting case of bradycardia, with epileptiform attacks, occurring in a young man, thirty years of age. The patient died in one of these attacks. The autopsy showed no evidence of arterio-sclerosis, no changes in the medulla, but a well-marked fragmentation of the heart muscle of the left ventricle and papillary muscles. The author inclines to the belief that neither the view of Stokes, who regarded the condition as due to a fatty degeneration of the heart-muscle, nor that of Charcot, who believed it to follow changes in the medulla oblongata, nor yet that of Huchard, who regards the condition as the result of arterio-sclerosis of the coronary vessels, can hold in all cases. The observations of Dehio render it extremely probable that the cause of the slowing of the pulse is not central, but lies in the heart wall itself. Jaquet is inclined to lay great stress upon vasomotor spasm as a cause of the condition, and calls attention to the similarity between these manifestations and those of intermittent claudication.

The author believes that Huchard goes too far in including under Stokes-Adams disease cases which show transient attacks of bradycardia from time to time without other symptoms. Properly speaking, only cases with slow pulse and syncopal or epileptiform attacks should be included under this heading.

In all such cases the danger of sudden death in an attack should be borne in mind, even where no apparent vascular changes are to be made out. Jaquet believes that in view of the lack of uniformity in clinical manifestations, as well as from a pathological and pathogenic point of view, it is inadvisable to speak of this condition as a disease. For the present we must regard it

as a symptom complex or a syndrome. It is, however, not impossible that in the future we may be able to discover some uniform cause for this manifestation.

Gonorrhœal Arthritis.—MARKHEIM (*Deutsches Archiv für klinische Medicin*, 1902, lxxii., 186) reviews 52 cases of gonorrhœal arthritis occurring during the last seven years in Eichhorst's clinic. In only one case were cultures made from the joints, and in that instance the staphylococcus aureus was obtained. In three instances cultures were taken from the blood by Prochaska, in two of which gonococcus was obtained. In a third case staphylococci alone grew, although at autopsy gonococci were found in the excrescences upon the cardiac valves, the patient dying of ulcerative endocarditis. The development of arthritis the author believes to depend upon especial characteristics of the gonococcus in given cases, certain observations tending to show that a culture of gonococcus which has produced arthritis in one individual is especially likely to do so in another. The author's observations lead her to concur in the well-known view that an individual who has once had gonorrhœal arthritis is especially subject to subsequent attacks. This predisposition appears to be acquired as a result of the first attack of arthritis rather than dependent upon any especial characteristics of the individual. A previous acute articular rheumatism predisposes to gonorrhœal arthritis, as does also, apparently, trauma.

With regard to the time of onset of the joint symptoms, in only 17 could positive statements be obtained. Of these 1 developed in six days, 1 a week, 2 two weeks, 6 three to five weeks, 3 two months, 1 patient six months, and 3 from four to seven months. In one instance the patient stated that infection had occurred twenty-four years before!

As a rule more than one joint was affected, though commonly the infection began in one joint, appearing in the second only after the process had come to a standstill. Of the 52 cases but 13 were monarthritis, in 12 two joints were affected, in 11 three joints, in 7 four; in the others the process was a polyarthritis, affecting all the way up to eight joints. The joints affected with greatest frequency were the knees, thigh-joints, the shoulder, the radiocarpal joint, the elbow-joint. In but one instance was the joint opened—that a case in which ulcerative endocarditis occurred. In not one of the other cases was suppuration supposed to have occurred. The author believes that this is due to the fact that puncture was never attempted. In 10 instances there was a marked effusion, with extensive œdema of the periarticular tissue. In all other cases the effusion and the periarticular swellings were slight or absent, the only symptoms being pains, spontaneous and on pressure, active and passive movements. This form was usually polyarthritic.

The duration was long, in but 2 cases less than five weeks; in 12 inside of two months; in 26 inside of four months; in 2 it lasted a year. The remaining patients left the hospital before recovery. Various complications were observed: 4 times, endocarditis; 4 times, conjunctivitis; 3 times, iritis; in 1 instance, sciatica. In only one instance was surgical treatment resorted to. Of these 52 cases 13 were discharged well. Complete ankylosis followed in five cases, in 7 there was a certain stiffness and limitation of move-

ment, and in all the other cases at the time of discharge there was still a slight swelling or tenderness on forced movements. The author believes the results to have been particularly good, and attributed this to the abstention from surgical treatment.

[In this conclusion the reviewer cannot concur. Modern experience has emphasized the importance of aspiration, bacteriological examination of the joint fluid, and surgical operation in many of these cases. Early surgical treatment in joints from which gonococci or pyogenic cocci are obtained on culture will probably save many joints.—W. S. T.]

Pressure in Pleural Effusions.—Bard (*Revue de Médecine*, 1902, xxii., 253, 340), whose valuable studies on intrathoracic pressure in pneumothorax have been already summarized in these columns, contributes some observations on the intrathoracic pressure in pleural effusions which are well worth careful consideration. Although the author finds it possible to measure the intrapleural pressure in serous or serofibrinous exudations with sufficient clinical precision, yet this estimation depends upon precautions and corrections which have not been carried out by previous observers. A minute observation of these precautions is absolutely necessary for reliable results. Contrary to the ordinary opinion that pleural effusions show a positive pressure varying from 10 to 30 mm. of mercury, Bard finds that the superficial pressure of the largest effusions is always negative on quiet inspiration, and that the same is true in an immense majority of cases, if not always, during expiration. Experiments on rabbits show that it is impossible to obtain positive intrapleural pressure by the injection of liquids. Whatever the nature of the fluid introduced into the pleural cavity, its excess is immediately absorbed. If the injection be made into an elastic bag, which prevents absorption, the animal succumbs in several minutes after the quantity injected is sufficient to create a positive inspiratory pressure, however slight it may be. These facts lead the author to suggest that "sudden death in large pleural effusions may be attributed to the sudden establishment of a positive inspiratory pressure as a result of the cessation of compensatory efforts, due itself to the exhaustion of the accessory respiratory muscles."

The mechanical influence of effusions, in sharp contrast to that of accumulations of gas, is independent of their pressure, and depends entirely upon their volume. These differences are due to the incompressibility and constant volume of fluids as opposed to the compressibility and elasticity of gases.

The author states that the careful study of intrapleural pressure in pleurisy gives us important information concerning the elasticity of the lung and its extensibility, while it may further give us information concerning the encystment or the free state of the effusion. Further observations concerning these points are, however, necessary. An interesting result of Bard's studies is his conclusion that "One should practice puncture by means of aspiration through a simple siphon, a process which is made easy in all cases by the use of certain simple precautions. It is thus possible to estimate the pressure at various intervals during the course of the evacuation of the fluid. . . . One avoids all accidents connected with puncture, all consecutive complications, and, what is more important, one obtains the best therapeutic

results by adopting the rule of ceasing the puncture as soon as the inspiratory pressure is feebly negative; that is to say, when the level of the fluid in the tube remains with calm quiet expirations at 0.01 or 0.02 c.m. below the level of the puncture. One may then conclude that the superficial intrapleural pressure has come down to about its physiological degree.

"The use of the siphon regulated and arranged as I propose is the only method which permits the limitation of the evacuation to the useful quantity; it thus allows us to practice thoracentesis with more security, and, moreover, with results more favorable than those which are to be obtained by aspiratory apparatuses."

[The article is well worth careful study. The description of the methods, which are, after all, relatively simple, would, however, be too long for this review.—W. S. T.]

Protodiastolic Murmurs in Mitral Disease.—Dagnini (*Riv. Crit. d. Clin. Med.*, 1902, iii., 206), in an interesting communication based on observations in the clinic of Murri, in Bologna, discusses the cause and frequency of the variations in character of mitral diastolic murmurs. It is not very unusual to meet with cases of mitral stenosis in which the characteristic long diastolic murmur, with presystolic accentuation, becomes feeble or interrupted in the middle of diastole with later presystolic accentuation. In other instances it may be uniform in intensity throughout diastole; again, sometimes it may be feeble or absent in the latter part of diastole; sometimes it may be absent altogether. These conditions, excepting the last, while not common in pure mitral stenosis, are, Dagnini believes, more frequent in combined stenosis and insufficiency. The ordinary presystolic accentuation of the murmur is due probably to the increased force with which the blood is propelled through the mitral valve at the time of the auricular contraction, and its absence, observed in late cases in which the left auricle is greatly dilated, is probably due in many instances to a loss of muscular power in the dilated auricle. But in just such cases where the left auricle is greatly distended, and the tension of the blood at the end of systole extremely high, it is not remarkable that at the beginning of diastole the rush of blood through the retracted orifice should be sufficiently forcible to cause a murmur early in diastole, which, owing to the atrophied walls of the auricle and premature filling of the ventricle, may disappear later. According to Potain, much depends on the manner in which the ventricle is filled. For instance, if a ventricle, the muscular walls of which are weak, be unable to entirely empty itself during systole, it may be filled so early in diastole that the auricle at the time of contraction finds it already so far distended that the ordinary increase in the rapidity of the flow from auricle to ventricle does not occur, and the presystolic murmur is wanting. Again, where, after rest or digitalis, there is slowing of the heart with lengthened diastole the same early filling of the ventricle may occur, resulting in a distinct pause between the murmur and the first sound.

Dagnini points out the fact that the conditions for such variations in the murmur of mitral stenosis are more commonly present in cases of combined lesion than in pure stenosis. In the first place, in instances where the stenosis is combined with regurgitation, the latter causes a greater dilatation

and an earlier loss of power in the left auricle. Again, in such cases the tension in the auricle at the end of systole must be extremely high, so much so that it is not remarkable that the great rush of blood through the auriculo-ventricular surface during the early part of diastole should produce a murmur just at the beginning of this period, while the sudden filling of the ventricle and the early dilatation and atony of the auricle tend to remove the causes of the presystolic accentuation. Dagnini further points out that, theoretically, the dilatation of the ventricle and the high tension in the auricle may well bring about murmurs in diastole in cases in which the stenosis is extremely slight, or indeed in the absence of actual stenosis as determined by ordinary measurements, if, as a result of slight sclerotic changes, the mitral ring be rendered more rigid than normal. It is not impossible that this may be the cause of many of the presystolic murmurs which have been reported in the absence of actual stenosis. In such cases there is in effect, a relative stenosis, both as regards the relation of the distensibility of the mitral ring to the degree of dilatation of the ventricle, as well as regarding the relation between the quantity of blood passing through the mitral orifice in a given diastole, and the size of the orifice. Dagnini believes that his observations justify the theoretical conclusions that: "(1) The characters of the diastolic murmur should vary, other things being equal, according to whether the stenosis be simple or complicated with valvular insufficiency; (2) that a stenosis of very slight extent may give rise to no murmur, while a stenosis of the same degree if accompanied by insufficiency finds in this latter lesion, conditions favorable to the development of a murmur in the first part of diastole; (3) that these protodiastolic or protomesodiastolic murmurs should be more frequent in combined lesions of the mitral valve than in pure stenosis."

[A hasty reference to the records of the fatal cases of mitral stenosis occurring in Prof. Osler's clinic would appear to lend support to the assertions of Dagnini that proto- and mid-diastolic murmurs are more frequent in combined mitral lesions than in pure stenosis.—W. S. T.]

SURGERY.

UNDER THE CHARGE OF

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A Case of Perforated Gastric Ulcer Simulating Appendicitis.—Horsford (*Lancet*, London, 1902, vol. i., No. 7) reports the case of a woman, aged thirty-two years, who gave a previous history of having had attacks of indigestion for two years, with occasional vomiting, but no hæmatemesis. Five

days previous to her admission to a hospital she had an attack of acute abdominal pain, most marked in the right hypochondrium, with vomiting at intervals during the day. The abdomen was soft, and there was no temperature. On the next day the temperature rose to 100° F., but this fell somewhat after the bowels were moved. Two days later she had another attack of severe pain, with tenderness at McBurney's point, and vomiting of bile-stained fluid with a stercoraceous odor. The temperature was 100° F., and the pulse 95. There was some bulging in the hypogastrium and right iliac regions, and on vaginal examination there was great bulging of the anterior vaginal wall, the uterus being pushed backward and upward. It was decided to perform laparotomy on the next morning, and the rest of the day and evening were passed in comparative comfort, but early the next morning she suddenly went into collapse, and died in less than an hour. The post-mortem showed an abscess between the coils of the small intestine, occupying the right iliac fossa and extending downward into the pelvis and upward along the ascending colon. The appendix was healthy, but on examining the stomach there was found on the anterior surface, near the pylorus, a perforated ulcer, oval in shape and three-quarters of an inch long. The peritoneal margin was ragged and apparently recently destroyed, but the mucous edge was smooth. The ulcer was not terraced, thickened, nor adherent to neighboring structures. No other ulcers were found.

Rupture of the Jejunum from Direct Violence without External Bruising.—Livingston (*British Medical Journal*, March 1, 1902) reports the case of a boy, aged sixteen years, who had been kicked by a horse in the abdomen, but who presented no sign of external injury. There was a history of vomiting immediately after the accident, and examination showed that the abdominal walls moved in respiration, although not quite freely; no tenderness in any particular spot on light pressure; dulness on percussion in the hypogastrium and flanks, in the latter situation changing with the position of the body. Urine was voided without difficulty. The pulse was 116, and the patient was shocked. The case was put at once to bed, and an effort made to relieve the shock. Two days later his condition suddenly became much worse—he went into collapse and died a few hours later. The autopsy showed several pints of bloody fluid in the peritoneal cavity and a tear in the jejunum near its commencement, close to the spine, about one and one-half inches long in the longitudinal axis of the bowel, at its free border. The edges of this tear were thickened and bruised.

A Study of the Cases of Accidental X-ray Burns Hitherto Reported.—Codman (*Philadelphia Medical Journal*, March 8 and 15, 1902), after an exhaustive review of this interesting subject, states in conclusion: (1) The frequency of X-ray injuries has been much exaggerated by the medical press owing to the wide publicity given to many early cases. (2) The writer has been able to collect somewhat less than 200 cases, less than half of which were serious, and about one-third of which occurred in X-ray workers. (3) Judging from the experience with these injuries in Boston, it is the writer's opinion that a fair proportion of the severe burns are included in this series, while the dermatitis of skiagraphers is less well represented.

(4) At a maximum estimate it is safe to say that not one patient in a thousand has been injured in the past five years by an X-ray examination, and in the past year not one in ten thousand. (5) More than two-thirds of these injuries occurred in the first two years of the use of the X-ray. Only one mild case is reported as occurring in the current year, those cases in which the exposure has been made for therapeutic purposes being excluded. (6) The cause of X-ray injuries is not definitely known. It is some form of energy closely allied to the photographically active X-ray, and radiates with it from the platinum terminal. (7) The primary injury is to the nerves controlling the nutrition of the skin. (8) There is no good evidence of injury to the deeper tissues without primary interference with skin. (9) The important factors which contribute to the production of X-ray burns are: The intensity of the current used to stimulate the tube; the quality of the tube, the distance and time of exposure; the idiosyncrasy of the patient. (10) The static machine is somewhat less likely to produce injury than other forms of apparatus. (11) From the data of the reported cases we can say that no burn has been produced by an exposure equal to or less than the equivalent of five minutes at ten inches. (12) It is impossible from the data to say how intense an exposure must be to produce a burn, for a comparison of the cases shows that an inconstant factor or factors exist. (13) Those inconstant factors are more likely to lie in the complex human organism than in the less complicated construction of the tube. (14) General experience has shown that soft tubes produce a more intense effect on the tissues than hard. (15) While we cannot control these inconstant factors therapeutic exposures will continue to be dangerous, and it is therefore important to record the exact conditions of the patient's local and constitutional idiosyncrasies as well as those of the tube. (16) In cases of injury the time before the appearance of the first symptoms has varied from a few minutes to three weeks. Five cases have remained latent for over three weeks; two of these for five months. (17) It is impossible to predict the severity of the lesion from the time of its appearance after exposure. (18) The writer suggests ten minutes at six inches from the platinum terminal as a standard therapeutic exposure. This will make comparisons between the inconstant factors easier. (19) Unless signs of dermatitis appear within three weeks after the exposure they are unlikely to appear at all. In one-third of the reported cases the appearance occurred within the first four days, in one-half the cases before the ninth day. (20) In the ordinary X-ray examination with fluoroscope or skiagraph the operator takes the entire responsibility of injury; in exposures for therapeutic purposes the patient shares the responsibility.

Spinal Anæsthesia.—Kallionzis (*Revue de Chir.*, 1901, No. 10) states that spinal anæsthesia at the present time is in the period analogous to the epoch of the discovery and subsequent experimentation with chloroform and ether as general anæsthetics. Tuffier has stated that he does not know of a single case which has been subjected to spinal anæsthesia and been followed by a lesion of the nervous system. Spinal anæsthesia has no operative mortality. The five reported cases of death were all postoperative. In two cases the cause was not given, while in the other three the cause was in no way related to the method of anæsthesia. The author reports eleven cases,

all successful, of operations under spinal anæsthesia. The anæsthesia was complete in every case. All had a slowing of the pulse and elevation of the temperature on the day of operation, seven had headache, four had pallor of the face, with copious perspiration, and three had vomiting. A comparison of the two methods of anæsthesia, chloroformization and spinal cocainization, shows that the latter has many elements in its favor, and its use should be carefully considered by all surgeons who have hitherto hesitated to employ it.

Chloroform and Ether Anæsthesia.—PONCET (*Gaz. hebdomadaire de Méd. et de Chir.*, March 6, 1902), after an admirable review of this all-important subject, states in conclusion: (1) Chloroform is more dangerous than ether, as all statistics show. The researches of Julliard show one death in every two or three thousand chloroformizations, and only one death in every thirteen or fourteen thousand etherizations. The author reports 29,000 personal etherizations with only one death, and that a child who had organic heart disease. (2) Ether does not cause the primary or reflex laryngeal syncope at the onset of the anæsthesia which is so suddenly fatal and relatively frequent when chloroform is used. Ether alone is to be preferred to mixtures for purposes of anæsthesia. (3) It has not been proved, and no statistics have established, that the postoperative pulmonary complications, such as bronchitis, congestion of the lungs, bronchopneumonia, œdema of the lungs, etc., are due to the irritant action of the vapors of ether. The so-called etherization pneumonia or chloroformization pneumonia are essentially infection pneumonias. The pulmonary complications are probably just as frequent in those operative cases which receive no anæsthetic. (4) It is not exact to say that the mortality after the narcosis by ether, in the days following the operation, becomes the same as that caused by chloroform, which kills during the anæsthesia upon the operating-table. This opinion becomes much less justified when one considers that the vapors of chloroform are more irritant than those of ether. (5) The contraindications to anæsthesia are the same as they formerly were. Cardiac or pulmonary lesions do not absolutely contraindicate etherization for a long or painful operation, but instead the anæsthesia in these special cases must be administered with extreme care.

Two Cases of Inoperable Scirrhus of the Breast Treated by Oophorectomy: Results.—PATON (*British Medical Journal*, March 1, 1902) reports the following cases:

CASE I.—Married, aged forty-three years, with an extensive infiltration of all of the left breast and some of the axillary glands with cancer. The breast and glands were removed, but six months later she again came for treatment with an inoperable recurrence and involvement of the opposite breast. Oöphorectomy was immediately performed, and a day or two later the patient was given 5 gr. of thyroid extract three times daily, which was continued for a period of three weeks. Subsequently the patient's mental condition became a source of trouble; she was very restless and unable to sleep, trying to get out of bed, and apparently rapidly going down hill. Later it was noted that the growth on the left side seemed a little smaller

and showed less tendency to bleed than formerly, but that the swelling in the right breast was increasing. As she was still very restless and sleepless, sulphonal (20 gr) every night was ordered. This had a very beneficial effect on her general condition, as she at once began to sleep better and became more herself; but there was no further improvement in the condition of the growth, while that in the right breast continued to increase, and she now suffered a good deal of pain. She was, however, able to get up, and her general condition remained about the same till January 5, 1901, when she was discharged. She died three months later.

Case II.—Married, aged thirty-one years, with the history that she had first noticed a lump in the left breast twenty-three months ago, but after the birth of a child it began to grow rapidly, and when she presented herself for treatment it involved the whole of the left breast, the corresponding axillary glands, and the glands in the posterior triangle. A month later an extensive operation was performed, the breast and pectoral muscle were taken away, as well as the contents of the axilla, but the cervical glands were not touched. The wound healed kindly, and two months later the ovaries were removed, and soon afterward she was discharged from the hospital in good general health, but there was no obvious improvement in the enlarged glands of the neck. She was carefully kept under observation, but the growth speedily recurred in the scar, and caused her death six months later.

THERAPEUTICS.

UNDER THE CHARGE OF

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Conditions Influencing Hæmolysis Caused by Glucosides. — Dr. E. Hedon finds the acidity of the medicine an obstacle to hæmolysis caused by solanine, while its alkalinity favors it. The antihæmolytic actions of acid sodium phosphate or sulphate are not specific, for all the free acids and acid substances possess it to some degree. Experimentally, it was found that in the rabbit 1.5 c.c. of centinormal hydrochloric acid for five drops of rabbit's blood protects this from four to five times the toxic dose. The same properties were proved for all the other acids, even carbonic and such acid amines as asparagin and glycocoll; and contradictory statements of other authors are due to the fact that they employed insufficient amounts of the acid substances, for with a proper concentration there always will be a modification of the stroma of the globules, which renders them impenetrable to the action of solanine. Conversely the same holds true with alkalies which are fixed and strongly held by the cells. The salts of the blood are not responsible for the

slight antihæmolytic effect which serum exercises toward solanine; they, on the contrary, through their alkalinity, favor it. There is every reason to believe that this effect is due to cholesterin. However, the mixture or combination of the glucosides with cholesterin, while non-toxic toward the red cells and other cellular elements, such as the bronchial epithelium and the epithelium of fishes, preserves all its poisonous properties for the animal as a whole, perhaps because disassociation again occurs, or perhaps because certain cells, as those of the nervous system, again render it toxic.—*Archives Internationales de Pharmacodynamie et de Therapie*, 1902, vol. ix., fasc. 5 and 6, p. 393.

Antibody against Leech Extract.—Dr. H. Wendelstadt was led by the close relationship of leech extract to the ferments and the animal and vegetable poisons with which an immunity can be produced, to experiment with the view of developing an antibody. The heads of leeches were triturated with powdered glass, the resulting mass extracted with normal salt solution and filtered so that 20 c.c. corresponded to fifteen leeches. The extract was then injected subcutaneously or intraperitoneally into rabbits, in doses from 1 to 5 c.c. Many animals died from sepsis or peritonitis, since it was not thought wise to sterilize the material. The serum of the five rabbits which had survived the injection of large doses showed a distinct reaction toward the extract in that the inhibitory action of the latter on clotting disappeared to a certain extent. By heating the serum up to 134° F. to 140° F. it was rendered partially inactive. It was found that the antibody develops after twenty-four hours; the maximum reaction is reached after forty-eight hours, but there still is some present two and three weeks after the injection. The proof that the antibody is really a specific one lies in the fact that the serum from injected animals, if mixed with blood, clotted in exactly the same time as normal serum with blood. The author also succeeded in causing the production of an anti-serum which naturally had much the same effect on coagulation as the original leech extract. The active principle here is not affected by heat. The origin of the various antibodies was found to be the pancreas, and to a less degree the liver and kidneys.—*Archives Internationales de Pharmacodynamie et de Therapie*, 1902, vol. ix., fasc. 5 and 6, p. 407.

On Immunity.—Dr. E. F. Bashford has been investigating this subject in consideration of the many uncontrollable factors which form important chapters in the study of immunity toward bacterial toxins, and since it seemed proper to ascertain if a similar protective mechanism could be induced by chemically simpler bodies, and thus an insight into the chemistry and physiology of the process be obtained. Pohl would seem to show that indeed such is possible, for he has found that rabbits could be immunized by gradually increasing doses of solanine, so that this drug no longer caused a hæmolytic action upon the red cells. Bashford, however, from his individual work, claims that this is not so; indeed, the red cells of a rabbit treated with solanine were found to be more instead of less sensitive to the action of this drug. This increased susceptibility may be explained as due to anæmia which had developed in the animals as a result of the repeated injections. Two rabbits were selected, one was treated for twenty-five days with almost fatal doses—twelve in number; the second left undisturbed, when a dose exceeding the

fatal one was then injected; both died in approximately the same time.—*Archives Internationales de Pharmacodynamie et de Therapie*, 1902, vol. ix., fasc. 5 and 6, p. 451.

The Last Stand.—Dr. Joseph Byrne discusses in a most interesting and able manner the small things which may determine for life or death when the patient is almost in extremis. "The practitioner who tries is often surprised at the many things that can be done in cases in which at first it seemed there was nothing for him to do but fold his arms ingloriously and let death stalk off unchallenged with the victim." This is the central idea that animates the discussion. In the matter of position in bed, when the patient is very low, when the jaw drops, and the tongue falls back in the throat, he should not be left lying on the back, for respiration will be mechanically interfered with to a great extent. Here the patient should be placed on the right side with the face looking downward over the edge of the pillow. The author strongly deprecates the modern drug-store prescribing of headache remedies which, he believes, are causative of neurasthenia and impotency. That both heat and cold can depress should be borne in mind. The question of visitors is tersely summed up. Transfusion, enteroclysis, and hypodermatoclysis are considered as very cardinal procedures, and every physician should be master of the technique of all three. They save life in hemorrhage, in poisoning by noxious gases, or in acute toxæmic states. Bloodletting, cupping, and artificial respiration have their special fields of application. Under the head of pharmacotherapy the author discusses the use of strychnine, cocaine, digitalis, strophanthus, morphine, hyoscine, quinine, bromides, iodides, alcohol, guaiacol, and oxygen. "The miserable logic that fosters pessimism" is the bugaboo that the author would seek to lay low.—*Merck's Archives*, 1902, vol. iv., p. 87.

PEDIATRICS.

UNDER THE CHARGE OF

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AND

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The Present Status of the Fourth Disease of Dukes.—On several occasions this department has presented abstracts of papers treating of a so-called fourth disease, as described by Clement Dukes (*Lancet*, July 24, 1900), which this able observer believed to be a distinct morbid entity occupying a position between rubella and scarlatina (see The American Journal of the Medical Sciences, February, 1901, p. 233; also January, 1902, p. 122).

The present status of the question is very impartially discussed in a recent paper by Claude B. Ker, Medical Superintendent of the Edinburgh City Hospital for Infectious Diseases (*Practitioner*, February, 1902, p. 139). After

a brief description of the salient features and symptomatology of measles, scarlatina, and rubella, he gives a careful résumé of Dukes' description of the fourth disease. As to confirmatory testimony from other observers, he refers to the paper of Dr. WEAVER (*Dublin Medical Journal*, June, 1901), who had been troubled during his service at the Southport Fever Hospital by an unusual number of "relapses" of scarlet fever. The symptoms of the cases described approximate closely to the description given by Dukes, symptoms of an apparently mild type of scarlatina following or being followed by a genuine attack. These milder attacks he considered to be instances of the fourth disease. In the discussion on "The Early Diagnosis of Infectious Diseases," in the Section for Diseases of Children at the British Medical Association meeting last year, Ashby and Sir William Broadbent supported the existence of the new disease, and Poynton described an outbreak in a school which had suggested the probability of such being the case.

The accuracy of Dukes' conclusions, however, has been questioned by other observers of wide experience. At the Cheltenham meeting many considered that the so-called disease was in reality a mild type of scarlatina. To these criticisms Dukes replied in a letter to the *British Medical Journal*, in which he made two statements of importance. First, that large numbers of these cases find their way to fever hospitals, though sometimes they are not admitted on account of their not being scarlatina; and, second, that on other occasions, when they are admitted, they communicate the fourth disease to the scarlatina patients, and that "what have been termed second attacks and relapses have been diagnosed." To this letter Dr. FOORD CAIGER (*British Medical Journal*, November 16, 1901) replied that it was exceedingly improbable that the medical officers of fever hospitals would decline to admit a disease so closely resembling scarlatina; that while it is true a certain number of cases do develop scarlatina after admission, almost without exception the original attack was of a negative character, and often more suited for an observation ward; that cases of scarlatina do not develop the fourth disease or anything like it, owing to the admission of these doubtful cases; that there is no epidemic prevalence in the wards of fever hospitals of such a disease; that cases which on admission resemble the type of what is called the fourth disease do not, in his experience, take scarlatina; and that, lastly, relapses do not occur frequently enough in scarlatina wards to be referred to the causes suggested by Dr. Dukes.

WASHBOURN (*British Medical Journal*, December 21, 1901), so far as outbreaks in the London Fever Hospital are concerned, confirms Caiger's experience at the Southwestern, and carefully analyzes the three epidemics described by Dukes, diagnosing the first as rubella, the third as mild scarlatina, and the second as both diseases together. He points out that neither absence of albuminuria nor a moderate pulse-rate contradicts the diagnosis of scarlatina MILLARD and WILLIAMS (*Ibid.*) hold similar views.

In summing up the evidence Ker thinks that Dukes lays too much stress on Cullen's law that one attack of an infectious disease always confers immunity, and that he goes too far when he claims scarlatinal relapses as additional evidence in favor of his disease. His own experience as to epidemics of a scarlatinal nature in scarlatina wards agrees with that of the London fever hospitals. He notes, as Washbourn has pointed out, that in Dukes' third

epidemic none of the boys had had scarlatina before, while eight had had rubella, and that the disease described was compatible with mild scarlatina. He agrees with Millard and Washbourn, that the fact of desquamation not having spread infection means little or nothing, and states that albuminuria is frequently absent in the early stages of scarlatina, and as for late albuminuria, he has at one time seen several hundred consecutive cases without one instance of it occurring.

As regards the incubation period of the fourth disease, Dukes states that it varies from nine to twenty-one days. While this tallies with his dates in the first epidemic, it also agrees with the incubation period of rubella, which it has been suggested was the infection actually present in this epidemic. In the second epidemic, in which rubella might have been present, the intervals are considerable; but in the third series of cases, which the critics claim to be scarlatina, new cases developed almost daily from March 14th to April 1st, the only blank days being the 16th, 18th, 23d, 24th, 25th, 30th, and 31st.

In closing this very impartial review the author is not willing to deny that a fourth disease exists, but concludes that the evidence brought by Dukes is not sufficiently convincing, and that the only decision possible at the present time is the Scotch verdict "not proven."

[It is quite probable that Dr. Dukes has noted exceptions and will move for a new trial. While admitting the force of opposing arguments upon the case as already presented, it seems reasonable to demand that the final settlement of this interesting question after all must be made outside of the fever hospitals, in order to remove the necessarily disturbing factor of scarlatinal infection. It should be noted that Dr. Simpson's suggestive series of cases, already referred to in this department, probably escaped Dr. Ker's attention, or were published too late to admit of discussion in his paper.—Ed.]

GYNECOLOGY.

UNDER THE CHARGE OF

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ASSISTED BY

WILLIAM E. STUDDIFORD, M.D.

Nodules in the Uterine Cornua.—Jayle and Cohn (*Revue de Gyn. et de Chir. Abdom.*, 1901, No. 3) report eight cases in which hard nodules were found in the interstitial portion of the tube; in five cases both tubes were affected. Peri-uterine adhesions were nearly always present, especially in the neighborhood of the cornua. Fifty-eight published cases are collected. The writers divide these nodules into three varieties—inflammatory, tubercular, and adenomyoma. Inflammatory nodules represent the result of

former interstitial salpingitis, especially gonorrhœal. Simple and telangiectatic adenomyoma are variously explained by different authors as due to former inflammation or of congenital origin, developing from the Wolffian bodies or Müller's ducts. The writers are inclined to accept Ricker's theory that there is a simultaneous inclusion of both epithelial and muscular elements.

It is difficult to diagnose the condition before opening the abdomen. All nodules in the uterine cornua should be excised. In those cases in which it is necessary to remove both ovaries it is better to extirpate the uterus.

Vascular Supply of the Ureter.—Feitel (*Zeitschrift für Geb. u. Gyn.*, Band xlvi., Heft 2) believes that ureteral fistulæ may result not only from direct injury during operations, but in consequence of necrosis following interference with the nutrient arteries of the duct; hence in dissecting out the ureter these vessels must be spared as much as possible.

Vaginal Myomectomy.—Olshausen (*Centralblatt für Gynäkologie*, 1902, No. 1) believes that the field of this operation is limited. Small myomata cannot be reached and enucleated as well as by the abdominal route unless the body of the uterus can be drawn into the vagina, which is not possible when the organ is large. The ideal case is one in which a submucous fibroid can be enucleated after splitting the anterior uterine wall, but the enucleation of sessile subperitoneal growths from the fundus by anterior or posterior colpotomy is, in the writer's opinion, seldom justifiable, epecially as they seldom give rise to any disturbances.

The same criticism applies to vaginal hysteromyomectomy. If the mass exceeds in size the pregnant uterus at three months the abdominal method is preferable.

The Relations of the Uterus and Bladder after Shortening the Round Ligaments.—Bulins (*Centralblatt für Gynäkologie*, 1902, No. 3) denies that the uterus is placed in a normal position after shortening of the round ligaments. It is true that the fundus is thrown forward, but the uterus as a whole is anteposed and elevated above its normal plane.

By experiments on patients who had submitted to the operation the writer found that the shortened ligaments preserved their functions, allowing the uterus to preserve its normal range of motion as the bladder was gradually filled and emptied, just as occurred also during pregnancy.

Tubo-ovarian Cysts.—Preiser (*Centralblatt f. Gynäkologie*, 1902, No. 4) reviews the different theories regarding the origin of these cysts. Some are undoubtedly formed by the union of a pyosalpinx with a follicular, corpus luteum, or proliferating cyst of the ovary, the wall of separation being absorbed. It is not so easy to explain the variety in which the fimbriæ do not disappear, as in the former, but are found within the ovarian cyst. The writer is inclined to accept Pfannenstick's theory, that an abscess forms around the distal end of the tube, the fimbriæ floating free in the sac, or being attached to its inner wall. An ovarian cyst may become adherent

to this abscess, with the formation of a tubo-ovarian cyst by the disappearance of the wall of separation, as before.

Waldstein claims that he has found between the tube and ovarian cyst a connecting membrane, which he thinks represents the organized sac of a previous hæmatocele. This theory the writer is unwilling wholly to accept, because of the frequency of double tubo-ovarian cyst as compared with the rare occurrence of double tubal gestation. Double pyosalpingitis, on the contrary, is quite common.

Sarcoma of the Uterus.—Knott (*Annals of Surgery*, 1901, No. 2) has collected 118 cases, the average age of the patients being thirty-seven years. In 40 cases the disease developed in the muscular wall of the uterus, in 33 in the endometrium, and in 29 the cervix was primarily affected. Attention is called to the frequency of sarcomatous degeneration of fibromyomata, especially cervical polypi.

Pain, hemorrhage, and a watery discharge are the initial symptoms, cachexia being a late manifestation.

The prognosis is bad. The mortality in 86 cases after total extirpation of the uterus was over 60 per cent. Pulmonary metastases are most to be feared.

Vaporization of the Uterus.—Lachmann (*Münchener med. Wochenschrift*, 1901, No. 22) reports 32 cases from Pfannenstick's clinic, including 12 cases of climacteric hemorrhage and 14 of hemorrhagic endometritis in young women. The writer states that while it is impossible to exactly control the action of steam upon the endometrium, the bad results reported by different observers were due partly to imperfect technique. He is opposed to the use of steam for the purpose of sterilizing the uterine cavity in septic puerperal cases, inoperable carcinoma, etc. Climacteric hemorrhage is the principal indication; hæmophilia is another. The results in younger women are often unsatisfactory; 6 out of the 14 cases reported were temporarily benefited.

Fuchs (*Ibid.*) reports the results of atmocausis in the Kiel clinic. The technique is as follows: In the absence of evidence of adnexal disease the cervical canal is dilated with tupelo tents, and after palpation of the uterine cavity it is thoroughly curetted and irrigated. Steam at a temperature of 115° to 120° C. is then introduced for from twenty to forty seconds. Twenty-two cases of climacteric hemorrhage are reported, treated during the course of six months. In 6 the flow ceased; in 7 after ceasing for several weeks the menstrual flow became regular; in 9 the hemorrhages returned, but were less profuse.

The writer believes that the indications for atmocausis are limited to cases of climacteric menorrhagia and to those of metrorrhagia in "bleeders."

It is important, he insists, to introduce the protecting tube not over half an inch above the os internum; hence the necessity of carefully measuring the length of the cervical canal beforehand.

Cancer of the Vagina in Procidentia.—Fleck (*Centralblatt f. Gynäkologie*, 1902, No. 4) reports the case of a nullipara, aged forty-three years,

with complete procidentia, in whom a large ulcerating surface was present on the vagina. Microscopical examination showed it to be epithelioma. The disease had advanced so far that an operation was impossible, and she died a month later with double pyelonephritis. The writer calls attention to the infrequent occurrence of cancer of the prolapsed vagina, only four cases having been reported.

Air as a Hæmostatic.—Kelling (*Münchener med. Wochenschrift*, 1901, Nos. 38 and 39) from a series of experiments in animals and cadavers finds that in cases of intraperitoneal hemorrhage air has a decided hæmostatic action. He introduces it through a trocar (after filtration through cotton), the pressure being indicated by a manometer. A pressure of 50 mm. checks bleeding from arteries of considerable size. The method is recommended in desperate cases of internal hemorrhage with profound shock, presumably where immediate abdominal section is contraindicated.

Functional Results of Ventrosuspension.—Brinkmann (Inaugural Dissertation; abstract in *Centralblatt f. Gynäkologie*, 1902, No. 6) analyzes 118 cases from the Bonn clinic. Of these 42 were cases of movable retroflexion; in 30 the uterus was adherent; 46 in which the adnexa were diseased were not considered.

Fifty patients were kept under observation. Of 26 with movable uterus 10 were cured or relieved, and in 16 there was no improvement. Only 50 per cent. of the 22 cases of adherent retroflexion could be regarded as cured.

The writer concludes that in a considerable proportion of cases of retroflexion (with and without adhesions) the symptoms are *not* due to the malposition.

Hysterectomy in a Young Child.—Lorthioir (*Journ. de Chir. et Annal. de la Soc. belge de Chir.*, 1901, No. 8) reports the case of a girl, aged three years, from whom he removed a fibroma which grew from the cervix uteri and protruded from the vulva. Three months later another growth appeared as large as the first, and was shown microscopically to be a round-celled sarcoma. With great difficulty the entire uterus was removed by morcellation, the little patient making a good recovery. Two months later the pelvis was filled with a tumor the size of the fœtal head. It was removed by abdominal section, with the adnexa, but death occurred in twelve hours.

Use of Pessaries in Retroflexion.—Koblanck (*Centralblatt f. Gynäkologie*, 1902, No. 20) reports 104 cases of movable retroflexion treated with pessaries, of which five were cured; that is, the uterus remained in normal position from nine to twenty-four months after removal of the instrument. In six other patients a permanent cure was probably obtained. Twenty-two patients were entirely relieved as long as they wore the pessary. The writer, after trying various models, gives the preference to Thomas' pessary.

Pseudomyxoma of the Peritoneum.—Fraenkel (*Münchener med. Wochenschrift*, 1901, No. 24) discusses the opposing views of Werth and Olshausen, the former teaching that this condition is secondary to the rupture of an

ovarian cyst with colloid contents, the latter that it represents a true metastasis. In the case reported by the writer the abdomen was opened three times in the course of three years (!), each time a bit of the diseased peritoneum being excised for microscopical examination. There was no trace of organized tissue, but simply spaces filled with gelatinous material, surrounded by a thin capsule of pseudomembrane. At the autopsy true metastatic growths were found only in the mesocolon, but this fact seemed to prove Olshausen's theory.

In a case of rupture of a cystic appendix the writer found masses of gelatinous material in the peritoneal cavity, the peritoneum being studded with numerous growths resembling chorionic villi, but showing under the microscope the ordinary structure of the serous membrane. This condition, he believes, is essentially different from that of so-called *pseudomyxoma peritonei*, in which there is present not only inflammatory changes around the gelatinous masses, leading to the formation of pseudomembrane, but also a myxomatous degeneration of the peritoneum with almost complete disappearance of elastic tissue.

Conservative Operations for Chronic Inversion.—Oni (*Annales de Gyn. et d'Obstétrique*, April, 1902), after reviewing the various methods of treating this condition, finds that thirteen abdominal operations have been performed by ten different operators, with a mortality of 15.3 per cent. and with 30.47 per cent. of failures. He accordingly infers that the abdominal route is not to be recommended.

As regards the different vaginal methods, he pronounces in favor of the one which he describes under the name of complete colpohysterotomy, which consists in opening the anterior vaginal fornix and vesico-uterine pouch, and splitting the entire anterior wall of the uterus from the os externum to the fundus. The inversion is then easily reduced, the uterus is anteverted, and the wound is sutured as in an ordinary Cæsarean section. The uterus is then replaced, the cervix is sutured with catgut, and the vaginal wound is closed with the exception of a small opening in which an iodoform drain is left for three days. Twelve successful cases have been reported by this method, in two of which the patients subsequently became pregnant.

Cystopexy.—Chiaventure (*Annales de Gyn. et d'Obstétrique*, April, 1902) describes the following operation, which he has practised successfully: The abdomen is opened with the patient in Trendelenburg's posture, the uterus is drawn upward and backward with a volsellum, and the vesico-uterine fold of peritoneum is put on the stretch transversely with two pairs of artery forceps. The transverse fold is incised and each flap is dissected off—one from the anterior wall of the uterus, the other from the posterior wall of the bladder. The bladder is separated from the uterus down to the point where they are intimately united. This corresponds to the line of the interureteric ligament, and serves as a guide to the ureters in passing the sutures. Three silk sutures are introduced through the base of the bladder above this line, enter the wall of the uterus at corresponding points, are tied, and the peritoneal flaps are united. Hysteropexy is then performed.

OBSTETRICS.

UNDER THE CHARGE OF

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Accidental Removal of the Ear by the Forceps.—ERSKINE (*British Medical Journal*, January 4, 1902) reports the case of a boy, born in a normal presentation, the back to the left and the vertex at the brim of the pelvis. The labor was very long, the patient having but little strength. She had slight uterine contractions, which did no good. As the mother was threatened with exhaustion, chloroform was administered and the forceps applied at the brim of the pelvis. The extraction was prolonged and very difficult, and the forceps slipped without warning just before the delivery of the child. On examination it was found that the auricle had been almost entirely removed. The child survived and the mother also. Subsequently a false auricle was fitted and the deformity entirely corrected.

Phantom Tumors.—In the *Lancet*, January 4, 1902, BENNETT, in a clinical lecture upon phantom tumors, describes the case of a girl, aged sixteen years, who presented all the appearances of being the subject of a large abdominal tumor below the umbilicus. Pregnancy had been suggested as the most probable explanation. On examination the shape of the abdomen was exactly that of a woman seven months pregnant. The swelling was resonant, and no solid tumor could be made out. At the lower border of the umbilicus there was an area of acute eczema. Phantom tumor caused by the irritation of the eczema was diagnosed. The tumor disappeared under anæsthesia. The eczema was then treated, and the tumor disappeared as the eczema healed. The patient left the hospital and finally returned with the eczema worse and the tumor larger.

Bennett describes two other cases of phantom tumors in women. In the first the patient had an elastic tumor on the inner aspect of the right thigh which disappeared under anæsthesia, and was permanently destroyed by removing the remains of a small sebaceous cyst near the vulva. In the second case the patient had symptoms of disease of the appendix, which were so typical that abdominal section was performed. On opening the abdomen the appendix and the parts about it were found perfectly normal. The gall-bladder was contracted, connected by inflammatory adhesions to the liver and duodenum, and contained a small stone in the duct. The irritation of the gallstone caused the symptoms relating to the appendix.

Spontaneous Rupture of the Uterus during Labor.—TÖRNGREN reports (*Centralblatt für Gynäkologie*, No. 1, 1902) the case of a patient in her eighth labor. She had had three normal births, one abortion, and two

confinements by forceps. The patient was in spontaneous parturition when she suddenly felt very ill and labor pains ceased. When the pelvis was examined it was found to be considerably contracted and markedly flattened. As the patient's dwelling was not clean, she was removed to a hospital. On examination the abdomen was distended and very sensitive, and near the umbilicus a portion of the fœtus could be felt with unusual plainness. There was a slight discharge of dark fluid blood. It was determined to perform craniotomy, and accordingly the basiotribe was applied and the head extracted without much difficulty. The placenta was found in the abdominal cavity upon the right side of the uterus. The rupture was upon the anterior wall of the womb in the usual location. There was also a tear through the muscular tissue between the lower uterine segment and the thickened portion of the womb. The patient perished of shock within thirty-six hours after the operation. Autopsy showed beginning septic infection as the cause of death.

Air Embolism during Labor.—Leopold (*Centralblatt für Gynäkologie*, No. 2, 1902) reports the case of a primipara, aged thirty-nine years. The patient's family and personal history was not especially good. Since the beginning of pregnancy the patient had suffered from swelling of the feet, headache, and spots before the eyes. The physician who was attending the patient had diagnosed nephritis and sent her to the clinic. On examination the urine contained 5 per cent. albumin with casts; the eyelids were œdematous; the child was in breech presentation with its back toward the right side; the heart sounds were plainly heard. The patient was at once given treatment to improve excretion and her general condition. In spite of warm baths and a milk diet, she grew steadily worse, the amount of urine diminishing and symptoms increasing. A month after admission it was necessary to induce labor by the introduction of a bougie. As labor halted, two laminaria tents were introduced and the vagina tamponed with gauze. The patient had slight pains, was very restless, and the fœtal heart sounds suddenly ceased. Her pains became strong, and during active labor the patient was suddenly taken with great dyspnœa, cyanosis, rapid and feeble pulse. Above the symphysis could be felt a crackling sensation resembling that of emphysema. The patient failed rapidly and was quickly delivered by perforation by the cranioclast. Upon autopsy the abdomen was much distended and contained an abundance of foul smelling gas. In the peritoneum there was blood-stained fluid and under the pericardium bubbles of air. Among the mesentery gas or air was found in bubbles or small collections, and also in the spleen. The stomach was distended with air and also a portion of the coat of the ileum. Beneath the capsule of the liver there was the same condition, and upon making examination for bacteria an abundant growth of large bacilli with rounded ends was found. The result of the autopsy was emphysema of the uterus, peritoneum, heart, and abdominal organs. Subacute nephritis was also present. It was first thought that a general infection with the bacillus coli communis must be present, but this could not be definitely recognized.

In discussion, Weiswanger reported a case of air embolism during labor, with fatal issue. The patient was a multipara who had a posterior rotation

of the occiput with a very large child. The patient was suffering greatly, and the urine was bloody. She was delivered by a very difficult version, and died suddenly after being placed in bed following delivery. Autopsy was denied.

Schramm reported a case from Scanzoni's clinic, in which it was necessary to remove the placenta after an easy labor. The uterus was thoroughly douched, when the patient suddenly collapsed and died. Klien did not regard Leopold's case one of air embolus, but of general infection by gas-forming bacillus. Goldberg reported one case in which after abdominal section emphysema of the abdominal wall occurred, which disappeared with difficulty and without disturbing the patient. In a second case of abdominal section an ovarian cyst as large as a twin uterus was removed. This case had been mistaken for pregnancy. Efforts had been made to bring on labor. Upon abdominal section emphysema was found at the fundus of the uterus, beneath the peritoneal covering. The patient recovered. Marschner reported a case in which air entered the uterus where a myoma complicated labor. A hot intra-uterine douche was given to prevent bleeding, when the patient collapsed and required artificial respiration.

Bossi's Method of Rapid Dilatation of the Cervix.—In the *Archiv für Gynäkologie*, 1902, Band lxvi., Heft 1, LEOPOLD describes his use of the instrument invented by Bossi, of Genoa. He became impressed with the value of this instrument during a visit to the inventor, when he saw him dilate completely the cervix in a case of pernicious anæmia in a multipara in whom it was necessary to deliver the child speedily. In twenty-five minutes the cervix was completely dilated, the membranes were ruptured, and the patient as soon as possible delivered by forceps.

Leopold has tried the instrument in twelve cases: in seven of eclampsia, one of advanced phthisis, one of pregnancy with uterine cramp, one of labor complicated by fever, and two cases of contracted pelvis. The instrument was satisfactory in his hands. Dilatation was secured in from twenty to thirty minutes. In three cases an unimportant laceration of the cervix occurred, which was immediately closed by a stitch. In eclampsia its use was especially successful. In two cases the convulsions ceased after the dilatation. All the patients so treated recovered.

The instrument is composed of four arms, which are made to radiate from a centre by turning a screw with a circular handle. The extremities of these arms may be covered by additional pieces having corrugations of considerable size, which prevent the instrument from slipping. It may be inserted without these pieces, and these may be added as dilatation advances. The instrument can be introduced when the os will admit one finger.

Acetonuria During Pregnancy, Parturition, and the Puerperal State.—In the *Archiv für Gynäkologie*, 1902, Band lxv., Heft 3, STOLZ gives the results of his examinations. He concludes that a mild acetonuria, which must be regarded as physiological, exists during pregnancy, labor, and the puerperal state. This acetonuria is unimportant, and frequently changes. An increased amount of acetone is often present for several days during pregnancy without symptoms and without apparent cause.

Acetone is more frequently found in the urine taken during labor than under other circumstances. The longer the labor the more frequently is it found and in the greater quantity. It is more frequent in first and second labors than in subsequent parturitions.

In the puerperal state acetonuria is common during the first three days; less frequent on the fourth day. After this it commonly ceases. Where acetonuria is present during labor it continues to be present during the first few days of the puerperal state. We are not aware of the influence which acetonuria exerts upon lactation or upon the interruption of the secretion of milk. Neither in pregnancy nor during labor is an increased acetonuria a sign of fœtal death.

So far as can be determined, acetonuria in pregnancy, labor, and the puerperal state is a physiological phenomenon without pathological import or cause. It must be referred to some variation in metabolism, usually of a transient and unimportant nature.

The Pathogenesis of Eclampsia.—In the *Archiv für Gynäkologie*, 1902, Band lxv., Heft 3, BLUMREICH and ZUNTZ contribute a thorough review of the literature of the subject, with an account of experiments made in animals by trephining and injecting solutions of creatin to determine the production of convulsions. These experiments were performed upon non-pregnant and pregnant animals. In the second series solutions of creatin were injected into the carotid vessels. In these experiments both pregnant and non-pregnant animals were utilized. As a practical result of the experiments it was found that the brain of the pregnant animal was much more susceptible to irritation than that of the non-pregnant.

Following these experiments comes a review of the various theories now extant regarding the cause of eclampsia. These divide themselves practically into two classes—one the theory of mechanical irritation as a cause, and the other the theory of toxins as a cause. The uræmic hypothesis, the auto-intoxication theory, and the theory that eclampsia owes its origin to substances produced in the fœtus—all of these receive attention.

The authors sum up the results of their experience and literary researches as follows: They do not by any means conclude that creatin or any other one substance is the cause of eclampsia. They believe that a number of substances resembling this may bring about the condition in question.

They think it fair to apply to the human species the conclusions derived from experiments upon animals. In doing this they call attention to the fact that the frequency of eclampsia is comparative with that of tetanus and chorea during pregnancy. Neurologists state that tetanus is rarely seen in women except in the pregnant condition. The same is true of chorea, which is rarely found in women except in the pregnant state. These circumstances and the result of experiment demonstrate the fact that a much smaller irritation in a pregnant patient is sufficient to produce an effect upon the nervous system than in the non-pregnant. It cannot be proven that the constitution of the brain during pregnancy is the essential cause for eclampsia.

In discussing the source of the irritating material the writers refer to future publications, giving the results of other experiments in demonstrating

the part played by the kidneys alone. They do not believe that the source of the poison is principally in the kidney. They call attention to the fact that hitherto our study has lain in the effort to ascertain the quantity of poison in the blood and urine. They believe it to be quite probable that the substances causing eclampsia do not appear in the urine as poisons, but that they are analogous to aromatic ethereal sulphates, which may be formed and decomposed in the body without appearing distinctly in the urine. These substances, if existing in the blood, might easily produce an effect at the centre of least resistance, which in pregnancy is often the nervous system. Future study will lie in the direction of an effort to extract from the important central organs of the body substances capable of producing irritation.

DISEASES OF THE LARYNX AND CONTIGUOUS STRUCTURES.

UNDER THE CHARGE OF

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Insufflation of the Œsophagus as a Means of Differential Diagnosis.—Dr. C. D. Spivak, of Denver, states (*New York Medical Journal*, August 11, 1901) that spasm of the œsophagus can be more readily diagnosed by insufflation than by the introduction of bougies, while the diverticulum in the upper third of the œsophagus can be recognized by inspection externally, as it will fill with air and present as a tumor in the cervical region. Furthermore, insufflation will indicate a differential diagnosis between diverticulum and dilatation of the œsophagus; for in the latter the air will pass freely into the stomach, while in the former the calibre of the œsophagus will be obstructed by the air which fills up the diverticulum.

In a case under Dr. Spivak's observation the air invariably forced the tube out of the œsophagus.

Foreign Body in the Œsophagus.—Dr. Russell S. Fowler, of New York, reports (*Medical News*, September 14, 1901) a case of an impacted penny in the œsophagus of a female child, two years and two months old. A Röntgen ray picture showed the penny hanging vertically in the œsophagus at the level of the sternal notch. Under the guidance of the fluoroscope a coin-catcher was passed beyond the coin and withdrawn with its imprisoned penny.

Ulcero-membranous Staphylitis.—In *La Parole* of March, 1902, Drs. Armand Siredey and Charles Mantoux record a case of ulcero-membranous staphylitis with fusiform bacilli and spirilli of Vincent, following a stomatitis of the lower jaw of the same character. The tonsils and the palatine arches were not involved. The patient, too, had albuminuria, which was attributed to the precedent stomatitis. The parasitic disease of two

months' duration was controlled in about eight days by applications of methylene blue.

In the same journal Dr. Emil Meyer, of New York, presents a similar paper upon affections of the mouth and throat associated with the fusiform bacilli and the spirilli of Vincent, reporting one case in which the disease occupied the tonsils and a portion of the uvula. Furthermore, Prof. Simonin, of Val-de-Grâce, communicates a paper upon "Complications of the Sore Throat of Vincent and Their Pathogeny," illustrated by eight cases.

Primary Tuberculosis of the Pharynx and Larynx.—Dr. J. W. Gleitsmann, of New York, reports (*Journal of Tuberculosis*, April, 1901) two cases cured, both in women, aged thirty-eight years. They were cured by persistent surgical procedure, chiefly curetting and lactic acid frictions.

Infectious Pharyngitis.—Dr. Philip King Brown, of San Francisco, Cal., records (*American Medicine*, April 19, 1902) a fatal case of acute primary infectious pharyngitis, with extreme leukopenia, in a married woman twenty-nine years of age, which proved fatal suddenly on the seventh day from œdema of the glottis with very acute onset. During the progress of the disease there had been a steady decrease in the number of leucocytes, which became so few on the seventh day of the disease that a fair estimate of the total number could not be made. The decrease in red cells was slight.

Dr. Brown reproduces in brief four similar cases reported by Senator in 1888, in which death took place suddenly on the fourth, sixth, and tenth days, respectively.

Tonsillar and Peritonsillar Suppuration.—In a paper read under this title before the American Rhinological, Otological, and Laryngological Society (*American Medicine*, April 19, 1902) by Dr. Henry J. Hartz, of Detroit, Mich., the author mentions, among other things, that the peritonsillar abscesses that have come under his observation have all exhibited an extraordinary if not abnormal development of the plica triangularis. He likewise calls attention to recurrent abscesses due to obstructions of the channels of drainage in the tonsillar region, which may be so firm as to force the purulent products into the pharyngomaxillary space, and thus prolong the suppurative process.

Acute Gout of the Pharynx.—Drs. M. Lermoyez and G. Gasne contribute an excellent article on this subject (*Annales des Maladies de l'Oreille, du Larynx*, etc., May, 1902), in discussing a case under their own care in which, after several days continuance, sudden violent sore-throat, with local inflammation simulating peritonsillar abscess, suddenly subsided into a first attack of typical gout in the great toe of the opposite side.

According to the authors, the manifestations of true gout can be discriminated from periamygdalitis—first, by their sudden onset, acute evolution, and instantaneous subsidence; second, by violent fever; third, by intense local pain, altogether disproportionate to the lesion apparent; fourth, by the tendency of the inflammation to extend to all portions of the pharynx; fifth, by the fluxionary character of the lesions, which give the throat a sombre-red

color, and the œdematous aspect; sixth, by the entire absence of exudation; seventh, by the habitual non-participation of the submaxillary glands.

Unusual Case of Rhinolith.—In a paper on "Rhinoliths and Foreign Bodies in the Nose" (*Medical Record*, April 12, 1902) Dr. J. M. Ingersoll, Cleveland, Ohio, reports the removal of fragments, at four sittings, of an irregular rhinolith weighing two grammes, the nucleus of which was a shrivelled bean which had been enclosed in the left nasal fossa of a man forty-six years of age more than thirty years previously.

Deflection of the Nasal Septum.—Dr. Nelson M. Black, of Milwaukee, in a paper entitled "One of the Etiological Factors in the Production of Deflected and Deformed Nasal Septums and the Methods for Its Relief" (*American Medicine*, February 15, 1902), calls attention particularly to some cases due primarily to a high-arched palate, the result of a deformity of the upper jaw, and the satisfactory results obtained by having the lateral diameter of the jaw widened so as to relieve the strain of the septum before performing any intranasal operation for its correction.

Nasal Ulceration.—In an article entitled "Three Cases of Rhinelcose" (ulceration of one wing of the nose), coincident with lesions of the posterior columns of the spinal cord, Messrs. Pierre Marie and Georges Guillain describe and depict (*Annales des Maladies de l'Oreille, du Larynx*, etc., May, 1902) the external characteristics of these lesions as well as the lesions in the spinal cord of two of them who died of advanced tuberculosis. The spinal lesions consisted of slight sclerosis in the lumbar portion of the cord, diminishing gradually in an upward direction until it became barely perceptible in the cervical region. In all three cases there were other cutaneous lesions of the face. The patients were all men, two of whom acknowledged syphilitic infection, while the third denied it.

The authors believe that the ulceration of the nose was rather coincident with the lesion in the central nervous system than dependent upon it, and presumed that remote syphilis was the link between them.

Acute Empyema of the Maxillary Sinus.—Dr. Linn Emerson, of Orange, N. J., briefly reports (*American Medicine*, April 19, 1902, a case which came under his care twenty-four hours after exposure on the forward deck of a ferry-boat during a severe snowstorm. The diagnosis was confirmed by transillumination and by discharging the pus from the meatus after the application of a pledget of cotton saturated with a solution of adrenalin chloride, 1 to 1000. The case recovered within five days, although the translucency of the two sides of the face did not become equalized for a month.

Five cases of acute empyema of the maxillary sinus (all in men) are reported by Dr. Wladyslaw Wroblewski, of Warsaw (*Archiv f. Lar. u. Rhin.*, 1900, vol. x. F. I.). These cases subsided spontaneously by resolution, or after the employment of very mild measures.

[In some cases, as reported by Avellis in the same journal, acute empyema terminates in caseation.]

OTOLOGY.

UNDER THE CHARGE OF

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Acute Middle-ear Suppuration in a Diabetic. Fistula of the Semicircular Canal. Deep Peri-articular Abscess on the Temporo-maxillary Articulation.—Man, forty-three years old, for some years suffering from diabetes of moderate degree. January, 1900, he had influenza; the frontal sinus was infected. February 18th, pain in the right ear. February 22d, seen for the first time. Perforation behind umbo; discharge. Tip of mastoid slightly tender; free paracentesis. The discharge increased under dry treatment, and a diffuse headache on the right side appeared. Temperature normal. Paracentesis without discharge. Then the middle ear was washed through the catheter with sterile water. Headache lessened after a few days; discharge was less, without wholly stopping. April 7th, sudden intense pain in and behind the right ear. Pars mastoidea showed intense reddening and distinct swelling. Temperature 38.2°. Opening of the mastoid determined upon, but put off because the urine showed a high acetone reaction.

April 9th. Operation. The cortex above the tip was perforated The mastoid process contained a single large hole filled with pus. Sinus covered with granulations; no occlusion. Fistula in the posterior wall of the bony external auditory canal. Free from fever, and above all else normal convalescence. Later a large collection of pus came from the depths; the pus from the tympanum increased again.

May 6th. A small fistula on the medial wall of the antrum led to a cell, the size of a pea, filled with pus. The fistula was cleaned out. It was bounded medially by the horizontal semicircular canal, which showed a fistula of pinhead size, out of which lymph slowly flowed. Quick closure of the wound followed, with continued suppuration from the tympanum. A small fistula persisted in the wound, but little pus came through. The perforation in the drum was enlarged by the cautery without effect on the tympanic discharge.

No threatening symptoms present, the patient went to the mountains. After some time the discharge increased, and it became difficult to chew, though little pain existed. The trouble was in the region of the right temporo-maxillary articulation. Evening temperature slightly raised. Patient returned home.

July 22d. In the region of the inferior bony and cartilaginous external auditory canal wall is a large polypoid granulation. Otherwise condition unchanged. After removing the granulations by a snare 1 c.cm of pus came out. The probe showed rough bone.

July 23*d.* Scraping out of the granulations, and again a considerable quantity of pus emptied out. After removing the lateral part of the inferior bony canal wall an abscess cavity was opened up. Loose tampon. Evening temperature 36.7°. In this cavity the posterior periphery of the capsule of the joint was visible; the movements of the jaw could be seen; also after carefully syringing of the cavity a small amount of pus could be brought out through movement of the jaw. A bent probe pressed on the posterior periphery of the capsule of the joint and pressed in the medial direction apparently far forward, it could be felt clearly through the right tonsil, apparently through a thick tissue layer.

Since the opening of the abscess cavity the pus stopped here as well as in the tympanum; it also completely stopped from the fistula of the operation wound. The temperature remained normal.

The further treatment consisted in syringing the rich pus-producing cavity with boric-acid water and injections of glycerin and iodoform. As no lessening of the discharge followed three weeks after, formalin in increasing strength, 1 to 5 per 1000, was syringed. The result of these injections, which always caused a slight but quickly passing burning sensation, was apparent. The pus stopped about the last of August. Soon the wound of the inferior canal wall closed also.

September 20*th.* On the inferior canal wall was a small dense scar. Operation wound on the pars mastoidea is completely cicatrized. Drum and hearing normal.

These fistulæ occur rather frequently in chronic suppurations, especially with cholesteatoma; rarely fistulæ occur in acute cases. Jansen reported 121 cases, which he collected in chronic suppurative cases. He had met with only three cases with caries of the vertical semicircular canal, and these were all cases which showed severe complications (tuberculosis, extensive extradural abscess, and purulent arachnoiditis). The seven cases of Stenger's likewise were chronic cases. Lucae wrote upon less than thirty-two cases of carious defect of the horizontal semicircular canal, two of which were in subacute suppurations (of three and five months' existence).

In Ephraim's case labyrinthine symptoms failed completely. The flow of lymph was small and could only be observed two days. This is contrary to Lucae's observations that the flow of the labyrinthine fluid is very plentiful in carious defect, contrasted with traumatic, where it is a small and gradual flow.—Von A. Ephraim, in *Arch. f. Ohrenh.*, Breslau, 1902, Bd. liv., Heft 3 und 4, S. 240.

Contribution to the Pathological Anatomy of the Auditory Chain of Ossicles.—1. Hammerschlag reports a case of synostosis of the malleo-incudal articulation, found in a man thirty-five years of age. No history of the auditory function was obtainable. On examining the right ear the malleus and incus were bound together. The mucous membrane of the middle-ear was everywhere quite normal. The incudostapedial joint was detached easily; the stapes was also intact and easily removed from the oval window.

On microscopical examination of the malleo-incudal joint a part of the joint was taken up by a bony bridge, which showed different breadths in the series of preparations, and here and there clearly showed Haversian canals. This bony bridge bound both ossicles together. Otherwise the joint was nor-

mal. Probably this bony bridge slightly, if at all, diminished the hearing power, for we know from the physiology of the sound-conducting apparatus that the large ossicles (malleus and incus) move as a whole in conducting sound. It cannot be decided with certainty that this case was the result of an inflammation, for the tympanic cavity was free from all inflammatory products. It must be supposed that a local disease of the joint had taken place or an inflammation which left this bony bridge as its product.

2. A case of malformation of the stapes accidentally found in the body of a dwarf—a girl about twenty years of age. Hammerschlag subsequently learned from the accompanying history that the patient had been treated in a general hospital for multiple tuberculous caries, and had died from exhaustion. The body clearly showed signs of cretinoid degeneration, and during life the patient, in many respects, gave one the impression of a cretin. It was difficult to understand her, for, on the one hand, her comprehension of speech was wanting, and, on the other hand, her own speech was very poor and indistinct. The patient had the appearance of a hard-hearing person. A correct investigation of the hearing had not been made intra vitam.

The right middle ear was wholly normal. On the left side the tympanic cavity, and also the attic and antrum, were diminished in all their dimensions. The dura of the temporal lobe was abnormally low and the superior osseous auditory canal seemed much thinner than normal. The oval window was completely covered over by the horizontal part of the facial nerve. On removing the malleus the stapes was easily detached from the oval window, and remained firmly bound to the malleus. This union was not osseous, but only rigid connective tissue. The incus and malleus were normal as to shape and size. Malformation of the stapes showed both cruræ formed for the most part only a rather thick osseous link. From the plate of the stapes there was a failure of differentiation into two cruræ, which, however, were bound together by a thin osseous plate, so that a free space did not exist between the cruræ. The stapes plate was reduced to about a third of its normal size, and the oval window was in keeping with the plate of the stapes, smaller in all its dimensions than in the normal. The microscopical investigation gave no important information, for the time between death and reception of the preparation was too long. Hammerschlag then cites references to malformations of the stapes.

I might close with the hint that to-day a systematic pathological-anatomical examination of the organ of hearing of cretinoid degenerated individuals should be demanded, for they quite frequently have arrests of development in the sound-conducting apparatus as well as in the labyrinth. It might be well to remember that endemic deaf-mutism forms an integral element of cretinoid degeneration (Bircher: *Endemic Goitre and its Relation to Deaf-mutism and to Cretinism*, Basel, 1882), and that most cretins show more or less high-grade disturbances of hearing, which in all probability can be traced back to arrests in development of the organ of hearing.

An exact knowledge of the organ of hearing in cretins, therefore, might be suitable to enlarge our knowledge of the pathological anatomy of so-called congenital deaf-mutism.—*Beiträg zur pathologischen Anatomie der Gehörknöchelchenkette*, Mit Tafel iv., S. 82–85. *Arch. für Ohrenheilkunde*, Band lv., Heft 1 und 2.

PATHOLOGY AND BACTERIOLOGY.

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On the Structure and Physiological Significance of the Hæmolymph Glands.—Morando and Sisto (*Archivio per le Scienze Mediche*, 1901, vol. xxv., No. 13) were led to undertake a study of these glands in order to determine, if possible, their exact physiological significance, and also to define more clearly their anatomical peculiarities.

Since the work of Gibbs, in 1884, several different observations have been made by Robertson, Clarkson, Vincent and Harrison, Drummond, and others on the occurrence of certain glands in mammals, fowls, and certain bony fishes, resembling in size and situation ordinary lymph glands, but usually red in color and of a histological structure peculiar to themselves. They are usually capsulated, and contain blood sinuses in place of lymph sinuses surrounding nodules of lymphoid tissue. In the sinuses, in addition to blood, are present lymphocytes, polymorphonuclear cells containing fragmented red blood corpuscles and blood pigment, and free blood pigment of various colors.

In addition to these elements Clarkson has claimed that nucleated red cells are present, from which fact he would regard these glands as hæmatopoietic. Nearly all the other authors have regarded them as functioning only in the destruction of red cells, as is shown by the presence of the fragmented cells and pigment in leucocytes.

The relation in situation and function of the hæmolymph glands to the spleen and to the accessory spleens that have been described by Tizzoni Griffini, Eternod, and others is even more marked than their relation to lymph glands. Tizzoni has shown that such accessory spleens increase in size and take on a marked erythrocytolytic function in diseases of the spleen after splenectomy. Malfucci has claimed a similar activity in the retroperitoneal lymph glands after transfusion. In their studies on the hæmolymph glands, Morandi and Sisto have worked particularly on those of man, but have also made observations on the dog, cat, rat, rabbit, and other mammals. The consideration of their work refers chiefly to the human organs.

Hæmolymph glands are found to occur in general wherever ordinary lymph glands are present, and are usually to be detected macroscopically by their smaller size and reddish color. The glands present so many variations both in macroscopical and microscopical appearance that the authors prefer to consider them under six different "forms" for convenience of description.

Their general description of the common characteristics of the glands varies in no particular from that already mentioned. They have, however, never seen nucleated red cells, and they mention specifically a peripheral sinus and division of the gland into cortex and medulla. The differences in the six forms in brief are:

Forms one and two have smooth muscle fibres in the cortex and lymphoid nodules which tend to reach to the periphery of the gland; form three has considerable masses of adipose tissue; form four has no separation between the cortex and medulla, and has very large sinuses; form five has large sinuses, which are separated from the nodular parts by smooth muscle bands; form six has no peripheral sinus.

The authors regard the function of hæmolymph glands, in addition to the production of lymphocytes, to be the destruction of red blood corpuscles, and never the formation of blood corpuscles. Their reasons for this conclusion are as follows:

1. The presence of granule-bearing cells containing broken-up red blood corpuscles and pigment.

2. The fact that removal of the spleen, thus destroying the principal erythrocytolytic organ of the body, will increase the number of these granule-bearing cells.

3. These may be further increased by giving the splenectomized animal hæmolytic substances.

4. No nucleated red corpuscles or anything suggesting hæmatopoiesis are ever found.

5. In cases of acute, severe anæmia with hæmoglobinuria produced in animals by injections of pyrogallic acid, no formation of red corpuscles can be found in these organs. Such a formation, however, may be caused in the spleen, after bleeding, when the bone-marrow is not sufficient to form adequate numbers of new blood cells.—F. P. G.

On the Histopathology of the Pancreas in Diabetes Mellitus.—Maximillian Herzog (*Virchow's Archiv*, 1902, Band clxviii., p. 83) reports five cases of diabetes mellitus, in every one of which changes were found in the islands of Langerhans of the pancreas. In only one case was there hyaline degeneration alone. In two cases thickening of the capsule and increase of intra-insular connective tissue was associated with a general cirrhosis of the organ. In two other cases numerous sections through the pancreas failed to show any of the islands of Langerhans. In their place all that remained was a small amount of connective tissue, and in one of these cases this change was practically the only one found in the organ. Herzog concludes that there is a specific relation between these lesions in the pancreas and diabetes mellitus; that hyaline degeneration is not an essential factor is seen by the last case. Further, he believes these specific changes speak in favor of the assumption that the islands of Langerhans are directly concerned in the elimination of an internal secretion containing a sugar-converting enzyme.—W. T. L.

Concerning Ascites Chylosus.—E. Pagenstecher (*Deutsch. Arch. f. klin. Med.*, 1902, Band lxxii., p. 105) reports a case of chylous ascites occurring

in a child, aged four months. At the operation, besides the chylous fluid in the peritoneum, the small lymph radicles of the mesentery were found dilated with milky fluid and frequently converted into small retention cysts. Pressure on the thoracic duct by a new-growth or enlarged glands could be excluded, and the only assignable cause was a chronic peritonitis.

Pagenstecher describes the anatomy of the thoracic duct with its branches and the common anomalies found. From an analysis of many reported cases he finds the chemical constituents of the chylous fluid vary somewhat: albumin, from 1.2 per cent. to 5.5 per cent.; sugar, usually from 0.03 per cent. to 0.38 per cent., but may be absent; fat, from 0.49 per cent. to 9.48 per cent., and a trace of peptone may occur.

He divides the so-called chylous ascites into two main groups: (1) The chyleform ascites; (2) the true chylous ascites. Under the first heading the milky appearance of the fluid may be due to: (*a*) Fatty degeneration of inflammatory products or cancer cells; (*b*) formation of fat by degeneration of serous endothelium; (*c*) milky appearance from chemical products.

Chylothorax he believes may be due to rupture of the thoracic duct, but rupture of the duct in the abdominal cavity is almost unknown.

The causes of true chylous ascites are: (*a*) Heart failure, causing venous stasis in the region of the innominate veins; (*b*) thrombosis of the innominate vein, with closure of the thoracic duct by foreign substances; (*c*) narrowing of the vein by disease of the wall; (*d*) tumor of the mediastinum pressing upon the thoracic duct; (*e*) tumor below the diaphragm pressing upon the thoracic duct or receptaculum chyli; (*f*) closure of the smaller branches of the thoracic duct along the mesentery; (*g*) thrombosis of the thoracic duct. In certain rare cases he believes both the chyleform and chylous ascites may be present, such cases occurring in carcinosis of the peritoneum, with pressure upon the thoracic duct by enlarged glands, etc.

The mechanism by which the chyle escapes into the peritoneal cavity is not by rupture of the lymph channels, but by a process of transudation. Thus in venous stasis two forces are at work; on the one hand there is an increased flow of lymph, and on the other hand this increased lymph flow is prevented from spreading into the collateral branches owing to the pressure exerted by the congested veins. Pagenstecher believes the main factor in the production of chylous ascites is pressure upon the finer branches of the thoracic duct, with or without pressure upon the duct itself. Pressure upon the duct alone, as is shown by experimental ligation of the duct, is not in itself sufficient to cause chylous ascites, the obstruction being probably overcome by a collateral circulation, which, of course, does not occur if these collaterals are also occluded.—W. T. L.

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SOME EXPERIMENTAL AND CLINICAL OBSERVATIONS CONCERNING STATES OF INCREASED INTRACRANIAL TENSION.[1]

THE MÜTTER LECTURE FOR 1901.

By Harvey Cushing, M.D.,
ASSOCIATE IN SURGERY, JOHNS HOPKINS UNIVERSITY.

Gentlemen: It is my privilege to bring before the College this evening, as the Mütter lecture, some of the results of a series of experimental observations which relate chiefly to the intracranial circulation as it is influenced by local pathological processes—a subject which, from a bibliographical standpoint, is prominently associated, among others, with the names of Haller and of Astley Cooper, of Fluorens and Majendie, of Key and Retzius, of Leyden, of Althan, of Kussmaul and of François Franck, of Naunyn, Mosso, von Bergmann, of Horsley and Adamkiewicz, of Leonard Hill, and, more recently, of Kocher.

My personal introduction to the subject was due to the interest of Professor Kocher, of Bern, and the investigations as originally undertaken at his suggestion had for their primary objective point the determination whether during an increase in intracranial tension the capillaries and smaller bloodvessels of the brain were dilated from venous stasis, or, on the other hand, whether a condition of capillary anæmia was brought about by such a state.

This question, naturally one of fundamental importance for the proper explanation of the phenomena attending states of cerebral compression,

[1] This paper, in substance, was presented before the College of Physicians of Philadelphia, on December 3, 1901. Its experimental basis will appear in Naunyn and Mikulicz's Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie, 1902, No. 9, under the title "Physiologische und anatomische Beobachtungen über den Einfluss von Hirnkompression auf den intracraniellen Kreislauf und über einige hiermit verwandte Erscheinungen."

curiously enough has been the occasion of much disagreement among writers. Its elucidation promised to render many of the problems relative to the symptom-complex of "Hirndruck" much more easy of interpretation.

Not wishing to trespass too far on your indulgence, it is my intention to avoid as far as possible theoretical grounds and the discussion of the technical details of the particular experiments, but to dwell chiefly on their bearing toward operative, clinical, and diagnostic procedures. The brevity of the hour may be an apology for the omission of an historical résumé of the subject.[1]

For the sake of convenience, and in order to avoid confusion from a terminology which has been the occasion of some misunderstanding when speaking of cerebral compression, a division into two groups of the causal processes of such a state will be made. The necessity of such a differentiation, according to von Bergmann, was first emphasized by Griesinger. These groups comprise, on the one hand, processes which occasion, for the most part, a *local compression* of the brain, with a resultant unequal distribution of intracranial tension, in contradistinction to those conditions, on the other hand, which bring about a *general compression* of the central nervous system, with an equal distribution of this tension. On clinical grounds, such pathological processes as a new-growth or abscess, a blood clot, or an abnormal and circumscribed collection of fluid in one part or another of the cerebro-spinal space, illustrate the former condition; that is, subject the brain to the effects of a *local compression.* A foreign body of this sort within the enclosing walls of the skull must be accommodated at the expense of the fluids, vascular and lymphatic, which constitute a not inconsiderable proportion of an otherwise incompressible brain mass. The practical non-compressibility of the brain tissue itself since the time of Alexander Munro's investigations has been unquestioned, and the introduction, therefore, of an intracranial foreign body is only possible through the emptying of the vascular channels in its vicinity. The pressure exerted by such a foreign body, as will be seen, is not transmitted equally throughout the cerebral chamber, and in consequence the circulatory embarrassment in corresponding degree is unevenly felt.

[1] An interesting historical and critical introduction to the subject of the intracranial circulation will be found in Mosso's work (Ueber den Kreislauf des Blutes im menschlichen Gehirn, Leipzig, 1881), and also in Berger's recent monograph (Zur Lehre von der Blutzirkulation in der Schädelhöhle des Menschen, Gustav Fischer, Jena, 1901); and in Leonard Hill's "The Cerebral Circulation," T. & A. Churchill, London, 1896. Ito in his paper (Zur Aetiologie und Therapie der Epilepsie, Deutsche Zeitschrift für Chirurgie, 1899, Bd. lii. S. 489) gives a most complete list of bibliographical references; and more recently von Bergmann (Der Hirndruck und die Operationen wegen Hirndruck, Handbuch der praktischen Chirurgie, 1900, Bd. i. S. 189) and Kocher (Hirnerschütterung, Hirndruck, u. s. w. Nothnagel's Specielle Pathologie und Therapie, 1901, Bd. ix. 3 Theil, 2 Abtheilung, S. 81) have critically reviewed the subject of the circulation in states of compression from the experimental and pathological standpoint.

In the second group of processes, namely, those associated with *general compression*, the intracranial tension may be considered to be equalized throughout the cerebral chamber, and in certain instances, indeed, over the entire central nervous system. Those traumatic cases followed by acute cerebral œdema, which Cannon and Bullard have recently ascribed to alterations in osmotic pressure—cases of acute hydrocephalus, cases of generalized meningitis, of hemorrhage into the subdural spaces from fracture of the base—processes such as these, chiefly ones in which the pressure is transmitted primarily through the fluid contents of the cerebro-spinal spaces, may be given in illustration of states associated with a general increase in intracranial tension.

Now it is not difficult to simulate experimentally the conditions produced by these two forms of compression, and I will endeavor to illustrate as briefly as possible the simple laboratory apparatus which has been employed to this end, as well as the method of direct observation of the cortical circulation during the experiments.

As early as 1811 Ravina, an Italian experimenter, in the attempt to demonstrate the pulsation of the brain within the enclosed cranium, inserted a glass window in the skull for this purpose. Donders subsequently, in 1851, employed a similar method, as did later on Kussmaul and Tenner in their attempt to disprove the so-called Monro-Kellie doctrine that the total amount of blood in the brain cannot vary with an intact skull. Although these observations are often quoted, the method used seems to have fallen into abeyance, and I am unaware that the procedure has been utilized in the study of circulatory changes during compression. It must be confessed that considerable skepticism was felt as to its practicability, but as a matter of fact it was through this method that most important corroboratory evidence of the vascular alterations during the experiments was obtained by immediate observation of the pial circulation.

An ideal window, doubtless, would be one which could be screwed into the trephine opening made for its reception; but as the simple provisional method which was first employed sufficed for all purposes, it was retained. It consists simply of a circular disk of glass with a bevelled edge made to fit into a large trephine opening, and held in place by two screws with flattened ends so bent that they hook under the edges of the opening. Under the trephine opening a small area of dura is removed sufficient in extent to expose the pial vessels overlying a convolution and at the same time an adjoining sulcus with its contained venous radicle. As a rule, also, the trephine opening in the bone has been made so as to overlap the median line, in order to expose the longitudinal sinus, to one side of which the opening in the dura has necessarily been made. (Fig. 1.) The window, though not hermetically sealed, nevertheless answers the same purpose as such a

one, since an increase of tension floats the dura up against the glass in valve-like fashion.

In a great number of my experiments, drawings of the exposed area of the cortex during different stages of compression were carefully made in color, usually with the help of a low-power lens. This was necessary in order to fix in the mind's eye the minutiæ of the smaller vessels and the ground-color of the brain. Only by such observation was it possible to carry a mental picture of the topography of the fine radicles, and consequently to observe accurately the time of their appearance and disappearance from the field of vision. (See Plate, Fig. A.)

For the production of local compression the particular form of apparatus employed was similar to that used by Horsley and Spencer in their experiments, and I believe originally adopted from François Franck.

FIG. 1.

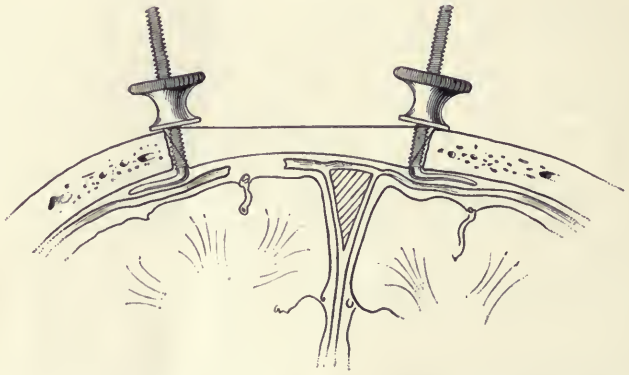


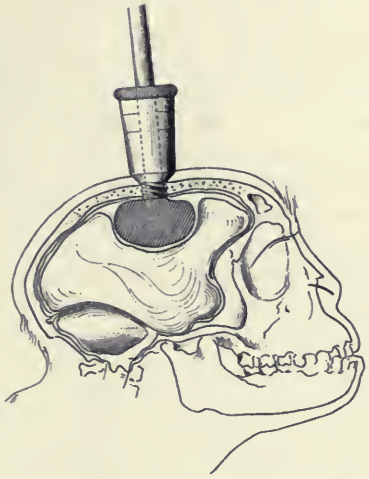
Diagram showing the cranial window in place, its relation to the longitudinal sinus, and the opening in the dura.

It consists of a double canula, the outer metal portion of which can be screwed into a trephine opening in the skull. Into this is inserted a second canula, the outer end of which communicates, by means of a heavy rubber tube of small bore, with a burette of quicksilver. To its inner or cranial end is attached a thin distensible rubber bag. (Figs. 2 and 3.)

By such an arrangement can be told not only the extent of encroachment upon the intracranial space by measurement of the amount of mercury allowed to enter the bag, but also can be told the degree of pressure necessary to evoke certain symptoms and to produce certain circulatory changes by the measurement of the height above the brain of the column of mercury in the burette. Let us suppose that this apparatus has been so introduced that pressure resultant to filling of the bag will act directly against the hemisphere without exciting sensory

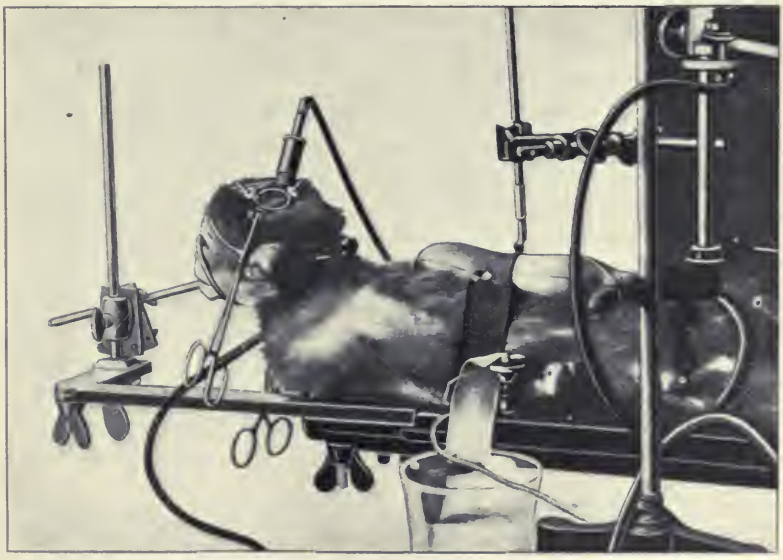
impulses from the stimulation of an interposed dura, a membrane which in the dog is especially sensitive. The first effect which will be

FIG. 2.



Semischematic representation of the method of producing local compression.

FIG. 3.



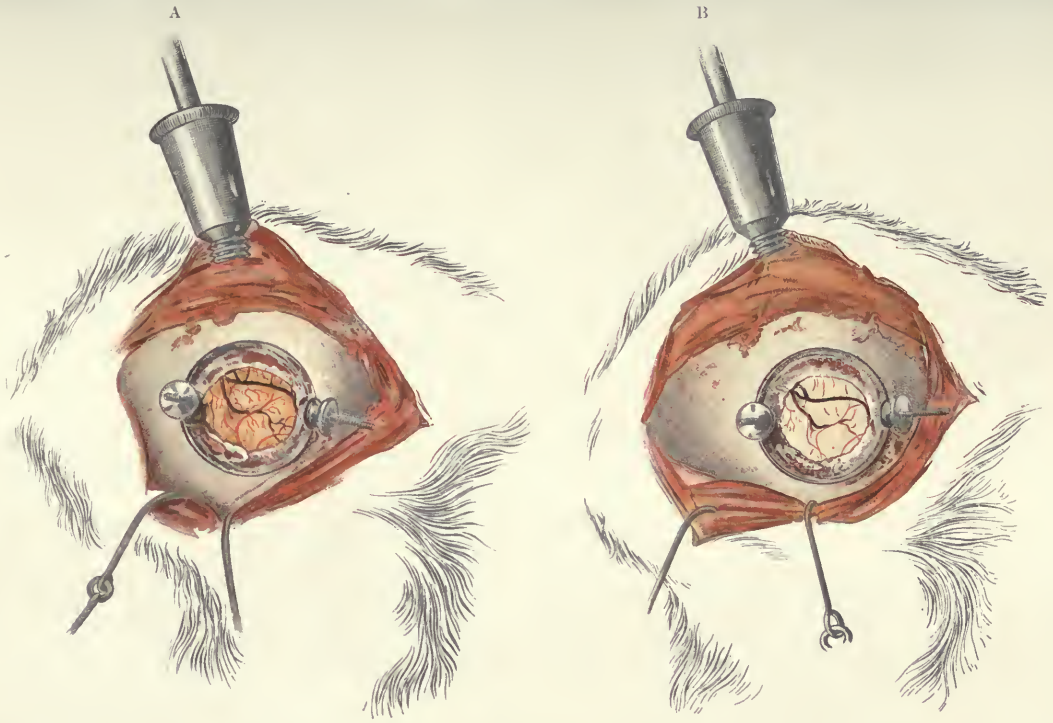
Photograph showing the cerebral window and local compression apparatus in place during an experiment.

seen to follow upon a moderate degree of compression will be a slight dislocation of the entire brain mass and a distinct widening of the

smaller venous radicles exposed under the window. They at the same time become darker in color, so that their differentiation from the arteries is no longer as difficult as it is in the normal state. As the size of the foreign body increases, this venous stasis becomes apparent at remote portions of the brain, and it can be readily made out in the eye-grounds, where it seems usually to be more marked on the side of the compromising body. If the distention of the bag is further increased the intracranial tension in its vicinity finally reaches that of capillary pressure, at which time the convolutions of the brain not only in the neighborhood of the foreign body, but if the process is still further advanced even in remote parts of the hemisphere, abruptly lose their rosy color and become blanched. (See Plate, Fig. B.) The veins meanwhile remain filled with dark blood, whose means of escape seems to have been cut off, as it were, at both ends. Now, such a condition of anæmia of the hemispheres may be brought about, in the dog at all events, with but little evidence of the so-called major symptoms of compression. There usually is some slowing of the pulse and alteration in respiration, but the tolerance which an animal shows toward such an interruption of circulation in the hemispheres evidences the fact that the medulla has largely escaped from the effects of the local compression.[1]

Thus, as Horsley and Spencer, Hill, and others have emphasized, the brain does not transmit pressure equally in all directions, and so the symptoms resultant to a compression force of a local process vary greatly in accordance with the proximity of the compromising body to the vital centres of the fourth ventricle or to its remoteness from them. This rule applies to local pathological processes as well as to experimental ones in the laboratory. The counterpart, furthermore, of the laboratory experience is regularly seen on the clinical operating-table during the procedure of the elevation of a lobe of the brain such as that necessary for the removal of the Gasserian ganglion. The narrowing of the intracranial space resultant to the extensive compression and elevation of the temporal lobe at such times is productive merely of a slight slowing of pulse, with compensatory rise in blood-pressure, due to a condition of intracranial venous stasis. Such a degree of compression as is necessary to expose the ganglion, if transmitted to the medulla, would naturally be rapidly fatal. If, therefore, in clinical

[1] The degree to which a downward dislocation of the hind brain through the foramen magnum may account for this escape cannot be absolutely determined. That it may play some part in certain animals with conical skulls, such as rabbits and dogs, is quite possible, and attention has been called to this fact by Hill. On frozen sections of brains which have been hardened *in situ* under such circumstances it can be readily seen that the medulla may be dislocated to a considerable extent into the spinal canal. A similar dislocation I have seen to be present in slight degree in a human brain in a case in which a cerebellar cyst had finally caused fatal compression.



These figures, reduced one-third from original sketches, have lost much in the process of reproduction. Head of Dachshund, showing local compression apparatus and cerebral window in position. *Exp.*, *Feb.* 22, 1901.

FIG. A.—Normal appearance before increase of intracranial tension. The larger vessels should be more of an arterial color.

FIG. B.—Same animal during a period in which local compression against the right hemisphere was carried considerably in excess of the measured arterial (femoral) pressure (local pressure exerted by mercury, 110 mm.; blood-pressure equals 100 mm. of Hg.; displacement of brain produced by bag, at this time, 7 cm.; measurement of brain post-mortem 70 cm.), showing transmission of compression effects to the cortex underlying the window (left hemisphere near parietal eminence). The larger veins remain full of dark non-circulating blood and present the appearance of being broken in places. The arteries are mere threads, and should be barely distinguishable. The cortex is completely blanched.

states some specialized centres or systems of neurones are not compromised by such a local compressing force, evidence of whose presence would thus be afforded by paralyses of one form or another, the cerebral chamber may harbor a foreign body of one-tenth to one-eighth the size of the brain without necessarily giving an indication of its presence and far from producing any of the so-called characteristic or major symptoms of compression. The venous stasis, however, which we have seen to be caused by such a condition naturally may account for some degree of apathy or stupor which usually accompanies it, and also may serve to explain the early congestion and widening of the veins of the fundus—the primary stage of the "Stauungspapille" of the Germans —in accordance with the original view of von Graefe. The symptoms produced by conditions of local compression, consequently, in so far as they are secondary to circulatory alterations, can be seen to be dependent entirely upon the position of the foreign body, what areas are involved in the local anæmia, and how far-reaching are the congestion effects.[1]

Owing to the irregularity, therefore, of these symptoms which this local method called out, and inasmuch as the data which we chiefly desired concerned the accurate degree of compression to which the *medulla* was subjected during the production of given symptoms, it was determined to employ some method of producing a general and equalized means of compression. In this way alone did there seem to be a possibility of accurately comparing the distinctive and peculiar symptom-complex of "Hirndruck" with the local degree of compressing force about the bulb. Such a "general compression" was produced experimentally by allowing normal salt solution, warmed to body temperature, to enter the cerebro-spinal space through a canula screwed into one part or another of the skull or in the lamina of one of the vertebræ. As a matter of

[1] According to the most recent view of v. Bergmann, if we interpret it correctly, all the symptoms of cerebral compression ("Hirndruck" in his sense) are due to the passive venous congestion which, as we have seen, is brought about by the pressure exerted by a foreign body. He believes, furthermore, that this pressure is transmitted equally over the entire central nervous system through the medium of the cerebro-spinal fluid, and consequently for equal degrees of compressing force, even in the case of a circumscribed body, that symptoms practically of equal severity would be evoked. With this view my experiments are not entirely in accord. It is possible that in some cases of local compression the escape of cerebro-spinal fluid by its natural channels may be interfered with owing to the dislocation of the brain from its normal position and the consequent obstruction of these channels of exit. Under circumstances such as these it is true that the local compression effects may be more evenly and widely distributed. In the majority of cases, however, this does not seem to be the case, and severe compression effects may be felt locally, and little, if at all, in remote territories where measurement shows that the tension of the cerebro-spinal fluid may be but little raised. Although agreeing in general with some of the principles brought forward by Adamkiewicz, a dispute in terminology over "Hirndruck" versus "Druck im Gehirn," seems rather meaningless. The writer inclines to the generally accepted view that the phenomena of compression are responsible to circulatory changes rather than to direct alterations in the nerve-tissue elements themselves from the compromising body as Adamkiewicz claims. In the states of general compression, in the sense in which we have used the term, conditions exist analogous to those claimed by v. Bergmann for all states of compression, but the process, however, must go on beyond one of venous stasis to one of vascular anæmia before the terminal symptoms of compression are produced.

fact, it was found to be immaterial, as far as the production of given symptoms was concerned, over what part of the central nervous system the fluid was primarily introduced, whether over the hemisphere, cerebellum, or cord. This fluid was allowed to enter through a rubber tube connected with a pressure flask, and would spread to all parts of the cerebro-spinal space. The tension under which it stood was regulated by the degree of elevation of the flask, and this was recorded at the same time on a revolving drum by the insertion of a mercury manometer in the course of the tube, in exactly the same way as the arterial pressure was recorded. Thus the blood-pressure and intracranial tension were written from the same abscissa, as is shown in the given chart.[1] (Fig. 4.)

Now there are certain objections which have been raised against the experimental production of an increase of tension by this method. In the first place, according to Adamkiewicz,[2] such a rapid escape of the compression fluid would take place by the normal channels of exit from the cerebro-spinal space that there would be a resultant overfilling of the right heart. Furthermore, it is objected that this escape of fluid would be incompatible with the continuance of an equalized distribution of pressure or one which is truly represented by the height of the pressure-flask.

As a matter of fact, measurement of the amount of fluid lost shows that it is not great, from 60 c.c. to 100 c.c. during a long period of compression—possibly of half an hour—which certainly is not enough to embarrass the cardiac action in the slightest degree. From many observations which I have made, however, there can be no doubt, in agreement with Adamkiewicz, but that there exists very free communication between the cerebro-spinal space and the longitudinal sinus. The original hypothesis offered by Key and Retzius, that the Pacchionian granulations subserve some purpose of filtration, can hardly be entertained; for though the points of exit of the fluid undoubtedly are in the situation of the *lacunæ laterales* of the sinus, into which these granulations for the most part project, their absence in the infant and in the lower animals would of itself be sufficient objection to this theory.[3]

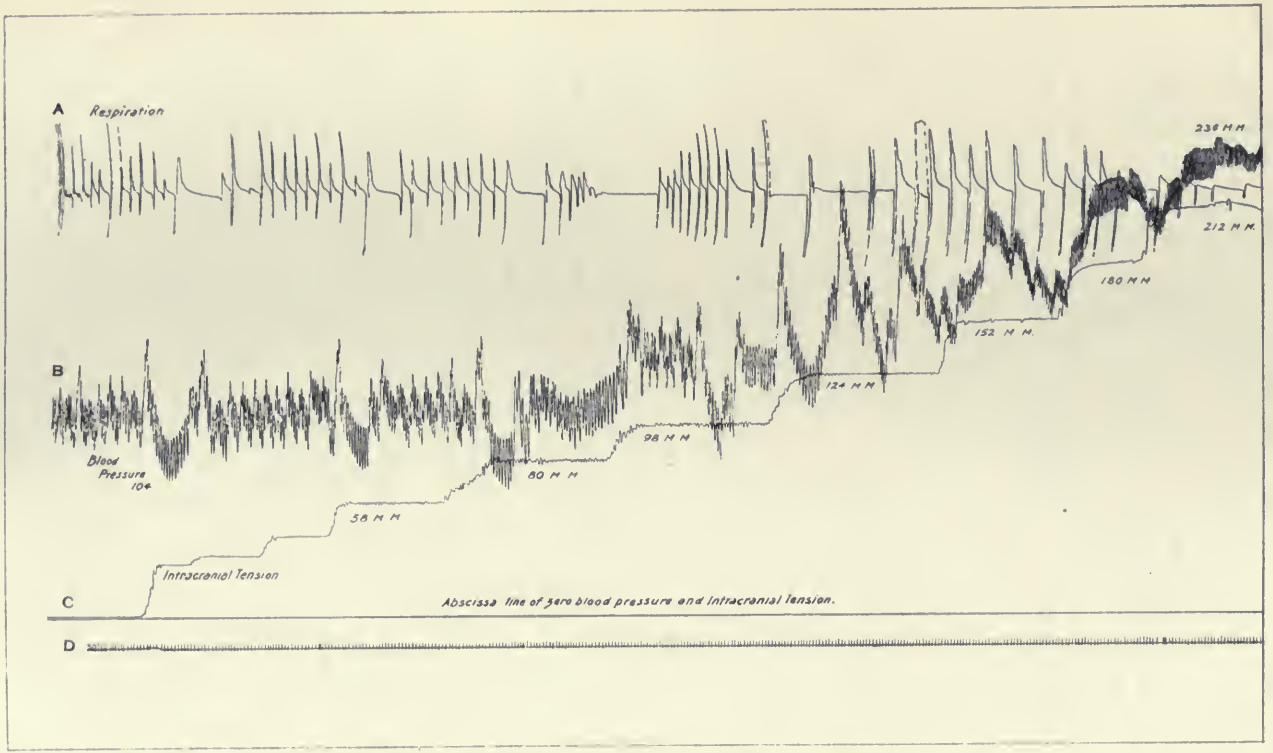
Whatever the nature of these openings may be, or wherever their situation, they certainly are of considerable size and apparently possess

[1] A great number of these charts, whose reproduction is impossible here, were shown for purposes of demonstration. A fragment from a single one of them, taken on a slowly revolving kymograph, accompanies this article.

[2] Neurologisches Centralblatt, 1897, No. 10, vol. xvi. S. 434.

[3] The writer has had the opportunity in Prof. Sherrington's laboratory of performing hemicraniectomy and of turning down the hemisphere for the purpose of stimulating the mesial surface of the brain in the case of several anthropoid apes: gorilla, orang-outang, and chimpanzee. In no instance was there evidence of villæ from the arachnoid projecting into the dura in the neighborhood of the sinus and causing difficulty of separation of the hemisphere at this situation, as is invariably the case in adult man.

FIG. 4.



Fragment of a chart of a "general compression" experiment on a dog. Showing a gradual increase in intracranial tension from zero to 212 mm. of mercury, the blood-pressure meanwhile increasing from its normal level at 104 to 231 mm. of mercury. Note continuance of respiration, absence of vagus effects, etc.

a valvular action. The process is not a mere filtration through a membrane. This is readily shown experimentally by the fact that an injection mass entered, for example, in the lumbar meninges, may be easily made to pass from the cerebro-spinal space into the longitudinal sinus, and thence through the jugulars into the right heart. An injection in the opposite direction by way of the veins never, or but exceptionally and in small amounts, gets into the cerebro-spinal space.

The freedom of the communication of the subdural space with the sinus is demonstrated, furthermore, by the substances which will pass from one to the other. If, as occasionally happened during my experiments with local compression, the rubber pressure-bag containing mercury should rupture, and the globules of quicksilver enter the subdural space, they will be found distributed in the sinus, the jugulars, in the right heart, and throughout the lungs. I have frequently corroborated this experience on the human body by injecting mercury into the lumbar meninges, post-mortem. If the head be inverted, the skull trephined in the median line, and the longitudinal sinus opened, the mercury will be seen to pass readily from the subdural space into the sinus. To illustrate further: on many occasions the attempt was made to produce general compression by the introduction of gases under pressure instead of using the salt solution as above described. Were the gas a non-absorbable one, the animals would quickly die of cardiac air-embolism; and if the jugulars were exposed, bubbles of it could be seen pouring down toward the heart. Exposure of the cervical lymphatics and of the thoracic duct, on the other hand, showed in all instances a complete freedom from gas.

Contrary to the general belief, the longitudinal sinus, in the dog at all events, may be completely collapsed by an increase of intracranial tension. This may play an important part in the prevention of the escape of cerebro-spinal fluid under conditions such as the experimental ones of which we are speaking. It is well recognized in clinical states that the obstruction to the outflow of fluid, be it held back in the ventricles by blocking of the foramen of Majendie, or in the subdural space by inflammatory obstruction of those orifices which lead into the sinus, is especially prone to be associated with pressure phenomena. The escape of fluid under normal circumstances in the adult, whether by the olfactory, optic, or spinal nerve sheaths, plays a relatively inconspicuous rôle.

Waiving these objections, therefore, as without consequence, let us suppose, for example, that the artificial cerebro-spinal fluid be allowed to enter, by means of such an arrangement as has been described, through a trephine opening in the arch of the atlas under which the dura and arachnoid sheaths have been opened. From its proximity to the foramen magnum this would allow the fluid to spread easily up over the

brain by way of the cisterna magna, and the full degree of pressure would be felt in the immediate neighborhood of the medulla. Now, in case of an increase of tension under such circumstances as this, vascular alterations similar to those which we have seen to follow upon the local compression may be observed by direct inspection of the cortex—alterations, however, much more regular in their appearance, and doubtless of corresponding degree, over the entire central nervous system. There occurs, primarily, evidence of stasis, with widening of the venous radicals and a marked color differentiation between the smaller veins and arteries. There also may be detected a distinct bluing of the rosy ground-color of the exposed convolution. Similarly, evidences of venous stasis may, in favorable cases, be made out in the fundus oculi. The eyes themselves become staring and prominent from a retrobulbar œdema, which soon spreads to the lids, and which is due to the escape of the compressing fluid along the optic sheath. This *hydrops vaginæ nervi optici* may accentuate, although I do not believe, in accordance with the theory of Manz, Schmidt, and others, that it is of itself responsible for the symptoms of the "Stauungspapille." It would seem, however, to play some part in the production of an exophthalmos. As the pressure is increased the longitudinal sinus wavers, narrows, and, from being a broad, blue band across the field of the window, thins until it is completely collapsed. Zeigler has brought forth experimental evidence to show that during an increase of intracranial tension the venous pressure in the sinus sagittalis is raised. Evidently, therefore, at some period during an early stage of compression some interference with the outflow of blood is brought about. Complete compressibility, however, of the sinus has been heretofore uniformly denied.

If I may be permitted a slight digression in order to speak for a moment of the anatomy of the venous circulation of the dog's brain, this compression of the sinus and the place where the cerebral veins themselves become obstructed may be made more clear. The large venous radicals which gather the blood from the hemisphere (the superior cerebral ones will be taken as a type of all others) come to lie in the sulci, where they are largely protected from pressure. Only in particular places do they depart from this protection in order to pass over the convex surface of a convolution. This occurs regularly at the superior longitudinal convolution, which they cross before emptying into the sinus sagittalis. At this point the veins seem to be especially subjected to the effects of compression. They enter into the sinus, for the most part, obliquely through long slits in the dura, which possess a valve-like action, so that an increase of tension in the sinus is not transmitted to the veins, and consequently an injection into the sinus, as we have stated, will ordinarily not pass back into them. The superior cerebral veins, furthermore, before entering the sinus, bifurcate, one large branch

entering the diploë to join the diploëtic sinus, the other branch continuing on into the sinus sagittalis. If the sinus becomes compressed the escape of blood may take place in large amount by way of the diploë. These diplöetic sinuses in the dog are very regularly and symmetrically placed,[1] and may accommodate, presumably, the entire bulk of the venous blood from the hemispheres. Although much more developed in canine skulls, presumably sinuses of similar import exist in many cases in the calvarium of man, and under conditions of increased intracranial tension the venous pressure transmitted to them may be greatly increased. It is the experience of all operators to have encountered cases in which a craniotomy has met with an almost uncontrollable hemorrhage from the diploëtic veins. In some cases of tumor, for example, with an associated great increase in intracranial tension, the resultant increase of pressure in the veins may be so great that the bleeding from the diploë is checked with difficulty and only by plugging the openings in the bone.

Let us return once more after this digression to our experiment. During this early period of venous stasis, clinical indications of intracranial mischief doubtless would be present not only from the evidence furnished by the dilatation of vessels in the eye-grounds, but also from the mental drowsiness, apathy, or stupor which this amount of increased tension would produce. The major and characteristic symptoms of compression, however, are not evoked until a later period. As can be seen by comparison with many of these charts before you, the pressure of the fluid against the brain may be increased to the point of its equalling blood-pressure before any symptoms referable to the centres in the medulla may be called forth. Doubtless the pre-exising venous stasis may in some instances be productive of a vagus irritation, with some slowing of the pulse, indicating a nutritional disturbance of the vagal centre; but experimental evidence goes to show that the flow of blood through the vascular channels under these circumstances of stasis is no less than before, the increase of venous pressure being carried back so that the blood flows through the vessels as it might through rigid tubes. It is not until the degree of compression approximates that of blood-pressure—that is, until a condition of anæmia is approached or produced—that the major features of the pressure symptom-complex are called forth. It has usually been stated by investigators that such a degree of compression, if held, will occasion the death of the animal. The actual sequence of events does not seem to have been appreciated, for the reason that there has been no comparative measurement of the blood-pressure and the degree of intracranial tension in so far as the effects of the latter are felt in the region of the medulla.

[1] Drawings of these sinuses are given in the Mitteilungen aus dem Grenzgebiete der Medizin und Chirurgie. Loc. cit.

The direct examination of the cortex at this period of equalization of blood-pressure and intracranial tension shows, as would be expected, an abrupt blanching of the exposed convolution. Its rosy color becomes of a grayish-yellow hue, and though the pulsating arteries themselves may be seen against this pale background, and the dark-blue veins in the sulci remain filled with blood, little if any circulation presumably passes between them. A corresponding degree of anæmia under these circumstances of "general compression" is present in the medulla, and the centres are poorly, if at all, supplied with blood.

Now, the usual consequence of this condition is not death, as commonly stated, but a stimulation of the vasomotor centre, which occasions a rise of blood-pressure sufficient to overcome the high intracranial tension. At the same time, through the cerebral window the rosy color can be seen to return again to the blanched convolution. The centres are once more nourished. Respiration, which may have ceased, is resumed, and the circulation by this regulatory mechanism has become re-established. If, after such a readjustment has taken place, the intracranial tension be once more increased and carried up to the point of again producing anæmia by exceeding the arterial tension, the blood-pressure once more rises, in its turn, to the point of exceeding the intracranial tension; so the process may be continued until the arterial pressure be forced to two or more times its normal level. The reaction is illustrated, in one way or another, in all of these charts, in some instances the pressure being held for a time as high as 250 mm. of mercury without evidence of vasomotor failure. As can be seen, on diminution of the tension the exact reverse of the process takes place, the blood-pressure taking a drop of a corresponding number of millimetres of mercury, always tending to remain, however, at a level which prevents the occurrence of anæmia at the bulbar centres.

I have endeavored to describe this reaction in its simplest form, and before speaking of the many variations which occur, let us see what is the physiological action of this response. The mechanism which calls it into play is not a difficult one to demonstrate in our animal experiments. If, in the first place, by division of both vagi we throw out of action their influence on blood-pressure and pulse-rate, and so eliminate the inhibitory action which stimulation of the vagal centre otherwise would occasion, the blood-pressure and the degree of intracranial tension, as the charts show, follow one another with even greater regularity than before. The vagus response, indeed, under other circumstances is apt to mask this simple vasomotor reaction.

If, again, the spinal cord be divided above the level of departure of the sympathetic nerves to the abdominal viscera, and thus the vasomotor control of the great splanchnic area be lost, and then cerebral compression be made, only the vagus effect will be produced, with a

slowing of the pulse, but with no rise of blood-pressure whatever. If both vagi and cord are divided there is no alteration whatever in either pulse or blood-pressure on increasing intracranial tension.[1]

Similarly on cocainizing the medullary centres, and thus in another way throwing out of action both the vagus and vasomotor centres, the blood-pressure will immediately fall, and an increase of intracranial tension will not occasion the usual rise in blood-pressure—at all events, not until the cocaine effect has completely worn away. [A series of charts are here reproduced (Figs. 5–9) to show this reaction.] That

FIGS. 5–9.—Charts from a compression experiment on a rabbit (April, 1901), showing the effects of cocainization of the medulla in counteracting the usual blood-pressure response. Charts to be read from left to right. They are considerably and unequally reduced in size. *A*. Respiration which, after cocainization of medulla (Fig. 2), is continued by artificial means. *B*. Blood-pressure from femoral. *C*. Zero abscissa for both blood-pressure and intracranial tension. The line is written by the pen recording the manometer level of the latter. *D*. Time.

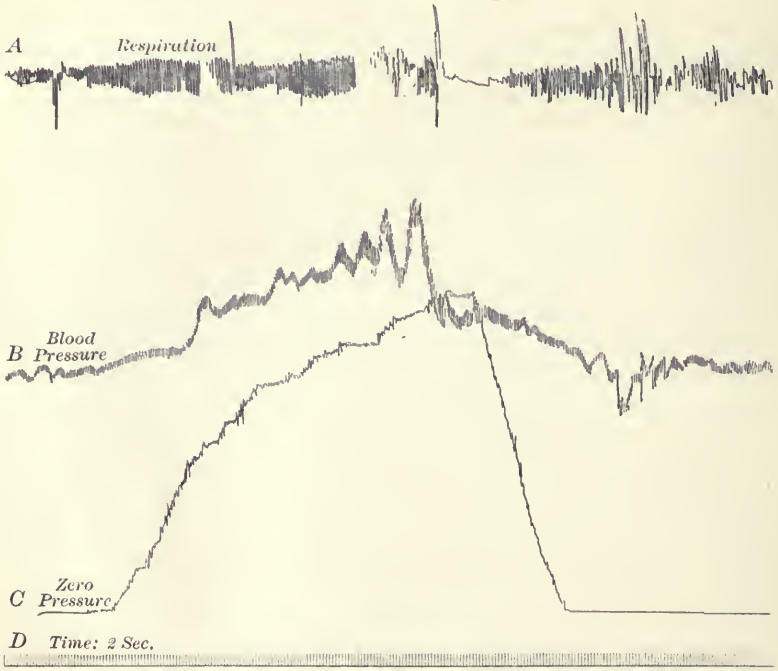


FIG. 5.—General compression experiment on a rabbit. Shows normal compression reaction. On a gradual increase of intracranial tension (*C*) to exceed the original arterial tension (*B*) the latter rises sufficiently to overcome the former. The pulse-rate is not affected, and the respiration continues. (Note that the pen recording intracranial tension (*C*) writes about 1½ cm. ahead of the blood-pressure pen (*B*).) On lowering the pressure flask to zero level the blood-pressure returns to its normal level.

[1] Charts illustrative of these reactions have been given in the Johns Hopkins Hospital Bulletin, 1901, vol. xii. p. 290.

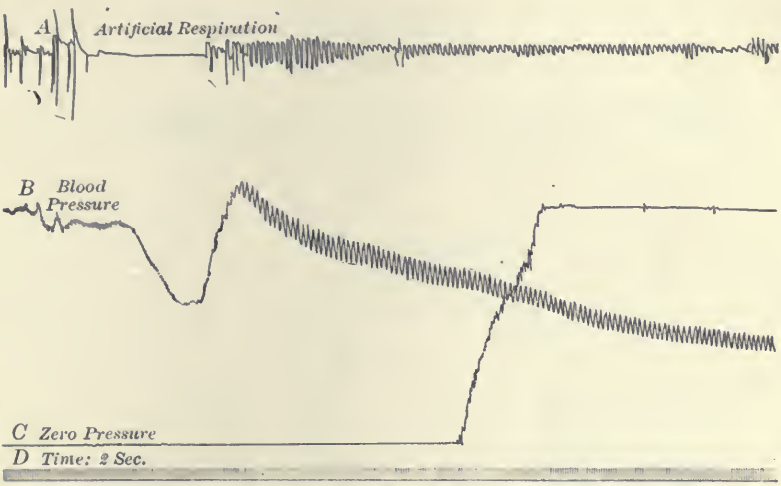


FIG. 6 shows effects upon blood-pressure in the same animal of an injection of cocaine into the neighborhood of the fourth ventricle—an immediate paralysis of respiration, with fall in blood-pressure and rapid pulse. Artificial respiration momentarily checks the blood-pressure fall. It, however, gradually drops to its paralysis level (see Fig. 7, *B*). An increase of intracranial tension (*C*) from its zero level to exceed the level of falling blood pressure is accompanied by no response on the part of the vasomotor centre. (This figure is reduced considerably more than the following ones).

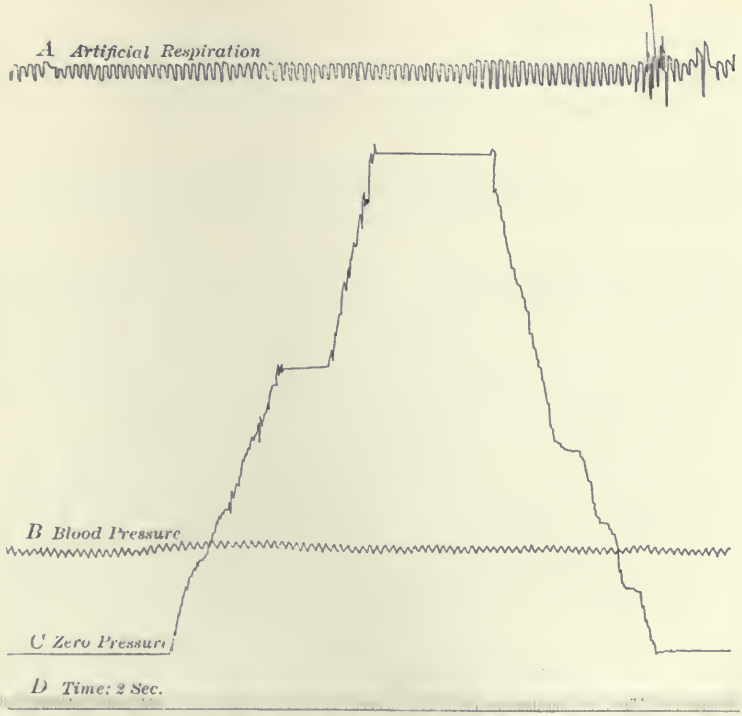


FIG. 7, showing blood-pressure (*B*) at its "paralysis level," 36 mm. of mercury, owing to vasomotor failure due to cocainization of centre. A great increase of intracranial tension (*C*) equal to 172 mm. of mercury does not affect blood-pressure to any appreciable degree.

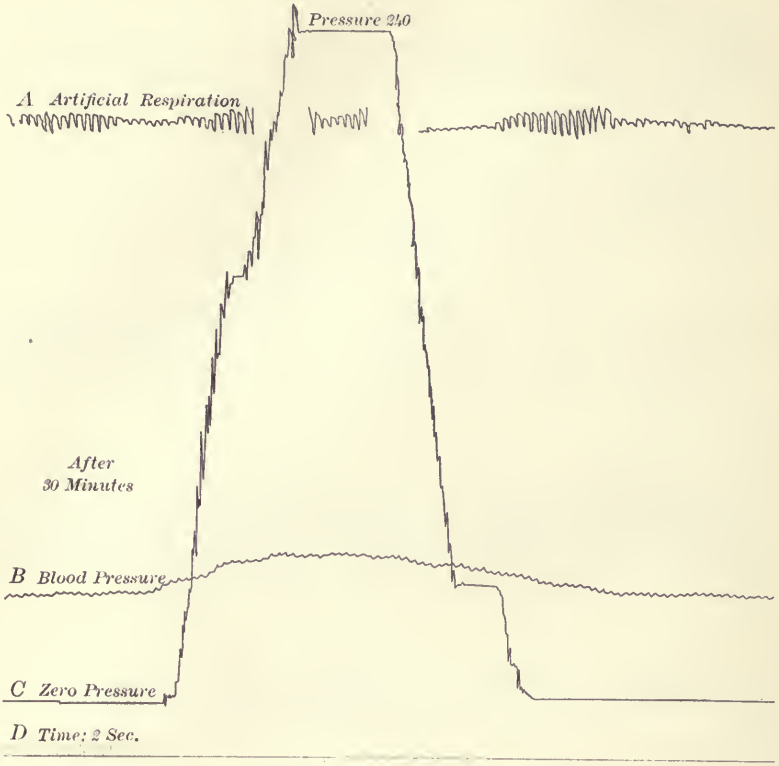


FIG. 8.—Same animal one-half hour later. Slight response on part of blood-pressure (*B*) to great increase of intracranial tension (*C*)

the mechanism is largely due to the vascular control of the great splanchnic field can be readily appreciated during an experiment by the exposure of a loop of intestine. The mesenteric and intestinal vessels can be plainly seen to diminish in calibre during the great rise in blood-pressure, and to dilate again with the fall that occurs in association with the release of the brain from the compression.

Now there are certain irregularities of interest, but of which I have avoided mention lest they confuse the description of this main underlying reaction. If, for example, the intracranial tension is *suddenly* brought to the point of equalling or of exceeding the blood-pressure, there ensue evidences of a pronounced vagus stimulation, usually with a complete checking or "Stillstand" of the heart, lasting at times over a period of thirty seconds and often associated with the production of spasms of the Kussmaul-Tenner type. If the pressure is held, however, there is finally a gradual release from this extreme vagus inhibition, the heart-beat slowly returns perhaps to its normal rate, and the blood-

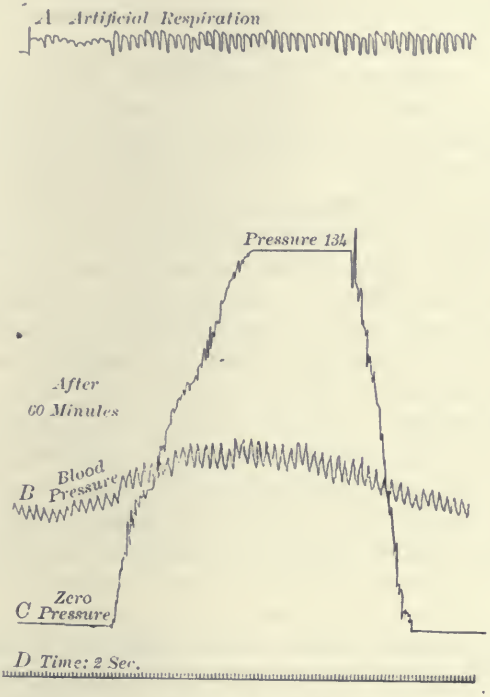


FIG. 9.—One hour later. Cocaine effects wearing away. Blood-pressure response to increase of tension more apparent.

pressure gradually ascends to or above its necessary level. Under conditions which presumably correspond more closely to the majority of those occurring in clinical states, in which there is a very much more gradual increase of tension, such a pronounced vagal irritation may be avoided, and the rise of blood-pressure will occur in anticipation of that degree of compression which would otherwise equal or exceed it, and so bring about a condition of anæmia of the bulb. Thus in many of the observations represented by these charts, by slowly increasing the intracranial tension, even though it ultimately be carried far above that corresponding to the original level of the blood-pressure, we have been able to avoid (as shown by the curves and as corroborated by the view through the cerebral window) any period of circulatory interruption in the medulla. (See Fig. 4.) Only exceptionally, however, has it been possible to obtain this vasomotor response in a fresh animal without sufficient circulatory disturbance in the neighborhood of the bulb to produce some slowing of the pulse and respiration. Usually, when the compression is occasioned with comparative rapidity (from eight to ten minutes, for example) symptoms are produced that are the experi-

mental counterpart of the deep, stertorous respiration, slow vagus pulse, and high blood-pressure which we see clinically in corresponding cases.

Observations which we have been enabled to make on an occasional case of fracture of the base in which hemorrhage has occurred into the subdural spaces have given us exact clinical corroboration of the experimental reactions. If in these cases it has been impossible to relieve the intracranial tension by the removal of a wide area of bone, a *circulus vitiosus* of symptoms is established in the following way. There is, in the first place, an increase of intracranial tension from the effused blood. When this becomes sufficient in amount to embarrass the circulatory conditions at the medulla the familiar clinical picture is displayed, with the slowing of pulse and respiration, and the high, bounding, incompressible, peripheral artery, whose tension can be measured, at times, almost at 300 mm. of mercury. This rise in blood-pressure, which under all circumstances is a conservative one, for the furtherance of a proper nutritional supply to the vital centres, here suffices merely to increase the intracranial bleeding, and thus in a still greater degree to increase the tension which has primarily evoked the response. Under such circumstances the vasomotor centre rapidly fails.

Another characteristic, which many of these blood-pressure curves show when the vasomotor centre is straining to overcome the condition tending to produce bulbar anæmia, is that of a rhythmic or wave-like variation in pressure—the well-known Traube-Hering waves—the causation of which has been the occasion of much dispute. In these instances it can be seen that the crests of the waves rise above and their hollows fall below the level of the intracranial tension. Examination of the circulatory condition of the brain through the window at the time of their production shows that an interval of cerebral anæmia corresponds to the low-pressure stage of the wave, whereas a condition of active capillary circulation rides on their crests. These circumstances are well shown on many of these charts taken during stages of general compression experiments. When the compression exceeds the blood-pressure anæmia ensues; the vasomotor centre is stimulated; the blood-pressure, rises in these cases higher than is necessary to readjust the circulation; the bulb is well supplied with blood—perhaps too well—and is hyperæmic; the stimulated centre relaxes to too great a degree; the arterial pressure falls below the level at which blood can enter the compressed vessels; the medulla once more becomes anæmic. Thus the centre is again stimulated, and so the process is repeated indefinitely. These rhythmic waves, furthermore, in many of these charts can be seen to follow the general level of blood-pressure as this is raised or lowered by alteration in the degree of intracranial tension.

It is quite possible that these rhythmic activities are nothing more than an exaggeration of the normal rhythmic waves of blood-pressure which are known to take place under a variety of conditions. Furthermore, as has been stated, the primary object of this elevation of blood-pressure seems to be for the continuance of nourishment to that most important of all centres, the respiratory one. A period of anæmia such as occurs during the low-pressure stages of the Traube-Hering waves leads promptly, as a rule, to the cessation of respiration. As long, however, as the vasomotor centre keeps the blood-pressure higher than that of intracranial tension, and at a point sufficient to keep the medulla supplied with arterial blood, respiration continues. Thus accompanying the crests of the waves of blood-pressure can be seen respiratory efforts, which assume more or less the character of the Cheyne-Stokes type of respiration. The period of shallow respiration or of actual apnœa accompanies that stage of the wave which is associated with cerebral anæmia. Such a periodicity of respiration, as we shall see, can be demonstrated clinically in association with waves of blood-pressure; shallow or passive respiratory efforts accompanying the low stage, deep and snoring respirations the rhythmic periods of its elevation.

The length of time experimentally during which these reactions can endure is considerable, even under the extreme degree of elevation—over 200 mm. of mercury from a level of 90 or 100 mm., in many cases—to which we have pushed the blood-pressure. These extraordinary responses under clinical conditions doubtless are called out only in rapidly fatal cases, such as those of basal hemorrhage with fracture, as has already been instanced. The more slowly the intracranial space is compromised probably the longer will the response hold. In the experimental as well as in the clinical cases, unless relief is given, a period comes at which the vasomotor centre weakens, loses its grasp on the great splanchnic field, the blood-pressure falls below that of the intracranial tension, the respiratory centre is no longer nourished, and the individual dies with a low blood-pressure and rapid heart, whose action may persist for hours, provided that the respiration is continued by artificial means.

A striking instance of this kind came under my observation a short time ago—one which illustrates just such a terminal stage and also the danger of any further increase of tension during the critical period of cerebral compression with bulbar involvement. The patient entered the hospital in a condition of profound stupor, with a subnormal temperature, a snoring respiration, a heart beat of fifty to the minute, a high-tension pulse (unfortunately it was before the days of a practical blood-pressure apparatus, and I cannot give the exact figures), and a "Stauungspapille"—all indicating such an increase of intracranial tension that the bulb was in the condition bordering on the so-called

"Lähmungsstadium" of the Germans. With evidence of an old otitis media as a localizing indication, an operation was immediately performed. The abscess was difficult to find, inasmuch as it had no apparent communication with the diseased temporal bone, and in the course of our search, during the elevation of the temporal lobe which was suspected to harbor it, the respiration ceased. The medullary centre, evidently suffering already from compression effects, could not endure this additional burden. On immediately releasing the pressure, and after some artificial respiratory efforts, spontaneous breathing returned. On resuming the search the abscess was finally located and evacuated, but the respiration during the procedure had again ceased. This time, in spite of artificial respiration, spontaneous breathing was never resumed, though every possible means of reawakening it by sensory stimulation and otherwise was resorted to. The characteristic rapid pulse, of low tension, indicating a vasomotor failure, had appeared, and at this low level of blood-pressure the heart continued to beat for *twenty-three hours*, during which time artificial respiration was continued. Though a careful gross and microscopical examination was made of the medulla of this case by Dr. Paton, no lesions worthy of note could be detected. Similar instances of respiratory failure anticipating the cardiac failure by many hours have been reported by Victor Horsley, Macewen, and Hudson.

It has been heretofore pointed out that in death from a fatal increase of intracranial tension the arrest of respiration precedes that of the heart. Back of the respiratory failure, however, in the majority of cases, and responsible for it, if we may judge from experimental evidence, stands the collapse of the vasomotor regulatory mechanism, which up to this time has held the blood-pressure at a height sufficient to overcome the abnormal extravascular tension at the medulla. Prompt surgical relief, with a wide opening of the calvarium, may save life even in desperate cases with pronounced medullary involvement. Thus an extensive craniectomy may completely, though temporarily, ward off the serious attacks which accompany the increasing tension of an intracranial growth. In acute cases, on the other hand, as in those of hemorrhage accompanying basal fracture, I believe that in the majority of instances the pressure symptoms may be completely and permanently warded off.

Two years ago there was brought to the hospital a small boy who had fallen, as a child falls, head downward, from a third-story window to a basement below. His skull had been fissured in all directions, like a fallen egg-shell, and when first seen he was nearly in the "Lähmungsstadium" of compression—comatose, with a slow pulse of very high tension, a Cheyne-Stokes respiration, and convulsive spasms of the Kussmaul-Tenner type, resembling those seen during the period of cere-

bral anæmia in the experimental conditions. An immediate operation—laying back the tense scalp by anterior and posterior flaps, such as are made on the autopsy-table, with elevation of large plates of depressed bone and the removal of many fragments—resulted in the immediate relief of all bulbar symptoms. The brain itself, however, was so hemorrhagic and disorganized that there seemed to be little hope of its ever returning to a functional condition. For three weeks the patient lived the life of a spinal animal, unconscious and with absolutely no spontaneous movement, but with normal pulse and respiration and normal visceral reflexes, so that he would swallow when liquid was put in the back of his mouth. Not until twenty-one days of this absolutely passive state had elapsed was there evidence of the return of some cerebral activity by a slight motion in one hand and the occasional feeble elevation of the eyelids. He ultimately made a complete recovery, but had narrowly escaped at the time of operation the period of vasomotor paralysis.

It must be remembered, however, that the sudden removal of pressure from the brain when the blood-pressure has been forced to considerable heights may be followed by a paralysis instead of a release from the major compression symptoms. The occasion of this is readily brought out by post-mortem examinations, which, under such circumstances, oftentimes discloses a brain and medulla of a uniform cherry-red color, from the widespread extravasation of blood due to the multiple rupture of the minute bloodvessels. The external supporting pressure of the high intracranial tension has been suddenly removed, leaving the internal or intravascular pressure too great for the strength of the vessel walls.

An opportunity was recently offered, in Dr. Osler's wards, to follow through the paralytic stage of compression a patient for the relief of whose condition operative interference had been refused. A brief relation of the clinical observations made in this case may more closely bring into line the bedside observations with some of these experimental experiences.

The patient was brought to the hospital with the history of indefinite mental symptoms which had extended over a period of some weeks. He had become somnolent and apathetic, and had gradually lost the use of the entire left side. Examination showed an individual in stupor who would not reply to interrogation, but could be roused sufficiently so that he would show his tongue and open his eyes. The eyeballs themselves seemed somewhat prominent and the lids somewhat congested. A bilateral choked disk of advanced degree was present. There was apparently complete motor paralysis of the left arm and leg, with some anæsthesia. The right leg was also paralyzed, and the increased muscular tonicity of the right arm showed that paralysis might

be expected there. There was no acceleration of the pulse (80). The respiratory rhythm was unaltered. There was no abnormal increase in blood-pressure. It was evident that some local process was present in the right brain, the tension from which was transmitted in sufficient degree to the opposite hemisphere to cause profound alterations in circulation, as shown by the pressure paralysis and by the change in the fundus oculi. No symptoms, however, had yet given evidence of any circulatory disturbance in the remote situation of the bulb. At the end of five days, with a gradually deepening stupor, the medulla began to show signs of involvement, chiefly as an increased tension of the pulse. As in the experimental conditions, when the intracranial tension about the bulb is slowly and gradually brought to the neighborhood of the blood-pressure the latter may rise to counteract its effects, without the production of the slow vagus pulse and deliberate respiration almost invariably seen in more rapid processes.[1]

At the time of this beginning period of bulbar involvement a needle was inserted in the lumbar meninges and the pressure there registered —as I believe the pressure should always be recorded in case of lumbar puncture—by connecting a long glass rod of small bore with the needle, and by measuring in this way the height to which the column of fluid rises. It should normally equal the venous blood-pressure, about 4 mm. of Hg. In this particular case the fluid rose to a height corresponding to 44 mm. of mercury. Evidently the local increase in tension was transmitting its effects, although in diminished degree, to the remotest part of the cerebro-spinal space. The blood-pressure meanwhile measured between 180 and 200 mm. of mercury. By means of the blood-pressure apparatus, furthermore, the rhythmic waves of arte-

[1] For the proper estimation of gradual alterations in arterial pressure in clinical cases reliance should not be placed alone on the palpating finger any more than that the hand should be depended upon for the determination of a patient's temperature. The arterial pressure should be spoken of in figures, just as is the temperature and pulse-rate, and not in the loose way generally employed, in which we describe it as "weak," or "thready," or "bounding," etc., as the case may be. For this purpose we should have a plotted record of the pressure, since it is of far greater importance in all conditions, surgical and medical, than is the pulse-rate which we so studiously record. There are to-day simple forms of apparatus which may be easily set up and employed for practical purposes. The particular form which has been introduced into the wards of the Johns Hopkins Hospital was demonstrated. It requires no particular familiarization for its satisfactory employment. It represents the Riva Rocci apparatus in its simplest form, and consists of a distensible rubber armlet made to encircle the arm or leg, and which may be inflated until the peripheral pulse is shut off. The degree of tension necessary to accomplish this is registered on a simple mercury manometer inserted between the armlet and the pump used for the inflation. It is true that this apparatus gives us simply a measurement of systolic pressure, and as Brush and Howell have recently emphasized, such a systolic pressure does not represent the mean blood-pressure. As a matter of fact, however, only in exceptional instances is there an inequality in the variations of systolic and diastolic pressures so marked as to be of clinical import, and the simplicity of this apparatus as a means of obtaining one of them, the systolic, renders it of inestimable value as a clinical "instrument of precision." The Mosso apparatus registering diastolic pressure, the Gärtner tonometer, and the Hill apparatus with spring manometer, all possess for clinical purposes insurmountable disadvantages.

rial pressure could be easily made out. If the encircling band of the apparatus about the upper arm was held at a sufficient degree of tension to collapse the brachial artery, and so to obliterate the radial pulse at the wrist, after a few moments the pulse would appear for a short time and then once more fade away, but only to again reappear in this wave-like fashion. A similar and associated periodicity of respiration, furthermore, was seen to be taking place. Coincident with the crests of the blood-pressure waves occurred active periods of respiration, with at the same time a wide dilatation of the pupils and the swinging out of the eyeballs in conjugate deviation toward the side of the lesion. Coincident with the periods of low blood-pressure occurred the shallow respiratory action, and at such times there was usually an asymmetrical condition both as regards the size of the pupils and the position of the axes of the globes.

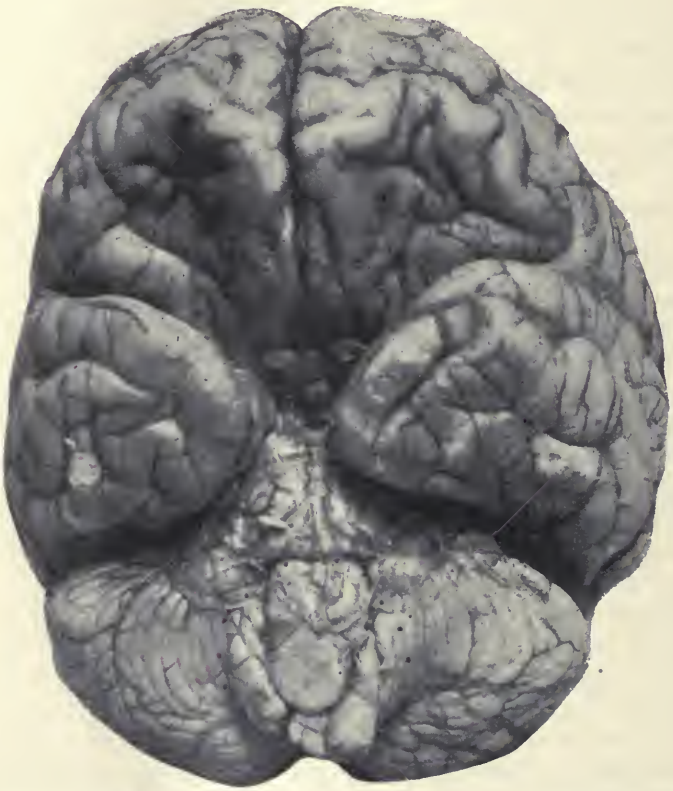
Other and detailed analyses of symptoms I will pass over, merely wishing to draw an analogy with the experimentally induced processes of like nature. After about twelve hours of the high-tension pulse the vasomotor centre began to show signs of failure, the blood-pressure gradually dropped, the tension of the cerebro-spinal fluid in the cord fell considerably, as was told by a second lumbar puncture,[1] and the patient finally died from a respiratory failure, leaving the rapid-running, uncontrollable pulse of complete vasomotor relaxation to end the story.

Clinical corroboration of these experimental data which have been given might be drawn from a multitude of cases. An instance of the effect of local compression in the near neighborhood of the medulla was given by a recent case of cyst of the cerebellum which was seen in Dr. Osler's clinic. As has been stated, the local compression effects are most pronounced in the immediate vicinity of the compromising body. A growth in the cerebellum consequently is one which is apt to suddenly throw out of action by circulatory embarrassment the regulatory centres in the medulla. This may occur before other absolute evidence of its presence has been given, and in this particular case the diagnosis of an intracranial growth had not been definitely made. From the remote-

[1] Just how much stress may be laid upon the measured tension of the fluid in the spinal meninges for purposes of diagnosis and for the estimation of degrees of concomitant intracranial tension, I am unable at present to state. Certainly in localized intracranial processes it does not represent, as v. Bergmann's theory would indicate, the degree of "Hirndruck," as this case clearly evidences for a general compressing force of 44 mm. of mercury is by no means a fatal one. Presumably the dislocation downward of the brain, and consequent blocking of the foramen magnum, plays a certain part in shutting off the spinal fluid from the effects of tension existent within the cranial chambers. Nevertheless, in the cases of cerebral tumor in which I have performed lumbar puncture, there has been some abnormal increase in the tension of the spinal fluid. In the clinical states representing conditions of general compression, such as meningitis, acute cerebral œdema, subdural hemorrhage, etc., the tension of the fluid in the lumbar meninges more nearly corresponds with the intracranial tension which is producing the compression symptoms.

ness of the process to the ophthalmic veins the vascular disturbances of compression due to venous stasis were not transmitted to the eye-grounds, which were normal in appearance. The patient complained of some occipital headaches, of weakness, and there was some exaggeration in the deep reflexes. A lumbar puncture had been performed, evidencing but slight, if any, increase in the tension of the fluid in the spinal men-

FIG. 10.



Photograph of the base of the brain of a case which died from compression effects of a cerebellar cyst. The dotted line corresponds to the imprint of the edge of the foramen magnum. A mould of the upper part of the spinal canal is made by the included portion of cerebellum and medulla.

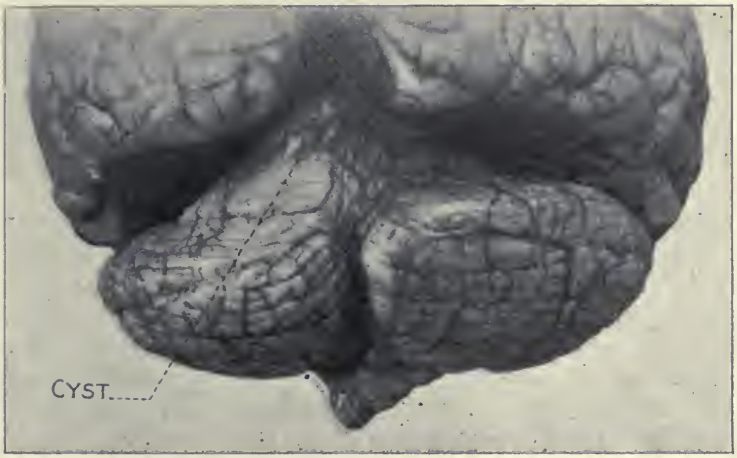
inges. The patient unexpectedly one night passed into the stage of medullary involvement, with loss of consciousness, a slow vagus pulse, stertorous respiration, and a very high blood-pressure, which, unfortunately, owing to the urgency of the case, was not registered, but which was said to have occasioned an almost incompressible pulse. In a short time the vasomotor mechanism gave way, respiration ceased in conjunction with the fall in blood-pressure, and, as in the majority of

these conditions, the heart continued to beat for some time after death had actually ensued.

The accompanying photographs (Figs. 10 and 11) show in this case the marked dislocation downward into the foramen magnum of the medulla, together with a surrounding ring of cerebellum. Whether this dislocation, as has been suggested in the case of lower animals, could allow the medulla in any way to escape from the compression effects, or whether it would actually increase their action, must remain a question of uncertainty.

There are other points of interest concerning which my curtailed time forbids making more than passing mention. The pulsation of the brain, for instance, which, on Mosso's principle of the plethysmograph,

FIG. 11.



Posterior view of same, showing cyst and portion of cerebellar mould of spinal canal.

increases *pari passu* with the increase of intracranial tension, becoming most marked when the pressure from without and the blood-pressure correspond, may give the surgeon at times valuable data. When transmitted to the artificial cerebro-spinal fluid, as in the experiments, it may even exceed in the length of the manometric excursions those of the arterial pulse itself. It is perhaps worthy of note that the character and height of this pulse-wave do not correspond exactly to that of the arterial pulse.

Of interest also is the question of vasomotor nerve supply to the cerebral vessels themselves. Undoubted experimental evidence of their presence has baffled physiological investigation, although the anatomist seems to have already prepared the ground by a histological demon-

stration of their presence. On the clinical side also the existence of such nerves would be favored by instances such as the recurring appearance of paresis or aphasia in cases of Raynaud's disease in association with evidences of local vasomotor spasm of other territories of the body. If, however, one may draw conclusions from the mechanism of the vasomotor centre above described, a mechanism which constricts the vascular fields of the body, thus raising the blood-pressure in order to supply an anæmic medulla with blood, a corresponding narrowing of the cerebral vascular field from the same stimulus would seemingly counteract the conservative object of this mechanism. Contrary to the positive statements of many, substances like epinephrin will blanch the pial vessels over the area of its application, as will occasionally a jet of cold water against the brain or the faradic current used for cortical stimulation. Whatever part, however, the cerebral vasomotor system may play, if such a system there be, it certainly is controlled from centres and by influences other than those which call into play the vasoconstriction in the peripheral and intra-abdominal fields.

From this rather superficial review of the alterations in the cerebral circulation as they are influenced by varying degrees of compression some effects stand out with especial prominence.

In the first place, the venous stasis, which becomes apparent on but a moderate increase of the tension, fortunately gives early evidence of itself in the eye-grounds except in those cases of local compression, in posterior basic meninges, for example, so remotely situated that the compression effects are not readily transmitted as far as the cavernous sinus and ophthalmic veins. Furthermore, local pathological processes, such as are confined to the hemispheres, may be responsible for local circulatory disturbances sufficient to cause a cessation of function of a large part of the forebrain without leading in any way to a corresponding implication of the medulla. When, however, the local process is in the near proximity of, or, if remote, when its effects are so far reaching that the vital centres of the bulb are compromised, the one symptom which with regularity is called forth, and which betokens a serious alteration in the local circulation, is a persisting rise in blood-pressure, which may or may not be associated with a pronounced vagus pulse, with rhythmic alterations in blood-pressure and with a retardation or periodicities of the respiration approaching a Cheyne-Stokes type.

The first and minor symptoms of compression are found in association with varying degrees of intracranial venous stasis, the major symptoms of "Hirndruck," with an approaching capillary anæmia of the medulla.

A REPORT OF NINETY-TWO CASES OF THERMIC FEVER TREATED AT THE PENNSYLVANIA HOSPITAL IN THE SUMMER OF 1901.[1]

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AND

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The 92 cases of thermic fever upon which this report is based occurred in the service of the writers at the Pennsylvania Hospital, Philadelphia, during the extremely hot weather of July, 1901, and includes all those showing a temperature of 100° F. and over, upon admission, and does not include a large number of cases of heat exhaustion. These records, unfortunately, are far from complete, as the extra work thus suddenly thrown upon the hospital staff made it impossible to keep full and accurate notes, the question of treatment being the one of paramount importance. Enough data have been secured to warrant, in our opinion, this report. The amount of work may be appreciated when it is known that 1,000 cases of all kinds were admitted into the wards during the first week of July.

Seventy-six cases were admitted on the first three days of July, 1901, with 19, 26, and 31 cases, respectively. These three days followed three very warm days in June, with a maximum temperature varying between 96° F. and 99° F. The maximum and minimum temperatures of these three days in July were as follows:

	Maximum.	*Minimum.*	
July 1 . .	100	82	
" 2 . .	102	94	(These days also showed a high humidity.)
" 3 . .	105½	80	

These records were kept at the Pennsylvania Hospital, and although higher than the official records kept by the Weather Bureau, probably represent more closely the temperature experienced by the great mass of people.

The first case was admitted on June 23d, while from the 6th to the 16th of July no case was admitted owing to a decided fall in the temperature.

The time of day at which the greatest number were received was from 11 A.M. until 5 P.M., the maximum being from 3 to 5 P.M., towards the close of the working day, showing the effect of fatigue and long exposure.

But little time probably elapsed between the onset of the attack and the admission of the patient into the hospital.

[1] Read at the meeting of the Association of American Physicians, May, 1902.

Sex. Thirty-one of the cases treated were females, as against 60 males. This is an unusually large proportion of women, but it should be mentioned that the most severe cases were usually found in men.

Age. The extremes of age of the cases were from seven months to over seventy years, the average being about thirty-seven years. Among the elderly patients might be mentioned one aged seventy years (died, temperature 110⅘° F.), one aged seventy-three years (cured, temperature 108° F.), one aged seventy-five years (cured, temperature 107⅗° F.), and one aged seventy nine years (cured, temperature 108° F.).

Color. Six of the number were negroes, emphasizing the previously well-known immunity of this race.

Nationality. The largest proportion of patients were natives of the United States.

Of the patients showing a temperature of

100° F.	to	and	not	including	101 F°.,	there	were	.	.	.	24	cases.
101	"	"	"	102	"	"	.	.	.	8	"	
102	"	"	"	103	"	"	.	.	.	10	"	
103	"	"	"	104	"	"	.	.	.	4	"	
104	"	"	"	105	"	"	.	.	.	4	"	
105	"	"	"	106	"	"	.	.	.	4	"	
106	"	"	"	107	"	"	.	.	.	8	"	
107	"	"	"	108	"	"	.	.	.	6	"	
108	"	"	"	109	"	"	.	.	.	8	"	
109	"	"	"	110	"	"	.	.	.	2	"	
110	"	"	"	111	"	"	.	.	.	8	"	
111	"	"	"	112	"	"	.	.	.	3	"	
112	"	"		113	"	"	.	.	.	1	"	
				"High"	.	.	.	.	.	1	case.	
				"Unknown"	.	.	.	.	.	1	"	
										92	cases.	

No patient with a temperature under 106° F. died, but above this temperature the proportion of "cures" to deaths was as follows:

106° F.	to	107° F.	6	cures	and	2	deaths.[1]	A mortality of 25 per cent.
107	"	108	5	"	"	1	death.	" 15.6 "
108	"	109	7	"	"	1	"	" 12.5 "
109	"	110	1	"	"	1	"	" 50 "
110	"	111	5	"	"	3	deaths.	" 37.5 "
111	"	112	0	"	"	3	"	" 100 "
112	"	113	0	"	"	1	death.	" 100 "

No case with a temperature of 111° F., or over, recovered.

The total number of deaths occurring numbered 13, a mortality of 14.4 per cent. The case recorded as of "unknown" temperature died, and is not included in the above percentage of deaths.

Convulsions. These were noted in 14 cases and were generally of severe type. They were largely tonic in character, and did not resemble those seen in epilepsy or in uræmia, and usually occurred in

[1] These cases, which so inordinately raise the percentage mortality for this class, are detailed somewhat below.

those showing a temperature of 106° F. or over. Retraction of the head was seen in several cases, with or without convulsions, and some showed marked excitement after the temperature was reduced, and struggled violently.

Five of the cases were not convulsed on admission, but showed this symptom after the temperature was reduced by rubbing with ice, with or without bleeding and transfusion. These cases will be spoken of again under the heading "Treatment." Some of the convulsions were unusually severe and tetanic in character. In one case where the temperature only reached 101⅘° F. there were marked tonic spasms of the hands and feet after consciousness was regained.

Mental State. Patients showing a temperature of 106° F., and over, were generally unconscious when brought to the hospital, although one case was unconscious with a temperature of only 101⅘° F., while the term "semiconscious" was recorded for many having the lower grades of temperature. Marked cerebral excitement, even requiring restraint, was seen in a few cases after the reduction of temperature was accomplished.

Pupils. Careful records of the state of the pupils were not kept. In 5 cases the pupils were noted as "contracted" in patients whose temperatures varied from 104⅕° F. to 111⅖° F. In 2 cases with a temperature of 110° F. the pupils were noted as "dilated." Nystagmus, both horizontal and vertical, was noted in 1 case with a temperature of 108° F.

Knee-jerks. The condition of the knee-jerks was examined in 6 cases where the temperatures varied from 101⅘° F. to 110⅘° F. These patients were all unconscious when admitted, and had either retraction of the head or convulsions, which were either tonic and local, or chronic and general. The patient whose temperature was 101⅘° F. was unconscious on admission, but upon a return to consciousness after treatment had tonic contractions of the hands and feet, and showed a marked increase in the knee-jerks, as might be expected from the reinforcement. The remainder of the cases had a total absence of knee-jerks. It is not noted at what time of the patient's stay in the hospital this symptom was noticed, except in 1 case. In this case the temperature reached 110° F., the man was profoundly unconscious and had dilated pupils, there was also retraction of the head, but at no time were there any true convulsions. He rapidly responded to the ice-rub and did so well that no other treatment was instituted. His knee-jerks were entirely absent on the day of his discharge, three days after his admission. An examination recently made of this patient showed the knee-jerks to be present, although a little less pronounced than usual. A second patient whose temperature also reached 110° F., and in whom this absence was noted, has upon a recent examination showed a return of this reflex.

This case had violent convulsions after his temperature had been reduced by treatment.

A third case, that of a powerful negro, was admitted totally unconscious, with a temperature of 108° F. This man also had general tetanic convulsions coming on after the reduction of temperature following the use of ice, bleeding, and transfusion. On the first day of his stay in the hospital it was found that he had absent knee-jerks. On recent examination of this patient, who still claims to be as powerful as ever, it was found that only the slightest possible knee-jerk could be obtained by reinforcement. His station was good, and he had no other evidence of disease of the spinal cord that could be detected.

It is worthy of note that two of these patients state that since the thermic fever they have been impotent, although before their attack they had been possessed of full vigor.

Urine. The urine was examined in 10 cases, but usually not until convalescence had set in, or the case had been retained in the hospital for several days. In 4 of these cases, with temperatures of 100⅘° F., 107° F., 110° F., and 110⅘° F., albumin in varying amount, with granular casts, was found. In 1 case granular casts, without albumin and in another albumin in small amount without casts was found. The urine record of the case showing a temperature of 110° F., an occasional hard drinker, aged forty-eight years, was as follows: specific gravity 1019, acid, albumin, no sugar, dark granular casts containing blood.

This case was lost sight of until very recently, when an examination of the urine gave the following results: specific gravity 1015, distinctly alkaline, light yellow, cloudy, albumin and sugar negative, triple phosphates, calcium phosphates and amorphous phosphates, making it probable that the thermic fever and not the previous physical condition had been the cause of the renal disturbance. In 2 cases sugar was found, 1 having a temperature of 102⅕° F., which was probably a true case of diabetes mellitus; in the second, with a temperature of 108° F., the "sugar" disappeared a few days after its discovery.

Habits. The previous habits of the patient seemed to have an important bearing upon the result, and to affect the latter unfavorably. In the mild cases no alcoholic history was obtained, possibly from lack of interest in the case or from press of more important work, and all recovered. In the severe cases 50 per cent. of those recovering gave an alcoholic history, and of those who died the same percentage was found. This record as to the use of alcohol was not made in all of the severe cases.

Blood. It was thought that many if not all of the symptoms of thermic fever might be due to dehydration of the blood from prolonged and excessive sweating. According to Vincent (Bordeaux *Thesis*, 1887), Chossat in 1868 first broached the theory that thermic fever was due

to excessive sweating and loss of water by evaporation from the lungs. A considerable number of experiments have been performed upon animals to show the effect of exposure to heat upon the composition of the blood. A few of these may be worthy of citing.

Vincent, in experimenting on animals, found an increase in the hæmoglobin percentage and an augmentation of the number of red cells by 300,000 per cubic millimetre.

Grawitz (*Zeitsch. f. klin. Med.*, 1892, Bd. xxi. p. 465), also by animal experimentation, found the specific gravity of the blood usually progressively increased by sweating, although in a small number of cases there was a lowering of the specific gravity. In 1 case the specific gravity rose from 1040 to 1051.

Löwy (*Berl. klin. Woch.*, 1896, No. 41) exposed rabbits to heat for twenty-four hours and found a diminution of the thickness of the blood and dry residue, but all of the tissues "poor in water." The blood serum, on the other hand, was found to contain less water than normal, and while the specific gravity of the blood was found to be diminished, that of the serum was decidedly increased. He attributes these alterations to changes in the vascular tonicity.

Friedländer (*Fortsch. der Med.*, July, 1897, p. 521), also by experimentation, found an increase in the number of the erythrocytes, still more marked increase in the number of the leucocytes, and an increase of the specific gravity and of the thickness of the serum.

Scagliosi (*Virchow's Arch.*, 1901, Bd. clxv., pp. 15 to 41) placed guinea-pigs in the sun in August and September and found an increase in both the erythrocytes and the leucocytes, especially the latter. He concludes from his experiments that "the blood shows an excessive increase in thickness of all formed elements, and of the neutrophilic cells. In some cases, also, a leucocytosis was present."

We can find but little evidence as to the condition of the blood in human beings exposed to excessive temperatures. Alexander Lambert (Loomis-Thompson, *Amer. Syst. of Practical Med.*, 1898, vol. iii. p. 873) states that in 1896 the hæmoglobin value in 12 cases examined ranged from 85 per cent. to 125 per cent. Leucocytosis was present and the leucocytes contained pigment. The changes described were present in those whose temperatures did not reach 105° F., as well as in those with higher temperatures.

Owing to the small amount of exact knowledge as to the condition of the blood in human victims, and owing to our thought that in changes in the blood an explanation of at least some of the symptoms might be found, it was our intention to pay particular attention to the condition of the blood in any cases of thermic fever brought to the hospital during the past summer. Unfortunately, the hot days caught us unprepared for as complete investigations as we should have wished. The

blood was examined in 17 cases. Among these, curious irregularities were found, making it impossible at present to do more than summarize them. In bleeding patients with sunstroke the dark color of the blood, not resembling ordinary venous blood, was noted. We had, therefore, hoped to obtain some facts regarding spectroscopic changes. Owing to the impossibility of at once obtaining the necessary apparatus a spectroscopic examination was made in only 2 cases, and in both of these the absorption band of hæmoglobin was found alone, although the appearance of the blood led us to think that possibly methæmoglobin might be present. The specific gravity was estimated in 4 cases; in 3 the specific gravity was 1055, 1056, and 1057, respectively. The fourth showed a specific gravity of 1074. This latter blood was from a patient who died two hours after admission in spite of everything that could be done for her. In this same patient the hæmoglobin value was 83 per cent., and the erythrocytes numbered 5,040,000, it being the only case in the series in which the erythrocytes were increased. The hæmoglobin was estimated in 5 other cases and amounted in these to 67, 85, 68, 74, and 68 per cent. The absence of constant high specific gravity and of increase in the number of the red cells rather surprised us, as we expected to confirm some of the results reported by others in this direction. The number of the leucocytes varied greatly. All but 3 of the severe cases examined showed at some time a high leucocyte count, but there was considerable irregularity in the time and duration of the rise. In some cases a leucocytosis of from 12,000 to 13,000 was noticed on admission. The increase was usually in the polymorphonuclears. In most of the cases in which there was a primary rise in the number of leucocytes followed by a fall and then a second increase in number, delirium tremens developed. No experiments regarding the toxicity of the serum for animals were made.

These results surprised us, especially as at the time when they were being obtained in the Ayer Laboratory of the hospital we felt justified in believing that the injection of large quantities of normal salt solution was saving some lives. To this view we still adhere.

It is a well-known fact that the treatment employed in thermic fever, viz.: cold baths, hypodermoclysis, transfusion, and bleeding, can alter materially the normal proportion of the elements of the blood.

In our cases, unfortunately, the examinations of the blood were made without any definite relation in time to the treatment as mentioned above, which might alter the findings, and in consequence vitiate somewhat the conclusions drawn, and explain in some degree the apparent discrepancies. Two explanations of the apparent contradiction of the clinical and laboratory results in our cases present themselves. It seems to us conceivable that the absence of marked elevation of the specific gravity of the blood, of its hæmoglobin contents, and of the

number of the erythrocytes may be due to the rapid passage of water from the tissues to the blood, as is seen in Hay's treatment of pleurisy with effusion, in removal of anasarca by eliminating methods, and in cholera. This theory it would be difficult to prove. A very plausible explanation of the benefit of the treatment used is that made practically certain by the work of Levene and Van Gieson as to the increased toxicity of the blood. Lambert (*Medical News*, July 24, 1897), who quotes these authors, also found that serum from the blood of some thermic fever patients caused the death of rabbits in doses of 9 c.cm. within an hour.

The serum removed at once was found by him to be less toxic to animals than was the serum of the same patients twenty to forty-four hours later.

If this auto-intoxication be the true explanation of the phenomena of thermic fever, the beneficial effects of hypodermoclysis or intravenous injection of saline solution can be readily explained by the "washing of the blood."

Treatment. The treatment of the mild cases (100° to 102° F.) can be dismissed with a few words. In this class there were 32 cases, although there are not included a large number of patients, the notes of whose condition are insufficient to allow of their classification. The indications for treatment in this class of cases were simply rest in a cool portion of the ward, the application of an ice-cap, the administration of the aromatic spirit of ammonia, or alcohol, or strychnine, and occasionally a cool bath. The cases whose temperature ranged from 102° F. to 106° F., numbered 22. These showed more severe symptoms than the milder group, and an approach to the symptoms of the higher temperatures was occasionally noted. The treatment of this class consisted in the administration of stimulants, as they were required by the state of the pulse, the application of an ice-cap, and either a cold bath or, in the more obstinate cases, the employment of rubbing with ice until the temperature approached the normal. None of these cases died. Cases with a temperature between 106° F. and 108° F. numbered 14. Three of these died, one being a man with a temperature of $107\frac{3}{5}$° F., the second a man whose temperature was 106° F. on admission, and who later died with well-marked typhoid fever, and the third being a woman in whom alcohol undoubtedly played a more prominent part in causing death than did the result of heat. These cases were taken to the heat tent, where they were treated in the manner mentioned below in considering the cases of still more severe type, where the temperature was 108° F. or over. The cases whose temperature reached a point equalling or surpassing 108° F. numbered 22. Of these 9 died. One case of "unknown" temperature died; 1 case with "high" temperature recovered.

All of the cases except those with a temperature below 102° F. were treated in a large tent open at the ends, covered with a fly and having an asphalt graded floor. The fly was kept constantly moist by means of a lawn-sprinkler placed on the ridge-pole, an expedient that did good service and did not seem to increase the humidity. Within the tent there were two large electric fans constantly working, and faucets were conveniently arranged for the furnishing of cold water. The tent was furnished—aside from the beds—with a movable bath-tub and a medicine cabinet. In a few cases the hose was employed by directing a stream of water from a distance over the patient's body. The experience this summer in the few cases in which this method was employed rather tended to confirm the observation of former years. While this method of applying cold seemed to aid respiration it rather increased the tendency to convulsive movements. The use of the bath-tub was soon abandoned owing to the impossibility of reducing the temperature by this means with sufficient rapidity to at all keep pace with the number of admissions. In addition to this, it required more physical labor to lift the patient in and out of the tub, and to practice friction on the surface than was the case with rubbing with large pieces of ice which acted more rapidly and equally beneficially in reducing the temperature. In many cases the temperature fell rapidly to normal after rubbing with ice from ten to fifteen minutes. With the fall of temperature consciousness frequently returned, and the patient required no further attention. Frequently with the return of consciousness delirium occurred, which was at times quite violent, and in a few cases persisted for some hours. Exceptionally a second rise of temperature occurred, but seldom to such a height that it was not controlled perfectly by either a cold sponge or one cold bath.

The question as to the advisability of bleeding in cases of sunstroke has been much discussed. As a routine measure of treatment we would by *no means* advise it. In certain cases, however, where with the fall in temperature there was not a corresponding decrease in the other grave symptoms, as well as during the existence of high temperature in desperately ill cases, we found it beneficial. Feebleness of the pulse was not considered a contraindication to this procedure, and in some cases the character of the pulse improved as the blood flowed from the arm. The measure was employed in 8 cases. Of these 4 died. In regard to bleeding, as well as in regard to the two measures still to be noticed, it is to be remembered that it was only employed in the most severe cases. The mortality percentage among cases in which venesection was practised was, therefore, necessarily high. It is our belief that in no case did the removal of blood do any harm, and in many cases the abstraction of blood was followed by an improvement in the circulation, in the character of the breathing, in the color of the patient, and in

the mental state, due either to this or to the introduction of saline solution. The amount withdrawn varied from 6 to 20 ounces.

The employment of normal saline solution introduced by various channels was first advocated upon purely theoretical grounds. As has been said above, while there is some evidence that diminished serosity is present in some cases, none of the tests which we were able to employ to confirm the existence of this condition enabled us to assert its presence in our cases. This will be seen in the detailed report of certain cases, with the account of the blood picture in the cases wherein this was examined. Hypodermoclysis was employed in 5 cases. All of these were of the severest type. Of this number 1 died. It was found that this method of introducing salt solution occupied too much time to be perfectly satisfactory. We believe that valuable time may be lost in getting the saline solution into the circulation by this measure, and it has the additional disadvantage of requiring the undivided attention of at least one person during ten or fifteen minutes at a time when rapid work is essential even with a large staff of assistants. Intravenous injection of normal saline solution was found to be more applicable because of the greater rapidity with which the blood was affected, and also because of the saving of time on the part of the assistants. This measure was employed in 10 cases; of these 4 died. The operation was readily performed and took but little time, because in the large majority of cases the same incision in the median basilic vein employed for bleeding was at once used for the injection of the saline solution. Although the conditions were by no means favorable for thorough antisepsis, in spite of all efforts to accomplish this, it is to be noted that in no case did any untoward results follow from infection of the wounds made either by the lancet or by the needle.

Our conclusions in regard to the value of the last three measures are that in some cases where the other symptoms do not improve, as the temperature is reduced by rubbing with ice, the abstraction of blood from the median basilic vein to the extent of from 10 to 18 ounces causes the pulse, respiration, and color of the skin to improve. On four occasions convulsions occurred after bleeding and transfusion. While it is difficult to estimate the value of the introduction of normal saline solution, we see no evidence of its having any harmful action, and usually felt assured that the patient's condition was improved by one or the other of these procedures.

Among the sequelæ should be noted 1 case of jaundice coming on three days after onset in a case having a temperature of 110⅘° F., where there was also delirium tremens.

While from the rapidity with which these patients were brought to the hospital we were unable to make as close a study of them and to keep as careful records of their condition as we wished, we make this

report in the hope that in the future we may be able to more completely study some of the many points of interest in this condition. It seems to us that valuable results might follow the further study of the condition of the eye-grounds, the specific gravity of the blood, its spectroscopic examination, a frequent estimation of the leucocytes and a more complete study of the toxicity of the blood serum. We also believe that the introduction of normal saline solution in large quantities into the body has a beneficial result, although the few examinations of the blood which we have had made do not directly point to the method by which it causes relief to symptoms. Possibly the toxicity of the blood, a subject into which we could not enter, may explain its supposed beneficial effect.

Abstracts of Certain of the Cases.

Two of the oldest patients were aged respectively seventy-three and seventy-nine years, each of them being admitted with a temperature of 108° F. The oldest of these showed a rapid drop in temperature with improvement in all of his symptoms under rubbing with ice. The younger one, aged seventy-three years, did not recover so completely on rubbing, and was given a pint and a half of normal salt solution under each breast, with rapid improvement of all of his symptoms. In the older man, aged seventy-nine years, the temperature did not reach the normal point until four days after admission. Another patient aged seventy-five years, was admitted with a temperature of 107⅘° F., and rapidly improved under treatment. He has since responded to our inquiry regarding his health at present, that he is weak and unable to walk—possibly as much from the effect of years as from the effect of heat.

Case 1025 should be included in the list of sunstroke occurring in old people. He was a man, aged seventy years, with a temperature of 110⅘° F. on admission, and with all the signs of senile degeneration well marked. Notwithstanding the vigorous application of cold his temperature remained high, rising to 108° F. after the primary fall to about 103° F. He died on the fourth day with a continued high temperature. He was neither bled nor transfused.

Case 1258.—P. M., male, aged forty-one years; brought in with a temperature of 110⅗° F. He was bled 12 fluidounces, and transfused 1 quart. His temperature fell to 101⅘° F. in about four hours, and he regained consciousness. The next day all he complained of was a slight headache. His knee-jerks were absent. He was discharged the next day feeling perfectly well. On the day of admission, hour not mentioned, his leucocyte count was 7500, and when discharged the count was also 7500.

Case 1138.—W. W., male, aged thirty-eight years; a moderate drinker of beer and ale, was admitted with a temperature of 106⅗° F., conscious, and with a diffused red rash over the body; he was given an ice-rub, and in two hours his temperature had fallen to normal, and

with the exception of a headache he felt well. He was discharged the next day. His blood examination on admission showed leucocytes, 9200, and on the following day 9850.

Case 914.—H. C., male, aged fifty-two years; admitted June 23, 1901, with a temperature of 104° F., conscious, although somewhat stupid and with severe headache and backache. His pupils were equal and contracted. He was given ice-rubbing and bathing. His temperature did not fall until the eleventh day, having been kept up by an intercurrent attack of enteritis. A leucocyte count taken on the day of admission, immediately after the ice-rub, gave 16,000. On the following day the specific gravity of his blood was 1055, the hæmoglobin 68 per cent., and the erythrocytes 4,906,000.

Case 1025.—J. W., male, aged seventy years; brought into the hospital in an unconscious condition, with a temperature of 110⅘° F., pulse feeble, pupils contracted, face cyanosed, head retracted. He was given an ice-rub, which was continued for over an hour, by which time the temperature had fallen to 102° F., and he became partially conscious, although unable to speak or understand. His arteries were very atheromatous, and arcus senilis was present. History of the previous free use of alcohol was not obtained. Knee-jerks were entirely absent. The urine was acid, with specific gravity of 1019. There was a ring of albumin, but no sugar. A few granular casts were found. After admission to the wards his temperature rapidly rose again, and on the fourth day he died despite the application of ice and the use of strychnine and nitroglycerin. The thermic fever in this case was merely the last chapter in a case of an old man with general arteriosclerosis. Before the ice-rub his blood was examined with the following result: specific gravity, 1056; erythrocytes, 4,225,000; leucocytes, 13,500; hæmoglobin, 85 per cent.

On July 2d, the next day, 10.30 A.M., hæmoglobin, 75 per cent.; leucocytes, 9850.

On July 3d, time not given: leucocytes, 11,000. Differential count: polymorphonuclears, 94.8 per cent.; small mononuclears, 48 per cent.; large mononuclears, 4 per cent.; eosinophiles, none.

Case 1044.—L. R., female, aged twenty-seven years; brought into the hospital unconscious, and with a temperature of 110° F. Her temperature fell to 105° F. under ice rubbing in three-quarters of an hour; she then had two convulsions, which were relieved by one-quarter of a grain of morphine hypodermically. Later in the day she was transfused with normal salt solution. For hours she was in constant tetanic spasm, and at times was quite noisy. Her temperature subsequently remained above 105° F. She had constant ice-rubbing, with no avail. She died twelve hours after admission.

Case 1126.—C. Z., male, aged thirty-nine years; was brought into the hospital with a temperature of 110° F., unconscious and pulseless, with cyanosed face, contracted pupils, and retracted head. He was rubbed with ice, and bled 11 fluidounces, and then transfused with one and one-half quarts of normal salt solution. Strychnine and digitalis were given hypodermically, and one pint of cold water enteroclysis given. When his temperature fell to 105° F. he went into violent convulsions. Two hours after admission his temperature had fallen to 102⅘° F., and he regained consciousness, but by evening his temperature had risen to 106° F., and he was again unconscious. The next day consciousness

returned and he developed delirium tremens, and it was then learned from his friends that he was seldom sober. On the third day his temperature rose to 106° F., and he died with signs of pulmonary œdema. On the day of his death, the third day after admission, his blood gave the spectrum of dilute hæmoglobin only.

Case 1130.—J. B., male, aged forty-nine years; was brought in unconscious with a temperature of 110° F., with rapid pulse, widely dilated pupils, and retraction of the head. This patient responded so rapidly to the ice rub that neither hypodermoclysis nor transfusion was resorted to, the temperature falling to normal in three hours. His knee-jerks were absent.

Case 1129.—S. R., male, aged sixty-three years; was admitted unconscious, with a temperature of 106° F. and pulse 132; he had incontinence of feces, and was very restless and noisy. He was given an ice-water tub, but the temperature only fell one degree, when a profuse rash appeared. After an ice-rub the temperature fell to 102⅘° F., and two hours after admission it was nearly normal. The man subsequently developed delirium tremens. His urine contained no albumin, but did contain a few granular casts. On the fifth day his leucocytes were 12,125. He made a perfect recovery, and was discharged on the twelfth day.

Case 1141.—W. J., male, aged fifty-seven years; a heavy drinker, was brought in with a temperature of 109⅖° F., profoundly unconscious, with strong odor of alcohol on his breath. He was rubbed with ice, and bled 10 fluidounces and transfused one quart of normal salt solution. A hypodermic injection of strychnine ($\frac{1}{30}$ grain) was given. In three hours the temperature fell to 99⅘° F., he then went into severe convulsions, which were quieted by a hypodermic injection of ¼ grain of morphine. On the third day his temperature began to rise, and he went into delirium tremens, and after developing Cheyne-Stokes respiration died on the following day. The leucocyte count was made immediately after admission, during transfusion, and showed 13,200. On July 4th, the day after admission, the count was 9200, and on the 5th, while in delirium tremens, the leucocyte count was 14,650. His blood gave the spectrum for hæmoglobin only.

Case 1161.—S. B., male, aged forty-one years, colored; brought in unconscious with a temperature of 108° F. An extremely muscular man, weighing 195 pounds. He was given an ice-pack, was bled 8 fluidounces, and transfused one quart. In less than two hours his temperature had fallen to 99° F., he then went into severe tetanic convulsions, for which morphine was given. By evening he regained consciousness, and felt none the worse for his experience. His knee-jerks were absent. He was discharged feeling well in two days. When seen ten months later his only complaint was an absence of sexual power.

Case 1142.—M. K., male, aged fifty-three years; was admitted at 2.15 P.M. on July 3d, with a temperature of 108° F. He was not unconscious, but was very weak, his pulse being not perceptible, but after the administration of ammonia it became so, and was 140 per minute. Under the ice-rub his temperature rapidly fell and became normal in less than two hours. He was discharged the next day apparently well. His leucocyte count before the ice-rub was 12,160, but by the next day it had fallen to 8700.

Case 1014.—L. N., female, aged twenty-one years, was a large healthy-looking woman; she was conscious when admitted, and with a temperature of 107° F. She had been ailing for some days before admission, and had had a convulsive seizure of some kind on the night before. She was rubbed with ice and given ammonia, but her temperature did not fall to normal until the next morning. She was discharged well on the third day. Before the ice-rub the specific gravity of her blood was 1057. The other blood examination was made after the ice-rubbing, and was as follows: Hæmoglobin, 65 per cent.; erythrocytes, 4,166,000; leucocytes, 10,250. On the next day the leucocytes were 7350, and on the day of discharge 8860.

Case 1027.—E. G., male, aged forty-eight years, tailor. Patient was overcome in his shop and was brought into the hospital in an unconscious condition, having but recently recovered from a debauch. His pulse was rapid, hard, and tense, his temperature was 110° F., his face cyanosed, his body rather rigid, and his head retracted. Patient had involuntary fecal movements. He was rubbed with ice, but as the temperature did not seem to fall quickly under the icing, a vein was opened in the arm and the patient bled 6 fluidounces. Two quarts of normal salt solution were given into the opened vein, and in about one-half an hour his temperature fell to $104\frac{1}{5}$° F. He then went into a general convulsion, which, however, affected the hands especially. Five hours after admission the patient was still unconscious, with stertorous respiration, but with a better pulse. Under further treatment with ice his temperature fell to 102° F., but by evening, after admission into the ward, it rose to 105° F.; tub-bathing was resorted to, but it was not until next morning that he regained consciousness. The urine then showed: specific gravity, 1019; ring of albumin, no sugar, dark granular casts containing blood. His knee-jerks were entirely absent. There was no paralysis. He remained in the hospital eleven days, and was discharged well but weak. When seen ten months later he expressed himself as feeling perfectly well, with the exception of an entire loss of sexual power, a condition which had not existed before. His urine was normal. Immediately after the ice-rub his blood was examined and showed: hæmoglobin, 67 per cent.; erythrocytes, 4,352,000; leucocytes, 8500. The leucocyte counts in this case subsequently were as follows: July 2d, 12.30 P.M., 10,466; 3d, 10.30 A.M., 10,250; 5th, 6 P.M., 8160; 8th, 10 A.M., 6000.

Case 1039.—E. G., female, aged fifty-eight years; brought into hospital unconscious with a temperature of 108° F., with a full, strong pulse, and cyanosed face. A vein was opened in the arm, but before anything else could be done she died, fifteen minutes after admission.

Case 1033.—Aged seventy-nine years, was admitted with a temperature of 108° F., and recovered promptly under treatment. Twelve minutes after admission the leucocytes were counted and found to number 11,750; polymorphonuclears, 72.4 per cent.; small mononuclears, 23.2 per cent.; large mononuclears, 4.4 per cent. On the day after admission, without evident reason, the leucocytes numbered 15,000. On the third day after admission they numbered 6000; on the day of discharge, six days after admission, they were 8000.

Case 1038.—Was admitted at 4 P.M., on July 2d, with a temperature of $110\frac{2}{5}$° F. On admission the leucocytes numbered 14,800; on July 3d, 11,320; on July 5th, 7850. He was discharged cured July 5th.

Case 1123.—Aged seventy-three years, was admitted on July 2d, with a temperature of 108° F. Beside rubbing with ice he was given one and one-half pints of normal saline solution under the skin. On the day of admission the leucocytes numbered 8525. July 3d, without evident cause, they numbered 9730, on July 5th, 13,800. He was discharged cured on the latter date.

Case 1034 was almost moribund when he was admitted at 2.30 P.M. on the afternoon of July 2d. Unconsciousness was complete; respirations were shallow and almost imperceptible, the pulse could not be felt at the wrist, the face was cyanosed, and there was present the curious mixed tonic and clonic convulsion so characteristic of thermic fever. The temperature in the rectum was 112° F. For a few minutes artificial respiration was practised, and free stimulation was instituted from the beginning. After a few minutes of artificial respiration oxygen was employed with benefit, while the patient was being rubbed with ice. By means of ice the temperature was shortly reduced to 104⅘° F., but as the patient's cyanosis, complete unconsciousness, and extremely feeble cardiac action with shallow respirations continued, he was bled to the extent of 16 ounces. Bleeding improved the character of the pulse, but the other symptoms still remained in evidence. A pint of saline solution was introduced under the skin and another pint was injected into the median basilic vein. The respirations became deeper and the pulse stronger, while the temperature fell to 100⅘° F. It was hoped that he would recover in spite of the fact that the convulsive movements continued after the above measures had been adopted, but at 8.30 P.M. on the same evening the patient suddenly died, his temperature having again risen to 105⅕° F. not long before death.

Case 1037.—An Italian, aged thirty-five years, was in a dangerous condition when admitted to the heat tent at 3 P.M. on July 2d. His temperature on admission was 109⅘° F. He was completely unconscious, strongly convulsed, with cyanotic face, and passing involuntarily the characteristic yellowish liquid stools. Rubbing with ice soon brought the temperature down to 103⅘° F., but unconsciousness and convulsions and cyanosis continuing, ten ounces of blood were withdrawn from the arm, a pint of saline solution was introduced into the cut vein, and one and one-half pints were given by hypodermoclysis. The notes state that before treatment the pulse was imperceptible and the respirations had almost ceased. After the bleeding and salt solution injections the condition steadily improved, and at 6.30 P.M. the patient was conscious, sat up in bed and asked for a drink of water. In this case the temperature did not reach the absolute normal until four days after his admission, although there was no evidence of any reason for its continued elevation. Before being given his ice-bath the blood was examined as regards the number of leucocytes. They were found to number 8000; polymorphonuclears, 89.2 per cent.; small mononuclears, 9.6 per cent.; large mononuclears, 1.2 per cent. On the next day the leucocytes numbered 13,225. On July 5th (two days after the last count) they numbered 6350. Spectroscopic examination showed only the absorption band of hæmoglobin.

Case 1047.—This case showed several interesting features. When admitted, at 4 P.M. on July 2d, he was unconscious, with stertorous breathing, cyanosis of the face, clonic convulsions, and a temperature of 110⅘° F. He was vigorously rubbed with ice, and during this pro-

ceeding struggled violently, although still entirely unconscious. The rubbing quite rapidly reduced the temperature, but the other chief symptoms still continued, and 20 ounces of blood were removed from the median basilic vein, followed by the injection of a pint of normal saline solution, and the injection beneath each pectoral region of one pint of the same material. After the primary fall his temperature rose again to 106⅕° F., between 7 and 8 o'clock in the evening, but speedily fell on a repetition of the rubbing with ice. On the next day he was perfectly rational and conscious, but showed marked icterus of the skin and conjunctiva. Four days after admission a typical attack of delirium tremens began and continued for three days. In spite of the deep pigmentation of the skin no bile was present in the urine. At no time could enlargement of the liver or gall-bladder be detected, and there was no evidence of pain, although this feature might have been concealed by his delirium. The jaundice persisted until his discharge, in apparently perfect health, on July 15th, thirteen days after admission. His temperature was irregular until July 12th, when it remained at about the normal point. On the day of development of the delirium tremens his leucocytes numbered 7500. Two days later the number rose to 9640.

Case 1190.—This case, dying with a temperature of 106° F., cannot be wholly attributed to thermic fever. While it cannot be denied that many of her symptoms and probably the exact time of her death were determined by the effect of heat, she died as does a case of alcoholism, not at all as does one of thermic fever. Death, therefore, should not be attributed to the latter cause.

Case 1007 was a large, fat Italian, admitted with a temperature of 108° F. He was semiconscious and delirious. The pupils were dilated, and there was combined horizontal and vertical nystagmus. In spite of his high temperature his pulse had a fair volume, which was very unusual in cases reaching that degree of severity. After a bath in iced water and being rubbed with ice, there was noticed what has been frequently seen in these cases, a profuse papulo-vesicular eruption of a dull-red color over the chest and abdomen. The temperature fell to 103⅕° F. after treatment for half an hour, and at the same time the delirium was replaced by perfect consciousness and a rational state of mind. The urine examined on the day after admission showed a trace of albumin with a few hyaline and granular casts. The notes state that the reaction for sugar was present, but no statement is made in regard to the test employed. In this case the temperature did not reach normal until one week after admission, although there were no new signs or symptoms explaining this continuous elevation. On the day before his discharge, one week after his admission, the albumin was still present (0.3 per cent.), but no sugar was found. Immediately after his first bath the blood was examined and showed: erythrocytes, 4,720,000; leucocytes, 16,000; hæmoglobin, 75 per cent. Nine hours later (June 30th): erythrocytes, 4,700,000; leucocytes, 9000; hæmoglobin, 74 per cent. Next day (July 1st): hæmoglobin, 73 per cent.; leucocytes before ice-sponge, 9800; leucocytes after ice-sponge, 7228. July 2d: leucocytes, 9600; 3d, 7250; 5th, 8300.

Case 1013.—A woman, aged thirty-six years, had her blood examined ten minutes after her first iced bath. The specific gravity was 1074; hæmoglobin, 83 per cent.; erythrocytes, 5,040,000; leucocytes, 12,500. Death occurred about two hours after the above count was made.

Case 1022.—A baby, aged thirteen months, was admitted with a temperature of 107⅘° F. It died before anything could be done for it, five minutes after admission. From the notes it is not possible to say definitely whether or not this was a case of intestinal intoxication.

Case 1023.—Admitted with a temperature of 111° F., died within eleven minutes of his admission to the hospital before any energetic treatment could be adopted.

Case 1024.—Admitted with a temperature of 111⅖° F., died within half an hour of admission, never recovering consciousness.

Case 1048.—Was dying when admitted, with a temperature of 111° F. Death actually occurred two minutes after admission to the hospital.

CHRONIC EMPYEMA OF THE FRONTAL, ETHMOIDAL, AND BOTH SPHENOIDAL SINUSES;

WITH EXTENSIVE NECROSIS, COMPLICATED WITH ADENOMA OF THE POSTERIOR ETHMOIDAL AND SPHENOIDAL REGIONS.*

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The bone necrosis frequently associated with suppurative inflammation of the accessory sinuses is, in the earlier stages, so often overlooked by the practitioner that the following interesting record of failure and success is of much interest:

Mrs. ——, aged forty-eight years, consulted me in the latter part of January, 1899, complaining of excruciating headaches, referred to the left side of the head, but with greatest intensity over the left frontal region. The pain was constant and has been increasing in severity until now it has become unbearable. She attributes the beginning of the headaches to a period about eight years ago, when during the convalescence from an attack of pneumonia she was seized with a most violent pain in the head, which was accompanied by great prostration. The condition at the time was described by her physician as a congestion of the brain. The pain passed off, however, within forty-eight hours. From that time until the present she has been annoyed by the dropping of mucus into the nasal space. This has increased within the past two years; and recently the discharge has become very fetid, so much so that she suffers continually from morning sickness. With the increase in the discharge the headaches have also increased, but whenever there is a diminution of the flow of the secretion the headaches become intensified. On examination there was no swelling about the face; but there was great pain on firm pressure over the supra-orbital ridge, and very great sensitiveness on pressure just under the ridge near its inner angle.

A rhinoscopical examination disclosed only a moderate amount of swelling of the middle and inferior turbinals on the left side, and a

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very slight deviation of the septum to the right. The middle meatus was to a considerable degree obliterated by the overhanging middle turbinal. No secretion was observed in the anterior nasal chamber. A posterior rhinoscopical examination showed the posterior extremities of the inferior and middle turbinals on both sides to be normal in color and size. Some thick, yellowish secretion was observed flowing into the postnasal space over the posterior extremity of the left middle turbinal. After thoroughly cocainizing the parts, the probe revealed extensive caries of the anterior ethmoid region. Examination of the frontal and maxillary sinuses with the electric light was of negative result.

The serious character of the patient's condition was explained to her; that there was an abscess of the frontal and ethmoidal sinuses with extensive bone disease, and an operation was advised; but upon her earnest solicitation an external operation was to be postponed until all intranasal methods had been tried.

April 22, 1899. Complaining of pain in the left eye, a blurring sensation, and with a feeling that the left eye is larger and heavier than the right. Examination by Dr. Wilmer, who had examined her eyes in 1896, found the refraction the same as at the first examination.

The curvature of the cornea in the left eye slightly changed, the slight astigmatism with the rule being less than in 1896. Vision in the left eye 20/20 as before, but now print near at hand seems clearer with the right eye than with the left. In both eyes fields for white and other colors are normal. Fundus normal, no pulsation of retinal vessels. The anterior ethmoidal cells were frequently curetted and much diseased bone was removed from time to time, giving the patient temporary relief by a freer drainage; this improvement, however, was only of slight duration.

May 10*th*. An unusually large piece of bone was removed from the anterior ethmoidal region by the curette, thus admitting of the passage of a canula into the frontal sinus, which was washed out with a saturated solution of boric acid; a large quantity of thick, fetid pus was brought away. This was repeated on several different occasions, but instead of giving the patient relief only increased her suffering to a very great degree. The passage of the canula into the frontal sinus revealed such an extensive disease of the bone that all hope of removing it through the nose was abandoned; and the pains increased to such an extent that the patient readily consented to more radical measures being taken for her relief.

June 4*th*. The patient having been prepared for the operation, and the left eyebrow shaved, she was placed under ether anæsthesia. An incision commencing just within the supra-orbital notch was made over the supra-orbital ridge down to the bone, extending as far as the nasal eminence. The flap thus formed, composed of skin and periosteum, was elevated and a button of bone about 1 centimetre in diameter was removed from the anterior wall of the sinus at a point about one or two lines from the median line and just above the supra-orbital ridge.

Upon opening the sinus it was found filled with thick, fetid pus and granulation tissue. After the removal of the contents of this cavity, the probe revealed extensive disease of its bony walls; there was some softening of its posterior wall near the floor, the partition between the two sinuses was extensively diseased and broken down, and the roof of the orbit was in such a necrotic state that a piece about the size of a

dime had to be removed. After the removal of all the diseased bone within the sinus by means of the curette, the ethmoid bone was next examined and found extensively diseased in its anterior region. With the little finger within the nose as a guide, the curette was passed from the sinus into the nasal chamber and all diseased bone that could be felt was removed, thus leaving a very large communication between the sinus and the nose. The sinus was then irrigated with a solution of bichloride of mercury 1 : 3000, its walls touched with a 20 per cent. solution of chloride of zinc and packed with iodoform gauze, one end of which was brought down through the nose to act as a drain. The wound was then closed, the edges of the periosteum being drawn together with catgut, while the external wound was closed with silk sutures, and the whole hermetically sealed with iodoform and collodion.

At the end of the second day the gauze drain was withdrawn through the nose, and through a canula passed through the nose into the sinus it was irrigated with a saturated solution of boric acid. The secretions rapidly subsided under daily irrigations, and in the course of three weeks they had practically ceased. The stitches were removed on the sixth day, perfect union having been obtained.

The patient was completely relieved of her headaches, her convalescence was rapid, and she expressed herself as feeling better than she had felt for several years. At the end of a month from the time of the operation she had sufficiently recovered to leave for York Harbor, where she was to spend the summer. At this time there was no headache and no secretion coming away when the sinus was irrigated. A rhinoscopical examination showed the nose free from secretion and in otherwise good condition, save for an enlargement of the anterior extremity of the middle turbinal, which had not been removed.

July 15th. She contracted a severe head-cold, and in the course of twenty-four hours the skin over the left frontal sinus was very red and swollen, the swelling involving the upper and lower lids of both eyes. In consequence of no secretion passing into the nose, the pain became excruciating; and as immediate relief was demanded, an opening was made into the sinus by Dr. Sprigg, her family physician, at the seat of the greatest swelling, which was some distance above the supra-orbital ridge, evacuating a large quantity of pus, thus affording considerable relief. The following day she was removed to Boston to be under the care of Dr. Coolidge, to whom I had previously referred her in case of necessity during my absence abroad. The suppuration being so profuse, and the passage between the nose and the sinus having closed, thereby preventing drainage through the nose, Dr. Coolidge enlarged the external opening, at the same time making a very free communication between the sinus and the nose. The wound was not closed, but treated by the open method. Although the patient was relieved to some extent of the pain, the suppuration never ceased. When she returned to Washington in October her condition was as follows:

There was an opening into the sinus about half an inch above the supra-orbital ridge and a small fistulous tract below this ridge just above the internal canthal ligament, through which pus came in large quantities; there was also a free discharge of pus through the upper wound, but little or none passing into the nose.

A probe passed into the sinus through the external wound showed extensive necrosis of the floor of the cavity, especially that portion in

relation with the ethmoid cells. It was found impossible to pass a probe from the nose into the sinus, the opening previously made by myself and Dr. Coolidge having closed completely.

The open method of treating the sinus was continued, the cavity being irrigated daily with one or more of the several antiseptic solutions employed, such as hydrogen dioxide, formalin, or a saturated solution of boric acid. In addition a gauze wick was introduced through the external opening to facilitate drainage. This method of treatment was faithfully followed for several months, with the expectation of my being able to re-establish the opening into the nose by means of the curette; but failing in this and in view of the tendency to the closure of the external opening, the patient's condition in the meantime growing worse, it was decided to open the sinus again.

January 7th, 1900. Having been prepared for the operation, the eyebrow shaved, she was etherized, an incision was made through the skin and periosteum in the line of the incision over the supra-orbital ridge in the original operation, the flap elevated, and the sinus exposed. The upper half of the cavity was filled with firm granulation tissue, while on the most dependent part of the floor pus was found in considerable quantity. After thoroughly cleaning the cavity out, the probe revealed extensive necrosis of the ethmoid bone, as well as that portion of the floor of the sinus in relation with it. As much of the diseased ethmoid bone as could be reached by means of a curette passed through the frontal sinus opening, using the little finger within the nose for a guide, was removed. The probe passed not only far back on the affected side, but it could be passed diagonally through to the opposite side without detection of any further diseased bone. It was thought that the probe must have reached the sphenoidal sinuses, although there was no positive means of verifying the belief. After thoroughly irrigating the parts with a solution of bichloride of mercury 1 : 3000, and packing the cavity with iodoform gauze, one end of which was drawn out through the nose, the wound was closed as in the original operation.

The night of the operation and the day following, the patient was very ill, complaining of intense pain on top of the head, and in the occipital region. During the night and part of the following day she was delirious. There was only a slight elevation of the temperature.

9th. Mind much clearer, pain in top of the head less, but she still complains of intense pain in the occipital region. The gauze drain was removed and the frontal sinus irrigated with a saturated solution of boric acid through a canula passed through the nose into the cavity. This was accompanied by a great deal of pain in the frontal region, but no pus was observed in the return flow. The sinus was irrigated daily, but with some difficulty, owing to the pressure of the middle turbinal, which interfered with the passage of the canula; although the anterior extremity of this bone had been removed by Dr. Coolidge and several pieces by myself, prior to this last operation, it still acted as an obstruction. The stitches were removed on the sixth day, good union having been obtained, and firm closure of the fistulous openings above and below the supra-orbital ridge. The patient expressed herself as feeling greatly relieved, all the occipital and frontal pains had disappeared and she seemed to be making a rapid and satisfactory convalescence, although the probe passed into the region of the anterior

ethmoid cells still revealed some necrosed bone; there were no sections found in the anterior nasal chamber nor in the postnasal space, and nothing abnormal was observed by posterior rhinscopy.

February 10*th*. One month after the operation, when everything seemed to be progressing favorably, she was seized with a violent headache referred to the frontal and temporal regions. This was accompanied by obstinate nausea and vomiting. The temperature, which up to this time had been normal, went up to 100° F. On attempting to wash out the frontal sinus the parts had become so swollen it was found impossible to pass the cannula. On using the probe under the middle turbinal an over-distended ethmoid cell was evidently penetrated, for a considerable quantity of foul-smelling pus made its appearance in the region of the middle meatus on its withdrawal. This gave her some relief, for the violence of the pain subsided, but there was a constant dull headache remaining. She complained of an intense itching of the skin over the left frontal region, which at times became very distressing. This sensation seemed always to be associated with some new invasion of the ethmoid cells.

From this time my efforts were directed to the removal of the diseased ethmoid bone; first removing portions of the middle turbinate, then with the curette and cutting forceps, diseased bone was removed as fast as was compatible with safety. The headaches continued with greater or less severity until about the early part of May, when they increased in intensity, the pain being referred principally to the supra-orbital and infra-orbital regions, and in the left eye. As the disease was evidently progressive in character she was put on a course of the iodide of potash, commencing with ten drops of a saturated solution three times a day; it was carried up to the point of tolerance, which was forty drops three times a day, but without the slightest benefit resulting.

June 1*st*. Pain in the left eye much worse than it has previously been, photophobia, lacrymation, and congestion of the conjunctiva, apparently no deviation of the eyeball from its normal axis. Palpation shows a swelling along the internal portion of the floor of the orbit, extending upward to the internal angle, and very painful to the touch. Ophthalmoscopical examination by Dr. Wilmer showed a pulsation of the ophthalmic veins.

As a result of the consultation it was thought that the ethmoid cells in relation to the inner wall of the orbit were involved, and in order to prevent an orbital abscess an operation was decided to be immediately necessary. The eyebrow was shaved and on the following day, June 2d, she was put under ether anæsthesia. An incision commencing at the juncture of the middle and outer third of the supra-orbital ridge was made through the skin and periosteum along the ridge to its internal angle, then curved and carried along the inner border of the nose to within an inch of its tip; the periosteum elevated above and below, thus exposing the contents of the orbit. There was found to be a bony swelling along the inner part of the floor and the inner wall of the orbit, extending some distance backward. The bone was so thin and soft that the weight of a light perforator passed between the trochlea and internal canthal ligament was sufficient to penetrate it, showing that the lateral wall of the orbit about the region of the os planum had become so thin that a little longer delay would probably have resulted in an orbital abscess. A sharp curette was passed through this open-

ing, bringing away some pus and a large quantity of soft and friable bone tissue. All diseased bone that could be detected was removed in this way. It was thought best to explore the frontal sinus; accordingly, the periosteum was stripped up sufficiently to expose that cavity thoroughly; it was, however, found filled with firm granulation tissue. Owing to the possibility of infection from the lower wound, the sinus was with some difficulty cleared out; after cleansing the parts a strip of iodoform gauze was passed through the ethmoidal opening into the nose, the periosteal wound closed with catgut and the external wound with silk sutures, the whole sealed with iodoform and collodion and protected by a bandage.

3*d*. Complains of little or no pain this morning, but has been more nauseated than after the previous operations; temperature 99° F.; considerable swelling of the upper eyelid and face, otherwise doing well.

4*th*. No headache, temperature normal, swelling of the upper lid very much less; removed gauze from the nose and irrigated with a saturated solution of boric acid; complains of intense vertigo and nausea.

5*th*. Swelling of the face and upper eyelid very much diminished; vertigo increasing; no pain; temperature normal; upon irrigating the nose only small particles of secretion brought away.

6*th*. Vertigo still very marked, swelling sufficiently subsided to admit of a thorough inspection of the eye, which was found to be in good condition; complains of photophobia and double vision. These uncomfortable and annoying symptoms continued for several weeks, gradually passing off. Eye kept bandaged to exclude the light. On the sixth day the stitches were removed, the wound having thoroughly healed.

12*th*. Complained this morning of feeling chilly; temperature, 99° F.; evening temperature, 102° F. Examination of the wound shows no swelling nor soreness, but there is some swelling of the middle ethmoid region; no secretions have been brought away by the irrigations.

13*th*. No further chilly sensations; feeling better; temperature 8 A.M., 100° F.; 12 M., 100° F.; 4 P.M., 99° F.; 8 P.M., 99° F. Some pus was brought down by irrigation.

14*th*. Vertigo and diplopia still continue, although to a less degree; secretions coming away freely; morning temperature normal, evening temperature, 99° F. No headache.

20*th*. Decided improvement in the patient's general condition since the last note; vertigo slight; diplopia has disappeared, no photophobia, no pain in or around the eye, which has returned to its normal appearance. Secretions, mucopurulent in character, but much less in quantity, coming from the middle ethmoid region.

Having improved sufficiently, she was removed to Chevy Chase, a suburb of Washington, for the summer. For the first ten days of her stay in the country her condition continued to improve, but on or about July 1st she contracted a severe attack of membranous colitis, which greatly prostrated her. During the acute illness, which lasted during the month of July and part of August, little or nothing could be done in a surgical way for the relief of her local trouble. The nose was irrigated daily with a boric acid solution, by which means a free

drainage was maintained. Up to the time of her removal to the country the middle turbinal and the ethmoid cells as far back as the middle of that bone had been completely removed. Although the probe still revealed caries of the ethmoid cells, and the secretions while greatly diminished in quantity still contained pus, the disease did not seem to be active. She was freer from pain in the head than at any time since the relapse in February.

September 12th. To-day she had a violent pressure headache; the secretions have practically ceased; refers the greatest pain to the occipital region and to the vertex; pressure back of both eyes, but most severe on the left side. A decided swelling is observed for the first time over the left eye near the inner angle of the orbit. Unfortunately, no ophthalmoscopical examination was made at this time. Upon examination of the ethmoid bone with a probe a small sinus was discovered, which extended some distance backward. This was enlarged with the curette, which

FIG. 1.

Knife for opening sphenoidal sinus.

permitted a free flow of secretion with much relief to the patient. The headaches now became quite frequent and were referred principally to the occipital region.

From this time on the remaining middle turbinal and the ethmoid bone were attacked with the cutting forceps and curette.

October 5th. Quite a large bony growth was observed for the first time, triangular in shape, with its base attached to the middle meatus, extending across the vestibule of the nose. After the removal of this bony obstruction a firm growth, grayish in color, was discovered springing from the ethmoid bone between the middle and superior turbinals and in the region of the posterior ethmoid cells; it was quite firm in consistency and did not bleed readily when touched with the probe. This growth blocked up the upper portion of the nose, pressing firmly against the posterior portion of the vomer, destroying the nutrition of this part of the septum and causing necrosis of the bone. After a partial removal it was found to extend backward and to be attached to the anterior wall of the left sphenoidal sinus.

This cavity was now opened by means of a bony flap being moved from its anterior wall by a peculiar shaped knife made for me by Tiemann & Co., shown in Fig. 1.

This knife is sharpened on two sides, the lower, which can penetrate the cavity, and the anterior with which a forward movement can be made, cutting through the anterior wall, then reintroducing it into the cavity at a different angle, a bony flap can be formed, the removal of which leaves quite a large opening in the sinus. After opening the sinus in the above manner it was found filled with thick, foul-smelling pus, the evacuation of which gave the patient the greatest relief. The occipital headaches, which had been almost constant, now ceased for a while.

After the left sphenoidal sinus was exposed, the probe revealed a very extensively diseased condition of the sphenoid bone; the septum between the two sinuses was carious and partly broken down, so that the two cavities communicated and were involved in the suppurative process; the roof of the cavity, at its junction with the nasal septum, as well as its floor, were also in a necrotic state. From time to time this diseased bone has been removed by means of the cutting forceps, giving the patient only temporary relief, for as fast as the growth is removed it forms again, blocking up the opening into the left sphenoidal sinus, which is used to drain both cavities. When the drainage is interfered with the pressure at the back of the eyes becomes very severe, and the headaches, which are referred to the occiput, vertex, and frontal regions, become almost unbearable. It has been necessary to cut away the growth about once in ten days or two weeks, but now, as it is growing with greater rapidity, it is necessary to operate oftener.

At the present writing of this paper the condition of the patient is as follows:

Both sphenoidal sinuses are the seat of the suppurative process, nearly the whole of the ethmoid cells on the left side having been removed; the anterior wall of the left cavity, part of the roof and floor, and the partition between the sinuses have been removed; yet in spite of the extensive bone removal, it is impossible to keep the cavities drained, owing to the location and rapid development of the growth. The indications at present are that it is extending into the deeper parts of the sphenoid bone, while the patient's strength is rapidly failing and her suffering greatly increasing, and it does not seem possible that any but an unfavorable termination of this unfortunate case is to be looked for.

The following is a report of the bacteriological examinations made by Dr. William Gray, of the Army Medical Museum:

On two occasions inoculations from the secretions of the sphenoidal cavities of Mrs. —— were made. Each time six agar tubes were used.

Of the first batch of tubes all showed a growth within twenty hours; the growths consisted of staphylococci pyogenes aureus and albus; the albus predominating. The growth in the tubes was not excessive, several showing the presence of but two or three colonies, while the tubes that contained the largest number of bacteria did not develop more than eight or ten colonies. It was thought at the time that besides the staphylococci there was a diplococcus present, but after repeated transfers this organism also proved to be a staphylococcus.

Of the second batch of six tubes, but three developed any growth, the other three remaining sterile. The growth proved to be the same as in the first lot of tubes, staphylococci.

Toubert,[1] in a paper on the intracranial complications following disease of the sphenoidal sinus, gives full details of two cases which came under his personal observation, together with a summary of twenty-two

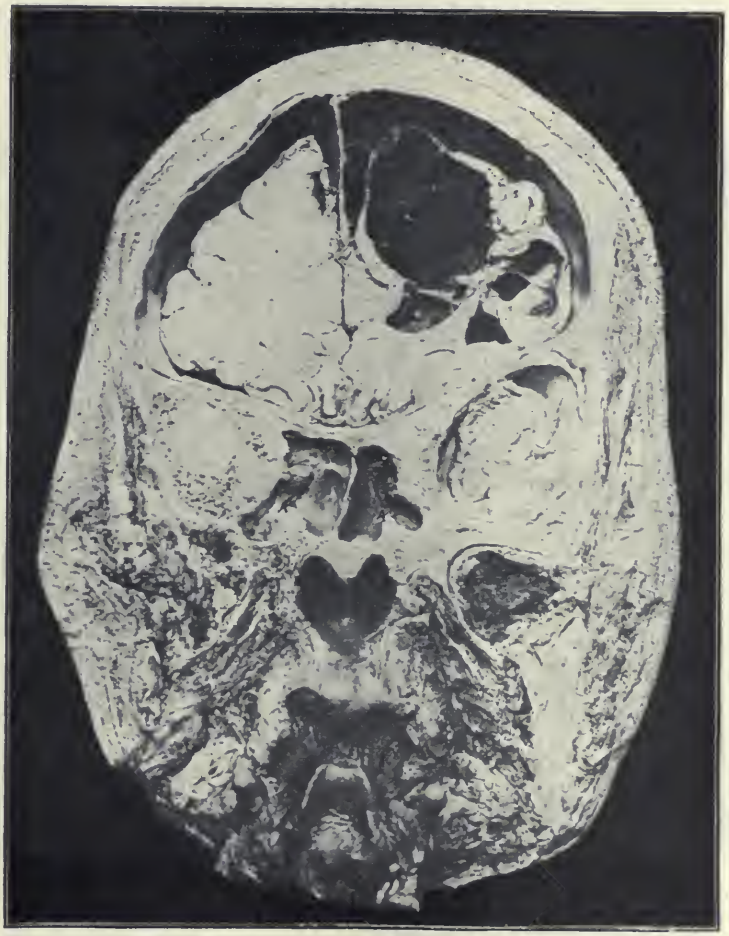
FIG. 2.

A photograph of two dry preparations, the upper picture showing a very large right sphenoidal sinus with its foramen located just below the posterior extremity of the superior turbinal, while the opposite half of the sections shows a comparatively small left sphenoidal sinus. The lower picture shows two complete left sphenoidal cavities with one foramen (B) in the lower.

others collected from various sources. He attributes the exciting cause to infection, sometimes by the bacillus of influenza, but principally by the pneumococcus or diplococcus of pneumonia, which occur both in the pus of the sinus and in that of the meninges, the organisms having made their way to the sphenoidal sinus from the nose, the nasopharynx, or from another sinus, as, for example, the ethmoid.

Infection may take place directly in connection with a general disease, such as pneumonia or erysipelas, or indirectly, (1) after febrile diseases, such as typhoid fever and influenza, or (2) after chronic diseases, such as syphilis, which tend to produce necrosis of the bone.

FIG. 8.



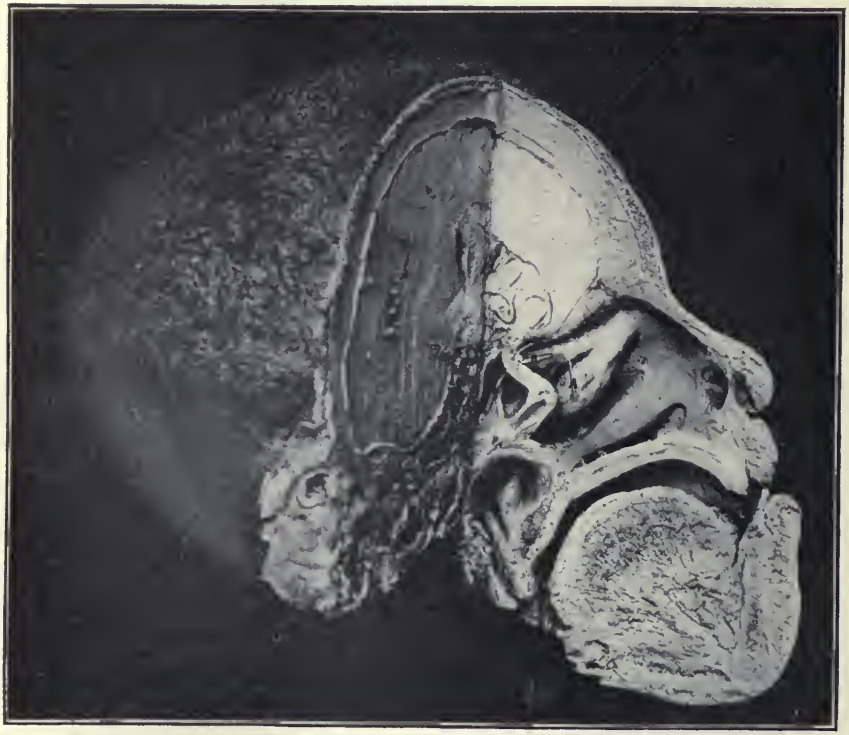
A photograph of a section made through the posterior third of the sphenoidal cavities, showing the foramina, A A, located about the middle of the anterior wall. The right sinus is well developed, while the left is partially subdivided by an incomplete partition. An additional point of interest in this specimen is a large abscess sac, which occupied nearly the whole of the frontal lobe, and a second sac occupying part of the temporo-sphenoidal lobe.

It is interesting to note that in my case the first symptom pointing to accessory sinus trouble was the so-called congestion of the brain eight years ago, following pneumonia, and which was nothing more nor less

than an acute abscess of the frontal sinus. Nothing having been done for the relief of this condition, the bone eventually became extensively necrosed, the disease steadily progressing until the whole of the corresponding half of the ethmoid, both sphenoidal sinuses, and a considerable part of the sphenoid bone itself have been involved in the necrotic process.

The bacteriological examination of these cases is important, and should always be made with the view of determining the cause of this

FIG. 4.



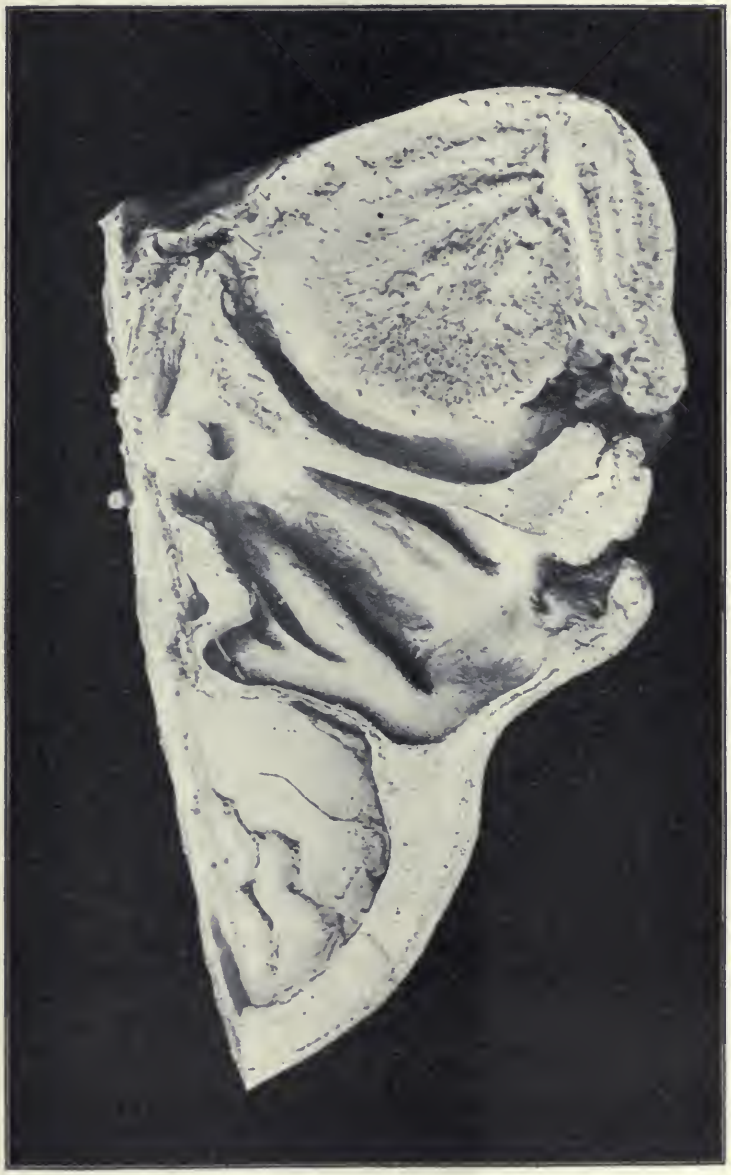
A photograph of a combined antero-posterior and transverse section, showing a very large left sphenoidal cavity with a very thick anterior wall bulging forward across the postnasal space.

little known affection. In two other cases, both of which terminated fatally, I neglected to have a bacteriological examination made. Both cases have been reported elsewhere, but a brief reference to them may be of interest in connection with this paper.

In one case both sphenoidal cavities were diseased in consequence of a neglected suppurative disease of the frontal and ethmoidal sinuses.

The patient died five days after an operation on the frontal sinus, an autopsy showing a meningitis resulting from an unrecognized abscess in the sphenoidal sinuses.

FIG. 5.

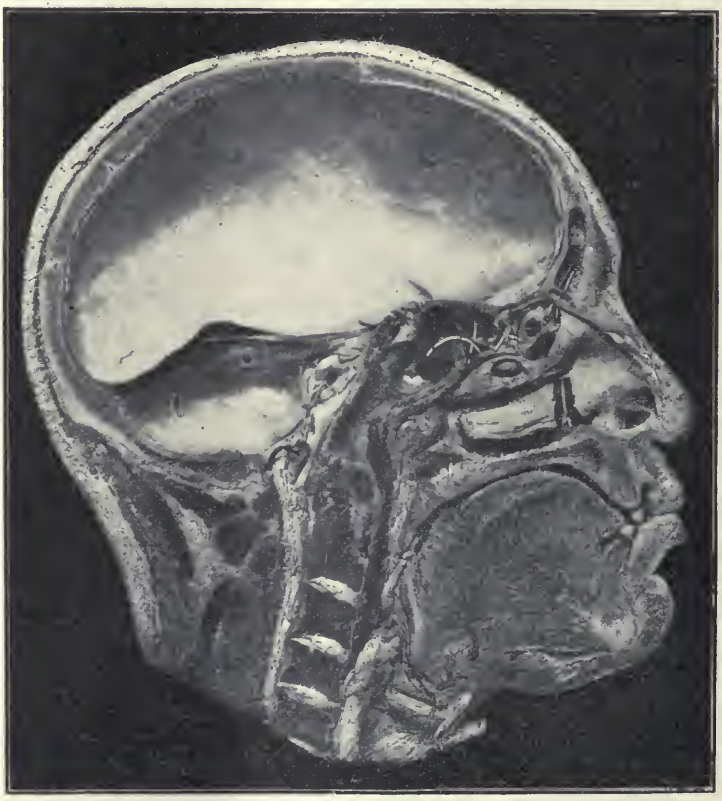


A photograph of the remaining portion of the section from the above preparation, showing a very small right sphenoidal sinus with its foramen presenting upward instead of forward.

In the second case a primary abscess of the sphenoidal sinuses was successfully opened, but during my absence from the city the patient died of meningitis, he having refused to remain in the hospital, where he could be under observation.

The sphenoidal cavities probably offer greater difficulties in the way of diagnosis and treatment than all the other sinuses, and the prognosis

FIG. 6.



A section with the middle turbinal partially removed, showing a very large anterior ethmoid cell, the middle ethmoid cells only partially developed, while the posterior ethmoid cell is quite a large cavity. The sphenoidal is unusually large in this specimen. F is a wire passing through the sphenoidal opening, the entrance into the posterior ethmoid cell, while B C D show three distinct openings into the frontal sinus. A is the entrance into the nasal duct.

is much more unfavorable, not only on account of the difficulty of keeping the cavities open, but also because malignant growths are much more frequently associated with them than with the other cavities of the nose. These cavities are subject to the same variations that we find in the other accessory sinuses. Although little has been done heretofore in bringing

out these irregularities, it is very important that they should be emphasized, in order that we may be on the lookout for them as a possible factor in cases that do not yield readily to treatment.

By far the best and safest method of opening the sphenoidal sinus is the one before mentioned; that is, after removal of the middle turbinal, with such a knife as used by Hajek or a modification of it, as shown in Fig. 1, a section is made in the anterior wall of the sinus, and with cutting forceps the opening can be enlarged sufficiently to meet the needs of the case. In a very narrow nose this method, however, might be impossible of execution; then that recommended by Jansen[2] at the International Medical Congress at Moscow might be tried. Jansen proposed to utilize the opening made in the maxillary sinus in cases of combined empyema of the accessory cavities, to open at the same time the posterior ethmoid cells, and next the anterior external wall of the sphenoidal sinus. The opening of the sphenoid is thus made easier and larger than by the nose, but it is often difficult and sometimes impossible, as remarked by the author, when the collection of blood is abundant, to distinguish between a large ethmoid cell and the sinus itself. This operation, I believe, has also been done successfully by Luc.[3] Furet[4] proposes the method of Jansen when the antrum is healthy and has practised it in one case successfully. He concludes that the nasal passages can be utilized in simple cases where the nose is sufficiently straight and large, and the maxillary route is indicated only in the following cases:

1. When the maxillary sinus participates in the inflammation.
2. In all inflammations of the sphenoidal sinus complicated with cerebral symptoms.
3. In all sphenoidal inflammations in subjects with narrow or abnormally formed nasal fossæ.

The new-growth in the case I have reported was first discovered about the latter part of September, 1900, and was probably the result of the irritation of the mucous membrane, whose vitality had been lowered by the prolonged inflammation of the adjoining cavities.

A part of the growth was sent to Dr. Jonathan Wright for diagnosis, and the following is his report: "Small, irregular masses of tissue; on microscopical examination prove to be made up of low-grade inflammatory tissue, the connective-tissue meshwork being filled not only with the products of inflammation, but with a typical proliferation of epithelium, often arranged in the forms of imperfect tubules and acini. In places there are irregular patches of epithelium and epithelioid cells, bloodvessels and true glands being almost absent. In all probability the growth had its origin in the glands of the mucosa. It is without doubt a malignant adenoma, and is apparently growing more rapidly than is the rule with these cases."

Pure adenoma is very rare in the nares; some authors, as, for instance, Bosworth,[5] deny that they ever occur within the nose. He states "that until further clinical evidence of the fact has been established we must conclude that unmixed adenoma does not occur within the nasal cavity." The mixed variety, however, as fibro-adenoma, myo-adenoma, angio-adenoma, papillary-adenoma, adeno-sarcoma, and adeno-carcinoma are relatively more frequent.

The principal features of these new-growths are their rose or grayish color, of firmer consistency than nasal polypi, rarity of epistaxis, and the preservation of a good general condition. These tumors are, according to Tissier,[6] generally benign, but may become malignant.

Upon reviewing the literature of this subject in the library of the Surgeon-General, U. S. A., I can find only five cases of unmixed

FIG. 7.

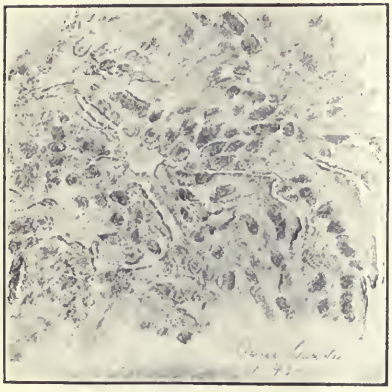
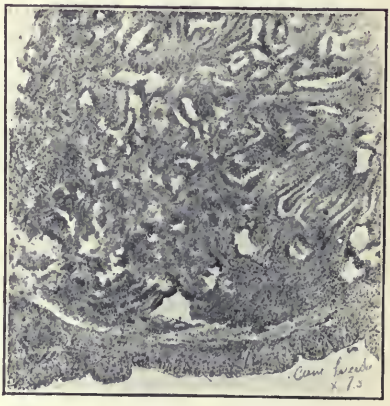


FIG. 8.



Figs. 7 and 8 are drawings made from microscopical sections of the growth.

adenoma of the nasal fossæ reported, while of the mixed variety the literature is very much more abundant. Two of the five cases are referred to by Bosworth, viz.: those of Gosselin and Puglièse.

Gosselin's[7] case was a man, aged fifty-three years, who came under his observation in 1858; in the previous year, however, he had several polypi removed from the right nostril, by Fallin. When he came under Gosselin's care there was stenosis of the right nasal fossa, by a rather large, grayish, soft tumor, extending back into but not adherent to the nasopharynx. It was attached to the upper and anterior part of the fossa. The growth was removed by external operation, which was apparently successful. Microscopical examination showed the growth to be composed of glandular structures, with abundant epithelial cells. Gosselin refers to two previous similar cases, one at the Hôpital Cochin,

and one at the Hôtel Dieu. This later case was operated upon by Robin. After removal the patient finally died of meningitis, caused by the invasion of the ethmoid and sphenoid.

Puglièse's[8] case was a woman, aged sixty-five years; eighteen months previously she noticed a small induration corresponding to the lower part of the left lacrymal sac, simulating a commencing lacrymal tumor. It gradually enlarged, without material pain, causing exophthalmus divergent strabismus. There was no nasal stenosis, epistaxis, or discharge.

Microscopical examination showed it to be adenomatous, with some epitheliomatous degeneration.

The growth originated from the glands of the mucous membrane on the outer wall of the upper part of the nasal fossa; after enlarging it perforated the bone and penetrated into the orbit, the ethmoid cells, and maxillary sinus. It was removed by external operation, which was apparently successful, no recurrence having been reported.

MacKenzie Johnson[11] reports a case of true adenoma of the nasopharynx, in a boy, aged thirteen years; there was a fine sessile tumor in the nasopharynx, pale red, the size of a small walnut; it did not bleed, and gave the impression of adenoids. The growth was removed with forceps and the patient was well within one year. Microscopical examination showed the tumor to be a true adenoma, covered by a cylindrical epithelium.

Thomas J. Harris[9] also reports a case of true adenoma of the nose in a man, aged seventy-eight years. Patient had been under his care for two years, for nasal growths, which completely filled both nostrils and sprang from the ethmoid. The growths were removed with the snare, and the bases curetted. There was a partial recurrence within a month; then freedom for a year. In November, 1894, there was a further recurrence in the left nostril, with pain and exophthalmus on that side, and the patient died. Microscopical examination showed the growth to be almost pure adenoma, with scattered areas of small, round, and spindle cells.

H. Eichler[10] related the history of a case of adenoma simulating polyp of the nasal septum. The patient, whose age and sex are not given, was sent to him for nasal obstruction. Examination showed hypertrophy of the mucosa of the lower turbinates and a polyp of $1\frac{3}{4}$ by $\frac{3}{4}$ by $\frac{1}{2}$ centimetre, attached to the septum on the left side, that was striking on account of its rosy-red color. It was removed with a snare. Microscopical examination showed it to be a pure adenoma.

Wright[12] says "that pure adenoma of the nose is almost unknown, although hypertrophy of the glandular structures of the mucosa is occasionally seen carried to such an extent that the question of its inflammatory origin may well be raised."

May 15, 1902. Since reading the report of this case at New Haven, a very decided improvement has taken place in the patient's condition. I have succeeded in removing the entire growth, and after an interval of one year there is at present no evidence of its return. The suppurative inflammation in the sphenoidal sinuses has ceased, and there remains only one small cell in the posterior ethmoidal region where pus is formed. Her general condition has improved to such a degree that she is able to attend to her household duties, and she is now leading a comfortable existence.

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2. Zur Radical operation cironischer combinirter Empyeme der Neben hôhlen der Nase. Congrèss de Moscow août, 1897.
3. Leçons sur les suppuration de l'oreille moyenne et des caviés accessories des fosses nasales. Paris, 1900.
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TRAUMATIC RUPTURE OF CHORIOID, WITH HEMORRHAGE FROM UPPER BRANCH OF THE INFERIOR TEMPORAL VEIN.[1]

By Charles A. Oliver, A.M., M.D.,
of Philadelphia.

Through the kindness of Dr. George C. Harlan, one of my colleagues at Wills Eye Hospital, I have been able to make a most careful ophthalmoscopic study of this most interesting case:

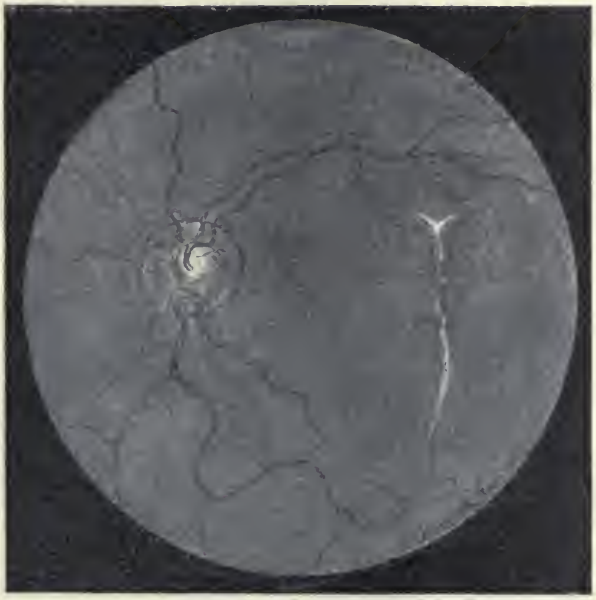
The patient, aged nineteen years, a waiter, was sent to the hospital by Dr. Harlan on December 23, 1898. The man gave a history of dimness of the vision of his left eye, dating back for one week, from having struck the eyeball against a protruding angle of a sideboard.

When I first saw him, an elongated Y-like break, situated immediately to the temporal side of the macula lutea, extending through the chorioidal membrane directly down to the scleral coat, was plainly visible. Running almost vertically upward in the split area and coursing over the corresponding artery, the upper branch of the inferior temporal vein could be seen. At a position in this break corresponding with a point just beyond the macular region there was a fresh hemorrhagic extravasation from the vein, which was commencing to undergo absorption. The most pronounced absorbing areas in the extravasation,

[1] Read before the Section on Ophthalmology of the College of Physicians of Philadelphia.

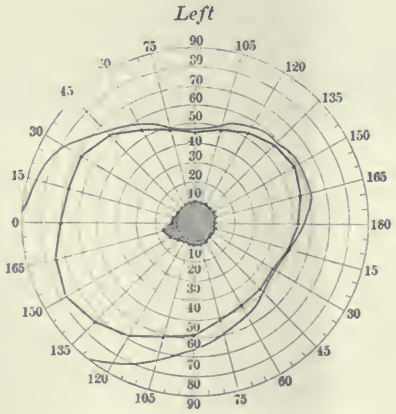
which were the thinnest and the least dense in the blood mass, consisted in four elongated finger-like tips that were situated on the inner surface

FIG. 1.



of the retinal sheet. The borders of the break were sharply outlined and were devoid of any pigmentation. The rest of the eye-ground, with

FIG. 2.



the exception of an almost imperceptible grayish haze just above and including the macular region, appeared normal.

These appearances are very well represented in Fig. 1, which

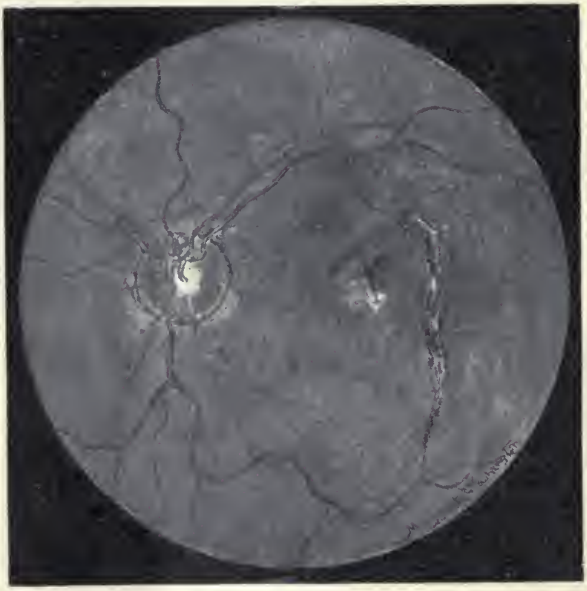
has been reproduced from a water-color sketch made at the time by Miss Margaretta Washington, of this city.

In all other respects the eyeball was apparently uninjured and intact. Central vision was markedly reduced (one-fortieth of normal), this being accounted for by the presence of an absolute central scotoma of about eighteen degrees in its long and ten degrees in its short diameter. (Fig. 2.) The extent of the visual field for both form and color was but slightly and concentrically reduced from the normal average. Both extra-ocular and intra-ocular muscle-actions were undisturbed.

The fellow-eye was healthy and performed its various functions properly.

One week later the fundus changes in the affected eye had become so different that a second sketch (shown in Fig. 3) was made by Miss

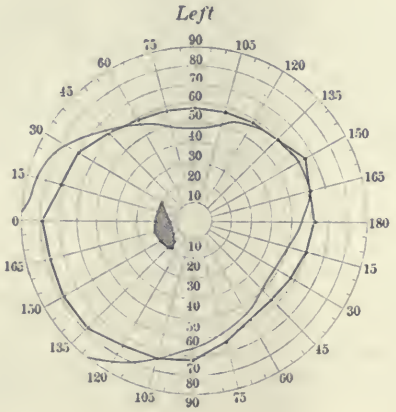
FIG. 3.



Washington. As may be readily noticed, the ophthalmoscopic appearance of gross inflammatory reaction in both the chorioidal and the retinal coats was brought into view. The fundus-reflex, particularly in the papillo-macular region, had undergone a decided change, and the surface of the retina had become very irregular. Areas of retinal thickening and opacification; elevated points of deeply seated hemorrhages; chorioidal thinnings and commencing degeneration; pigment aggregation around the borders of the most disturbed portions of the two coats, with marked retraction of the edges of the slit-like rupture, which had become serrated, constituted the main details of a picture which was in gross contrast with that of the previous week. If to these changes an engorgement of the main venous trunks, a broad yellowish halo of retinal opacity around the optic nerve-head, and a pronounced degree of lessening of the large retinal hemorrhage in the

linear rupture, be added, a series of most characteristic peculiarities that may be considered as expressive of the gross inflammatory stage of the condition are obtained.

FIG. 4.



In spite of these changes the field of vision for white (as shown in Fig. 4) had become somewhat larger, and the scotomatous area had

FIG. 5.

become much smaller and had removed outwardly so as to entirely include the physiological blind-spot. Vision had risen to two-fifths of normal.

On January 16, 1899—seventeen days after the date of the making of the second water-color drawing—a third sketch (as shown in Fig. 5) was made by Miss Washington. In it it will be found that the hemorrhage in the rupture had disappeared, the previously underlying retinal vessel wall could be plainly seen as intact, and the contained venous portion of the current was uninterrupted in its flow. The large area of localized œdema, which was situated just above the macula and which had become partially opaque, was replaced by a semi-atrophic spot. Midway between this area of degeneration there was a linear atrophy which had been represented in the second sketch by a short vertical line of deeply-seated pigment aggregation. The entire papillo-macular region, particularly along the borders of the areas of atrophy, was much more densely pigmented than before, and had become yellowish in many places. The yellow opaque halo around the optic disk had broadened and apparently had become more consistent. The fine macular twigs of the retinal artery series still pursued their undisturbed courses over the large atrophic area, while the previous engorgement of the main vascular stems of the retinal circulation had subsided, and the tint of the contained venous blood had again become normal.

The visual field exhibited a persistency of the excentrically placed positive scotoma, and central vision remained practically the same as before.

Remarks. The case has been considered worthy of record upon account of the great rarity of opportunity to obtain graphic studies of three of the most important stages in the disease, stages that are so unlike and so rapid in their onset and so brief in their duration.

REPORT OF THREE CASES OF CREEPING LARVÆ IN THE HUMAN SKIN (HYPONOMODERMA, KAPOSI).

By Arthur Van Harlingen, M.D.,
of Philadelphia.

The number and variety of animal parasites of the human skin are probably greater than has been generally supposed. On account of the rarity of such cases, however, they frequently go unrecognized or are mistaken for other affections of the skin.

The cases I am about to describe were met only at long intervals, and in an extended experience I have not encountered any others. Two of them occurred in children. The third case was that of an adult, and has been published before under another name, but I shall cite it as illustrating an affection which in this country and climate must be very rare.

Case I.—Harriet V., aged four years, was brought to the Howard Hospital, on October 21, 1884, with an eruption on the foot of three or four weeks' duration. According to the account given, this eruption

had originated on the heel in the form of a small water-blister, which had gradually extended on one side while healing on the other, following a serpiginous course up and inside of the foot just in front of the heel, and terminating in a spiral in the skin over the inner malleolus.

The appearance of the lesion was that of a line of small vesicles resembling, in a magnified degree, the furrow made by the itch insect. The lesion was about four inches in length and about one-sixteenth of an inch wide. It was extremely itchy.

The patient was directed to have the skin well rubbed with an ointment of sapo viridis and tar along the line of disease. Under this treatment the lesion gradually disappeared, until, at the end of four weeks, not a trace remained.

FIG. 1.

CASE I.

I felt certain that the disease in this case was caused by an animal parasite. The peculiar beaded appearance, due to the string of small vesicles containing black granules—probably débris or fecal matter—was, as has been said, very much like the furrow of the itch insect, but on a larger scale. The itching sensation was also very characteristic. This is commonly most marked during the activity of the parasite where the furrow is extending rapidly, but the fact was not particularly noted in this case.

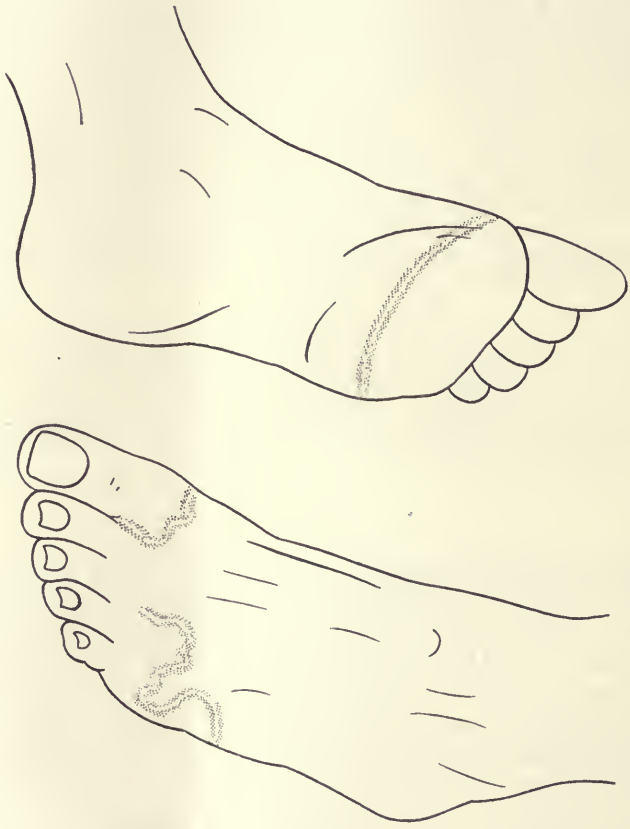
CASE II.—John W. K., aged five years, was brought to the Children's Hospital, on October 23, 1901, displaying an eruption on the sole of the foot, consisting of a flat, red, narrow line curving from one side of the foot to the other, and resembling the edge of a circinate erythema, for which, indeed, I mistook it at first sight. The child's mother, however, persisted in the assertion that there was a worm beneath the skin, which at times was prominent and at other times seemed to sink out of sight, changing its locality also from time to time, and meandering over the foot from one place to another.

Unfortunately, the mother's statement was weakened by a description which she gave of the worm, saying that it "seemed about an inch long, having eyes and a prominent head." This statement was

evidently imaginative. There had been some inflammatory symptoms, and there was considerable itching in the part, especially at night.

No history pointing to exposure could be obtained. The child did not go barefoot while in the city, but during the previous summer, while at Atlantic City, he had run about upon the sand without shoes or stockings, and had suffered, his mother said, from a slight cut in the sole of the foot at the point where the disease was afterward first noticed.

FIG. 2.



CASE II.

The patient was kept under observation, but for some time no change appeared in the red line, which extended across the sole of the foot. When seen on December 26, however, the appearance of the lesion had decidedly changed. It now appeared raised and of a brighter red, like a whip-cord under the skin, and the child complained of pain in the part.

Within the next few weeks the lesion had made considerable progress, extending at one end, running around the side of the foot, and pushing its way in an irregular line over the dorsum and toward the bottom of the little toe.

The progress of the parasite was so rapid at this time that a few hours would suffice to show perceptible progress. Dr. Siter, at my request, cut down on the extremity of the red furrow, hoping to intercept and extract the parasite, but no living organism could be found.

The patient disappeared from view after this, but on April 4, 1902, I called upon the mother, and found that immediately after the little operation the red line began to fade away, and in a short time had disappeared. Up to the present time, although three months have elapsed, there is no tendency to a recurrence of the disease.

It is possible that Dr. Siter's incision may have exposed the parasite, which was washed away in the bleeding that followed.

The third case I have to report occurred in an adult, but as it illustrates the affection under consideration I will give an abstract of it.[1]

CASE III.—H. C. B., an employé in the Custom House, came to my office on January 17, 1888. He said that he came in contact with

FIG. 3.

CASE III.

invoices from all parts of the world, but did not handle foreign goods. He stated that he never lived outside of Philadelphia. The affection had first showed itself three months previously in the form of a small, red, itchy pimple on the back of the hand. This soon began to extend and elongate, taking on a serpentine form and pushing along under the skin, which it elevated in its passage, leaving a red, cord-like elevation of the epidermis. The late Prof. Agnew, under whose care the patient was at that time, used hypodermic injections of a 50 per cent. solution of carbolic acid, but without effect, and the parasite continued its course, running between the fingers, then diagonally across the palm of the hand, and finally terminating in a whorl-like curve over the wrist-joint, to which point it had reached when I first saw it. Under the thinner skin the lesion looked like a vesicular eruption.

I must confess that in this case, also, I was at a loss to make a diagnosis, and finally decided upon one which I now believe to have been erroneous, namely, that of dracunculus or filaria medinensis. Under

[1] The case was published in the Medical and Surgical Reporter, October 6, 1888, under the name of "filaria medinensis," a misnomer.

this belief I cut down upon the supposed worm at various points in its course, but, of course, without finding it. I then prescribed asafœtida, which has been used successfully in filaria medinensis, under which the red cord rapidly sunk to the surface, turned brown, and faded away.

As there was still some slight trace of irritation at the extremity of the lesion when I last saw the patient, I am not perfectly sure that a cure was effected. The patient, however, was of the opinion that the parasite was dead.

The cases just described are, I believe, the first to be reported in this country. A few similar ones are to be found in European medical literature.

So long ago as 1870 Lee[1] reported under the title of "Creeping Eruption" the case of a child, aged three years, who had first shown signs of the disease three weeks previously. A red line was noticed by the mother just below the right ankle. This gradually travelled up the leg and thigh and onto the abdomen, meanwhile fading on the leg. There was no pain or itching. On examination a pale rose-pink line, one-eighth to one-sixth of an inch in breadth, could be seen coursing across the abdomen below the umbilicus, presenting several loops. In some places this line had a stippled character, like a number of dots, rather than a continuous line. (This is similar to the appearance shown in my Case I.)

A piece of skin was cut out near the termination of the line, for microscopical examination. No parasite was found, but the red line began to fade immediately, and soon disappeared.

Later, Lee[2] reported a similar case occurring in an adult. Here the disease began in the buttock, and was supposed to have been contracted in a water-closet.

Walter G. Smith[3] described a somewhat similar case beginning as a swelling in the outer ankle of the right foot, painful, and moving slowly up the leg and body to the right axilla, right breast, and back of the neck. The line then terminated in an abscess, which opened and gave exit to a dipterous larva, 9 mm. in length and 2 mm. in diameter, of which Smith gives a figure. Several similar larvæ were afterward observed in this same case, each pursuing a course similar to the first one.

I am inclined to think this affection due to some different parasite from that causing the eruption in my cases. The ending was different, as none of my cases showed a terminal abscess; nor do I think it possible that such a large parasite could have been the cause of the narrow line; it would have excited more irritation than was observed in my cases.

[1] Transactions of the Clinical Society, vol. viii. p. 44. [2] Ibid., vol. xvii. p. 75.
[3] Transactions of International Medical Congress, 1881, vol. iii. p. 181.

Under the title of "Larva Migrans," Crocker[1] reports a case where as much as seven inches' progress was made in a day. Repeated efforts were made to capture the supposed larva by cutting out pieces of skin at and beyond the end of the red line, but without avail.

Kaposi[2] gives illustrations of the affection, and calls it *hyponomoderma*, from *ὑπόνομος* and *δερμα*, "that which burrows under the skin"—a non-committal term. Another name given to the disease is *myiasis linearis*. He has only seen four or five cases in his enormous experience, but the affection is said to be more common in certain parts of Russia and in Arabia.

It is unfortunate for the completeness of these cases of mine that I have been unable to demonstrate the larva supposed to have caused the skin symptoms. No better fortune, however, has attended the efforts of other observers, and the particular parasite which gives rise to the skin phenomena has never been demonstrated.

It will be noticed that erroneous diagnoses were made in two of my own cases at first. The affection is at times quite difficult to make out, as its appearance changes considerably. Lee's case was examined by several experienced dermatologists, including Sir Dyce Duckworth, but their opinions were wide of the mark. The discovery of the particular larva producing the affection is a great desideratum.

BENIGN CYSTIC EPITHELIOMA: REPORT OF TWO CASES PRESENTING UNUSUAL FEATURES.

By M. B. Hartzell, M.D.,
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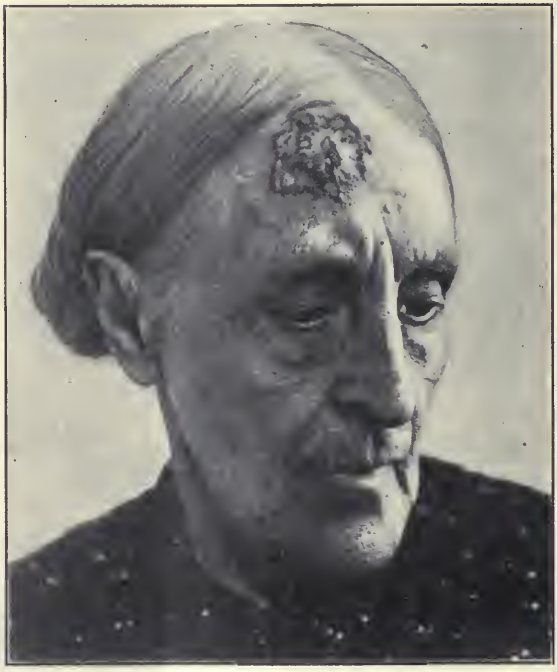
The two following cases of benign cystic epithelioma which I have had the opportunity to study with some detail within the past two years present clinical types of this interesting affection which, so far as I have been able to learn from a careful review of the literature of the subject, have not yet been described.

Case I.—Mrs. E. K., a woman, aged about eighty years, whom I saw through the courtesy of Dr. W. D. Robinson, her family physician, had a rounded, dollar-sized patch of nodules, made up of several smaller, coalescing groups arranged in an irregularly circinate manner around scar-like areas, situated on the right side of the forehead, over the frontal eminence. These nodules, for the most part confluent, were the size of a hempseed, firm, translucent, bluish-white, with a small blue-black dot in the centre of each, resembling a minute gunpowder

[1] Diseases of the Skin, Philadelphia, 1893, 2d ed., p. 926.
[2] Harnkrankheiten, Aufl. 5, 1899, p. 1039.

stain. Near the centre of the patch was an oblong, superficial ulcer covered with a thin crust. The patient stated that the disease had lasted six or seven years, beginning with a single lesion "like a mosquito-bite," and spreading slowly by the addition of new nodules rather than the enlargement of the old ones, which, after reaching a certain size, remained stationary. The central ulcer was of much more recent date, having appeared about two years ago. There was no pain or any other marked subjective symptom. No similar lesions were present on any other part of the body.

FIG. 1.



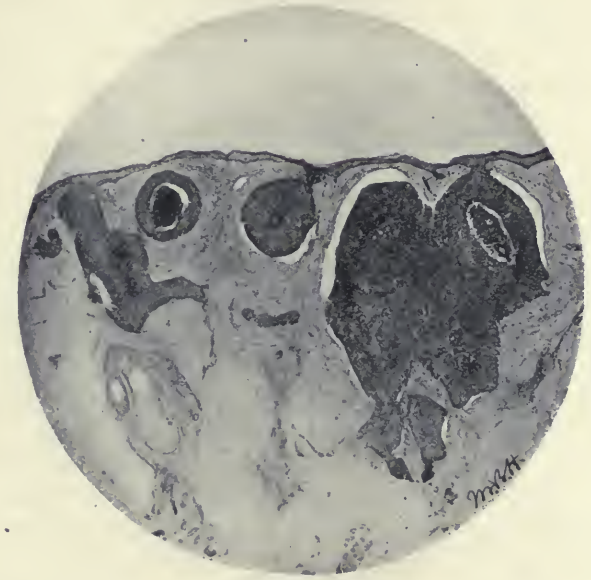
For the opportunity to study the second case clinically and microscopically, and for the use of his notes, I am indebted to Dr. Charles N. Davis, under whose care the patient had been for some time.

CASE II.—F. G., a nurse by occupation, aged thirty-eight years, in excellent general health, had six or seven dime- to half-dollar-sized oval and irregularly shaped, sharply limited patches, consisting of central areas of scar-tissue and atrophied skin surrounded by a bead-like border of pinkish and yellowish large pin-head to split-pea-sized nodules, situated on the upper part of the back and chest. Three of these patches were over the right scapula, one over the left, and two beneath the left clavicle. The nodules were quite firm and slightly translucent, as if containing fluid, but none was obtained upon punc-

turing them. Scarring was present only in the larger patches upon the chest, where an unsuccessful attempt had been made to destroy them with the curette; but the atrophy in the remaining patches was a part of the disease process, the patient stating most positively that no treatment of any kind had been applied to the lesions upon the back. It should also be noted that in the curetted patches new nodules had made their appearance at the border of the cicatrix. The affection was not attended by subjective symptoms of any kind, and had lasted four or five years.

Lesions were excised in both cases for microscopical examination—in the first case from the border of the patch upon the forehead, and in the second from both the chest and back. The microscopical

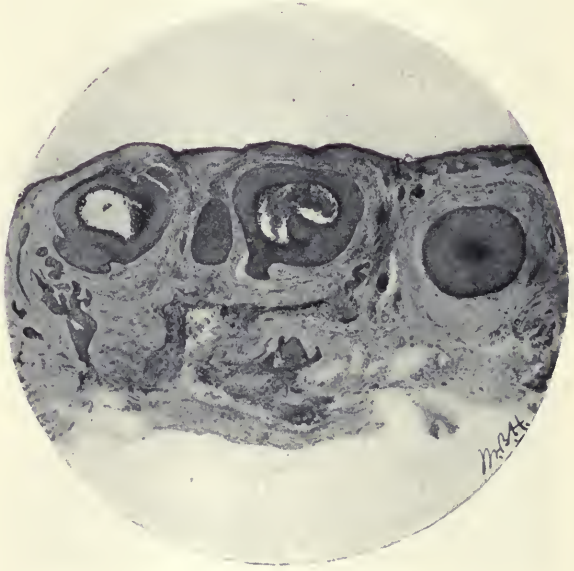
FIG. 2.



appearances corresponded very accurately with those described by previous observers, and were practically the same in both cases. The epidermis presented no abnormality except a slight thinning in places where it had been subjected to pressure from below by the cell-masses about to be described. In the upper and middle portions of the corium were numerous round, oval, and irregularly shaped masses of columnar and oval epithelial cells, the greater number of which contained a central cavity in which was a quantity of granular débris evidently resulting from degeneration of the centrally situated epithelium. (Fig. 2.) About the borders of many of these cell-masses the cells were of the columnar variety, and were arranged radially, presenting a palisade-like appearance. They stained much more deeply

than the oval cells in the centre of the mass, many of which took the stain feebly or not at all. A considerable number of the round and oval cell areas, when followed through a series of sections, were found to be connected with the basal columnar cell layer of the epidermis, and had evidently taken their origin from the cells of this layer. Besides the round masses there were others presenting a great variety of irregular shapes, sending out branching processes and containing curiously tortuous cavities in their interior. Followed through a series of sections they could, in some instances, be traced to hair follicles, from which they seemed to have originated. In some of the sections made from a nodule taken from a patch upon the back of the

FIG. 3.



second case a large epithelial tract presenting a reticulated arrangement was seen, resembling to some degree the structure of an angioma, but the connection of this mass with the epidermis was easily demonstrated. No such arrangement of the epithelium was observed in any of the other lesions examined. In the small epithelial masses the central cavity was correspondingly small, and was filled with an amorphous material exhibiting the staining reactions of colloid matter. In the largest cysts observed in sections of the lesion taken from the first case a considerable quantity of brown, granular pigment was noticed, but none was observed in the sections of the second case. (Fig. 3.) Around the epithelial cell-masses there was a moderate round-celled

exudate, and in some instances a well-marked ring of fibrous tissue separated them from the fibrous tissue of the corium. The sebaceous and sweat-glands were in appearance altogether normal.

These two cases present certain noteworthy peculiarities. In all those hitherto reported the nodular lesions were scattered about over the face and upper part of the trunk without any special arrangement; nothing like the circumscribed patches described above was observed. The advanced age, too, at which the disease first showed itself in one of the cases was decidedly unusual, as in all those previously described it first appeared early in life, commonly within the first two decades. The ulceration which occurred in this case is likewise worthy of special note, although this has been previously observed by Jarisch, White, and Hallopeau, each reporting a case in which ulceration resembling that of ordinary epithelioma took place, but the scar-like atrophy common to both cases has not hitherto been observed.

In 1892, under the name epithelioma adenoides cysticum, Brooke reported four cases of a cutaneous disease, all occurring in the same family—a mother and three daughters—characterized by a nodular eruption confined almost exclusively to the face, there being only a very few scattered lesions upon the shoulders and upper part of the arms. Most of the nodules contained one or more milium-like bodies, and the eruption was so abundant in places as to form lumpy patches on various parts of the face. Microscopical examination of the lesions showed that they were composed of an epithelial new-growth in the corium, which in some sections resembled a sweat-gland adenoma. There were numerous epithelial tracts coiled on themselves, forming masses of various shapes in which were circular or oval cavities filled with colloid matter or horny epithelium. In other sections dense cell-masses predominated, there being few tube-like tracts. In all cases the cell-masses were separated from the surrounding connective tissue by one or more layers of palisade-like cells, which stained more deeply than the cells in the interior of the mass. The connective tissue about the epithelial masses was finer than normal, forming a dense capsule. In some of the sections the neoplastic epithelium was connected with the epidermis and with the hair sacs, and the author believed these structures to have been the piont of origin of the tumors. These cases were regarded by Brooke as being identical with the cases of Jacquet and Darrier and others, which had been previously reported under various names, to which reference will again be made.

About the same time Fordyce reported two cases, occurring in a mother and daughter, resembling in all their clinical and microscopical features those described by Brooke. There was the same nodular eruption confined to the face and neck, and the same epithelial new-growth in the corium. Some of the tumors were made up almost

entirely of densely packed epithelial cells, while in others the epithelium was arranged in bands and tracts intricately intertwined. In still others there were "pearls" and "cell-nests," as in ordinary epithelioma. In some instances the cell tracts presented an alveolar structure resembling glandular tissue. A direct connection of the cells of the new-growth with the columnar cells of the epidermis and with the external root-sheath of the hair was observed in some of the tumors, and the author thinks it evident that the epithelial masses forming the tumors were the result of the proliferations of these structures.

In 1894 Jarisch described a case of eight years' duration, occurring in a young man, aged twenty-two years, in which, besides a nodular eruption situated upon the eyelids, glabella, and temples, there were several small ulcers resembling ulcus rodens. No similar lesions were present upon any other part of the body. Microscopical examination of the nodules and ulcers revealed an epithelial deposit in the *pars papillaris* and the upper part of the *pars reticularis*. These occurred partly as round-cell masses, partly as branching cell tracts tending toward a central point which either enclosed a hair or concentrically layered, flattened, cornified cells. These cell-masses and tracts were separated from the adjoining connective tissue by one or more layers of darkly stained, cylindrical cells. The cells within this palisade-like border varied from round or polygonal to spindle shape, the former being found in the broad masses, the latter in the slender tracts. The connection of the cell tracts with the hair follicles could be established with ease, but no such connection with the epidermis or sweat-glands was observed. In some of the sections the cell-masses seemed to spring directly from the epidermis, but when these were followed through a series they were always found to be connected with hair follicles. Although the case was regarded by Jarisch as being identical with those described by Brooke, he gave it a new name—tricho-epithelioma, as indicating its origin from the hair follicles.

White has reported the case of a woman, aged forty-five years, with some fifty papules and tubercles upon the face, varying in size from a pin-head to a dime and even larger, the small lesions being the color of the skin, while the larger ones were much redder. A number of the medium-sized tubercles were either depressed in the centre or had begun to soften, and were covered with brown crusts. Two or three lesions were much more prominent than the rest, with abrupt, perpendicular edges and depressed centres, like Hutchinson's crateriform epithelioma. On the right upper eyelid, on the inner portion of both lids of the left eye, and on the side of the nose were open ulcers presenting the characters of rodent ulcer. Besides the lesions on the face there were a few on the neck, shoulders, and forearms, but none of these had undergone any secondary change. Bowen, who examined

the tubercles microscopically, found epithelial masses in the corium arranged in islands and elongated tracts, the latter being connected and intermingled in a complicated way. In the midst of the epithelial islands and bands were small cysts with granular or homogeneous contents; in a few, corneous material, either alone or with colloid, was present. In all the tumors connection of the epithelial mass with the lower cells of the rête could be demonstrated. No proliferation of any of the glands of the skin was found. This case is remarkable for the secondary ulceration and the unusual size of the lesions.

Hallopeau has likewise reported a case, although under another name, in which ulceration resembling that occurring in ordinary epithelioma took place. The diagnosis apparently was entirely clinical, as no account of the histology of the lesions is given. The eruption was situated upon the lids, and had existed since infancy.

Wolters has recently reported a case which differs clinically from those previously reported in that there was but a single lentil-sized, yellowish-red tumor over the right eyebrow. The patient was a girl, aged twenty years, and the lesion had existed since birth. It was composed of a maze of cell tracts containing large and small cysts. The epidermis was everywhere intact, but the interpapillary pegs were unequally developed and of varying shapes, and many of them were in direct connection with the cell tracts running through the cutis in all directions. The cysts contained either homogeneous colloid masses or horny, laminated globes. Besides slender epithelial tracts there were others, thicker and more massive, which seemed here and there to be connected with hair follicles, and which, like the others, contained cysts. Most of the epithelial tracts originated from the interpapillary pegs, but their origin from the hair-sheaths could also be demonstrated. The sebaceous and sweat-glands and the bloodvessels were normal.

Within a few months Pick has described a case which seems to be intermediate between benign cystic epithelioma and adenoma sebaceum, presenting some of the features of both neoplasms. A man, aged forty-three years, with a marked acne rosacea, had an eruption of small nodules seated upon the temples and forehead. There was likewise a slightly depressed, atrophied patch over the left zygoma. The nodules were found upon section to be composed of variously sized and shaped epithelial cell-masses partly anastomosing with one another. These epithelial new-formations began immediately beneath the epidermis, and extended, with their processes, down to the fat tissue. Their lobed structure recalled that of the sebaceous glands. The external border of the new-formed cell-masses was formed by cells arranged in a palisade-like manner, with well-stained nuclei. These cells were in all respects like those of the basal layer of the epidermis, with which, when the cell-masses joined the epidermis, they insensibly

blended. In the cell-masses were variously sized cysts, occasionally empty, sometimes containing a mass staining intensely with acid dyes (eosin, picric acid) or finely granular material. The sweat-glands showed no abnormality. The histological picture corresponded with that presented by the cases of Brooke and Fordyce. The author concludes that the case was one of multiple adenoma of the sebaceous gland, corresponding to the sebaceous gland nævi, and that, upon the basis of such an adenoma, epithelial tumors showing the histological peculiarities of epithelioma adenoides cysticum were formed by the proliferation of the border epithelium of the sebaceous gland acini.

In connection with this case reference should be made to the two cases of nodular eruption of the face and scalp reported by Balzer and Ménétrier, and Balzer and Grandhomme as adenoma sebaceum, since they were most probably examples of benign cystic epithelioma. Microscopically, the tumors were found to be composed of proliferating epithelial tissue arranged in lobules containing cysts, the seat of the neoplasm being the pilosebaceous apparatus.

In all the cases thus far referred to the lesions were practically confined to the face, and in all the microscope showed an epithelial new-growth having its origin in one or more of the epithelial structures of the skin.

In 1887 Jacquet and Darier described for the first time a disease of the skin characterized by an eruption of papules and tubercles confined exclusively to the anterior surface of the trunk and inner surface of the upper extremities. Darier, who examined the lesions, found that they were composed chiefly of a great number of epithelial tracts situated in the middle portion of the derma, cylindrical in shape, and ramifying in all directions. Almost all of these epithelial tracts presented globular, cystic dilatations containing blocks of an amorphous, refracting substance. The arrangement of the epithelial tissue, its localization, and the multiplicity of the tumors led the authors to regard the affection as an adenoid epithelioma; and, although not able to certainly trace a connection with the sweat-glands, they concluded that the neoplasm originated in these structures. As indicating the origin of the lesions they designated the malady eruptive hydradenoma. Two years later, at the Paris meeting of the International Congress of Dermatology and Syphilis, Jacquet exhibited a second case presenting the same clinical features, but he denied the relationship of the disease to the sudoriparous apparatus, believing that the nodules were epithelial tumors developed from "erratic para-epithelial débris," and proposed a new name for it—benign cystic epithelioma. Upon the same occasion Quinquaud likewise presented a case in which there were hundreds of nodules, limited, as in the other cases, to the trunk. He expressed himself as being uncertain as to the origin of the neoplasm,

but thought that it might have started from aberrant epithelial cells. At a later period Philippson reported two cases, and Torok one from Unna's clinic. The former regarded the tumors as benign epitheliomata with colloid degeneration, and endeavored to identify the affection with colloid milium; the latter considered the disease cystadenoma which had originated in the sweat-glands. Jarisch and, quite recently, Wolters have reported cases which they considered identical with those of Jacquet and Darier, Quinquaud, Philippson, and Torok, clinically and microscopically; but they denied the epithelial character of the malady, being able, as they believed, to trace the new-formed cell-masses to the endothelium of the bloodvessels. These authors regard the affection as quite distinct from benign cystic epithelioma.

From the foregoing brief summary it is apparent that more or less confusion exists as to the exact relationship of the cases of this last group to benign cystic epithelioma and to one another.

In conclusion, it seems probable that all these cases, described under such a variety of names, represent three affections, presenting lesions which can only be distinguished from one another with the aid of the microscope, but which are quite distinct in their nature and origin: First, benign cystic epithelioma, in which the lesions are usually, but not always, situated upon the face, and have their origin in the basal layer of the epidermis and the external root-sheath of the hair; second, cystadenoma, in which the eruption occurs upon the trunk, the tumors starting in the sweat-gland apparatus; and third, hæmangio-endothelioma, likewise situated upon the trunk, but originating in a proliferation of the endothelium of the bloodvessels.

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POST-OPERATIVE NON-SEPTIC LEUCOCYTOSIS AND OTHER BLOOD CONDITIONS.[1]

By Herbert Maxon King, M.D.,
of grand rapids, mich.

The following observations were undertaken, in the first instance, for the purpose of establishing a normal standard of leucocytosis in non-septic post-operative wound repair. It was thought that could such a standard be established, any material departure from it, following an operation, might be regarded as an early sign of post-operative sepsis, and possess a clinical value accordingly.

The first series of observations in ten cases was begun in the autumn of 1898, and completed prior to the annual meeting of the Michigan State Medical Society in May, 1899, at which meeting, by request, I presented a preliminary report, which was published in the *Transactions* for that year. In this first series the chief interest attaches to the rise and fall of the post-operative leucocytosis, a differential count of varieties of leucocytes not being attempted. It was observed, however, that the numerical value of the red blood corpuscles as well as the hæmoglobin *rose after operation*, even where considerable blood had been lost at the time of operation, and this led, in the second series, to a more systematic study of the red elements and hæmoglobin, for the purpose of ascertaining whether this increase in peripheral blood value following operation was real or apparent. At the same time the leucocytes were studied not only as a whole, but in the relation of their varieties to each other. If by blood examination it were possible to differentiate between an aseptic wound repair and the commencement of a septic process following operation at a time sufficiently early to be of practical value to the surgeon, a study of the blood in all surgical cases of major importance would be the rule of practice; and while the conclusions to be gathered from the records of my two series of cases are perhaps not sufficient for the establishment of fixed standards, the findings in certain respects appear so constant as to warrant their acceptance as *rules* in the pathology of post-operative wound-repair.

I am by no means so certain of the *clinical* importance of blood examinations in these cases. It was thought that such examinations systematically made would show a marked "jump" from the leucocytosis (if it existed at all) of the aseptic process to the familiar blood picture of sepsis, and that at a time so early as to be of practical value. My observations seem to have demonstrated two points of some importance in this regard:

[1] Read before the Chicago Pathological Society, May 12, 1902.

First, that the leucocytosis of a normal wound-repair (even where healing is rapid and by first intention, when no drainage is employed, as in simple laparotomy for tuberculous peritonitis) may be very marked; and second, that the "jump" in degree of leucocytosis between the two conditions does not exist at all.

On the other hand, these experiments demonstrate that at a time subsequent to operation, when the results of infection are most prone to appear, the leucocytosis of normal wound-repair is on the decline; and that if, therefore, the leucocytes appear in increasing number at such a time it may safely be assumed that infection has occurred, such other morbid conditions as effect similar changes in the constituent elements of the blood being eliminated. Further, that while in the blood of the healthy individual there is a standard average number of leucocytes (7500 to 1 c.mm., the different varieties occurring in practically uniform proportion), it is found that the subject for the operating-table, while not necessarily septic, is, of course, not in a normal condition of health, and will therefore present, very frequently, marked variations from this average, associated or not with anæmia or chlorosis. A count made prior to operation will, therefore, represent the "special normal" for each particular case to be observed, which it is of the first importance to ascertain if any significance is to be attached to the post-operative observations. The relative proportion between the various forms of leucocytes is also found to be very inconstant in such conditions as usually demand surgical relief, but this fact is of less importance to the present purpose.

In its relation to septic infection, then, a single examination of the blood made subsequent to operation is of little value either to pathology or diagnosis, since it may present a leucocytosis perfectly normal to one patient which would be quite as abnormal to another. A series of observations commencing six hours or more prior to operation and carried through the period when sepsis may be a possible element of danger will, on the other hand, convey much that is significant to the progress of the wound-repair.

The method of observation adopted in my first series of ten cases was as follows:

First. A complete quantitative examination of the blood (exclusive of a differential leucocyte count) was made from six to twenty hours prior to operation. (In Case VI., first series, this examination was made three days prior to operation, the delay being occasioned by the appearance of menstruation, and a second leucocyte count was made seventeen hours before operation.)

Second. A leucocyte count was made six hours after completion of operation.

Third. A second quantitative examination similar to the first was

made twenty-four to thirty hours after operation except in the first two cases.

Fourth. A leucocyte count was made every twenty-four hours thereafter until all danger of sepsis had passed and the leucocytes had fallen to practically a normal number.

The same instruments were employed in all cases (the Thoma-Zeiss hæmocytometer and von Fleischl's hæmoglobinometer). My pipette for red corpuscles counts rather lower than it should; but as the same pipette was used constantly, and comparative observations are all that are necessary, the results meet the requirements.

In estimating "color index," 5,000,000 per cubic millimetre of red corpuscles was taken as the normal 100 per cent. This is rather higher than normal for women, but a single standard for all cases was considered advisable. Like conditions of nutrition were observed in all examinations, and by reason of the surgical nature of the cases, of course, digestion leucocytosis was always to be excluded from consideration.

The greatest possible care was exercised in procuring the specimens, diluting and mixing the same, and counting; but as absolute accuracy is not obtainable with the Thoma-Zeiss apparatus, note was not made of anything under 100,000 per cubic millimetre in counting the red cells, nor under 100 in the colorless elements.

The blood in all cases is peripheral and obtained from the finger-tip by a puncture sufficiently deep to allow of procuring the specimen without compression.

Such other precautions as were possible were taken to avoid errors in technique.

For obvious reasons, major operations alone were selected for the purpose, both in the first and second series. In the first series of ten cases all were abdominal sections except one, which was an amputation of the breast for malignant disease. One of the abdominal operations was also for malignant disease. None of the second series was a malignant case. Neither of the malignant cases presented evidence of cachexia, which, had it been present, would, of course, have rendered them valueless for the present purposes on account of the leucocytosis which characterizes the blood in such cases.

Notwithstanding the nature of the disease in a few instances in both series, so far as could be determined the general health in all cases was fairly good, with one exception (Case VII., Series II.).

There had been no history of recent suppuration, nor was any pus present in any of them at the time of operation nor subsequently during the periods of my observations.

Of the first series, nine were operations upon adult women, and one (the appendectomy) upon a vigorous young man.

Of the second series of seven cases all were abdominal sections in adult women.

The several operations in the two series were as follows:

Series I. Case I., abdominal section for oöphorectomy.

Case II., abdominal section for oöphorectomy (malignant).

Case III., abdominal section for ventrofixation.

Case IV., abdominal section for ventrofixation.

Case V., abdominal section for oöphorectomy.

Case VI., abdominal section for oöphorectomy.

Case VII., abdominal section for appendectomy.

Case VIII., amputation of the breast and removal of the axillary glands (malignant).

Case IX., abdominal section for removal of papillomatous cyst.

Case X., abdominal section for ovarian cyst.

Series II. Case I., abdominal section for removal of the tubes and ovaries.

Case II., abdominal section for ventrofixation and breaking adhesions.

Case III., abdominal section for removal of the tubes and ovaries.

Case IV., abdominal section for oöphorectomy.

Case V., abdominal section for gallstones.

Case VI., abdominal section for ventral hernia.

Case VII., abdominal section for abdominal tuberculosis.

The method adopted in the second series of observations, as above stated, is somewhat more exhaustive than that in the first, and consists in the following routine:

First. A quantitative examination, including a differential computation of leucocytes and the estimation of the proportion of nucleated erythrocytes, is made a few hours prior to operation. This, of course, necessitates the hardening and staining of cover-glass preparations.

(This additional and rather monotonous labor was suggested by the red-cell finding in the first series, where the second general examination, made from twenty-four to thirty hours after operation, invariably showed increase, at times startling, in the number of erythrocytes per cubic millimetre, and usually also in the hæmoglobin. It was thought that if this increase were real—*i. e.*, due to stimulation of the hæmogenetic function—there would appear with the increase in erythrocytes a proportional increase in nucleated red cells.)

Second. A leucocyte count is made six to twelve hours after operation.

Third. A second general examination similar to the first is made from twenty-four to thirty hours after operation.

Fourth. A leucocyte count is made every twenty-four hours following, as in the first series.

Fifth. A final general examination similar to the first is again made one hundred and twenty hours or more after operation, chiefly for the purpose of determining whether the apparent increase in erythrocytes is sustained.

To better illustrate the changes occurring in the blood in the course of these examinations four charts have been prepared.

Chart I. presents a table of the rise and fall of the leucocytosis, pulse and temperature (recorded at the time of the leucocyte count in each instance), time of examination relative to operation, and the character of the operation made in each case of the two series.

In studying this chart the following points are noted:

1. Case VII., Series I. (appendectomy; active inflammation not present). On the second day after operation two counts were made, four hours apart, as, owing to chill and rise in temperature, with the appearance of icterus, sepsis was feared, which the leucocyte count excluded.

2. Case V., Series II. (removal of gallstones). This case was recorded for fourteen days after operation, owing to continued leucocytosis, the explanation of which lay in an obstinate and persistent diarrhœa, with some bloody discharge from the bowels and considerable secondary anæmia, as shown by the final examination.

3. Same case as above. This count was made three days prior to operation, and, owing to my absence from town, observations on the second and third days after operation were not obtained.

4. Case VII., Series II. (laparotomy for abdominal tuberculosis). This case died from shock of multiple perforation of the gut sixty-six hours after operation and twelve hours after the last leucocyte count, which was made evidently about two hours *after* perforation occurred. Necropsy showed an extensive "dry gangrenous" condition of a large part of the intestinal wall.

This is the one exception to the generally fair health in all of the cases recorded.

From the foregoing chart a supplementary table of averages is compiled, representing graphically the mutual relation of pulse, temperature, and leucocyte variation. (Chart II.)

This relation, as may be seen by reference to Chart I., is not constant; indeed, except in a general way, the pulse, temperature, and leucocytosis appear to bear no direct relationship to each other in aseptic wound-repair.

A few salient points should be noted from these tables:

(*a*) Of the seventeen cases recorded, maximum leucocytosis was reached in from six to twelve hours after operation in nine, in from twenty-four to thirty hours after operation in six, and in from forty-eight to fifty-four hours after operation in one.

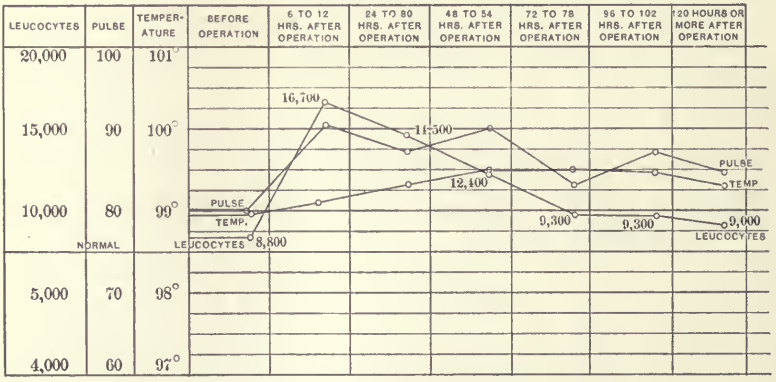
CHART I. (SERIES I. AND II.)—TABLE OF LEUCOCYTOSIS, PULSE, TEMPERATURE, ETC., IN SEVENTEEN CASES.

Case.	6 to 24 hours prior to operation.	6 to 12 hours after operation.	24 to 30 hours after operation.	48 to 54 hours after operation.	72 to 78 hours after operation.	96 to 102 hours after operation.	120 or more hours after operation.	Remarks.
I.	14,700 P. 90 T. 99	18,800 P. 88 T. 100.2	20,000 P. 84 T. 99.8	12,100 P. 80 T. 100.4	13,000 P. 96 T. 99.6	7,800 P. 94 T. 99.4	9,300 P. 88 T. 99.4	Oöphorectomy.
II.	12,500 P. 86 T. 99.4	24,000 P. 64 T. 99.2	13,400 P. 86 T. 100.2	9,400 P. 90 T. 100.4	7,500 P. 84 T. 100.2	7,200 P. 88 T. 100	.....	Oöphorectomy (malignant).
III.	5,000 P. 88 T. 99	10,000 P. 84 T. 99.2	11,000 P. 78 T. 99	8,000 P. 68 T. 100.2	5,000 P. 64 T. 99.6	.....	.....	Ventrofixation.
IV.	5,000 P. 84 T. 98.5	15,000 P. 100 T. 98	15,600 P. 102 T. 99.4	18,000 P. 94 T. 99.2	10,000 P. 90 T. 99.2	10,000 P. 100 T. 99.6	5,900 P. 92 T. 100.2	Ventrofixation.
V.	9,000 P. 76 T. 98.5	17,000 P. 90 T. 99.4	11,000 P. 94 T. 99.2	11,000 P. 90 T. 98.5	9,400 P. 90 T. 98.5	8,100 P. 96 T. 99	.....	Oöphorectomy.
VI.	12,200 P. 80 T. 99.8	13,800 P. 80 T. 99	6,600 P. 84 T. 99.4	13,100 P. 80 T. 99.8	11,800 P. 76 T. 99.8	9,000 P. 64 T. 99.4	.....	Oöphorectomy.
VII.	10,000 P. 60 T. 98.4	18,100 P. 70 T. 98.8	11,200 P. 60 T. 99	7,000 7,200 P. 80 T. 100.4	12,000 P. 72 T. 99	10,500 P. 60 T. 99	6,800 P. 60 T. 98.8	Appendectomy.
VIII.	7,500 P. 70 T. 98	18,800 P. 112 T. 99	16,300 P. 102 T. 99.6	11,900 P. 90 T. 99.4	6,300 P. 90 T. 99.6	.....	.....	Amputation of breast (malignant).
IX.	3,800 P. 68 T. 99.6	7,800 P. 84 T. 99.2	10,900 P. 100 T. 99.2	7,500 P. 92 T. 100	7,500 P. 89 T. 98.6	2,800 P. 81 T. 99.4	.....	Cystic tumor.
X.	5,300 P. 102 T. 100	10,900 P. 88 T. 98.4	11,200 P. 80 T. 99.4	.....	6,600 P. 74 T. 99.8	.....	.....	Cystic tumor.
I.	5,900 P. 64 T. 99.4	12,800 P. 80 T. 98	20,900 P. 96 T. 99.8	15,600 P. 76 T. 98	10,600 P. 72 T. 99	7,500 P. 72 T. 100	5,900 P. 72 T. 99.6	Removal of tubes and ovaries.
II.	16,500 P. 94 T. 99.4	26,300 P. 100 T. 99.8	18,800 P. 86 T. 100	20,000 P. 90 T. 99.8	10,000 P. 90 T. 100.6	13,100 P. 110 T. 100.6	14,300 P. 90 T. 100	Ventrofixation and adhesions.
III.	6,300 P. 64 T. 97.8	7,200 P. 100 T. 100	4,400 P. 82 T. 98.8	6,000 P. 74 T. 98.5	5,000 P. 80 T. 99	6,900 P. 72 T. 98.6	.....	Oöphorectomy.
IV.	7,500 P. ... T. ...	17,800 P. 82 T. ...	11,900 P. 72 T. 98.8	.....	10,700 P. 86 T. 100.1	6,600 P. 76 T. 99.1	.....	Oöphorectomy.
V.	5,000 P. 70 T. 98	14,000 P. 96 T. 98.8	12,500 P. 72 T. 98.8	.....	.....	18,500 P. 108 T. 98.6	16,000 P. 114 T. 99.4	Gallstones.
VI.	10,000 P. 68 T. 98.2	.....	21,500 P. 80 T. 98.6	16,000 P. 98 T. 99.6	13,100 P. 90 T. 99.6	12,800 P. 98 T. 99	10,000 P. 90 T. 98.6	Ventral hernia.
VII.	14,000 P. 122 T. 100.2	25,000 P. 114 T. 100.6	26,000 P. 106 T. 99.4	19,000 P. 160 T. sub.	.....	.....	.....	Laparotomy for abdominal tuberculosis.

(*b*) Exclusive of Case VII., Series II.—which from its nature should obviously be omitted from present consideration—the five highest leucocyte counts recorded occurred as follows: Case II., Series II., 26,300, six hours after operation—ventrofixation; Case II., Series I., 24,000, six hours after operation—oöphorectomy; Case VI., Series II., 21,500, twenty-four hours after operation—ventral hernia; Case I., Series II., 20,900, twenty-four hours after operation—oöphorectomy, etc.; Case I., Series I., 20,000, twenty-four hours after operation—oöphorectomy. Excepting in these cases no leucocytosis of 20,000 to 1 cubic millimetre or more was observed.

(*c*) One other of these cases requires special mention—Case IX., Series I. It will be observed that the leucocyte count before operation in this case indicated a condition of leucopænia, being 3800 (considerable chlorosis also existed in this case, the color index being 0.50), and on the fourth day after operation it fell to 2800. The maximum leucocytosis in this case occurred about thirty hours after operation, and amounted to 10,900, which would be equivalent to 15,000 in one whose blood was normal to start with.

CHART II.



Average pulse, temperature, and leucocytosis in seventeen cases.

(*d*) The least variation in the leucocyte count occurred in Case III., Series II., which was an oöphorectomy. The nature of the operation in itself, therefore, seems to have little effect upon the degree of leucocytosis.

From Chart II.—which represents graphically the *average* pulse, temperature, and leucocytosis in the seventeen cases—it will be seen that the leucocytosis (taking the average) rises to its maximum in from six to twelve hours after operation, from which point it steadily declines to normal, which may be said to be reached about one hundred and twenty hours after operation. That there may be many exceptions to this average, however, without signifying sepsis is a fact demonstrated in the tables of Chart I.

CHART III. (SERIES II.)—PER CENT. AND ACTUAL NUMBER PER C.MM. OF RESPECTIVE VARIETIES OF LEUCOCYTES BEFORE AND AFTER OPERATION.

Case.	Time.	Small lympho-cytes.	Large lympho-cytes.	Poly-morpho-nuclear neutro-philes.	Eosino-philes.	Transi-tional forms.	Myelo-cytes.	Total.
I.	12 hours prior to operation	31 % 1829	12 % 708	54 % 3186	Small fract. % 177	3 % 177	.....	5,900
I.	30 hours after operation	2 % 418	11 % 2299	84 % 17556	None	3 % 627	.....	20,900
I.	126 hours after operation	9 % 531	12 % 708	75½ % 4454+	½ % 29+	3 % 177	.....	5,900
II.	18 hours prior to operation	10½ % 1732+	5 % 825	82 % 13530	.....	2½ % 412+	.....	16,500
II.	24 hours after operation	9 % 1692	7½ % 1410	81 % 15228	.....	2 % 376	.....	18,800
II.	168 hours after operation	22 % 3366	11¼ % 1759+	61¼ % 9409+	3½ % 535+	1 % 153	½ % 76+	15,300
III.	18 hours prior to operation	35 % 2205	15 % 945	45 % 2835	1 % 63	4 % 252	.....	6,300
III.	24 hours after operation	7 % 504	6 % 432	84 % 6048	.....	3 % 216	.....	7,200
III.	120 hours after operation	37 % 2553	6 % 414	53 % 3657	1 % 69	3 % 207	.....	6,900
IV.	12 hours prior to operation	43 % 3225	5 % 375	49 % 3675	1 % 75	2 % 150	.....	7,500
IV.	30 hours after operation	9 % 1071	4 % 476	83 % 9877	.....	4 % 476	.....	11,900
IV.	126 hours after operation	28 % 1848	7 % 462	60 % 3960	1 % 66	3 % 189	1 % 66	6,600
V.[1]	3 days prior to operation	25 % 1250	10 % 500	62 % 3100	.....	3 % 150	.....	5,000
V.	6 days after operation	8 % 1000	10 % 1250	78 % 9750	1 % 125	3 % 375	.....	12,500
V.	14 days after operation	18½ % 2886	8 % 1248	68½ % 10686	2 % 312	2½ % 390	½ % 78	15,600
VI.	12 hours prior to operation	10 % 1000	16 % 1600	68 % 6800	3 % 300	3 % 300	.....	10,000
VI.	30 hours after operation	7 % 1505	5 % 1075	86 % 18490	.....	2 % 430	.....	21,500
VI.	150 hours after operation	13 % 780	10 % 600	75 % 4800	1 % 60	1 % 60	.....	6,000
VII.[2]	60 hours prior to operation	19 % 2660	11½ % 1610	68 % 9520	½ % 70	1 % 140	.....	14,000
VII.	30 hours after operation	7½ % 1950	6½ % 1690	85 % 22100	.....	1 % 260	.....	26,000

Chart III. is a table of the differential computation of leucocytes, in percentages and actual number per cubic millimetre, made shortly before operation, again twenty-four to thirty hours after operation (except in one instance), and lastly, one hundred and twenty or more hours after operation (also excepting one instance) in the seven cases of the second series.

[1] In this case an accident to the cover-glass preparations prevented a differential computation on the first day after operation. One was made, therefore, on the sixth day when leucocytosis had declined to about the same degree as that of the first day after operation. Leucocytosis persisted at the fourteenth day, owing to diarrhœa and secondary anæmia. This experiment is therefore vitiated.

[2] This is the case which died from shock sixty-six hours after operation, making the final examination impossible.

The chief object here is to demonstrate again what has so frequently been done before, namely, that the principal change in the colorless elements of the blood in leucocytosis occurs in the neutrophiles, which are increased out of all proportion to the other leucocytes; indeed, in the instance of the small lymphocytes in my seven cases the second examination made during the maximum leucocytosis showed actual diminution in number per cubic millimetre in every case but one (Case VI., Chart III.).

The large lymphocytes are found, at the same time, slightly increased in actual number per cubic millimetre except in two cases (Cases III. and VI., Chart III.).

Transitional forms, also, at the same time are increased to some extent except in one case (Case III., Chart III.).

In the case of the polymorphonuclear neutrophiles, however, there are no exceptions, and the increase in actual number is so considerable as to be readily apparent, while in relative number their percentage rises sharply in all but one case (Case II., Chart III.), where it remains nearly stationary, owing to the existence of a marked leucocytosis prior to operation, with comparatively little variation in this respect during the whole course of observations. (See Case II., Series II., Chart I.)

In the first series of examinations, as before stated, two counts of the red corpuscles were made in eight cases—the first count shortly prior to operation, and the second from twenty-four to thirty hours after operation. I expected to find a diminution in erythrocytes following operation, especially in cases where any considerable blood was lost. The contrary, however, obtained. My attention was about this time called to an excerpt from an article by Ermanno Pinzani,[1] who found the red cells and hæmoglobin increased following oöphorectomy, and evidently believed the increase to be real.

The results in the eight cases of my first series were as follows:

Case III.—The red corpuscles increase, in the second examination, more than 500,000 over the count in the first examination; hæmoglobin remaining the same, thus lowering the "color index."

Case IV.—The numerical increase in the second over the first examination is 1,400,000, while the hæmoglobin advances from 70 per cent. to 90 per cent.

Case V.—The cellular increase is 1,000,000; hæmoglobin, 5 per cent.

Case VI.—In this case the increase is insignificant.

Case VII.—The numerical increase is 2,100,000, and hæmoglobin, 5 per cent.

Case VIII.—The increase is again insignificant, being only 100,000, hæmoglobin remaining unchanged.

[1] American Journal of Obstetrics, April, 1899.

Case IX.—The numerical advance is 300,000; hæmoglobin, 5 per cent.

Case X.—The cell increase is 500,000, while the hæmoglobin advances 15 per cent.

On account of these rather unexpected findings it was thought best to carry the observations a little further in the second series. A third examination was, therefore, made in the latter series, one hundred and twenty hours or more after operation, to determine whether this increase in erythrocytes was sustained. At the same time cover-glass preparations from each examination were stained and a systematic search made for nucleated red cells. It was believed that if the advance in red corpuscles were real, and not merely a phenomenon of transient character occurring in the peripheral blood, there would be a noticeable increase of nucleated red cells in the circulating blood, such as obtains in any blood regenerative process, notably in the secondary anæmia following severe hemorrhage.

The results of these observations in the second series are shown in the tables of Chart IV. It will be seen that while in every instance the second examination shows an increase in erythrocytes over the first of from 100,000 to 1,000,000, the third examination shows a return of the red cells to practically the number counted at the first examination. The same is true of the hæmoglobin to all practical purposes.

The rule adopted in regard to the nucleated red cells was to record all observed while counting 300 leucocytes, taking a different cover-glass preparation for each 100 or 150 leucocytes counted, to avoid errors arising from faulty distribution of blood.

Only one case (Case I., Chart IV.) shows any practical increase in the number of nucleated erythrocytes. It is significant that this is the case which shows the greatest and most persistent increase in red cells of any of the series.

In view of the findings in this series it must, I think, be admitted that the apparent increase in the red cells following operation is not real—*i. e.*, due to the excitation of the hæmogenetic function, but rather is due either to the temporary abstraction of the fluid constituents from the blood or merely a phenomenon of the peripheral blood and of transient character.

To a certain extent the leucocytosis might be explained in the same way; but after all allowance is made for such possible error there would still be left no inconsiderable leucocytosis, which is further proved real by the changes in relation between the various forms which have been recorded in Chart III.

It must further be admitted that chloroform anæsthesia (which was employed in all of these cases, sometimes alone, and again only at the start and followed by ether) may play some part in the leucocytosis

following operation; for I have had the opportunity of observing that chloroform anæsthesia alone is capable of producing a leucocytosis in the peripheral blood, which, however, is scarcely more persistent than that produced by the digestion of a hearty meal, and consequently, of course, need not be seriously considered in this connection.

CHART IV. (SERIES II.)—TABLE OF ERYTHROCYTES, HÆMOGLOBIN AND NUCLEATED RED CELLS BEFORE AND AFTER OPERATION.

Case.	Time.	Erythrocytes.	Hæmoglobin (v. Fleischl).	Color index.	Number of nucleated red cells per 300 leucocytes.
I.	12 hours prior to operation	3,800,000	50 %	0.66	One.
I.	30 hours after operation	4,800,000	65 %	0.68	Four.
I.	130 " " "	4,600,000	60 %	0.65	None.
II.	18 hours prior to operation	4,300,000	85 %	1.00	One.
II.	24 hours after operation	4,600,000	92 %	1.00	None.
II.[1]	168 " " "	.....	.....	.....	"
III.	18 hours prior to operation	3,800,000	82 %	1.08	"
III.	24 hours after operation	4,700,000	85 %	0.90	Two.
III.	120 " " "	3,900.000	85 %	1.09	None.
IV.	12 hours prior to operation	3,400,000	80 %	1.18	One.
IV.	30 hours after operation	3,900,000	90 %	1.15	None.
IV.	126 " " "	3,100,000	70 %	1.13	"
V.	3 days prior to operation	3,600,000	70 %	1.00	"
V.	24 hours after operation	3,800,000	75 %	1.00	"
V.[2]	11 days " "	2,400,000	55 %	1.14	"
VI.	12 hours prior to operation	3,400,000	80 %	1.18	"
VI.	30 hours after operation	3,500,000	80 %	1.14	"
VI.	150 " " "	3,000,000	80 %	1.33	"
VII.	2 days prior to operation	3,100,000	50 %	0.80	"
VII.	30 hours after operation	3,900,000	65 %	0.83	"

The conclusions which I think may be safely drawn from the foregoing are:

1. An increase of from 5000 to 10,000 leucocytes per cubic millimetre following operation in from six to thirty-six or even forty-eight

[1] The record of this examination for estimation of red cells and hæmoglobin has been lost.
[2] This is the case before spoken of, in which a persistent diarrhœa followed operation, causing secondary anæmia.

hours is a normal post-operative condition, provided it be not sustained.

2. Probably the maximum leucocytosis in the majority of cases occurs within the first twelve hours after operation, and is very transient.

3. The leucocytosis in the normal reparative process bears but slight relation to the pulse and temperature.

4. A post-operative leucocytosis of 10,000 or more *above the individual normal* sustained for more than a few hours may be looked upon with suspicion.

5. The apparent increase in number of erythrocytes following operation is not caused by an actual increase of red cells in the circulating blood.

To Drs. Eugene Boise and Richard R. Smith, of Butterworth Hospital, and Drs. Schuyler Graves and O. E. Herrick, of the Union Benevolent Association Hospital, I am indebted for the opportunity of making these observations, every courtesy possible being extended me by all of these gentlemen during their respective services.

ENTRANCE OF AIR INTO THE VEINS, AND ITS TREATMENT.

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Although the dangers accompanying sudden entrance of air into the venous circulation were recognized early in the eighteenth century by such observers as Redi, Valsalva, and Morgagni, it remained for Beauchesne, in 1818, to first report a death, verified by autopsy, due to entrance of air into the jugular vein during an operation for the removal of a tumor from the neck.

The discussion following Beauchesne's report has been carried on during the past century by such clinicians and experimentalists as Barlow, Mirault, Delaporte, Ammussat, Cormack, Wattman, and others—during the early part of the nineteenth century—and later by Senn, Hare, Treves, Porter, Hektoen, Draper, and Davidson.

The conclusions which have been reached are various. On the one hand, we have heard warnings against its dangers; others have endeavored to dispel the dread of this accident existing among surgeons. Some have taught that the merest bubble of air entering the veins may cause alarming symptoms, possibly death; while others have

claimed that large quantities of air may be injected into the veins near the heart with no ill effects save a slight, temporary fall in the blood-pressure. Even among those who have believed in the dangers attending the accident, opinions have differed as to the direct cause of death.

Treves believed that death was due to arrest of pulmonary circulation, the air in the right heart being mixed with blood, and preventing action of the tricuspid and pulmonary valves, but little blood reaching the left ventricle, and anæmia of the brain following.

Cormack thought that death was due to gaseous distention of the right heart.

Bell asserted that the cause of death lay in the transference of air to the base of the brain, with consequent respiratory paralysis.

Virchow claimed that complete air embolus of the pulmonary artery, with consequent loss of blood to the coronary circulation and arrest of the heart in diastole, was the immediate cause of death.

In citing these cases I have by no means exhausted the differences in opinion which have existed during the past century among eminent observers.

While the cause of death has been a subject of much controversy, the fact that death does occur and is due directly to the entrance of air into the veins is acknowledged by surgeons generally, there being few notable exceptions.

Hare, in 1889, published a paper in the *Therapeutic Gazette* voicing views on this subject at variance with the popular idea. In comparing his paper with that of Senn's, published four years previously, we must be impressed with the fact that in experimental work personal equation plays no insignificant part. Both are men whose opinions carry weight; and yet we find, on the one hand, Hare, after experimenting with some seventy dogs, asserting that even large quantities of air do little harm, while small amounts, varying from 20 c.c. to 40 c.c., injected into the jugular vein cause little more than slight transitory fall in blood-pressure; on the other hand, Senn found that small quantities of air when injected into the jugular vein proved fatal in a large percentage of his dogs.

While this accident occurs more commonly during operations in the neck and axillary regions, the veins in other parts of the body are by no means exempt.

Davidson reports the case of a Hindoo woman who died suddenly, after a normal labor, and in whom the autopsy revealed dilated uterine veins, congested lungs, and a right ventricle filled with mixed air and blood.

So, also, Wyman reports a death following rapidly the aspiration of a pelvic tumor, where the autopsy showed a right heart dilated with air, while neither ventricle contained any blood.

Volkmann reported a death due to entrance of air while aspirating a longitudinal sinus.

Bergmann describes the case of a man whose occiput was injured; the man died in four hours. On post-mortem examination both lungs were found œdematous, and there was a very extensive form of air embolism, the air probably entering through the injured torcular.

A death has been reported from entrance of air into the sinuses of the dura mater. However, so much more frequently has this accident occurred during operations in the region of the axilla and neck that this has come to be known as the "danger zone."

Senn says: "Clinical observation and experimental research have established the fact that the venous circulation is directly influenced by respiration within a certain area, and that inspiration of air, in the majority of cases, takes place in the veins thus affected, constituting the justly much-dreaded 'danger zone.'"

It is in these veins near the heart that the so-called suction force is exerted. When a vein is completely severed and its lumen closed by collapse of its walls the danger is practically *nil*. Partial division or nicking of the vessel constitutes the condition favorable to the drawing of air into the vein.

The peculiar relation of the external jugular vein to the cervical fascia and of the axillary vein to the costo-coracoid fascia renders the lumen of these vessels patulous even when cut through. This is also true of veins whose walls have been diseased, thickened by calcareous deposits, or in such conditions as periphlebitis, where the surrounding inflammatory tissue is intimately connected with the walls of the veins. Thus the factors in this region upon which this accident depends are two—patulous veins and suction force exerted during inspiration.

The accident has occurred with greatest frequency during removal of tumors from the neck and axilla, amputation at the shoulder-joint, resection of the scapula, ligation of the subclavian, and venesection of the jugular vein; but it may occur in the most trivial operation in this region, and more frequently in the cervical veins than in the axillary.

The symptoms attending this accident as described by various surgeons and coinciding with my own observations in experiments on dogs are: A hissing noise accompanies the entrance of air into the vein; the blood-pressure immediately falls; the heart—at first tumultuous, with a churning sound plainly heard over the præcordial area, synchronous with the heart action—becomes rapidly weak and irregular; convulsive twitchings of the entire body occur; at this time (and the preceding symptoms have occupied scarcely thirty seconds) the pulse has disappeared, the heart has ceased except for an occasional impulse, the breathing becomes labored and rapid, and after a few violent

inspiratory efforts the animal dies. The picture is one of cardiac failure, with secondary respiratory paralysis due to anæmia of the brain centres.

While working with Dr. Kemp in the Columbia Physiological Laboratory, two years ago, to determine the effects on blood-pressure of infusion with normal salt solution introduced at temperatures ranging from 105° to 120° F. the following accident occurred:

A moderate-sized dog was given a dgm. of morphine at 10 A.M.; at 10.45 A.M. ether was administered. When the animal was completely anæsthetized a tracheotomy was performed for convenience in administering the ether during the further course of the experiment.

The right carotid was then opened, and into it was inserted a manometer tube, which in turn was attached to the kymograph, so that any changes in blood-pressure occurring during the experiment might readily be noted.

The right femoral artery was exposed, and into it a canula was tied. As a final procedure the femoral vein was opened, and through the canula placed in its lumen we expected to perform our infusion. The saline infusion was then prepared at a temperature of 105° F. and placed in the douche bag. The kymograph was set in motion and the normal blood-pressure noted—*i. e.*, 182 mm. We now removed through the canula placed in the femoral artery 100 c.c. of blood; the pressure slowly fell during the bleeding to 110 mm. After waiting two minutes for spontaneous recovery in pressure, which invariably occurs after bleeding, we prepared to start our infusion.

The canula in the femoral vein was carefully filled with salt solution, so that no air might enter when the infusion was started. Through some misunderstanding the same precaution was not exercised on the tube of the douche bag, consequently it was filled with air between the clip and the distal end; so when it was attached to the canula in the vein and the clip opened, a column of air 3 feet long and 6 mm. in diameter was forced into the vein by the pressure of the fluid in the bag; about 12 c.c. of air must have been injected in this way. The air was plainly seen rushing through the glass canula. The blood-pressure fell in a few seconds to near zero. (See Fig. 1.) The churning sound observed in these cases was distinctly heard; the heart's action became at first tumultuous, and then rapid and weak; convulsive muscular twitching began; respirations were labored and inspirations deep and gasping; death seemed certain. Instead of removing the canula and stopping the infusion the saline was immediately increased in temperature to 120° F., and artificial respiration by means of Hoyt's artificial respiration apparatus was begun. Slowly the action of the heart returned; a slight tracing reappeared on the drum, and the blood-pressure slowly arose. The infusion was continued, being given very slowly; artificial respiration was fixed at 20 per minute; in fifteen minutes the heart had regained its expansile force, the tracing on the drum was normal, and respiration was much improved. Accordingly both infusion and artificial respiration were stopped. The blood-pressure remained at 156 mm., and we continued our original intentions on the same dog for the subsequent hour and a half.

This experiment was particularly valuable because of the fact that the entrance of air was entirely accidental, and happened under conditions that might well have occurred clinically. It seemed to show that the entrance of air into a vein under pressure was dangerous and might lead to a fatal termination. It also seemed that in the treatment of this condition direct venous infusion with normal salt solution at a temperature of 115° to 120° F. and artificial respiration were important factors. I was lead by this result to continue the experiments on a series of dogs at the Columbia Physiological Laboratory last winter.

In the first five experiments the following routine was followed: The dog was given morphine in dosage from 5 cgm. to 1 dgm., according to its size; after waiting half an hour the animal was etherized and tracheotomy was performed. The femoral vein was exposed for injection of air and infusion; a canula with a stopcock attachment connecting with the atmospheric air, in order that the syringe might be filled without removal from the vein, was inserted and tied in place, and the carotid artery on the right side was then exposed and connected by means of a manometer tube to the kymograph. I have chosen Experiment 3 as a fair representative of this class.

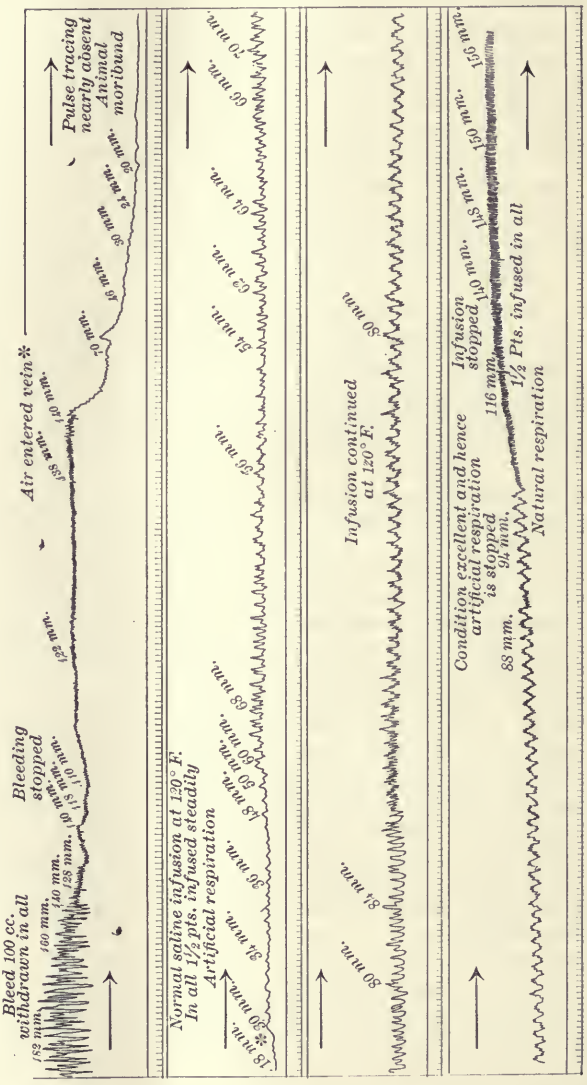
A white setter, weighing forty pounds, was given 1 dgm. of morphine, and 75 c.c. of air was injected into the vein. The pressure dropped from 124 mm. to 8 mm. in a period of time covering fifty seconds. Immediately following the entrance of air the heart became tumultuous; a churning sound was plainly heard in the chest; in a few seconds the heart became weak and irregular, the femoral pulse disappeared, and finally the heart ceased to beat perceptibly. The respirations were not affected until some seconds after the heart began to show the first changes; then they became labored and more rapid. This was followed by the peculiar forced inspirations noted in all these cases, and the respirations did not cease entirely until one minute after the last heart tracing was noted on the drum. An infusion of normal salt solution at a temperature of 120° F. was given, without the slightest result; the dog was dead. The autopsy revealed the right ventricle distended with air; the large venous trunks contained many air bubbles, as did the pulmonary artery. The coronary vessels were found filled with air emboli and the heart was fibrillating; this continued for about fifteen minutes.

In all these dogs the air was injected with considerable force; the maximum amount used in any individual case was 75 c.c. Infusion was resorted to in six dogs, with recovery in two. In one of the dogs which recovered I believe such would have been the case with no treatment; thus there was but one favorable result following treatment by infusion alone. (See Fig. 1—accidental entrance of air during infusion.)

In one dog, after a temporary rise in blood-pressure, too much infusion was allowed to enter the vein, and it died of pulmonary œdema.

In another dog death occurred when artificial respiration was begun after a temporary rise in blood-pressure had been noted following infusion.

FIG. 1.



On the rest of the dogs experimented upon infusion had no effect whatever. In all the primary effect of air injection was on the heart, the respiratory symptoms being secondary. An autopsy was performed

after each experiment, except Experiment 1, where entrance of air was accidental, and in all the animals the coronary vessels were found full of air emboli and the heart fibrillating; in four of the five the right ventricle was distended with air.

I am inclined to believe that death in these cases was due to one of two possible causes: First, gaseous distention of the right ventricle, with loss of contractile power, failure of both pulmonary and tricuspid valves to act, failure of blood to reach the left ventricle, and consequently anæmia of the brain centres. The second, and it seems to me the more important factor in the death of these animals, was the plugging of the coronary vessels with air emboli. The heart being deprived of its circulation was thrown into fibrillation, and death ensued. This was observed by Cunningham in 1898. Erichsen, Cohnheim, Rechberg, Porter, and others found that by tying off the coronary vessels or injecting them with a preparation of wax, paraffin, and soot, thus completely shutting off the intrinsic circulation of the heart, the heart becomes irregular, the pressure sinks, and the ventricles beat arrythmically; that is, they cease to beat as a unit, but individual muscle fibres continue an inco-ordinate contraction for some time. This is precisely the condition observed in these dogs.

I cannot agree that respiratory failure plays a primary part in the result, as is believed by Hare and others. Hare reports two cases in which he injected the carotid artery; in one 40 c.c. of air was used, and in the other 20 c.c.; each was equally fatal, and respiratory failure was in these cases the primary cause of death, the heart beating some time after respiration ceased. His deductions based on these experiments are as follows:

"Under such circumstances" (air injected into the carotid) "the results are quite different from those seen after opening the jugular vein, but nevertheless totally disprove the theory that it is by cardiac failure that death under such circumstances occurs." This statement holds good only in so far as injection of the arteries with air is concerned, air emboli being carried directly to the base of the brain and the respiratory centres, while, when the venous system is injected the air is carried to the right ventricle, and the resulting mechanical dilatation of that receptacle causes anæmia of the brain centres and secondary respiratory paralysis. If Hare means to apply the results of his experiments with injection of air into the arteries to similar injections of the veins I think his conclusions are obviously erroneous. (See Fig. 5, Experiment 17.) Rapid injection of air was an important factor in obtaining the preceding results, for, as will be seen later, considerable quantities of air may be slowly injected without serious effect.

I was impressed with two facts in my first experiments: First, that entrance of air into the veins is a serious accident, which may well

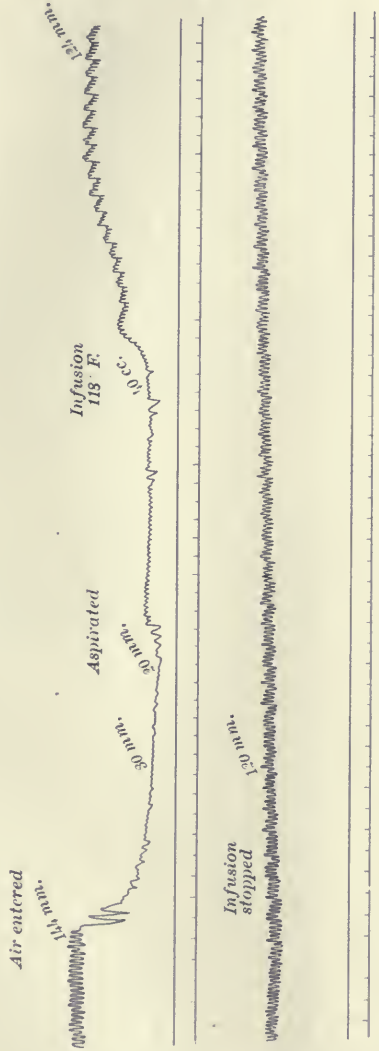
result fatally; and secondly, that when the right heart is distended with air, infusion can be of little service until that air is removed. I believe with Treves that artificial respiration is unnecessary, if not contra-indicated, there being no primary respiratory failure, and the dyspnœa being due not to lack of air, but lack of blood in the lungs.

In 1885 Senn, after injecting air into the veins of dogs, aspirated the right heart by means of a needle about 2 mm. in diameter, forced through the chest wall into the ventricle; 30 per cent. of his dogs recovered after this treatment. It seemed to me that if this were followed by infusion of saline at high temperatures we might expect even a higher percentage of recoveries. Accordingly I experimented on some eleven dogs, with this object in view. The same routine was followed as in the former experiments, with two differences: the external jugular vein was used for our injections of air instead of the femoral, and in the treatment an aspirating needle, 2 mm. in diameter, was forced into the right ventricle, and the air removed by means of Hoyt's vacuum pump before infusion was begun. I shall let Experiments 10, 13, 15, and 17 represent this class.

Experiment 10 (No. 1).—This dog—a heavily built bulldog, weighing 34.5 pounds—was given 1 dgm. of morphine about an hour before the anæsthetic was commenced. As we intended to allow this dog to come out of ether we did not do tracheotomy. As much care as possible was used in asepsis; after anæsthetizing, the carotid and jugular were exposed and treated as in the other experiments. Everything being ready, the kymograph was set in motion and the normal pressure noted; in this case it was 148 mm. After waiting five minutes 75 c.c. of air from an Ultzman syringe was injected into the left jugular vein. The effect was instantaneous; within ten seconds the pressure fell from 140 mm. to 40 mm.; the heart was tumultuous; the churning sound before described was plainly heard; in a few more seconds the pressure had fallen to 18 mm. (which is practically zero, as it will never fall to actual zero, even when the animal is quite dead, until the arterial canula is removed); the heart grew rapidly weak, until all pulse tracings finally disappeared from the drum; the respirations still continued, however, though labored and gasping at this time. We then inserted a needle into the fourth left interspace, about an inch from the sternum; the vacuum apparatus was set in motion and a vacuum created in the bottle; the needle was then thrust obliquely into the right ventricle, and about 150 c.c. of air mixed with blood was drawn off. The pressure arose immediately, the pulse tracings reappeared on the drum, and the cardiac expansions increased; at this point infusion was begun, and about thirteen ounces of normal salt solution at a temperature of 120° F. was allowed to run in very slowly. One minute after this treatment the pressure had risen to 128 mm.; infusion was stopped, the vessels were tied, and the wound was closed with catgut sutures. The dog was then placed in a cage, was wrapped in blankets, and was surrounded by hot-water bottles. The ether was stopped at 1 P.M.; at 2 P.M. the dog came out from under the influence of his anæsthetic; at 5 P.M. the same day he was weak, but able

to stand. At this time half a pint of milk was given him, which he retained. The next day he got "regular diet." During the next five days he continued to do well, took his nourishment eagerly, and, with the exception of a stitch abscess in the femoral incision, was apparently as well as before the operation.

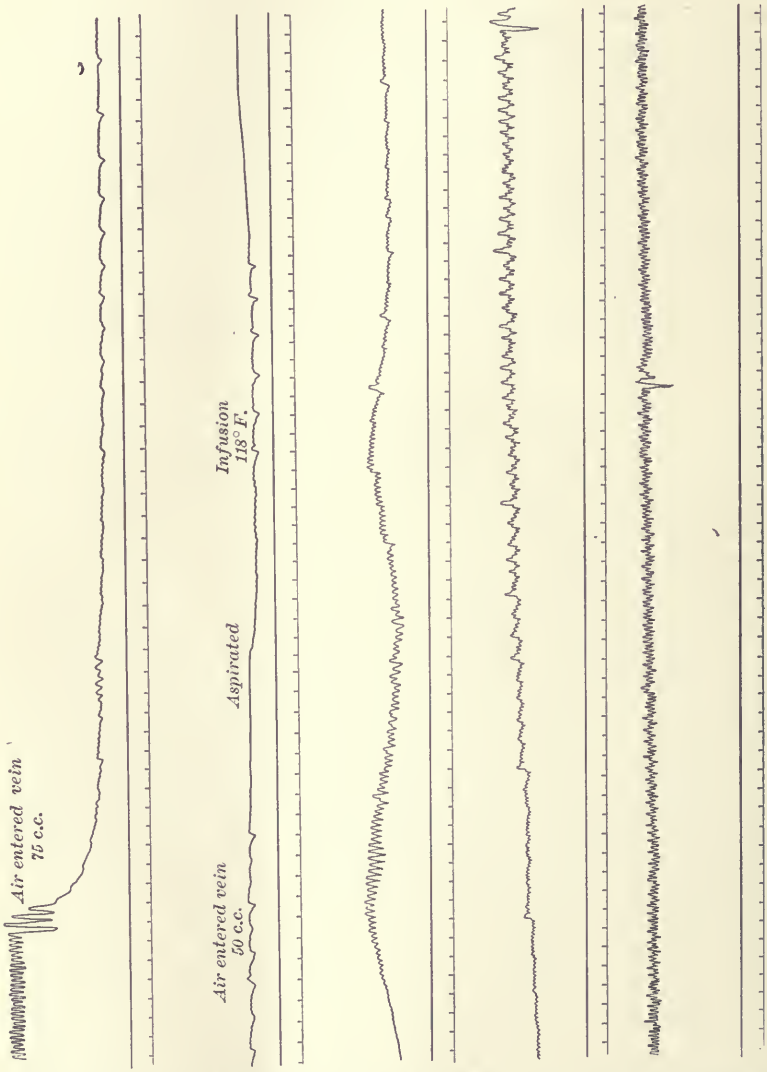
FIG. 2.



No. 2.—On the morning of the sixth day the same dog was again etherized, the opposite jugular was exposed and opened, and 75 c.c. of air was injected. Immediately the same symptoms developed as were present in this dog six days previously. No treatment was resorted to in this case, and the dog died. After waiting for five minutes the chest was

opened, the right ventricle was found distended with air, the auricles were spasmodically contracting, the coronary vessels were filled with air emboli, and the heart was fibrillating; this continued for fifteen minutes. The old puncture scar was visible at the base of the right ventricle; there was no blood in the pericardium.

FIG. 3.



Experiment 13.—A dog weighing forty-four pounds was given 8 cgm. of morphine, anæsthetized with ether, and dealt with in the manner above described. Everything being ready, the kymograph was set in motion at 11.38 A.M.; at 11.44 A.M. 75 c.c. of air was

injected into the jugular vein. The blood-pressure immediately fell from 162 mm. to 50 mm.; the heart continued to beat perceptibly, the tracing on the drum showed less expansion, and the pulse was rapid, weak, and irregular. We did not resort to any treatment at this time. After waiting four minutes the pulse began to improve, and the pressure slowly rose until it reached 160 mm., and the dog was in quite as good condition as before the air was forced into the veins; thus in this case 75 c.c. of air had but a transitory effect on the heart. After waiting for twenty minutes (and during that time the heart remained in good condition) we forced 75 c.c. of air into the jugular vein (see Fig. 3); instantly the pressure fell, the femoral pulse disappeared, and the tracing on the drum was barely perceptible; in about two minutes the gasping respiration peculiar to these cases commenced. We then injected 50 c.c. of air; in three minutes after the first injection of air the dog was apparently dead. At this juncture the needle was inserted and the right ventricle was aspirated; in a few seconds a faint impulse was felt against the needle, and this was followed by a feeble tracing on the drum, and respirations began again. An infusion of normal salt solution at a temperature of 120° F. was begun, and the pressure slowly rose until in three minutes it had reached 180 mm., about a pint of salt solution in all having been used. After waiting twenty minutes the dog was killed with chloroform. On opening the chest no air was found in the heart or coronary vessels and no effusion of blood in the pericardium.

Experiment 15.—A fairly large dog weighing thirty-eight pounds was given 9 cgm. of morphine; at 10.30 A.M. anæsthesia with ether was started, and the operation was proceeded with as in the other experiments. At 11.08 A.M. the kymograph was started and a normal tracing obtained; at 11.10 A.M. 50 c.c. of air was injected into the jugular, and this was followed by a slight fall in blood-pressure, which, however, was speedily recovered from, and no treatment was necessary. At 11.15 A.M. 100 c.c. of air was injected; the pressure fell directly from 150 mm. to 12 mm.; no heart-beat was registered; no pulse could be felt; there were several gasping inspirations, and the dog seemed quite dead. After waiting some seconds to make sure that the animal would not recover spontaneously, and still no tracing showing any movement of the heart, the right ventricle was accordingly aspirated, and when a few ounces of mixed air and blood had been drawn off the heart's action could be felt against the needle, and also the tracing and pulse reappeared. In this case no infusion was done; the pressure rose to 150 mm., and the heart's action continued fairly good—a little irregular for a few minutes, and later quite normal. At 11.30 A.M. 100 c.c. of air was injected, causing a fall in blood-pressure, but the heart continued. (See Fig. 4.) At 11.35 A.M. the blood-pressure had risen to 120 mm., and 50 c.c. of additional air was injected. This was sufficient; the pressure fell, and there was neither pulse nor tracing in forty-six seconds. The dog being practically dead, the heart was aspirated, when the pressure rose to 72 mm. in one minute, the pulse being then slightly irregular and feeble. It continued in this manner until 11.40 A.M., when an infusion was done. This was followed by another rise in pressure to 125 mm., an increase in the force of the heart, and a regular pulse. The animal was finally killed by an injection of 100 c.c. of air into the jugular vein.

An autopsy showed the right ventricle filled with air; the coronary vessels contained air emboli; there was no effusion into the pericardium.

Experiment 17 (No. 1).—In this case we determined to do a sterile operation, inject air, aspirate only, and allow the dog to recover if he

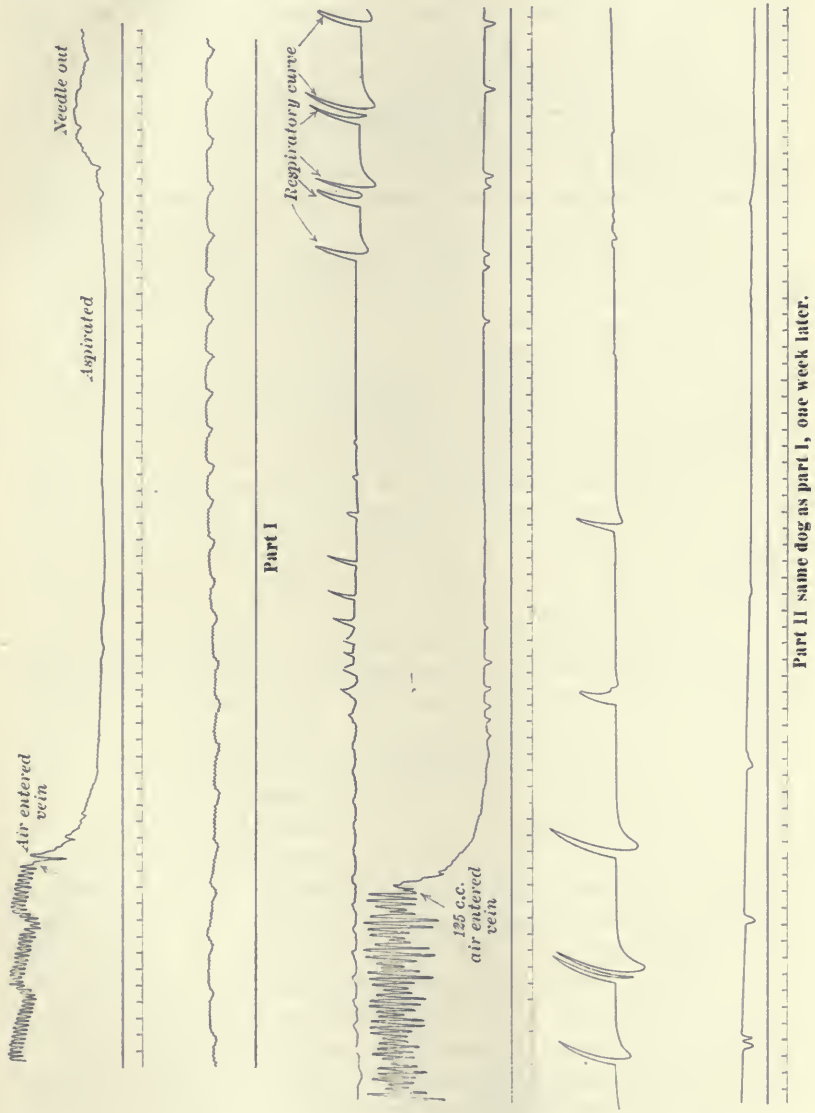
FIG. 4.

would. The dog in this case was a large, powerful bulldog, weighing forty pounds. He was accordingly given 1 dgm. of morphine at 10.30 A.M., and at 11 A.M. ether anæsthesia was started. The right carotid was opened, a manometer tube was inserted, and also the left jugular

vein was opened. No tracheotomy was done in this case. At 11.34 A.M. 125 c.c. of air was injected into the jugular. (See Fig. 5.) The pressure fell immediately from 140 mm. to 20 mm.; the heart's action

FIG. 5.

FIG. 6.



ceased, no pulse being perceptible, and no pulse tracing was observed for thirty-two seconds; a needle was then introduced into the right ventricle and 150 c.c. of mixed air and blood withdrawn. Almost immediately the pressure began to rise and the heart's action to be

shown on the tracing. In this case the pressure rose very slowly, requiring one-half hour to reach 90 mm., and the expansion of the ventricles was greatly restricted compared with the normal tracing at first obtained. The wounds were sutured and collodion dressing was applied. The dog was placed in a cage and was surrounded by hot-water bottles. He recovered from the anæsthetic about 2 P.M.; when seen at 4 P.M. he was in good condition. The next day he was placed on a "regular diet." The dog recovered strength so rapidly that it was decided to repeat the experiment on the same animal.

Experiment 17 (No. 2).—On the sixth day the dog was given 1 dgm. of morphine, and later was anæsthetized; the opposite vessels to those used in the first case were then exposed and treated as before. In the second operation the respiratory tracing was attached to the kymograph to show the effects of air on the respiration more clearly. When the kymograph was started the large excursion in the heart tracing often noticed after morphine has been given was seen in this case. The heart's action was good; pressure 180 mm.—higher than it had been before the first operation. At 10.55 A.M. the respirations were 20 per minute; pulse 98. At 11.08 A.M. 125 c.c. of air was introduced into the jugular vein; immediately the pressure fell from 180 mm. to 28 mm., and in twenty-four seconds no tracing was perceptible on the drum and no pulse could be felt. There was little change in the respirations for several seconds after this, and they continued for two and one-half minutes after the heart had ceased, deep and gasping, as was beautifully shown on the tracing. (See Fig. 6.) The dog died, and on autopsy the right ventricle, as in other cases, was found dilated with air, and air was found in the coronary vessels.

The great excursion of the respiratory tracing in the preceding experiment demonstrates the deep inspiratory efforts of the animal, caused by anæmia of the brain centres when the cardiac circulation is interfered with. I think that this chart (Fig. 6) clearly shows—Hare's opinion to the contrary notwithstanding—that in the venous injection of air failure of respiration is dependent on cardiac failure.

In eleven experiments (from 7 to 17 inclusive), of which four have been described (*vide supra*), nine dogs recovered after aspiration and infusion, one dog died because the needle used was too small to aspirate the heart, and one dog died in spite of treatment. Two of the animals which finally recovered required large quantities of air (250 to 400 c.c.), injected forcibly, before the pulse tracings on the kymograph entirely disappeared. Three of the dogs which recovered were eventually killed by venous injection of air (see Experiments 10, No. 2, 15, and 17, No. 2), and on autopsy the coronary arteries were found injected with air, the right ventricle was dilated, and the heart was fibrillating. The introduction of the needle into the heart had no ill effects on that organ, and in but one case was any leakage into the pericardium found.

In applying the results of these experiments to the operating-room and the human subject I would divide the treatment into two parts—preventive and radical.

1. *Preventive.* When operating in the region known as the "danger zone" none but the prone position should be permitted, for should one of the veins be injured the semiprone or sitting posture predisposes to entrance of air into the veins. If any dissection is necessary, as is often the case, it should invariably be performed with a blunt instrument, never with a scalpel. Especial care should be used if the operation be one for the removal of cancerous or tuberculous glands, which are always more or less intimately connected with structures adjacent.

2. *Radical.* Should attention be called by the hissing sound accompanying the rush of air into the veins to the injury of a vessel in this region, the finger should be forced into the wound to prevent further entrance of air, the wound cavity should be filled with salt solution, and the chest should be compressed forcibly. If bubbles are seen in the fluid contained in the wound they are due to air coming out. If, however, the heart becomes tumultuous, if the churning sound attracts attention, and if the respirations become labored and the inspirations forced, a needle should be inserted into the fourth left interspace one inch from the left border of the sternum; it should be directed obliquely upward and backward, and the right ventricle will be entered; aspiration should be continued until the blood comes out unmixed with air; then, an assistant having previously prepared a solution of normal salt at a temperature of 115° to 120° F., the patient should be infused until fluid has been introduced equal in quantity to the blood taken from the heart. The most convenient region in which to perform this infusion is the median basilic vein.

To sum up, the following facts seem clear:

1. That entrance of air into the veins, even in small amounts, is to be dreaded, as it may result in death.

2. That death is due to gaseous distention of the right heart or to air emboli in the coronary vessels, and not to primary respiratory paralysis.

3. That combined treatment by aspiration and infusion we may expect to be attended with good results.

In conclusion, I would say that I believe the statement "that large quantities of air may be introduced into the veins without unfavorable result" to be pernicious teaching and not supported by fact.

[I wish to avail myself of this opportunity for thanking Mr. J. T. Hoyt for the very valuable assistance rendered me in his management of the apparatus during the course of these experiments.]

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A CASE OF SUBPECTORAL ABSCESS.

By Gwilym G. Davis, M.D.,
of Philadelphia.

In the issue of The American Journal of the Medical Sciences for November, 1900, Dr. John H. Musser has gone over the literature of this affection, with an abstract of twenty-three cases besides those of his own.

The present case occurred in a man, aged thirty years. He was a worker in the boiler-room of a paper mill. Ten days previous to admission to the Episcopal Hospital, while firing boilers, he became overheated and went outside to cool off. He says this caused him to catch cold, and in a few days he noticed a lump forming on the left side of his chest. He stated that he was subject to colds and attacks of sweating. He was a Pole and spoke no English, and it was difficult to elicit the history.

On admission his temperature was 102° F.; pulse, 118; respiration, 28. On the left side of the chest was a large mass which extended from the nipple below to the clavicle above, and from the edge of the sternum out nearly to the deltoid pectoral groove. It was not red, but was tender and pitted on pressure, and deep fluctuation was plainly evident. The swelling was not pointed but flat, showing that the pus was deep seated. There was no tendency shown anywhere on the surface of pointing or breaking through. The axilla was absolutely healthy, and, as can be seen from the accompanying illustration, the anterior edge of the axillary fold was not encroached on. The depression which normally exists between the inner edges of the deltoid muscle and upper edge of the pectoralis major was perfectly preserved. There were no lesions on the left arm, but on the left hand there were the remains of several old cuts, but nothing recent. He failed to recall any injury to the affected parts or any recent suppurative lesions of the hand. He had an irritative cough with a scanty expectoration of white, frothy sputum. Physical examination of the chest was negative.

An incision was made under the anterior fold of the axilla and several ounces of greenish pus evacuated, a large drainage-tube being introduced. In four days the temperature had fallen to normal, the drainage-tube was removed, and his cough had disappeared. Later he was discharged practically cured.

The pus which was evacuated contained an enormous number of staphylococci, with some streptococci.

In searching for a cause nothing positive could be found. That the coughs to which he was subject originated the trouble is not likely. The cough which he had on admission was evidently secondary to the irritation of the pleura from the inflammation just outside. It ceased as soon as the abscess was evacuated. Had infection followed lung trouble it would have shown itself in the lymphatic glands around the root of the lung. It could only have involved the subpectoral tissues by setting up a localized pleurisy and the infection travelling by direct continuity of tissue. If this had been the origin there would not only have been a previous history or evidence of lung trouble at this point, but the abscess would not have healed so rapidly after being opened. In localized empyemas which point externally healing is usually a very slow process, a sinus remaining for a long time.

If the origin of the infection is sought in the hand, here again we find the evidence insufficient; not only were the cuts slight, but they had evidently been received a long time previously and had given rise to no inflammatory troubles. Infection in such cases shows itself in an involvement of the glands at the inner side of the elbow or the glands in the axilla which lie along the axillary vessels. These were absolutely not involved. A possible explanation might be found in his occupation. Being a fireman and engaged in shovelling coal, it is possible that he may have strained some of the deep fibres of the pectoralis major muscle. The serous effusion following might have become infected through the blood. Calling it idiopathic seems to be begging the question. None of these explanations being satisfactory, we must

simply admit that we do not know the manner and origin of the infection.

An interesting feature of the case is the fact that the abscess showed no signs of pointing, and the question suggests itself as to what would have been the course of events had it been allowed to go on. The pus would not be likely to extend upward on account of the clavicle, and the costo-coracoid membrane.

It might have burrowed inward to the anterior mediastinum or involved the pleura, or, as is most likely, it would have pushed its way toward the axilla and opened along the anterior edge of the axillary folds. If, however, it passed behind instead of in front of the pectoralis minor muscle it would then have bulged into the axilla and showed itself somewhat more posteriorly.

In view of the thickness of the tissues covering the abscess and the lack of any evidences of their implication in the inflammatory process, it is not likely that the pus would have found an exit superficially through the skin.

ANOMALOUS POSITION OF THE COMMON CAROTID, VISIBLE IN THE PHARYNX.

By George B. Wood, M.D.,
of Philadelphia.

Although generally considered of not much importance, anomalies of the carotid artery do occasionally present peculiarities which, under certain diseased conditions, would lead to most unfortunate accidents, and, therefore, I desire to report the following case:

E. M., aged five years, born in Philadelphia, was brought by her mother, because of nasal discharge, to Dr. Freeman's clinic at the Children's Hospital. The child was well nourished, more than usually bright, and seemed perfectly well except for her nasal condition, and apparently possessed no outward abnormality nor deformity. Her catarrhal condition dated from a cold of the previous winter. She sleeps with the mouth closed and has no symptoms of nasal obstruction. The only serious sickness which the child has had was considerable gastro-intestinal trouble when an infant only a month or so old.

Examination. There is practically no enlargement of the cervical lymphatic glands, though one very small nodule can be felt at the angle of the jaw on the left side. On the same side the pulse of the anterior carotid artery is easily felt just behind the angle of the lower jaw, and can be traced downward to the upper border of the thyroid cartilage. On the right side there is no pulsation behind the angle of the jaw, the carotid pulse being first perceived at a point about a quarter of an inch above the upper edge of the thyroid cartilage. From thence downward

the beating of the right carotid can be readily traced. The left nasal fossa is very free, though containing considerable thick mucopurulent secretion, especially along the floor. The septum is fairly straight, and the turbinals smaller than normal. The right fossa is also free, and contains considerable thick, almost crust-like exudate. The pharyngeal vault is freely visible through both fossæ; and the pharyngeal tonsil seems small and not obstructing. The teeth are in perfect condition, and the palatal arch about normal. The fauces are not congested, and the faucial tonsils only slightly enlarged. On the right side of the pharynx, projecting at times almost to the median line, is a large pulsating bloodvessel, about the size of a lead-pencil. By forcibly depressing the tongue, this bloodvessel can be seen running from below upward and slightly inward until it reaches a point about opposite the uvula, whence it takes a course slightly outward and upward. No posterior rhinoscopic view is possible on account of the irritability of the throat. The lingual tonsil and larynx are normal.

Showing the position of the pulsating vessel (×) on the right side of the posterior pharyngeal wall.

The diagnosis of the nasal condition is incipient atrophic rhinitis, but the condition which interests us at present is the arterial anomaly. It is impossible, without a post-mortem examination or dissection, to state exactly what artery is involved and how the blood supply to the throat and nose is changed by the anomalous condition. There are two probabilities: either an enlargement of the internal carotid artery, with absence of the external carotid artery; or an enlargement of the ascending pharyngeal, with absence of the external carotid. The presence of the temporal pulse on the right side shows that at least some of the normal branches of the external carotid are in existence, and that therefore there must be some sufficiently large source which is so located as to be able to give off these branches. On page 502 of Morris' *Anatomy*, under variations of the external carotid artery, we notice the following: "A. It may be absent, the branches usually derived from it

coming off from the upward continuation of the common trunk." Also in Quain's *Anatomy*, "absence of the external carotid artery has been met with in some rare cases, the several branches arising at intervals from a single trunk which represented the internal and common carotids." In Deaver's *Anatomy*, "the external carotid artery may be absent, the branches of that artery arising from the common carotid artery, which continues upward as the internal carotid artery."

From this it appears that a continuation upward from a common carotid trunk may readily account for the findings in our present case. From the position of the bloodvessels, however, it would seem at first sight that the artery involved was an anomalous ascending pharyngeal. The text-books on general anatomy do not mention among the variations of the ascending pharyngeal artery any anomaly of sufficient size to give off the normal branches of the external carotid. Conditions closely resembling the case in question have been described in some of the text-books on diseases of the nose and throat, the descriptions ascribing the anomalous artery to the ascending pharyngeal. On page 488, of Burnett, Ingals, and Newcomb, we find the following: "An abnormal vascular condition not infrequently seen is that of unusually large and pulsating vessels on the posterior and lateral walls of the pharynx. The vessel usually affected is the ascending pharyngeal artery, as determined by its position on the superior constrictor and its vertical direction." Kyle, in his book, on page 479, says: "The branches of the ascending pharyngeal may be unusually large, or the ascending pharyngeal artery itself show distinctly in the wall of the pharynx."

It is not a very uncommon thing in atrophic throats to see the pulsations of a small artery (ascending pharyngeal) on both sides of the median line. The artery in these cases is scarcely larger than one-sixteenth of an inch in diameter, and can scarcely be mistaken for such a condition as is seen in our present case. Further, the more clinical though specialized works, because of their treating the question from a clinical aspect, must of necessity do more or less guessing as to the exact condition of affairs, except, perhaps, where they have obtained their knowledge from some work on anatomy. Therefore, I believe, that while keeping in mind the limits of our present knowledge, the most plausible theory as to the condition of the parts in the case just reported would be to consider the anomalous artery an upward continuation of the common carotid trunk.

The clinical importance of a case like the above is considerable, although at present there is not any special danger or even inconvenience to this patient. If in such a case a retropharyngeal abscess coexisted, or a suppurative peritonsillitis were to develop in the posterior position, the surgeon after having done his duty by giving vent to the

pus might easily find himself called upon to check a most embarrassing hemorrhage. It would be well for us to bear in mind that the condition in this child was only accidently discovered while she was being examined for an ordinary catarrhal inflammation.

Since the above report has been sent to the printers I have seen another case of apparently the same condition in a boy about seven years of age. The findings in this second case correspond so exactly the one just portrayed that another description would be superfluous. The enlarged artery was on the same side of the pharynx, though possibly somewhat more prominent.

THE TREATMENT OF PNEUMONIA.[1]

By Reynold Webb Wilcox, M.D., LL.D.,
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The treatment of pneumonia always possesses great interest for the physician, both because of its prevalence and of its high mortality. Any method of treatment which can reduce the latter is well worthy of our consideration. What the mortality really is can be roughly stated as that about one-fourth of all patients attacked die. The laity regard this disease as even more fatal. Actual statistics vary much. Wells, in an analysis of nearly a quarter of a million cases, determined a mortality of a trifle over 18 per cent., the collective investigation of the British Medical Association 12 per cent., while of about forty thousand cases in the German army the fatality was less than 4 per cent. The significance of these figures lies chiefly in indicating the class of patients in which this disease is so fatal—the alcoholic subjects, debilitated and especially old individuals. I think almost any collection of mortuary reports will show that at least one-fourth of all necropsies will reveal chronic interstitial renal disease. Death more commonly takes place from gradual toxæmia or mechanical interference with circulation or respiration, the last being a gradual exclusion of air by the filling up of the ultimate air spaces of the lungs, and, as a consequence, compression of the capillaries. Another factor to be considered is the depressing effect of a great loss of blood serum if an extensive territory has been invaded by the disease. The dangers from the heart have always received attention at the hands of the clinician, and digitalis and other cardiac remedies enter into most schemes for the treat-

[1] Read before the Medical Society of the State of New York, at the Ninety-sixth Annual Meeting, 1902.

ment of pneumonia. For many years I have been impressed by the good effects obtained by the use of the nitrites in conjunction with strychnine, so ably advocated by Smith. The bleeding of the patient into his systemic arterial system by nitroglycerin or sodium nitrite, and the stimulation of the heart by strychnine nitrate, the loudness of the pulmonic second sound being taken as a guide, has been of remarkable service in my hands. Of late erythrol tetranitrate, in dose of one-half grain every four to six hours, gives more even and controllable effects than the evanescent nitroglycerin or the uncertain sodium nitrite. Strychnine I employ hypodermically as the nitrate, in doses from one-sixtieth to one-fifteenth of a grain every four to six hours, until I find the pulse satisfactory. Alcohol is only given to alcoholic subjects, and then with a free hand. Ammonium carbonate in ten-grain doses, in two ounces of milk every two hours, replaces strychnine in the aged. I believe that when we have employed these remedies with discretion and persistence we have done the most to meet the mechanical conditions that is at present possible. I am aware of the excellent results claimed for and obtained by veratrum viride in the very early stages of the disease occurring in young or even middle-aged robust individuals. However, the period of the disease and the class of suitable patients are far too limited in metropolitan practice to allow this to be considered as a proper routine treatment. I have seen brilliant successes and quite as often unfortunate results, and only exceptionally would I employ it at the present time. Bleeding is mentioned chiefly in the hereditary text-books, and to it the same remarks, perhaps more stringently, will apply. It is also a notorious fact that bleeding does not give as good results in pneumonia as in cyanosis with dilated right heart due to other causes. This observation leads to the questioning as to how much the pressure in the pulmonary artery is raised by extensive pulmonary consolidation. Clinically, the method above outlined has improved our results. Experimentally, Welch showed that it is very difficult to raise this blood-pressure unless extremely large areas of circulation were cut off. Quite recently Wood, Jr., has shown that various influences (among others, asphyxia) elevate the blood-pressure in the pulmonary artery, and this elevation is not a passive one. Experimentally, he shows that nitroglycerin and the other nitrites, while lowering the elevation of the aortic pressure, cause a slight elevation in the pulmonic system. Certainly at present the results of experiments do not very closely tally with those of observation.

In addition to the statement made above as to the unsatisfactory results of venesection, it should be stated that the effect of the toxins on the cardio-respiratory centres and of pyrexia on the heart-muscle must always be taken into consideration in discussing this difference,

and this brings us to the matter of toxæmia. There is certainly a considerable percentage of instances where the demonstrated area of consolidation during life and the evident amount of hepatized lung after death are absolutely too small for any mechanical theory to account for the fatal issue. Here toxæmia must be the efficient cause, and both prognosis and treatment should be largely influenced by our knowledge and appreciation of it. Before the modern concept of toxæmia had become established—in fact, before the microbic theory of pneumonia had been postulated—calomel was a favorite remedy. Later quinine, chloroform, and salicylic acid had a certain established reputation. In spite of all, the death-rate, if we may judge from hospital statistics, compared by decades, did not sensibly change. So late as 1897 Osler believed that we had no reliable measures at our disposal to combat the toxæmia of pneumonia. Within two years, however, Cassoute and Corgier reported that after continuous administration of fairly large doses of creosote carbonate (containing 91 per cent. of creosote, and made from it by the action of nascent carbon dioxide) in most cases a typical fall of temperature occurred during the first twenty-four hours of treatment, and if the remedy was persisted in for a sufficiently long period of time, the apyrexia became permanent. Relapses and sequelæ so frequently seen under other methods were entirely absent. So positive an assertion could not escape attention. Creosote —better beechwood creosote—is not a new remedy, but its caustic action and its irritating action upon the kidneys when given in necessary amounts had prevented its use. So pronounced were these untoward actions that I had abandoned its use in pulmonary tuberculosis several years earlier. The daily dose of creosote carbonate was from two to four drachms, the dose interval being six hours. So soon as the temperature reaches the normal the amount is reduced to one-half, and this is continued so long as auscultatory signs persist. What are the results? Cassoute and Corgier reported favorably upon eighteen cases; Stokes, seven; Bridges, eight; Frieser, nine; Meitner, thirteen; Eberson, four; Van Zandt, sixteen; Von Ruck, twenty (complicating pulmonary tuberculosis); Weber, nine; and Thomson eighteen cases. From these observations the statement of Van Zandt is fair—that creosote carbonate cuts short or aborts a large percentage, mitigates almost all the rest, and in a small percentage of pneumonia there is no result. Certainly if the early appearance of the crisis is any indication of the value of the treatment this remedy merits a careful trial.

My own experience covers thirty-three patients, with no deaths. The disease terminated by lysis in nine; by crisis in twenty-four. Crisis occurred on the sixth day in one, seventh in two, eighth in nine, ninth in six, tenth in three, eleventh in two, and on the twelfth day in one patient. In two patients above the age of seventy, lysis occurred.

Of three alcoholic subjects, in two lysis and in one crisis was noted. Two instances of double pneumonia, both terminated by lysis; in one the infection of the two lobes was contemporaneous, in the other by sequence. Aside from the remarkable reduction of mortality, the increased percentage of cases in which crisis is noted is suggestive as to the true significance of that phenomenon and is an argument for the value of the remedy in nullifying the bacterial activity and its results.

Of the accessory treatment, in addition to that with reference to the mechanical conditions, particular attention should be paid to the emunctories, in order that all avenues by which toxins can be eliminated, may be open. In patients suffering from renal disease of the interstitial variety, intestinal irrigations of a gallon of decinormal saline infusion, at a temperature of 108° F., practised twice daily through a rectal tube, is a most valuable method of provoking diuresis, stimulating the heart, and to a less extent, producing diaphoresis. Naturally, it thoroughly cleanses the large intestine. Intestinal antisepsis, as advocated by Waugh—one-sixth of a grain of calomel every hour for six doses, with saline laxatives enough to empty the bowels completely and keep them open afterward with from three to six grains of zinc sulphocarbolate every two to four hours, at other times than the calomel and salines, until the stools are odorless, and then just enough to keep them so—has been of frequent use and followed by marked benefit. It is true, however, that under the creosote treatment tympanites is rare, and the necessity for this remedy much lessened. Oxygen is of value if the respiratory surface is greatly decreased. It is perhaps at times used unnecessarily, but no harm results. In the earlier days of my practice cold applications to the surface were employed, but in recent years fever is held in less importance on the one hand, and cold water is now admitted to be a poor antipyretic, on the other, so that these have been abandoned. As for diet, milk, diluted with lime-water, or Vichy, or peptonized or fermented, should be our main reliance.

The present status of the treatment of pneumonia is especially satisfactory when results are considered. To summarize: 1. Continuous, persistent, and generous administration of creosote carbonate. 2. Careful adjustment of mechanical conditions. 3. Thorough evacuation of toxins by all possible ways. 4. Temporary supplemental oxygen by inhalation. 5. Liquid diet until physical signs disappear.

To be avoided, are antipyretics, opiates, ill-advised external applications and slowly-acting heart remedies, as digitalis.

A REVIEW OF THE STUDY AND TREATMENT OF HEATSTROKE AT THE PENNSYLVANIA HOSPITAL AND ELSEWHERE, 1751–1870.[1]

By Joseph M. Spellissy, M.D.,
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Knowledge of the pathological effects of heat and of its literature has been acquired by most authors on these topics, in the reverse of the ideal order.

Unexpected experience has incited study that should have been preparatory. Such study has almost invariably resulted in the expression of two regrets—one, that so little was written; the other, that there was yet so much to know.

A liberal experience in 1892, the availability of case statistics dating from 1751, of meteorological data from 1831 and of case histories from 1873, at the Pennsylvania Hospital, all prompted not only their study, but also that of collateral publications. This reading betrayed that many authors wrote in ignorance of the work of their predecessors and of their contemporaries. Therefore the erroneous belief "that so little was written" justly gave way to regret that much which was written was so little known. This fact, and the completion by the Pennsylvania Hospital of its first century and a half of medical record, prompts the writing of this review and the publication, at a later date, of supplementary papers dealing either with other periods or branches of this topic.

The aim of this contribution has been to present for convenient reference, in chronological order, the observations, thoughts, and often the words of workers in this field during the period named.

INTRODUCTORY.

Biblical references[2] to fatality following exposure to the sun are followed after the lapse of centuries by the observations of Forestus,[3] in 1562, of Baglivi, in 1694, and of Lancisi, in 1705.[4] These three observers confounded the effects of heat with the symptoms of apoplexy, and this confusion was perpetuated by some observers up to 1852.

Forestus recommended, in the treatment of this condition, stimulating frictions, and observed that in many instances blood-letting was unne-

[1] Read in outline before the College of Physicians, June 1, 1901.
[2] J. J. Levick. The American Journal of the Medical Sciences, 1859, vol. xxxvii. p. 40.
[3] Loc. cit., p. 49.
[4] Loc. cit., p. 48.

cessary. He was the first to distinguish two types of cases, the mild and the fatal. Baglivi and Lancisi also recognized the predisposing influences of heat and humidity, and added that the depressing influences of prevalent war were contributory. On July 8, 1707, many people and animals were reported by Mosely[1] to have died in England from the heat of the sun. In 1738, in the early part of August, as reported by Dr. Lining,[2] the thermometer in the shade at Charleston, S. C., rose successively for some days to 98° F., and "several persons died of apoplexies." In 1743, from July 14th to 25th, 1100 people are reported by this authority to have perished in the streets of Pekin from the same cause.

Periods I. and II.—1751–1810.

Diagnoses of Apoplexy, Effects of Drinking Cold Water, and Coup de Soleil Confounded.

In 1769, eighteen years after the founding of the Pennsylvania Hospital, its records show the first entry of the pathological effects of atmospheric heat—under the diagnosis of "hurt by drinking cold water." This case was that of a woman who spent two days in the hospital. Fifteen similar entries with such variations in phrasing as "convulsions" or "inflammation of stomach from drinking cold water," making a total of 16 cases and of 3 deaths, the first of which is recorded on the 31st day of the 8th month, 1793 (see Graphic and Statistical Chart in later publication), are entered on the hospital register prior to 1831, when the phrases "Effects of Heat" (May 1, 1831) and *coup de soleil* (June 1, 1831) appear for the first time, showing an advance in the etiological appreciation of this condition. The last entry of "drinking cold water" is made on June 10, 1838.

The diagnoses having in common a reference to "cold water" were, doubtless, made or directed by subscribers to the popularly accepted teaching on the subject by Dr. Benjamin Rush, who, however, was not associated with the hospital as one of its visiting physicians at the time of the first cold-water diagnosis noted—1769—but became so, fourteen years later, on May 26, 1773, and so continued until his death April 19, 1813.

In 1789 Dr. Benjamin Rush[3] published in London his *Medical Inquiries and Observations*, one of which is entitled *An Account of the Disorder Occasioned by Drinking Cold Water in Warm Weather, and the Method of Curing It.*

It had been noted by Dr. Rush that in some summers four or five

[1] Mosely. Tropical Diseases, London, 1803, p. 57.

[2] Dickson. Observations on the Effects of Heat. The American Journal of the Medical Sciences, 1828, vol. iii. p. 268.

[3] Rush. Medical Inquiries and Observations, 2d edition, Philadelphia, 1789, p. 150.

persons, usually laborers, died suddenly in one day subsequent to drinking pump water. The following paragraphs present the pith of his observations:

"Three circumstances generally concur to produce disease or death from drinking cold water: 1. The patient is extremely warm. 2. The water is extremely cold. 3. A large quantity of it is suddenly taken into the body." The danger is in proportion to the degree of combination of the three circumstances cited.

"In a few minutes after the patient has swallowed the water he is affected by a dimness of sight; he staggers in attempting to walk, and unless supported, falls to the ground; his nostrils and cheeks expand and contract in every respiration; his face appears suffused with blood, and of a livid color; his extremities become cold, and his pulse imperceptible; and unless relief is speedily obtained the disorder terminates in death in four or five minutes.

"*I know* of but one certain remedy for this disease, and that is *liquid laudanum.* The doses of it, as in other cases of spasm, should be proportioned to the violence of the disease. From a teaspoonful to near a tablespoonful have been given in some instances before relief has been obtained."

Patients were directed—

"1. To grasp the vessel out of which they are about to drink for a minute or longer with both hands; that a portion of heat may be abstracted from the body and imparted to the cold liquid.

"2. If they are not furnished with a vessel to drink out of, but obliged to drink at a pump or spring, always to wash their hands and face, previous to drinking, with a little of the cold water. By receiving the shock of the water first on those parts of the body, a portion of its heat is conveyed away, and the vital parts are defended from the action of cold."

The theory presented and the treatment advised by Dr. Rush in relation to the observations quoted was subscribed to by partisans and controverted by opponents, who also contended much among themselves, and who—with their posterity—may be roughly classed as follows:

I. Those who, like Dr. Rush, failed to distinguish the effects of heat and those of all kinds of *immoderate drinking.*

This class may be thus subdivided:

1. Those who agreed with Dr. Rush's theory and treatment of the effects of cold drinks upon overheated and exhausted persons.

2. Those who differed with Dr. Rush upon these topics.

II. Those who contended that the "disorder" described by Dr. Rush was due to *the effects of heat,* of which thirst and drinking is a symptom and not a cause.

This class contains vitally differing beliefs:

1. Those who held that heat effects were always *congestive*, that they frequently resulted in apoplexy and that the condition must always be met by depletion. This is the earliest teaching in this matter, and it had its supporters as late as 1856.

2. Those who deemed heat effects to invariably result in *exhaustion* demanding routine application of heat, administration of stimulants, and without exception contraindicating blood-letting.

3. Those who saw that heat effect and apoplexy were diseases apart, and also that heat caused at least two widely differing conditions:

a. Febrile or congestive, demanding the application of cold and sometimes benefited by depletion.

b. Exhaustion—indicating rest, sometimes stimulants and artificial heat, and always contraindicating blood-letting.

This classification represents the principal differences of opinion that have obtained at various periods down to the present day; it necessarily fails to take account of several composite beliefs, and contains many subdivisions. Each subdivision of Class II. may again be subdivided, according as its exponents thought that direct *solar* heat, or knew that its indirect form and that *artificial* as well as solar heat, would produce the results observed.

In 1798 Dr. James Currie[1] published in his *Medical Reports on the Effects of Water* a chapter entitled "On the Disease that Arises from Drinking Cold Liquid, or Using the Cold Bath after Severe Exercising." Like Dr. Rush, he failed to note that the accompanying atmospheric heat, in the majority of the cases cited, was the exciting and not, as they supposed, merely a predisposing cause. He otherwise elaborately differed from Dr. Rush. According to Dr. Currie's theory of the fatal phenomena reported, the latter occurred not because the individuals drinking were overheated, but because they had been overheated. They had, he supposed, paused after their exhausting exertions, had begun to chill by perspiration, were in a condition of depression fatally increased by the draught of cold water—that could have been taken with impunity in the heat of exercise. He, therefore, considers the precautionary suggestions of Rush—because of their nature chilling—as contributory to and not preventive of evil. That this scholarly physician in Liverpool should at that period fail, in reading, to detect symptoms incident to torrid temperature outside of his experience, is hardly surprising. There were, however, those who, with advantages of observation, correctly divined heat to be the cause of the supposed cold water malady, and classified its manifestations.

[1] Medical Reports on the Effects of Water, Cold and Warm, as a Remedy in Fever and Other Diseases, Whether Applied to the Surface of the Body or Used Internally, Including an Inquiry into the Circumstances that Render Cold Drink or the Cold Bath Dangerous to Health, etc. James Currie, M.D., F.R.S., Liverpool, 1798, p. 95.

Period III.—1811–1841.

Supposed Cold Water Effects Recognized as Coup de Soleil, Which Is Still Confounded with Apoplexy.

In 1811 Hillary's[1] work on *Tropical Diseases* appeared, with notes by Benjamin Rush. It states that upon the change of the weather from very dry and warm to very moist and warm "dysenteries became very frequent;" "and some were seized with apoplexies and palsies, and some of the first died before any proper assistance could be called in." In a foot-note he queries: "Were not the apoplexies and palsies also produced by the same causes, viz., a diminution or stoppage of the perspiration?" etc. This report is replete with meteorological data; but some of the cases referred to evidently resulted from heat and humidity, and not from apoplexy.

In 1814 Dr. Benjamin H. Coates "inhabited the Pennsylvania Hospital," as he reported in 1858, in his discussion[2] of Dr. Levick's "Remarks on Exhaustion from Heat (Sunstroke)," before the College of Physicians. He recalled that at this time, by order of the Humane Society, the public pumps were posted with cautions against sudden death from drinking cold water. He saw many persons at the hospital (Pennsylvania) alleged to be suffering from a spasmodic affection of the stomach, described by Dr. Rush as a result of drinking cold water; but it was Dr. Coates' opinion, and that of some medical attendants at the hospital, that these patients were usually under the influence of ardent spirits and suffered rather from congestion of the brain than that of the stomach.

Speaking of the cases in 1814, Dr. Coates goes on to say: "The cephalic cases received little other treatment than rest, silence, a gloomy room, *cold to the head*, mild stimulants to remote parts of the skin, laxatives, and a cool abstemious and sedative diet." This is the earliest mention found of the use of cold in these cases. He comments that the great terror of the destructive effects of the use of ice in drinks, etc., and its apparent dangers were then (1858) forgotten. He had not examined the hospital records, but had no recollection of any death in such cases at that period, 1814. The hospital records are confirmatory (see chart in later statistical publication). The cases could not have been of grave character.

In the winter of 1818, Dr. D. Francis Condie, as he reported in 1850 to the College of Physicians, in his discussion of Dr. Pepper's communication on "Coup de Soleil," attended a "colored preacher" seized in the

[1] William Hillary. Observations on the Changes of the Air and the Concomitant Epidemical Diseases in the Island of Barbadoes, etc., 2d edition, London, 1776, p. 18, with notes by Benjamin Rush, Philadelphia, 1811.

[2] Transactions of the College of Physicians of Philadelphia, 1858, n. s., vol. iii. p. 235.

midst of his exhortation, in a crowded and overheated church, by convulsions alternating with tremors. Dilated pupils, thready pulse, and clammy surface were accompanying conditions. He says: "In this case the disease was produced by the exhausting effects of undue exertion in a heated and confined atmosphere; and he believed that in those who are attacked while laboring in the open air, during the intense heat of summer, it is also produced by exhaustion, and not by any direct influence of the sun's rays, as some have supposed." Dr. Condie's narration of this case and his comments upon it place him not only as the first to distinguish between congestion and exhaustion from heat, but also as the first to recognize that heat alone was the essential cause of the phenomena the which for many years later were attributed to the sun alone. In this regard it is interesting to refer to Dowler's explicit and contrary statement in 1841 (p. 496 of this review), also that Dr. Geddes[1] ("Clinical Observations on Diseases of India, 1846") relates a case of heat effect occurring in a convalescent from measles, who was in hospital and not exposed to the sun.

In 1818 Dr. John Watts, Jr.,[2] submitted to the Medical Society of the County of New York, "Remarks on the Supposed Effects of Drinking Cold Water; Illustrated by Cases which Occurred During the Hot Weather of the Summer of 1818."

This paper is of peculiar interest, as the first published protest against attributing to water the effects of heat. The reminiscences of Dr. Coates referring to 1814 were not recorded until 1858. The theory voiced by Rush was popularly accepted. This initiatory attack, though not without fault, was well prepared and pushed far, but it took many others to eradicate an error which was last defended in 1859.

The author most ably and fairly reviews and discusses the cold water controversy, quoting Rush,[3] Currie,[4] and Jackson.[5] He takes ground: that the "usual effects" of intemperate water drinking are not denied, nor altogether its agency in producing the symptoms noted; that an "ardent sun" independent of water drinking is in itself sufficient to cause "*coup de soleil*, or sunstroke;" that the symptoms of the latter are "analogous" to those attributed that summer to the effects of cold water; that the contention of the author had the support of reputable physicians who characterized patients suffering from this disease as "rum and sun cases;" that although the disorder described by Rush terminates by "death in four or five minutes," yet no "sudden death" had been heard of from this cause; that laudanum was not, in this regard, a specific remedy, since no recovery was attributed to its sole influence, whereas, many cures were

[1] Wood. Sunstroke, Philadelphia, 1872, p. 10.
[2] John Watts, Jr. The Medical and Surgical Register, New York, 1818, p. 81.
[3] Rush. Loc. cit. [4] Currie. Loc. cit. [5] Jackson on Cold Water, p. 377.

noted in sequence to copious bleeding; finally, that there was reason to fear that some persons fell "victims to the injudicious and extravagant administration of laudanum." The abuse of opium at this time in the treatment of heat or cold water effects was probably the cause of this helpful remedy falling into disfavor until reintroduced in 1868 by Drs. Hutchinson and Norris (p. 520 of this review).

The symptoms he cited of the group of 13 cases reported are typical of the major form of heat effect. It is of interest to note that: "The heat of the body was likewise remarkably great, and in some instances continued for a long time after bleeding."

Two of the 13 cases reported, died; but one was examined by autopsy, and it exhibited "about five ounces of extravasated blood on the surface of the dura mater." This case, apparently of true apoplexy, naturally confirmed Dr. Watts in his prejudice that the pathological result of heat effect was apoplexy.

The scheme of treatment included: "laudanum, æther, and other stimulants," "when the apoplectic symptoms had not yet supervened," the influence of these agents was but "momentary," apoplectic symptoms developing in a short time; the rubbing of aqua ammonia over the whole body, a measure credited with lessening the bodily heat as well as arousing the patient from an apparently fatal torpor; and, finally, large and repeated bleedings. It was upon blood-letting that Watt placed most reliance. Several of his patients were bled of sixty, and one of eighty ounces in two hours.

As he inveighed against overdosage with laudanum, so did those following him unsparingly condemn routine and reckless blood-letting.

In 1821 the British frigate "Liverpool,"[1] when in the Persian Gulf, lost "from a species of *Coup de Soleil*," three lieutenants and thirty men in one day, although double awnings were stretched and the decks kept wet.

In 1824, as reported by Dr. Samuel H. Dickson[2] in 1828, nine consecutive days on which the temperature was 90° F. or above, preceded by six days in which the temperature was 90° F. or near it, resulted in 34 deaths from "apoplexy and insolation" in Charleston, S. C.

In 1826 Dr. Daniel J. Carroll,[3] presented his "Observations on the Morbid Effects Produced by Drinking Cold Water." This article, in spite of the contrary desire announced in the introduction, admirably presents the confusion of ideas prevalent upon the effects of heat at this time. It begins as follows:

"Notwithstanding the number who are supposed annually to perish from this cause (referring to the title), yet there are many cases which

[1] Wellsted's Travels to the City of Caliphs.
[2] Dickson. The American Journal of the Medical Sciences, 1828, vol. iii. p. 271.
[3] Carroll. Philadelphia Journal of the Medical and Physical Sciences, 1826, vol. xiii. p. 122.

result from heat alone, or exposure to the direct rays of the sun, producing the *coup de soleil* of the French. Other forms of cerebral affection, from simple congestion of the brain to apoplexy (though as discordant with this, in their nature as mode of cure), have, nevertheless, been erroneously attributed to cold water," etc.

In spite of the avowed intention of the paper to distinguish heat from cold water effects, it details with evidences of much unconsciousness and erudition undoubted cases of sunstroke as due to cold water drinking. An interesting feature of the symptomatology is the mention of a vesicular eruption. Like Watt, he comments upon much fatality resulting in mild cases from overdosing with laudanum."

In 1828 Dr. Samuel H. Dickson[1] varied the monotony of title favored by foregoing authors on this topic by publishing the first paper avowedly dealing with "Observations on the Effects of Heat." Reference to the experimental endurance of extraordinary temperature without evil effect is followed, first, by a study of the phenomena and treatment of the condition now popularly known as spring fever, and second, by a report of the cases of insolation and *coup de soleil* from the persistently hot weather in 1824 already noted. His tribute to the cold water theorists is to advise the drinking of cold water in hot weather.

Without having witnessed post-mortem section of a case of heat effect, he concludes the condition to be one of venous engorgement tending to apoplexy. He divides the cases he reports into two classes, the apoplectic or cerebral, and the phrenetic or meningeal. He cites in confutation of Rush a case of apoplexy supposed to be produced by heat, a mulatto with subsequent hemiplegia, who immediately preceding his attack drank water the temperature of which Dr. Dickson found to be about the same as that of the patient. The inference being —that thirst is a symptom marking the onset of the attack. As the water was not cold, it could not, as supposed by the bystanders, have excited an attack of the disorder described by Rush. The coincidence of this case occurring on a warm day in a man laboring in the sun was apparently confirmatory of the theory that heat is productive of apoplexy. On the other hand, cerebral hemorrhage has not been observed at autopsy in cases of heat effect, and the latter most rarely results in hemiplegia.

The cases described as apoplectic were bled, and those classed as meningitic were treated by cold affusions poured from a height on the head of the patient, who was raised to a sitting posture. The return of symptoms calling for a repetition of the affusion is the first record found of what still proves a valuable aid in treatment. The author saw "in

[1] Dickson. Observations on the Effects of Heat. THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, 1828, vol. iii. p. 268.

one day five persons, three of whom recovered entirely under this simple means of cure." If the recovery was not thus complete, and mania and phrenitis supervened, the cases were for the most part manageable, but now a free use of the lancet became necessary, and purgatives of the *most active* power were demanded.

In 1830 Dr. William W. Gerhard,[1] later a visiting physician to the hospital, was the first to record negative post-mortem appearances of the brain in cases that had died from the effects of heat. His observations are thus presented:

"Symptoms of the same character occur from the effects of heat upon the nervous system during the warm season. During the intensely hot weather of the summer of 1830 I witnessed the opening of the bodies of twenty or thirty persons who died from this cause. We found no organic disease of the brain, but merely a slight congestion—such as is observed in other acute diseases—*which it would be idle to set down as a cause of death.* These were the appearances in those only who died suddenly of exposure to heat; for if time elapses for reaction to come on, inflammation of the brain may take place, but it is then a secondary affection."

In 1830 *The Boston Medical and Surgical Journal,*[2] No. 17, June 8th, reprints the paper of Dr. Rush already quoted (p. 486), and in No. 18, on June 15th—the next issue—publishes a protest to the theory of Rush by Dr. F. J. Higginson, who supports the views of Currie,

In 1831 meteorological observations were begun at the Pennsylvania Hospital, and they continue to the present day. The Government Weather Bureau was not established until many years after that of the hospital. The relation of atmospheric temperature to the occurrence of illness from heat will be considered in a later and statistical publication on this topic. It is of interest to note that the institution of atmospheric observations at the hospital, in 1831, is coincident with its first recorded diagnosis of "Effects of Heat" and *coup de soleil,* such cases prior to that time being attributed to the effects of "drinking cold water."

In 1831 Andral,[3] of Paris, under the classification of "The Eighth Form of Cerebral Congestion," notes a definite thermometric relation between high atmospheric temperatures and the occurrence of symptoms that he classes with cerebral congestion and apoplexy. He reports a number of cases, without fatality, occurring in young soldiers and treated at La Pitié. He also described the post-mortem conditions in

[1] Graves' System of Clinical Medicine, with Additional Lectures by William Gerhard, Philadelphia, 1848, p. 677.

[2] Boston Medical and Surgical Journal, 1830, vol. iii. p. 265.

[3] G. Andral. Medical Clinic, or Reports of Medical Cases. Translated by D. Spillan, Philadelphia, 1838, p. 108.

two of three undoubted sunstroke cases, and noted in both of them petechiæ, liquid blood, pulmonary, cerebral, and venous engorgement, and in one of them that had *contracted heart*, which later was observed experimentally by Bernard, in 1859, and by Wood at autopsy, in 1863. No cerebral or meningitic effusions were discovered.

In 1836 the first English report of congestion of the lung as a post-mortem observation, in 1834, in the cases of three soldiers, was made by J. J. Russell,[1] of the Seventy-third Regiment, English Army. He was surprised to find no congestion of the brain. It must be remembered that even up to 1856 the effects of heat were confounded with apoplexy.

The exciting cause was exposure to the sun at the funeral of a general officer at Madras, India; the predisposing causes were red coats and military stocks. Some eighteen men were overcome. Three died promptly where they fell, and two others some hours later. In the fatal cases the symptoms and post-mortem appearances were alike. The symptoms reported were "*excessive thirst*, and a sense of faintness; difficulty of breathing, stertor, coma, lividity of face," and one examination of the pupils of one man, found them contracted. The autopsy discovered neither congestion nor accumulation of blood in the brain. The lungs were congested to blackness, there was a collection in the right heart and the adjoining vessels. "The chief seat of mischief was in the chest and not in the head."

In 1836 Dr. Robert M. Huston,[2] as stated in his discussion of Dr. Pepper's paper of 1850, witnessed four post-mortem examinations of men sunstruck while working in a culvert, and was amazed to find no congestion of the brain.

In the period of 1811–1814, fifteen cases of heat effect were treated at the hospital, with a mortality of three. The recognition by Condie, in 1818, that artificial heat and the indirect as well as the direct rays of the sun were exciting causes of what was then known as *coup de soleil*, or heat apoplexy; his perception that the effects of this condition were chiefly twofold and widely differing in form and treatment; the discovery by Gerhard, in 1830, that, contrary to centuries of conviction, the pathology of the condition was quite distinct from that of apoplexy; the report by Andral, in 1831, of petechiæ, of liquid blood, of pulmonary, cerebral, and venous engorgement, and of contracted heart as the characteristic pathology of this condition, which he did not interpret correctly, but which was later verified as the true morbidity of this state by Russell (1834), Bernard (1858), H. C. Wood (1863), and Stiles (1864)—these are the most noteworthy discoveries of this period.

[1] J. J. Russell. The London Medical Gazette, vol. xviii. p. 71.
[2] Transactions of the College of Physicians, 1850.

Period IV.—1841–1870.

Heat, Artificial as Well as Solar, Experimentally Demonstrated the Exciting Cause. Success of Refrigerating Treatment.

In 1841 Dr. Thomas M. Markoe[1] reported among a number of cases treated at the New York Hospital, one, Case IV., entitled "Congestive Apoplexy from Drinking Cold Water," the history and post-mortem examination of which classify it as a fatality from heat. The first use of ice water affusions is recorded in the treatment of this case. Autopsy, eighteen hours after death, discovered severe venous congestion of the brain, the sinuses to be swelled with darkened blood, the membranes to be darkened, and the brain on section to exhibit bloody points. There was no extravasation. Blood flowed from the divided vessels at the base of the brain. The complete details of this case help to accentuate one's surprise at the diagnosis.

In 1841 Dr. Bennett Dowler,[2] of New Orleans, published a paper, entitled "Solar Asphyxia, Coup de Soleil, or Sunstroke." It begins as follows: "In the numerous works written or republished in the United States, I have not seen any satisfactory notice of this very frequent and, in the South, most fatal of all maladies." Ten and nineteen years later Drs. Pepper and Levick, respectively, regret the lack of literature on this topic even at those later dates. Dr. Dowler's paper is remarkable for its breadth and detail of observation. As the isolated study of one man it is very accurate and long antedates corroborative publication by others. Two of its last pages (215, 216) are well devoted to a clear differentiation between sunstroke and apoplexy, which for years later were confounded commonly. The name *Solar Asphyxia* was adopted by him "several years before" he "had an opportunity of testing by dissections the character of the disease, which"—he claims —"it so fully expresses." He adds, "*Pulmonary apoplexy* is a name more characteristic of the morbid appearances of the lungs, but it makes no allusion to its solar origin or to the symptoms of suffocation which mark its progress."

Thus, knowledge of the congested condition of the lung in the major form of heat effect was recognized clinically by Dr. Dowler before its verification by him at autopsy. His observations were more detailed and comprehensive than those of Dr. Russell, made in 1834 and published in 1836. Dr. Dowler states his observations and nomenclature to antedate, by several years, their publication in 1841. The earliest case he cites, he attended in 1836.

[1] T. M. Markoe. A Report of Cases Treated in the Second Surgical Department of the New York Hospital. The American Journal of the Medical Sciences, 1841, n. s., vol. ii. p. 343.

[2] New York Medical Gazette, 1841, vol. i. p. 209.

He next presents the practical importance of the classification of solar diseases, and submits the following: 1. Solar exhaustion or syncope. 2. Solar or sun pain. 3. Solar excitement or inflammation. 4. Solar asphyxia, which he makes "the principal subject of investigation." He first distinguished between the two extremes, saying: "Solar exhaustion differs from solar asphyxia, both in symptoms and treatment. In solar asphyxia the skin is extremely hot, and generally dry; there is a choking sensation and a total loss of sense. In solar exhaustion, the skin is moist, pale, and cool; the breathing is easy, though hurried; the pulse is small and soft; the vital forces fall into a temporary collapse, the senses remaining entire." The conditions described are, undoubtedly, those we know to-day respectively as *heat* or *thermic fever*, and as *heat exhaustion*, and the treatment advised for solar exhaustion is the same as that now in use for heat exhaustion. This is the first publication of these distinctions of the results of heat. Dr. Condie assigns his *recognition* of them to 1818, but he did not *publish* them until 1850, and he correctly ascribed the conditions observed to heat, whether of solar influence or not. Whereas, Dr. Dowler says: "Solar and terrestrial heat differ essentially in their action; on health the latter seems never to produce any morbid effects, resembling sunstroke, though many firemen in boats, foundries and furnaces are exposed to a high temperature." On the other hand, Dr. Condie lacked Dowler's clear conception of the differences between heat effect and apoplexy. This is apparent in Dr. Condie's discussion of Dr. Pepper's paper, when he says: "That the direct influence of intense solar heat may produce congestion of the brain and apoplexy, Dr. Pepper admits, and Dr. Condie has known it to produce well-marked meningitis."

To return to Dr. Dowler's classification of solar diseases, he thus defines Classes II. and III.: "II. Solar, or, as it is commonly called by the people, *sun pain*, is a chronic disease in which the abdominal organs are more or less deranged, though the most remarkable symptom is a pain in the head while the sun is above the horizon." "III. *Solar excitement* or *inflammatory reaction*, sometimes follows solar asphyxia of the second degree, being attended with febrile heats, arterial throbbings and headaches." Classes II. and III. would be considered, at the present day, as different degrees of meningeal congestion or inflammation from heat.

Want of acclimation he considers strongly predisposing to solar disease, which he pronounces an urban disease affecting those not thoroughly acclimated to the city. The most thoughtful explanation of why heat effects are chiefly confined to large cities is furnished by Dr. Lente (p. 501). Dr. Dowler quotes the great fatality on the "Liverpool" (p. 491) as an instance of lack of acclimation. He notes that he has seen but one negro die of sun exposure—that the disease is practi-

cally confined to males; females, comparatively, being unexposed to the sun. He knew only of one woman to be affected, she happened to be a negress, and recovered. But even the negro, though not prone to fatality, required acclimation. "Slaves from Missouri, Virginia, and Maryland suffer as much if not more from debility than the whites during the first and second summers." "Even horses are debilitated, often get the *thumps*, and frequently die from solar asphyxia during the acclimation period. This is so well known that an acclimated horse or mule is worth much more than one not so protected."

Among his enumeration of the predisposing causes of solar asphyxia —*i. e.*, heat or thermic fever—are a full meal, unsuitable clothing, and fatiguing labor. He erroneously considered exposure to the direct rays of the sun as the only exciting cause of the symptoms he witnessed. That the same phenomena could result from artificial heat was outside his experience. He explains that the man struck down in the street with solar asphyxia is commonly mistaken for an apoplectic, some of the bystanders put ice to his head, "and the first bleeder that can be had performs blood-letting." He records a case of solar asphyxia that he bled with successful result at the instant of onset, also a case of solar excitement—meningitis—that it cured. Referring to the first case, he says: "In this case, blood-letting was probably useful, but in nine cases out of ten it is useless, if not worse, accelerating the death from five to fifteen minutes. During the last five years I have been called to see a very considerable number of sunstruck persons, within five or ten minutes after they fell in the streets; formerly I used to bleed them, and, though *the great heat of the body is thereby suddenly diminished*,[1] the pulse becoming soft as air, yet by the time the arm is tied up (which is done more for form than necessity), the patient is choked suddenly, and to appearance, by a tenacious mucus, the breathing not ceasing gradually as in other disease, but instantly, the face turning livid, and even its veins, especially upon the forehead, becoming at the moment distended. Bleeding hastens the strangulation, though it is always desired by the friends."

While he condemns bleeding in general he states that its instant performance is the only possible hope of those stricken with solar asphyxia of the first degree, which he considers as practically fatal and within half an hour if the onset occurs in the most heated part of the day. The application of ice to the head and the pouring of ice-water over the head and neck are enumerated in conjunction with general sinapisms as methods of treatment employed in solar asphyxia, but they are not specifically commended. This is the first mention I find of the use of ice and of ice-water affusions. He gives an elaborate

[1] Italics introduced.

description of the symptomatology of solar asphyxia and notes as do other early observers the inability of the grave cases to swallow. He expresses the opinion that it was hurtful to attempt medication by mouth as increasing the tendency to strangulation. "In the act of dying, he noticed a slight curving of the body laterally,[1] with a feeble contraction of the fingers. In solar asphyxia, the symptoms and the manner of death are more uniform than in any other malady. *The heat of the body, both before and after death, is a most remarkable circumstance.*[2] In the hurry incidental to a death so sudden I have not had an opportunity of applying the thermometer, to ascertain the exact temperature; but judging from the sense of touch alone it would seem greater than in the hottest fevers. The heat may be felt, radiating from the patient's body, at a distance of two or three feet. In cases where the patient has not been bled copiously the heat is very pungent. The heat of the body continued, generally many hours after death, including the whole night. This is the more remarkable, as our nights are not hot and sultry, but accompanied with breezes, which, by morning, cool even the walls and pavements."

"*After the death of the lungs, or the cessation of respiration, the heart and arteries will, in some instances, continue to act.*"[3]

This remarkable paper, which also contained much data here unnoticed, and the report of several cases, the first occurring in 1836, thus concludes: "The solar heat probably accumulates upon the surface of the body faster than nature can refrigerate through the lungs and the skin by evaporation; inequilibrium presses upon the vital energy, which, being exhausted in the contest, as well as by excessive labor, is unable longer to neutralize the excess of temperature—often 40° F. more than that of the body. Vital chemistry is unequal to the task of preventing the conduction of heat into the body, and death is the consequence."

The explanation of "the vital chemistry" was not successfully attempted until it was begun by Claude Bernard, in 1858, carried further by Stiles in 1864, and far advanced toward completion by Dr. H. C. Wood in 1872 (see pp. 509 and 514).

In 1845 Dr. Dowler,[4] who had for some time been studying the antemortem and post-mortem thermometry of yellow fever and of many other diseases, published in September the following most interesting observation, both medically and historically:

On July 24, 1845, he observed in a case of "solar asphyxia," twenty minutes before death, an axillary temperature of 111° F. One hour

[1] Lateral convulsive contraction was noted by the reviewer in one case observed by him in 1892.

[2] Italics introduced.

[3] This opportunity occurred in 1845, and the temperature then recorded was the first reported of cases suffering from heat effect.

[4] The Medical Examiner, Philadelphia, 1845, n. s., vol. i. p. 526.

after death the thermometer registered 113° F. From that time the cadaveric temperature began to decline. Nine hours after death the temperature was 109¾° F. The observer makes the following comment:

"I have had much experience in this malady, but never happened to take my thermometer with me before; but I am convinced that solar asphyxia, in the first degree is the hottest of all maladies, and can hardly be less than 120° F. in many cases! The patient seldom has more than *one premonitory symptom—a sudden dryness and heat of the skin.* I suppose that this man's heat was below the average; certainly not so great as some others, according to my touch."

This seems, without doubt—the language is so explicit—the first thermometric observation of heat effect made by Dr. Dowler, although Dr. Levick[1] credits Dr. Dowler with the record of an ante-mortem observation of 99° F. and a post-mortem observation of 104° F. in a case of heat effect on May 3, 1844, a year earlier than the case cited, but no reference is given. Either is as far as the reviewer knows, the first thermometric observations ever made of the effect of atmospheric heat on man.

In 1846 Dr. Geddes[2] reports a case of heat effect developing in a convalescent from measles in a hospital ward. This is the first published report of heat effect not caused by solar heat. The case reported by Condie is of prior date, 1818, but was not published until 1850.

In 1846 Dr. Israel Moses[3] published a report entitled "Exhaustion by Heat and the Effects of Cold Drinks when Heated"—the context suggests *when the drinker is heated*—was meant. Sixteen cases are reported. They are classified, in brief, as cases of apoplexy, exhaustion, and effects of drinking cold water.

As in the paper of Dr. Carroll (p. 491), the prefatory classification is not carried out, and detailed histories show that undoubted cases of heat are erroneously considered as cold-water effects, Rush and Currie being quoted. Six of the cases died, of which four were bled. The author considers bleeding contributory to fatality, and advocates treatment by the hot bath 104° F. to 108° F., "aloetic enemata," sinapisms and frictions.

The six fatal cases were examined post-mortem, the lungs being congested in five, and not markedly so in Case X. The brain was found congested in Cases I. and IV., the membranes in Case VI., Cases VII. and VIII. were too much decomposed for examination; in Case X. no marked congestion was observed.

[1] Pennsylvania Hospital Reports, 1868, vol. i. p. 382.

[2] Geddes. Clinical Observations of Diseases of India. London, 1846. See Sunstroke, H. C. Wood, Philadelphia, 1872, p. 10.

[3] Israel Moses. The New York Medical and Surgical Reporter, 1846, vol. i. p. 11.

In 1849 Dr. Henry Hartshorne was the first of the staff of the Pennsylvania Hospital (he being a resident physician) to publish a report[1] of *coup de soleil.* He described four cases treated in 1846; two were fatal, the second was a chronic alcoholic, and the third died on admission. He notes that several other cases occurring in the city at the same time all proved fatal. His treatment is advanced and interesting, and he records the first use at this hospital of ice and of the cold douche to the head. Two of his cases were bled, but with difficulty, by cupping at the back of the neck: one died, the other recovered. Sinapisms were applied to the abdomen and legs. Aromatic spirits of ammonia were given by the mouth, and turpentine by the bowel. One case, while having cold applied to the head, was placed in a warm sitting bath.

In 1850[2] Dr. William Pepper, the elder, reported before this College twenty cases treated at the Pennsylvania Hospital in the seven[3] preceding years. Of these ten died, seven recovered, and three, partially recovered, became insane. All of these cases had been bled before admission to the hospital. Dr. Pepper reports symptoms and post-mortem appearances. Both these conditions were possibly modified by the bleeding to which the patients were subjected before being admitted into the hospital. The "pallid, flaccid, and softened" condition of the heart noted in four cases by Dr. Pepper and reported in one by Dr. Reed in discussion, were also due, probably, as suggested by Dr. Stiles,[4] to post-mortem change, the autopsies being made six to eight hours after death. Autopsy was found impracticable by Dr. Levick[5] ten hours after death. Dr. Horatio C. Wood[6] makes the following suggestion in regard to these cases. "The cases were very probably true sunstroke and not simply heat exhaustion, as I have suggested, and the cool skin was the result of the bleeding. The soft, flaccid hearts were found because the temperature not being high at the time of death the cardiac myosin did not coagulate."

Dr. Pepper says: "The disease is evidently one of nervous exhaustion. The cases of apoplexy and congestion of the brain occasionally produced by insolation should be carefully distinguished from the cases above alluded to, the pathology and treatment of the two being very different." Again: "The cases we usually meet with during the intense heat of our summers present no symptoms similar to those which result from cerebral congestion, and demand for their cure stimulants

[1] The American Journal of the Medical Sciences, 1849, n. s., vol. xviii. p. 66.

[2] Ibid., 1851, n. s., vol. xxi. p. 183.

[3] The hospital records for this period, and for ten preceding years, show the admission of but fifteen cases, six of which died and nine recovered.

[4] Boston Medical and Surgical Journal, 1864, vol. lxx. p. 349.

[5] The American Journal of the Medical Sciences, 1859, vol. xxxvii. p. 49.

[6] Wood. Sunstroke. Philadelphia, 1872, p. 107.

instead of bleeding." Dr. Pepper closes by commenting on the absence of satisfactory medical literature on the subject at that day. This was the first presentation of this topic to the College of Physicians, and it is also the first, though not a very clear report by a member of the staff of the Pennsylvania Hospital and by a Fellow of the College of the difference between exhaustion and congestion following exposure to the sun.

Dr. Condie, in discussion of Dr. Pepper's remarks, gives a most clear and differential description of the symptoms of exhaustion from heat, and also—which Dr. Pepper did not—of congestion (fever) from heat. As already cited (p. 489), his recognition of these conditions dates back to 1818, and has such priority but not that of publication. He also makes distinction in the treatment, condemns bleeding for heat exhaustion, and, on the other hand, tells how he saved life by bleeding in a case of heat congestion accompanied by convulsions. His belief that heat effect may result in apoplexy has already been noted (p. 496). Post-mortem examination of the brain convinced him that "these cases are dependent upon acute meningitis." His is also the first recognition that artificial heat as well as solar heat can produce the condition at that time only attributed to the sun.

Dr. Reed also took part in the discussion, reporting a case which was subsequently examined post-mortem, a foot-note states that the heart in this case was flaccid.

Dr. Parrish closed the discussion. While acknowledging the value of Dr. Pepper's observations, he noted that they were in opposition to the prevalent doctrines of congestion and inflammation applied to all violent diseases which destroy life.

On page 536 of the same volume of THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, Dr. Frederick D. Lente, resident surgeon at the New York Hospital, answers Dr. Pepper's expressions of surprise that there was so little and such vague literature upon this subject: The victims of heat are principally laborers in cities "who earn their daily bread by their daily work, and are consequently compelled usually to labor during the intensest heat of the day, when the thermometer in the shade ranged from 96° F. to 100° F., and over, with not only the direct rays of the sun playing upon them, but also the reflected rays from the pavements and buildings. Added to this as the efficient and exciting cause, we have fatigue, intemperance, and often insufficient or improper food as predisposing agencies; these causes usually do not exist in the country and in small communities," etc. The city heat subjects are attended by private physicians only in emergency, being usually summoned to the relief of a man "who has fallen down in a fit while at work." These cases are, therefore, bled—hence, Dr.

Pepper's cases were all bled before admission—and sent to hospital. The majority are admitted between the daily visits of the chief, and so are practically only observed by the resident physician, " who in the discharge of his multitudinous duties " takes no particular notes of these cases. It follows that there is little and vague literature. Dr. Lente reports that in 1847 thirty-seven cases occurred in four days, most of them dying so promptly as to be attended only by the coroner. Animals, omnibus horses especially, were also stricken. Of *forty-two* cases admitted into the New York Hospital in the five preceding years, *twenty-four* died, and eighteen survived. In eight post-mortems there was congestion of the lung in two, and of the brain in four. There was no evidence of inflammation of the brain. One of the most discriminating observations of this paper is that the prognosis depends upon the stage in which the case is seen. So that one " physician might have ten cases, and all might recover; another might have the same number, and the treatment be equally judicious, yet nine out of the ten might die."

In 1852 Dr. C. A. Gordon,[1] an English army officer, had under his care in India, a number of cases of sunstroke, which he reported in 1857, stating that apoplexy and *coup de soleil* include the same conditions of body. Of the twenty-eight cases of heat effect that came under this author's notice but one recovered. His paper is important as bridging the epochs in one of which the effects of heat were ill-described as apoplexy, while in the other the terms insolation and sunstroke evinced a correct appreciation of the exciting cause in some cases, although both terms are too restricted in meaning to embrace the bodily effects of artificial as well as of solar heat.

Dr. G. S. Beatson, staff surgeon of the first class, English Army, criticises the paper of Gordon, because he stated that apoplexy and sunstroke included the same condition of the body and constituted one disease. Beatson admits the close connection between these diseases, but denies their identity in pathology and in treatment if the latter is to include blood-letting. He inveighs against the latter, and quotes fatality as a sequence, and suggests it to be consequence. He opposes to Gordon's almost certain mortality in all cases of this affection a report of eight to ten cases treated in India, in which but one case was bled, and with fatal result, and the remaining cases which were not bled recovered. The treatment of the latter included the removal of the patient to a cool place, the loosening of his clothes, and effusions of cold water on the head, chest, and epigastrium.

In 1853 Dr. T. H. Bache, resident physician of the Pennsylvania Hospital, as he reports in a discussion of Dr. Levick's paper read before

[1] Medical Times and Gazette, London, 1857.

this College in 1858, attended a number of sunstroke cases—they were mostly fatal (six out of ten cases)—and the post-mortem condition of the *heart was not softened*, as reported by Pepper of the cases he had seen.

In 1854 Dr. H. S. Swift,[1] resident physician of the New York Hospital, published his "Observations on Exhaustion from the Effects of Heat (*Coup de Soleil*)." This paper is important as marking a period of some advance and certainly in knowledge concerning heat effects.

The author states that the sixty cases he reports were admitted to the New York Hospital in the "past summer" were of the class at first called *coup de soleil*, but later regarded by the profession as prostration from heat, "combined, perhaps, with the effects of large draughts of cold water." The city inspector reported for that year 260 deaths from *coup de soleil*, without including many cases designated as "congestion of the brain and the effects of cold water." Dr. Swift finally dismisses this topic, saying, "Deaths from the effects of cold water are not so frequently met with as is generally supposed," and then quotes Dr. Dickson, who (p. 492) scouted the production of heat effects by cold water. As the paper of Dr. Moses is the last one found that refers to this subject by title, so is the paper of Dr. Swift the last to at all consider it, unless reference is made to that of Dr. James Trask, who published an account of "Alarming Effects from Drinking Cold Water after Violent Exertion in Cold Weather—February." The symptoms in this case were similar to those of shock, and in no way resembled those of heat effect. The case would not suggest comment in these pages but for Dr. Trask's closing sentence: "The appearance of this man (the patient) resembled that of most persons suffering from the too free use of cold water in the hot weather of summer; the sudden ingestion of a large quantity of cold water causing congestion of the brain." This sentence is the last expression of this opinion found by the reviewer. Its date of publication is 1859, twenty-eight years subsequent to 1831, when the last entry of "effects of cold water" appeared on the records of the Pennsylvania Hospital, where this curious error in diagnosis originated in 1769.

Of the sixty cases reported by Dr. Swift, eleven occurred in a hotel laundry, and several in a sugar refinery. Eight of the sixty cases were women, who, as a class, are unexposed to the sun. These data confirmed the view of Dr. Condie suggested to him by a case occurring in a heated room in the winter of 1818, and the report by Dr. Geddes, in 1846, a case originating in a hospital. They rendered untenable the opinion of Dr. Dowler that the direct rays of the sun (p. 496) were

[1] Swift. The New York Journal of Medicine and Collateral Sciences, 1854, n. s., vol. xiii. p. 45.

essential to pathological results from atmospheric heat, and, moreover, created a need for new and precise terminology descriptive of heat effects in man.

The phrases current at this time for heat effect were apoplexy from heat, *coup de soleil*, sunstroke, insolation, ictus solis, erethismus tropicus, heat exhaustion, nervous debility from heat, and the terminology of Dowler (p. 496). Russell (p. 494) was the first to publish (1836) his knowledge gained by autopsy, that the major form of heat effect was not apoplectic and was coincident with engorgement of the lungs. Dowler, independently, reached the same conclusion by clinical observation (1836), confirmed it later by post-mortem section, and in 1841 published a differential diagnosis between apoplexy and heat effect. He at this time seems to have stood alone in the combined knowledge of the following data:

1. That heat effects were not associated with apoplexy.
2. That they were accompanied by pulmonary engorgement.
3. (*a*) That they consisted of two principal, widely differing varieties, one of "exhaustion" and the other of "asphyxia," or, as would be said to-day, of fever—which he was the first to recognize thermometrically (1845); (*b*) that the treatment of these conditions was in strong contrast, blood-letting being contraindicated in cases of exhaustion, and advisable in selected cases of asphyxia or fever; (*c*) that there was an intermediate and sometimes sequent condition which he respectively recognized under the titles of "pain" and of "excitement or inflammation," and which are now grouped under the single title of meningitis. His predecessors and for twenty years subsequent to 1841, the date of publication of his first paper, his contemporaries confounded the effects of heat with apoplexy. Thus, some authorities maintained that cerebral congestion was always present in heat effect and always demanded depletion. Others held that nervous exhaustion was the only pathological result from heat, and that blood-letting was never permissible. Others again recognized that effects of heat might be exhaustive or congestive, but went astray by identifying fever with apoplexy, cold-water effect, etc.

This confusion of ideas resulted in a babel of tongues, so that *coup de soleil*, insolation, etc., were used by different authors with varying significations and limitations of application. The paper now in review, that of Dr. Swift, typifies this chaos of thought and nomenclature as well as marking, as already noted, a period in which speculation began to crystallize into precise knowledge.

The following quotations from Dr. Swift, as well as those from Dr. Pepper's paper (p. 500), illustrate the contention and misapprehension prevalent on this topic at that day:

"It is now only five or six years since the nature of this disease was

pointed out, and yet the profession, generally, have but vague and indefinite ideas respecting it, and it is a matter of surprise that medical literature is so deficient on the subject."

As evidenced by the references in the foregoing pages, and they are but a suggestion of the publications on this subject, the quantity of literature was not so much at fault as the availability of knowledge of its existence.

Again: "The term *coup de soleil* as applied to this disease is a misnomer. It is a popular rather than a professional appellation. All our authors agree that 'cerebral apoplexy' is occasionally produced by exposure to the direct rays of the sun. This I regard as true *coup de soleil*. The subject now under consideration is an entirely distinct affection. It is now almost universally admitted to be mere nervous exhaustion produced by protracted and violent exercise in an overheated atmosphere."

"Of the large number of cases observed by me, none were strictly apoplectic, and no lesions were noticed in those which proved fatal, sufficient to account for death. These two opposite conditions—the 'cerebral congestion' and 'nervous debility'—require opposite modes of treatment, and should be carefully distinguished from each other." The "cerebral apoplexy occasionally produced" by the sun was current belief. "Of the large number of cases—60—observed 'by him' none were strictly apoplectic," is definite knowledge gained by investigation; nevertheless, current belief, and "all our authors" are not repudiated —but evidence is presented to that end. The reference to "the subject under consideration being mere nervous exhaustion" would mislead to the belief that the minor degree of heat effect as described by Dowler and observed to-day was meant by the author, did he not quote Dowler's description in contrast to his own, and give a most discriminating and detailed symptomatology dividing the condition in mind into three stages: 1. That of onset. 2. That of the course, in which "the skin is hot," "the temperature 112° F.," "according to Dowler." 3. The stage of collapse; this leaves no doubt in the reader's mind that the major form of heat effect is classed under the title of nervous exhaustion.

In a well-marked case that had been classed as having apoplectic symptoms and was bled, death occurred in twenty-one hours. The autopsy, performed eighteen hours later (too late to permit reliable observations—reviewer), discovered no marked congestion of brain or lungs, and a flaccid heart filled with fluid blood. The liver was much congested, other organs healthy. He comments as follows:

"This case was doubtless one of 'nervous exhaustion,' a condition so often mistaken for and associated with 'cerebral apoplexy,' and it was the only one in which reaction ran sufficiently high to indicate depletion. But even in this the post-mortem disappointed us. I have

only seen a few, a very few, cases of insolation verified by post-mortem examination—certainly, not *one* during the past year, although examinations were made *in all the cases* in which we suspected any cerebral lesion."

The following paragraph notes a radical change in treatment: "Blood-letting is now nearly abandoned. Formerly nearly every case treated before admission to the hospital had been bled. But not a *single patient* had been bled of those admitted during the past summer. They do not bear well even the local abstraction of blood by cupping."

It was the period of reaction. Before laying down this very interesting paper, it will be well to note some of its statistics: The total number of cases admitted to the New York Hospital from 1845 to 1854 was 150, of which 78 died. The number of cases under Dr. Swift's observation was 60; the mortality more than one-half. On admission 44 cases were insensible, 16 stupid or sensible; the pupils were dilated in 30, contracted in 19, and natural in 11. The temperature of the body was hot in 34, warm or natural in 11, cool in 18; respiration hurried in 44, pulse uniformly accelerated 100 to above 160; convulsions in 24; delirium in only a few; 52 were males; and the average duration of fatal cases about four hours. "In 33 fatal cases the pupils were contracted in 20, moderately dilated in 7, and markedly so in 6; while in the successful ones the pupils were dilated in 19, and nearly natural in 16. No case recovered in which the pupils were contracted. The treatment included the hot bath, sinapisms, enemata of aloes or turpentine and "ice to the head *when the temperature is elevated.*" . . . "Indiscriminate use of cold affusions is productive of harm. Injurious and often fatal effects result from them."

In 1854 Dr. J. R. Leaming, in the same number of the *New York Journal* as the paper of Dr. Swift (p. 58), advises for heat effects the use of hydrochlorate of ammonia in 8-grain doses. The suggestion is made from the employment of the drug in four cases concerning which the author truly states his notes to be "very meagre."

In 1856 Dr. Sanford B. Hunt[1] published his "Observations on the Cause of the Disease Known as Sunstroke." In this paper, dealing largely but with greater originality and aggression with the facts observed concerning the large number of cases occurring in the service of Dr. Swift, in 1854, reactionary opinion swings further, and in some instances the conclusions are broader than the facts.

He first considers the question:

Are the direct rays of the sun necessary to the production of the disease known as sunstroke?

[1] Sanford B. Hunt. Buffalo Medical Journal, 1856, vol. xii. p. 23.

He cites that in the sunstroke *epidemic* in New York, August, 1854, of the 235 deaths from this cause, 49 were females. In view of this fact and the comparative non-exposure of females to the sun, added to the occurrence of the laundry and sugar-house cases, and of similar cases, as recorded by the health offices of various cities answers this question, beyond contention, in the negative.

Secondly, is congestion of the brain the special pathological condition in this disease?

Again referring to the cases of Swift, Dr. Hunt says: "At any rate, enough is known to prove that contracted pupils and convulsions are not to be accepted as sufficient proof of congestion, and we must wait for actual post-mortem evidence of it to verify its existence. It is already plain that only a very limited number of cases are congestive, and it is quite probable that that limited number will be much decreased on careful study."

He approves Swift's title of "Nervous Exhaustion from the Effects of Heat" as the designation of the disease, and immediately beneath the second inquiry of the paper says: "It is only recently that the fact has been fully recognized, that in the great majority of instances of sunstroke, the symptoms have been those of syncope or exhaustion." Knowledge of the paper of Dr. Swift and of the fact that he includes under the title of exhaustion major cases of heat effect, make it plain that Dr. Hunt like Dr. Smith used this term in error, because too broadly denominating by it, heat effects of hyperpyretic character as well as those of exhaustion from heat to which the phrase should be limited as suggested by Dr. Dowler and practised to-day.

What are the facts in relation to heat as a cause of coup de soleil?

He answers this question by quoting meteorological data in evidence of a greater number of cases of heat effect occurring on hot humid days than on hotter days but of dry heat.

He states: "The facts adduced are conclusive that, though a certain temperature is necessary, neither the frequency or the fatality of the disease increase with a further rise of the thermometer. Heat is not the essential cause; neither are the direct rays of the sun necessary."

"What then is the essential condition for the production of *coup de soleil*, or rather exhaustion from the effects of heat?"

"High humidity is the essential condition. This opinion is based upon weather records and upon analogy."

"In the first place the condition of nervous exhaustion is never produced by a high, dry heat."

Dr. Hunt disclaimed originality for his views on the etiological influence of the disease "known as sunstroke," yet such a claim would have been pardonable, considering that he is the first to present the

scientific evidence of hygrometry in support of an observation probably first published by Lancisi, as already noted in 1694. It hardly is necessary to say that the influence of humidity in the production of heat effects is generally acknowledged, but when Dr. Hunt says that they are "never produced by dry heat"; "that, though a certain temperature is necessary, neither the frequency or fatality of the disease increase with a further rise in the thermometer;" and finally, "that the essential condition for the production of *coup de soleil* is high humidity and not heat," he goes too far. The paper, as a whole, is one of much originality, force, and some discovery; it finally refers to the institution of "experiments to determine as to what power a humid atmosphere exerts on the absorption of the solar rays," and the message of the author is best expressed in his sentence saying, that "examination of such weather records, corresponding with periods of mortality from sunstroke, as have fallen under 'his' notice, have uniformly resulted in fixing a high temperature of evaporation as the efficient condition of the cause of the disease, and that without definite relations to the dry bulb temperature."

In 1856 Dr. J. B. S. Jackson[1] reported a case of recovery from sunstroke which occasioned discussion in which Dr. Strong presented a classification of cases into two groups not very clearly described.

Drs. Parkman, Cabot, Bigelow, Senior, and Coale also took part in the discussion.

In 1856 Dr. Charles Morehead,[2] in the first edition of his *Researches on Disease in India*, treats of the pathological effects of heat under the headings of "Apoplexy" and "Cerebral Affections Caused by Elevated Temperature."

In his consideration of apoplexy he at once distinguishes between a "correct" use of the word as signifying cerebral *congestion*, with or without effusion or hemorrhage, and a looser use of the term, including in its meaning cerebral "*determination*" as applied to the effects of excessive heat or of alcohol. He quotes statistics in evidence that heat effects were often and erroneously classed as apoplexy.

In treating of "Cerebral Affections Caused by Elevation of Temperature" he makes a triple classification of symptoms, which, it is plain, are those of three stages in the major form of heat effect. He records that the pupils in the cases he observed were primarily contracted, but finaly dilated—an observation later confirmed by Dr. Stiles' experimental investigations.

The pathology noted includes vascular turgescence of the membranes

[1] J. B. S. Jackson. Extracts from Records of Boston Society for Medical Improvements, 1856, vol. ii. p. 9.

[2] Morehead. Clinical Researches on Disease in India, London, 1860, first edition, vol. ii. pp. 577–582.

and substance of the brain, posterior congestion of the lungs, engorgement of the venous circulation and of the right heart with badly coagulated blood. Phrenitis and encephalitis are pronounced of rare occurrence.

The following paragraph presents a "suggestion" that has claim to priority, and that anticipates some of the conclusions derived from experiments reported three years later by Bernard:

"Active cerebral determination of blood takes place as a consequence of exposure to elevated temperature, and coexists with the symptoms above detailed; but it may be doubted whether it is a sufficient explanation of the proximate cause of the phenomena. From a review of all the attendant circumstances it seems to me not an unreasonable suggestion to offer that *the temperature of the blood may become much increased, and to this altered condition of the blood the deranged actions may in part be due.*[1] The nature of the cause and the pungent heat of the surface of the body, which is invariably present, may be used as grounds for this opinion. The tumultuous action of the heart is also a characteristic symptom, and seems to me to point to a direct influence of the *cause* on that organ."

Although Dowler was the first to measure the degree of elevation of temperature, he, like Russell, attributed the chief cause of fatality to the lungs. Morehead was the first to suggest the abnormal elevation of the temperature of the blood to be the primary cause of trouble in heat effects, and its *direct influence* to be secondary.

In 1857 Dr. B. Darrach,[2] resident physician in the New York Hospital, treated four cases by stimulants and by *rubbing the entire surface of the body with ice;* three of his cases recovered, one died. He reports the cases equal in severity to four previous cases in which the ice was only applied to the head, and all four patients died. This is the first report of the application of ice to the whole body in the treatment of this condition.

In 1858, Claude Bernard[3] announced in his lectures to the College of France that the temperature of mammals and birds could be elevated 4° C. to 5° C. (7.2° F. to 9° F.) above normal, and that the animals, without exception, died when their temperature became elevated to this degree. On autopsy, the *heart* and other muscles of the body were found *rigid.* In the history of the pathology of the major form of heat effects, this communication is only second in importance to the first observation of temperature in this disease, by Dowler in 1845. The significance of the phenomena observed by Bernard will become more apparent with the reading of his report of further experimental data and of his deductions.

[1] Italics introduced.

[2] Darrach. New York Journal of Medicine, 1854, n. s., vol. xii. p. 45.

[3] Bernard. Lectures to the College de France, 1858, vol. iv. p. 209.

In 1858 Dr. Levick[1] reported to the College of Physicians twelve cases treated that year at the hospital; one of these cases occurred in a sugar refinery, three cases died, and also a cured case suddenly on the sixth day after recovery. Dr. Levick notes the differences between exhaustion and congestion as bodily results of heat, and urged that for these dissimilar conditions different modes of treatment were required, and that, therefore, diagnosis was important, and he italicizes his belief that the process is most frequently one of exhaustion. He deemed none of his cases in need of bleeding. He comments upon the coincident value of turpentine in the treatment of malignant fevers and of sunstroke. He notes the post-mortem appearance of the blood in typhus to resemble that in sunstroke; that putrefaction in the latter disease was so rapid as to prevent autopsy ten hours after death; that in the last case reported symptoms of inflammation of the brain were corroborated by post-mortem discovery of extensive inflammation of its base.

In January, 1859, Dr. Levick[2] contributed to THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES the most comprehensive history and analysis of this subject published at that time, and to the references of which this review is much indebted. In confirmation of artificial and solar heat being alike productive of the same symptoms, as evidenced by the cases reported by Swift, Dr. Levick alludes to the case already noted, which he reported the previous year, and which developed in a sugar refinery. Contrary to first impressions, he subscribed to the observations of Dr. Hunt with regard to humidity being an etiological factor "of the disease known as sunstroke," but Dr. Hunt's assertion that disease from heat is "never produced by a high, dry heat" is disproved by Dr. Levick, who quotes the case detailed by Russell as occurring "at a season when the hot land winds had just set in, rendering the atmosphere dry and suffocating."

Dr. Levick, like Andral, comments upon the coincidence of atmospheric heat, and the epidemics of apoplexy noted by Forestus, in 1562; but while Andral would confirm this observation, Dr. Levick maintains that the epidemic character of the disease in hot, humid weather is only explainable by the inference that at least many of the cases were *not* due to apoplexy, but to the effects of heat.

He notes and accepts the post-mortem observations that establish apoplexy and heat effects to be dissimilar conditions, and also those concerning the fluidity of the blood and the general venous and especially pulmonary engorgement. He again comments upon the rapidity of putrefaction noted by him the year before. He quotes Pepper, Lente, and Swift in agreement upon the flaccid condition of the heart.

[1] Levick. THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, 1858, vol. xxxvi. p. 404.
[2] Ibid., 1859, vol. xxxvii. p. 40.

He by inference condemns blood-letting. He advocates cold affusions and the use of ice to the head in selected cases. He warns that "the full bath is not without danger." The chief indication for its use is found in the stimulus afforded by the *hot* bath. He finally quotes the "happy results" obtained by Dr. Darrach in "frictions of the body *with ice*" to relieve the burning heat of *the skin*, which is justly viewed as a most unfavorable prognostic symptom. Carbonate of ammonia and the aromatic spirits are recommended for administration by the mouth, and oil of turpentine by the bowel.

This very exhaustive article closes with the following reference to sequelæ which are best presented in the words of the author, as future reference will be made to it:

"After the immediate symptoms of an attack have passed, as after cholera, typhus fever, etc., so with sunstroke, various internal inflammations may be developed—as of the brain, the lungs, etc.—which require a treatment entirely unlike that mentioned above. In this way we have cases reported as meningitis resulting from exposure to heat; but according to my observation, these differ from sunstroke in their gradual mode of attack, although just as apoplexy may occur in warm weather, so may meningitis; but in by far the greater number of cases of sudden attacks of illness from exposure to heat, inflammation of the brain is not the pathological condition. Nor must we be misled by the presence of delirium, or of a hot skin, in such cases. The latter we have present even in malignant typhus, and no fact is better known to the pathologist than this; that, in typhus and typhoid fever, phenomena almost identical in character with those of inflammation of the brain may be present, and yet, after death, no lesion of this organ be found. In the words of Dr. Bartlett, when writing of typhus fever, "delirium and somnolence have occurred as frequently, and as strongly marked, in patients whose brains presented no changes, as in those of an opposite character."

It is interesting to note that general frictions with ice were approved by the author for the relief of an "unfavorable *symptom*" affecting the skin and employed empirically. The pathology demanding refrigeration as one of the vital principles in the treatment of the major form of heat effect was not yet understood. That it had been divined, is suggested by the comment of the reviewer (p. 509) on the notes of Bernard. His second announcement, now in order, sheds much light on the pathology of heat effects, implying the essential necessity of employing cold in their treatment.

In February, 1859, Claude Bernard[1] reported the results of two experiments "on the cause of death in animals submitted to a high

[1] Comptes-Rendu des Séances et Mémoires de la Société de Biologie, 1859, Tome iii. Series B. 51.

temperature." He refers to his announcements of the year before and presents the data of subsequent observations and his conclusions.

Experiment 1. A rabbit subjected to a temperature of 55° C. to 60° C. (131° F. to 140° F.) fell on its side and died quickly. The temperature of the rectum and thorax taken at once was 44° C. to 45° C. (112° F. to 113° F.). The heart was still, was firmly contracted, and contained no blood. The muscles and limbs were stiff, and did not respond to galvanism. The blood of the ears was black, presenting no apparent alteration of character. Poured in a glass it coagulated well, and the exposure exhibited a ruby red color.

Experiment 2. A younger rabbit that had not been permitted to feed preceding the experiment, as had the first rabbit, succumbed a little more slowly to the effects of heat; otherwise the same phenomena were exhibited at both experiments.

He explains the cause of death in these cases to be *due to the purely physical fact of the elevation of the temperature of the blood.* This elevation is such as to be incompatible with the exercise of muscular contractility, and consequently of the cardiac functions. The heart is stopped and becomes incapable of vital functions. The muscular fibres of animals having a precisely similar temperature exhibit after death rigidity and immobility. Dr. Kühne has shown that in these conditions the rigidity was due to coagulation of a special matter contained in the muscle. As he had observed the muscles of animals dying of cold, although rigid, to be of alkaline reaction, he concludes that the usual muscle acidity accompanying cadaveric rigidity should not be considered as a cause of rigidity, since the latter can exist without acidity.

In 1860 Dr. Charles Morehead[1] published a second edition of his *Clinical Researches*, containing an enlarged chapter on "Sunstroke." This title, condemned by the author in his first edition, is employed in the second, and broadly applied to the effects of the indirect as well as the direct rays of the sun. This chapter represents the experience and opinions, unpublished as well as published, of many Anglo-Indian surgeons as well as the personal observation and views of the author. It contains a new classification of symptoms dependent upon an Anglo-Indian recognition that in the effects of heat there are different varieties, which he denominates as follows:

1. Comal, which is cerebro-spinal in origin.
2. Syncopal, which is a cardiac type.
3. Comal and syncopal combined, the origin of which is cerebro-spinal as well as cardiac, and is therefore denominated as "mixed."

The symptoms detailed of the first, or cerebro-spinal variety, show it to be identical with the condition known to-day as thermic or heat fever.

[1] Morehead. Clinical Researches on Diseases in India. London, 1860, second edition, p. 603.

The second, or cardiac variety, may be subdivided into two types. In one the individual, "without premonitory warning," and generally consequent on direct exposure to the sun, falls down, gasps a few times, and dies.[1] The authority for this instantaneous form is assigned to Dr. Pirrie. Such instant fatality is contrary to the experience of most observers. Rush described it, but his contemporaries Condie and Watt discredited it. Dowler reports instances of death occurring in twenty or thirty minutes, but hours are usually occupied in the fatal progress of this affection. The second form of the cardiac variety is not instantly or necessarily fatal. This subdividing of the cardiac variety is a distinction made by the reviewer, and not the author. The symptoms detailed of this type—for instance, "a cold and clammy skin"—identify it, without doubt, as that of heat exhaustion, in spite of the fact that the author groups in it cases of most unusual and instant fatality.

In the third, or mixed variety, the author assembles atypical cases of the two varieties described, more especially mild cases of the first variety.

On the topics of symptoms, pathology, etiology, and treatment, the author, though at times in disagreement with modern conclusions, often penetrates with clear-minded energy to first causes or perceives indications that were not recognized as true by many observers until years later. Justice can only be done this most instructive chapter by consulting the original.

In 1863 Dr. Horatio C. Wood, Jr., published in The American Journal of the Medical Sciences a report of eight cases affected by heat, seven of which died; a ninth case that died is recorded in the hospital records, and was probably not under Dr. Wood's care. He expresses his belief that heat produced different classes of cases called sunstroke, but he had observed only the fatal variety which he had reported. Dr. Wood is the first of the staff of the Pennsylvania Hospital to publish thermometric observations of his cases, but the first reports of this character are those of Dr. Dowler. The maximum temperature observed by Dr. Wood during life was 109.75° F., but one hour after death the temperature of 110.75° F. was recorded in one case.

Dr. Wood's report is still unique in its wealth of post-mortem notes. In the six autopsies recorded the following observations were most constant. None but the slightest congestion of brain, meninges, and lungs, although the meningeal and pulmonary veins were loaded with blood. The blood was dark, fluid, tending to acid reaction and not to coagulate. Its microscopical examination in one case is the first recorded in this disease. The red globules were found "a little more

[1] Pirrie. Insolation, Sunstroke, or Coup de Soleil, Lancet, May 20, 1859.

opaque than normal, and aggregated in rouleux and masses. No abnormal proportion of white corpuscles." "The *heart* was in all cases *rigidly contracted.* The veins were surcharged with blood." In this, as in other diseases, ecchymoses are characteristic of altered blood. The pathognomonic post-mortem results of fatal blood disorders are like those of sunstroke; "alteration and destruction of the crasis of the life fluid, without structural changes in the solids."

He states that alterations in the blood produced by heat are responsible for the cerebral symptoms observed, that death is brought on by loss of power in the central nervous system, and he substitutes thermohæmia, or "thermic fever," as the name of the condition in place of sunstroke. The name thermic fever is an advance in specific terminology, because the first word accurately gives the cause of the trouble, and the latter word states the condition resulting from the cause; the two words combined limit their application to the grave form of bodily effects from heat which is accompanied by an elevation of temperature that tends to the extreme. He condemns the prejudice against drinking water, and urges the ingestion of fluids, because the blood has been deprived of its serum, it may be by pints, through the action of the perspiratory glands. He acknowledges treatment to have been futile in his hands, and quotes and suggests Taylor's[1] recommendation of cold affusions as practised in India.

An analysis of Dr. Wood's reports of his cases discovers that cold was employed only in the treatment of three, namely: Cases III., IV. and VI. Cases III. and IV., axillary temperature 109° F., had ice frictions; Case VI., femoral temperature 104° F., was treated with cold affusions, *which aggravated the tendency to convulsion.* Two of the cases were intemperate; the other, temperature 109° F., was sixty years of age. The two cases of 109° F. were not brought to the hospital until two hours after the onset of the attack. The cases of 104° F. had been suffering from the effects of heat four days before admission. These were all unfavorable cases for treatment, and they all died.

In 1864 Dr. R. Cresson Stiles[2] published the results of the first experimental "observations on animals subjected to an elevation of temperature in various modes, and which presented a series of symptoms very closely allied or identical with those of sunstroke as 'he' had seen it, and as 'he' found it described by careful observers." These experiments were inspired by the diversity of existing opinion respecting sunstroke, by a desire to test the accuracy of the "currently received pathology of the disease," and with a prejudice in favor of a poisonous quality being acquired by the blood. This theory he credits

[1] Lancet, 1858.

[2] Boston Medical and Surgical Journal, 1864, vol. lxx. p. 349.

to Dr. H. C. Wood, in the publication just summarized. The investigations of Dr. Stiles soon caused him to abandon this theory or rather to "regard the only poisonous property of the blood to be its elevated temperature."

Dr. Wood, in his *Boylston Prize Essay*, 1872, p. 103, thus concurs with Dr. Stiles: "I believed at that time (referring to his paper of 1863) that the nervous symptoms were due to the development of a poison in the blood;" not perceiving that the heat itself was the poison.

His conclusion is formulated in the title of his paper: "Sunstroke, or Paralysis of the Heart by Heat."

He reached his conclusions by five classes of experiments:

Class 1. "Those in which warm-blooded animals were subjected to an elevation of temperature; the symptoms they manifested observed, and post-mortem appearances noted."

Method. The animals were either placed in glass bell-jars of sufficient capacity for free respiration—and the jar covered and immersed in water of 115° F., later raised to 120° F.—or, held by the nape of the neck, they were directly immersed in the heated water.

Results. They exhibited the phenomena of sunstroke, and died. A hearty meal hastened fatality. The sequence of symptoms were restlessness, increased pulse, and respiratory rate, distention of bloodvessels, slight outcry, coma, primary dilatation of pupil, soon followed by its contraction. Upon contraction of the pupil, subjection to artificial heat was discontinued. Within a half-hour of the occurrence of pupil contraction, the bloodvessels cease to be distended, then cyanosis, slowing of the respiration, convulsions occasionally, and death follow. The animals directly immersed in water exhibited within five minutes rigid and permanent contraction of all muscles.

Autopsy, of immediate performance, discovered abdominal and thoracic temperatures not above 115° F., and either the heart ventricles firmly contracted, or permitted the observation of their contraction within ten minutes after death. The auricles were distended with blood and exhibited fibrillar movements. Neither brain nor lungs were congested. The venæ cavæ were engorged with dark alkaline blood rapidly coagulating. The cut heart ventricles were acid in reaction. The microscopical appearance of the blood was normal, but that of the heart fibres showed loss of striæ. In a few hours heart rigidity gave way to flaccidity. Putrefaction was soon manifest. Hence, the prompt autopsies made by Dr. Horatio Wood discovered heart contraction, in contrast to the flaccid hearts observed several hours after death by Dr. Pepper.

Class 2. "Those in which artificial respiration was practised as soon as the animal became comatose, or the pupil became contracted."

Results. Life was not thus prolonged even subsequent to trachęotomy.

Class 3. "Those in which blood heated to 120° F. was injected into the veins of the animal from which it had been drawn, or in which the blood of an animal perishing from the disease produced by heat was injected into the veins of an animal of the same species."

Results. No toxic symptoms ensued.

Class 4. "Those in which it was proved that the muscular system of an animal could be paralyzed by heat while its nervous system was left intact."

Method. "The reflex actions of animals apparently moribund from the effects of heat presented a decided contrast to those of narcotism, or exhaustion of the nervous system." In cold-blooded animals, on account of the sluggishness of their circulation, the heart is the last organ to be influenced by a heated liquid. When thrown into water of 115° F. all the muscles of a frog become rigid in a few minutes. In partial immersion only the part immersed is affected. After immersion and rigidity of long duration, not only do irritation of distinct nerve centres cause convulsions of the immersed parts, but irritation of nerves locally and equally exposed to the heat that has rendered the muscles of the part rigid will meet convulsive response.

Hence the nervous system is less sensitive to heat than the muscular.

Class 5. "Experiments on muscular contractility is affected by heat."

Results. The more violent the activity of muscles subjected to heat, the more promptly did they become rigid. While the cut surfaces of muscles made rigid by heat are decidedly acid, those of animals dying of other agencies (*e. g.*, section of medulla or toxic tetany) are not. The non-striated muscular fibre of arterioles of heat-stricken animals would not contract in response to cold or galvanism, but intestinal peristalsis was well marked. The normally contracted pupil of the dead frog dilated on immersion in water at 118° F.

The experimental data of the paper was supplemented by clinical and post-mortem observations on man, and a presentation of existing theories of his own. Finally, in the recapitulation of his experimental results are the following notes:

"A temperature of the blood below 115° F. is sufficient to destroy life in all vertebrates, and causes phenomena similar to those of sunstroke, while a temperature between 115° F. and 120° F. is sufficient to cause rigid contraction and paralysis of the muscles whether connected with or separate from the body of the animal. The more violently a muscle is made to contract before subjection to heat the sooner it becomes paralyzed."

Dr. Dowler's observation of axillary temperature of 112° F. establishes that the temperature of the blood in sunstrokes is sufficient to produce paralysis. The dilatation of the capillaries is explicable by the direct effect of the heated blood upon the muscle fibres of the walls of the arteries and arterioles. The cerebral symptoms and the full and forcible pulse may be due to this dilatation.

"The effect of heated blood upon the heart is termed paralysis rather than exhaustion, because the heart has been shown to have the power of directly paralyzing its muscular tissue, and because in sunstroke the first stage, or that of frequent and forcible contraction of the heart, is not an essential part of the disease."

This paper not only confirmed the announcements of Bernard, although it does not allude to them, but it also contributed much new knowledge which later was largely corroborated by other observers, and doubtless helped to inspire their work.

Receiving ward (North House) and sunstroke tent, Pennsylvania Hospital.

In 1866 Dr. George B. Wood, visiting physician to the Pennsylvania Hospital, in the sixth edition of his *Practice of Medicine*, advocates the term *heat fever* in preference to the term *thermic fever*, suggested by Dr. Horatio C. Wood, and of which heat fever is but a translation. Either of these names Dr. George B. Wood prefers to insolation, etc.,

because the condition in mind though a consequence to heat is not one exclusively of solar heat.

In 1866 Dr. Levick, as he reports in 1868, treated 22 cases in one week at the hospital (see Graphic and Statistical Chart, in later publication). Of 12 cases treated by affusions and entire bath, 7 died. Of 7 rubbed with ice, 6 recovered; 2 of these had temperatures of 109° F. This is the first record of a recovery from such elevation of temperature, and it apparently marks the first fully intelligent application of cold in the treatment of heat fever. The earlier use of general ice frictions (p. 511) was to relieve the heat of the *skin*. The treatment by Dr. Levick of the cases occurring in 1866 must have been instanced by his appreciation of the indications of the newly discovered pathology of this disease, for general refrigeration of the blood, and, with equal propriety, it might be said of the muscular tissues, but that Dr. Levick in the paper next in order of review, refers only to that portion of the paper of Dr. Stiles that deals with the blood, and makes no allusion to his discoveries concerning the action of heat on muscle.

In 1868 Dr. Levick, in the *Pennsylvania Hospital Reports*, vol. i., p. 24, contributes a paper entitled, "Heat Fever (Sunstroke)," and credits the title of Dr. George B. Wood. No allusion is made to "thermic fever," a title of prior date, coined by Dr. Horatio C. Wood.

The paper begins and ends with emphasis on the fact that "two or more pathological conditions, very distinct in their phenomena if not in their nature, are often spoken of indiscriminately as insolation or sunstroke." It has two "obvious forms," and another, of which he says, "surely, it were an unnecessary refinement to give this disease a classification separate from meningitis." He, therefore, differentiates, and so clearly as to need no present modification, three forms of heat effect: 1. *Exhaustion from Heat.* 2. *Meningitis.* 3. *Heat Fever.* Dowler, in 1841, made the same classification with a different terminology, limiting the exciting cause to solar heat; whereas, Dr. Levick states specifically that either of these forms of heat effect may arise from solar or from artificial heat. He also refers to high humidity as a strong etiological factor in the production of pathological results from heat, and suggests that the mortality on the "Liverpool" in the Persian Gulf was possibly increased by keeping the decks wet (p. 491). Due credit is given the paper of Dr. Hunt.

A detailed clinical history, with notes of autopsy, of microscopical examination of the blood, and of a control experiment with, and examination of, the blood of a healthy individual, is followed by a claim for priority in noting the resemblances between the "phenomena of sunstroke and those of an idiopathic fever." The claim is supported by quotations from the essay on sunstroke in THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, 1859, p. 50, already noted and by a repe-

tition of the parallel between the symptoms and post-mortem appearances of heat fever and of typhus fever as a type of the idiopathic fevers. The teachings at the Pennsylvania Hospital of Drs. Gerhard and Pepper that the "essential pathology of this disease (the major form of heat effect) was to be found in an altered condition of the blood" is cited. "It was but a step further to notice the resemblance of the phenomena to those of an idiopathic fever."

The microscopical examination of the blood is the third reported in this condition, being preceded by that of Dr. H. C. Wood and also by that of Dr. Stiles in his experimental work. The negative observations of Dr. Stiles are in agreement with those of Dr. Wood and of other investigators of the appearances of the blood in this condition. Dr. Levick stands alone in reporting crenation of the corpuscles. The control experiment was made at his request by Dr. Roland G. Curtin, of the Philadelphia Hospital. Of four ounces of blood taken from a healthy woman, and divided into two equal portions, one was microscopically normal and clotted in twelve minutes. The other was gradually heated in a sand bath until the blood reached a temperature of 120° F. "The second portion was gradually heated in a sand bath until the thermometer placed in it was at 120° F. Under the microscope, the red corpuscles were now found to be about half their usual size, shrivelled, and crenated. This blood coagulated in five minutes less time than the first portion did. So far then as this proves anything, it would seem to show that while the vitality of the corpuscles of the blood may be destroyed by heat alone, something more than this is required to destroy its property of coagulating, when drawn from the circulation.

In the *Essay* of 1859, p. 51, already quoted on this point (p. 510 of this review), Dr. Levick expressed his belief in a "poisoned condition of the blood." The following quotation, referring to this point, shows a modification of opinion: "Absence of toxic properties would seem to be established by the experiments of Dr. R. Cresson Stiles." . . . It is interesting to recall that Dr. Horatio C. Wood expressed the same belief in 1863, and, as already stated, recants it in 1872.

The question of change in theory in treatment indicating the application of cold was raised on page 511 in noting the cases occurring and treated in 1866. The following paragraph presents Dr. Levick's view on this subject:

"Of the *modus operandi* of ice in these cases, but little need be said. In all probability it acts by its refrigerating properties alone, and yet, when the instantaneous effect of a drop or two of water on the red corpuscle as seen under the microscope is recalled, the question will present itself, Can there be any endosmotic action of the water in these cases which is eagerly seized upon by the parched blood?"

This third paper of Dr. Levick is of epochal import, and marks the beginning of intelligent treatment of the conditions considered.

In 1868, in the second volume of the Hospital Reports, Dr. James Hutchinson publishes a paper upon the success of one-fourth grain, hypodermic doses, of morphine in the control of convulsions in four[1] cases of sunstroke treated at the hospital that year. The injections were suggested and given by Dr. Herbert Norris, resident physician.

In Period IV., 1841–1870, 164 cases of heat effect were received at the hospital, the mortality being forty-nine. In this epoch marked progress was made in the study and treatment of heat effects. The most notable events were the first use of ice-water affusions, by Markoe, and of ice applied to the head, as noted by Dowler, both in 1841; the publication by Dowler, in the same year, under a different terminology, of the classification recognized, but not published, by Condie in 1818; the further classification by Dowler of a meningitic type; the recording by Dowler, in 1845, of the first thermometric observation of hyperpyrexia (113° F.) in the major form of heat effect; the suggestion by Morehead, in 1856, that the pathology of the condition depended on the temperature of the blood being abnormally increased, and possibly acting directly on the heart; the first application by Darrach, in 1857, of treatment by general refrigerating friction with ice; the confirmation of Morehead's "suggestion" by the experimental work of Bernard in 1858–59 and by Stiles in 1864; the comparison of heat effects with fevers by Levick, in 1859; the discoveries of the last two observers of the effects of heat upon muscle and nerve; the negative microscopical examination of the blood by Wood, in 1863, and his denomination of the major form of heat effect as thermic fever; and, finally, the institution of an intelligent use of opium in the control of convulsions by Hutchinson and Norris, in 1868. The achievements of the period reviewed were but preparatory for further advances in the period 1841–1870, which will be presented in a later publication.

[1] In four cases is this use of morphine recorded by Dr. Hutchinson—not sixteen, as stated on p. 110, by Dr. Horatio C. Wood, in Sunstroke.

REVIEWS.

Regional Anatomy of the Head and Neck, for Students and Practitioners of Dentistry. By William T. Eckley, M.D., Professor of Anatomy in Dental Department, University of Illinois, in the College of Physicians and Surgeons, Medical Department University of Illinois, etc., and Corinne Buford Eckley, M.D., Demonstrator of Anatomy in Dental Department, University of Illinois, College of Physicians and Surgeons, etc. With 26 plates in black and colors, and 36 illustrations in the text. Philadelphia and New York: Lea Brothers & Co.

It may be true that there are departments of anatomy with which the dentist is particularly concerned, but it is not true that he is particularly concerned with certain departments of anatomy only. The intelligent practice of dentistry must be founded upon a fair working knowledge of the structure of the entire human organism, and the inference may be readily drawn from the existence of a special work of this character that it contains all that is necessary for a dental practitioner to know of the special subject of which it is the exposition of only a small though even very important portion. We fail to see that this work contains anything of special importance which is not adequately set forth in standard works on the general subject of anatomy. The arrangement of the various topics is illogical in the extreme. The initial chapter is a chapter of forty-one pages, which is devoted to the Anatomy of the Trifacial Nerve, followed by about twenty pages more of description of the muscles of mastication. Chapter III. is devoted to a description of the roof of the mouth, and Chapter IV. to the mouth itself. Why such a division should be made does not appear. The balance of the subject, fairly covering the Anatomy of the Head and Neck, concludes with Chapter XVII. upon the Osteology of the Region.

There are numerous inaccuracies in the work, and a large number of repetitions which mar its usefulness—for example, in stating the composition of the pre-maxillæ, "the corresponding part of the lips is included." It is unusual to describe the soft tissues as part of a bone. Of the ethmoidal cells, he states that the anterior open into the frontal sinus. The published dissections of Cryer show that such is not the case, and further, page 96, with reference to the anterior ethmoidal cells, the author states that they open into the middle meatus of the nose. Page 111, it is stated that the mental artery is a branch of the internal maxillary, while as a matter of fact it is a branch of the inferior dental. Page 115, the statement is made that "The orbicularis oris surrounds the mouth," a looseness of statement inexcusable in a scientific work.

At page 135, in describing the common roof structures of the five triangles of the neck, no mention is made of the platysma myoides.

Whole paragraphs, even pages of text, are repeated at times almost verbatim, and the work will need most thorough revision in order to justify its publication and make it a useful text-book for students. Therevision should comprise not only the elimination of actual errors, but a more orderly arrangement and the avoidance of so much repeated matter.

The mechanical make-up of the work is most excellent. The illustrations, which are almost wholly taken from standard authors, are of a high grade, the paper and presswork being above criticism.

E. C. K.

Die Verdaulichkeit der Nahrungs—und Genussmittel auf Grund mikroskopopischer Untersuchung der Fæces. Mit 102 Abbildungen. Von Kreis-Physicus a. D. Dr. Med. F. Schilling. Leipzig: Hartung & Sohn.

Die Fæces des Menschen in Normalen und krankhaften Zustand mit besonder Berücksichtigung der klinischen Untersuchungsmethoden. Von Dr. Ad. Schmidt und Dr. J. Strasburger, Privatdocenten an der Universität Bonn. I. Theil, mit 6 lithographischen Tafeln. Berlin: August Hirschwald.

Chemical investigation of the feces has given the student of the digestive processes much information concerning the results of intestinal changes, but has been of very secondary value as a help to clinical diagnosis or to treatment. Within recent years, however, since Szydlowski, in 1879, laid the first really substantial foundation for the study of the feces, unceasing effort, in certain lines, has been put forth in the study of the intestinal dejecta. These two works represent the latest and best observations on the subject. Ledder-Hulsebosch, in 1899, presented an admirable work on the same subject, but limited his observations to vegetable detritus; both of the works here mentioned treat of the animal foodstuffs as well.

The former work of Schilling may be dismissed with a few words—it is an excellent résumé of the subject, and from the general point of view would make a good introduction to the study. The figures are numerous, and for the most part good, although inclined to be schematic. His illustrations of the various types of muscle detritus are open, we believe, to criticism. It is doubtful if the differences he notes in the muscle cells of allied animals are as distinct as his drawings would lead one to believe.

The work of Schmidt and Strasburger is, in the first portion here offered, a most excellent one, and deserves special commendation. To the clinician who is keenly alive to the importance of intestinal digestion this work will come as an added help to illuminate this dark chapter of symptomatology. Especially is this true for the pediatrist, and, if we read the signs of the times, a much needed light for the study of the intestinal dejecta, beyond the casual observation and perhaps the use of litmus paper, is, for the most part, done in a most perfunctory manner.

There is no doubt that, for American medicine at least, the use of the microscope as a means of diagnosis in intestinal derangements has been

greatly undervalued, and the more extended application of this aid to clinical medicine would do away with many of the peculiar ideas concerning certain forms of diet. S. E. J.

The Practical Medicine Series of Year-Books. Vol. V. Obstetrics. By Reuben Peterson, A.B., M.D., and Henry F. Lewis, A.B., M.D. Chicago: The Year-Book Publishers, 1901.

If the whole series of *Year-Books* is equal in excellence to the volume before us, nothing more can be asked. As its title indicates, the aim of the series is to review the advances made in medicine and surgery during the past year. This, in the present volume, has been most thoroughly and satisfactorily accomplished. No work done upon obstetrics during the past twelve months has been omitted, and the space allotted has been gauged to a nicety to meet the relative importance both of the subject under consideration and the value of the work itself. Thus, a very valuable result has been secured in that the size of the book has been kept within the limits of the ordinary pocket volume.

As an index to the completeness with which the authors have done their work, it may be mentioned that there is a very satisfactory account of the recent investigations of Webster upon Human Placentation, as well as a full consideration of the year's work in the field of local anæsthesia in its relation to obstetrics. W. R. N.

Lecons de Clinique Obstetricale. (Lectures in Clinical Obstetrics.) Par le Dr. Queirel, Professor de clinique obstétricale à l'École de médecine de Marseille; Membre correspondant de l'Académie de Médecine. Paris: G. Steinheil, Éditeur, 1902.

This series of lectures covers the most important topics in obstetric practice. Obstetric antisepsis forms a proper introduction to the volume. The writer's usage in this important particular is shown to be that of the most intelligent students of the subject. His method of performing craniotomy is by the use of the basiotribe, and in cases where the child is dead and the pelvis considerably contracted, he has succeeded in delivering the patient by symphysiotomy and the use of the basiotribe, thus avoiding abdominal incision.

In a lecture upon pelvic hæmatocele, he describes an interesting case of a nulliparous patient who had amenorrhœa. While having a tooth extracted she was seized with violent pain in the abdomen, with vomiting and partial syncope. She had a slight discharge of bloody fluid afterward. Upon examination the uterus was found the size of the fourth month of gestation. A tumor filled the cul-de-sac, which was soft in consistence and not especially painful. The case was treated by incising the posterior cul-de-sac and turning out a large quantity of clotted blood, douching the cavity with biniodide of mercury solution and packing it with iodoform gauze. The patient perished not long afterward with signs of peritoneal infection.

At autopsy, clotted blood was found throughout the abdomen among the intestines, with beginning formation of pus in the left iliac fossa. The origin of the hemorrhage had been the left Fallopian tube, a pavilion of which was dilated and had evidently contained an ectopic gestation. There was no trace of embryo. This lecture is followed by one upon ectopic gestation, in which a case of abdominal pregnancy is described, successfully treated by abdominal incision with the gradual discharge of the placenta through the abdominal wall.

Abdominal obstruction, rigidity of the cervix, vesicular mole, prolapse of the cord, purpura, epithelioma, and puerperal infection are among the subjects treated in the remainder of the volume.

The author publishes a lecture upon tuberculosis complicating pregnancy, which calls forth an introductory preface from Pinard.

Pinard does not share the view of those who consider tuberculosis an indication for the induction of labor, and he cannot accept the dictum of Peter regarding the tuberculous woman—in youth no marriage; after marriage, no pregnancy; and when a mother, no lactation. Pinard believes that the best results are obtained by treating the tuberculous patient as any other case of tuberculosis would be treated, and by allowing the pregnancy to take care of itself.

The volume concludes with a statistical account of the clinic at Marseilles, covering 827 cases of labor. Among these there were performed the usual operations of obstetrical science, including three symphysiotomies and two entire hysterectomies, one for cancer and one for rupture of the uterus, with infection.

With the exception of a few temperature-charts the book is without illustrations. It is fairly well printed and of convenient size.

E. P. D.

The Practical Medicine Series of Year-Books. II. General Surgery. Edited by John B. Murphy, M.D. Chicago: The Year-Book Publishers, 1901.

The outward appearance of this book is far from prepossessing, as both binding and paper are of poor quality. One's idea, however, of its worth rapidly changes upon its perusal, as it contains an excellently arranged summary of the best surgical literature of the year. The editorial notes of Murphy, which frequently occur throughout the pages, are very fine. A few articles which might appear to some to be of value are wanting, but it is impossible in such brief space to include all articles, or even to give to the best sufficient space. It would, however, appear to us that excellent judgment had been exercised in the selection and arrangement of the articles for abstraction and comment.

This review of the surgical literature is not as extensive as that found in other publications of a similar nature, but the volume, because of its small size and light weight, will be found very convenient.

The type is remarkably clear considering the very poor paper which is used. Many of the illustrations, however, suffer from the condition of the paper on which they are reproduced.

At the end of the book is found an excellent index which renders ready reference easy.

J. H. G.

Études Anatomiques sur les Grossesses Tubaires. (Anatomical Studies in Tubal Gestation.) Par le Dr. A. Couvelaire, Ancien interne des hôpitaux; Chef de clinique obstétricale à la Faculté de Médecine de Paris. Paris: G. Steinheil, Éditeur, 1901.

This monograph gives the results obtained in the anatomical study of 35 cases of tubal gestation. The author finds that the ovum lodges in the isthmus of the Fallopian tube much less commonly than in other portions of the tube. In his 35 cases there were but 5 of this sort. In these cases the sac enlarged freely toward the abdomen, pregnancy was interrupted early by apoplexy of the ovum, accompanied by rupture into peritoneal cavity with intraperitoneal hemorrhage.

The ovum lodges far more frequently in the ampulla of the tube. In the author's 35 cases of tubal pregnancy, in 28 the ovum lodged in the ampulla. Of these 28, 8 cases were terminated by apoplexy of the ovum. This happened not by primary rupture of the sac, but simply by the formation of hematosalpinx, with or without hematocele. Primary rupture is much later in ampullar pregnancy than when the ovum is in the isthmus of the tube.

Chapter second of the volume is devoted to the anatomy of the pregnant tube aside from the sac of the embryo. In treating of the reaction which the tube shows to the presence of the embryo, the author finds that the further the pregnancy advances the more pronounced are such modifications. They are also more intense in accordance with the immediate proximity of the sac of the fœtus. These modifications embrace all the histological elements of the Fallopian tube. In studying the anatomy of the ovum in the tube itself the author finds that the chorion of a young tubal embryo is villous throughout its entire extent. Such a young embryo is inserted upon a part only of the wall of the tube. One of its extremities adheres to the Fallopian tube, while the other lies free in the cavity of the tube. The chorion of the tubal embryos not more than three months advanced shows no special development of villi. The placenta which becomes discoid is localized only as a part of the circumference of the embryo. Up to the period of three months the free extremity of the ovum does not contract adherence with the tubal wall. In general, the ovum within the tube undergoes evolution with a discoid placenta. Its relations with the cavity of the tube are identical with those seen between an intra-uterine ovum and the wall of the uterus.

In considering the attachment of the ovum to the wall of the tube the author finds that from the fourth week the border of the zone of insertion of the embryo to the tube, and finally all the tissues, show tubal epithelia. From the fourth week on the ovum in the tube is surrounded by tissue resembling exactly the decidual lining of the uterus. The spaces between the villi are separated from the wall of the tube by a layer of irregular cells whose connective tissue support resembles a network of fibrin. It is also found that large cells are present in the tissues surrounding the endothelium and in the cavities of the uterine sinuses analogous to the cells found in the external capsule of the ovum. There is practically no limit between the external capsule of the ovum and the wall of the sac. In the immediate neighborhood of the capsule external to the ovum the wall of the tube presents a dense infiltration with leukocytes, considered by some to be a reaction limited entirely to

the maternal tissues. The wall of the embryo has an extent in structure differing greatly in proportion to the stage of the pregnancy and to the region of the tube from which the specimen is taken. The extent of the sac is considerably less at the border of the attachment of the sac to the tube than upon the free pole of the tube, and this is true the further away from the point of rupture that one examines the specimen. When a section is made through the mesosalpinx the extent of the sac of the embryo seems increased by the tissues of the mesosalpinx.

The author believes that in the gravid tube from the fourth week to the third month there can be shown a limiting membrane on the side of the cavity of the tube extending to the free extremity of the ovum. This membrane is composed of an alveolar stroma containing abundant cells, with large nuclei. The placenta from the eighth to the twelfth week is developing at the border of the free pole of the ovum and also upon the wall of the tube. The wall of the tube opposite the free pole of the ovum is covered by a lining of mucous membrane. The limiting membrane of the free pole of the ovum does not seem to have the function or position of a reflexa.

In considering the question of the mechanism of the rupture of tubal pregnancy it is found that rupture most often occurs at the parietal zone of attachment of the ovum.

The text of the monograph is supplemented by fifteen clinical observations giving the history of cases forming the basis of this publication. Twenty plates are added as illustrations. The works of those who have written upon the subject are quoted, although there is no considerable bibliography.

This monograph is an interesting contribution upon an interesting and important topic. It deserves a place in the literature of the subject, and should be consulted by those who study tubal gestation. The illustrations are not especially satisfactory, as many of them are inferior in clearness. There are no colored illustrations. E. P. D.

Principles of Bacteriology: A Practical Manual for Students and Physicians. By A. C. Abbott, M.D., Professor of Hygiene in the University of Pennsylvania. New (6th) edition, revised and enlarged. In one 12mo. volume of 636 pages, with 111 illustrations, of which 26 are colored. Philadelphia and New York: Lea Brothers & Co.

Within the last few years such advances have been made along the lines of bacteriological research, and so much light has been shed upon the problems of immunity and infection by studies in this direction, that a new edition of this work comes at a most opportune moment. Designed especially for students and those wishing a general practical knowledge of the subject, the book fills a distinct want. The first chapters deal with methods of sterilization, preparation of culture media, and the technique of staining. All the descriptions are clear, and the text is sufficiently illustrated to demonstrate the application of these methods. The technique of animal inoculation is also discussed, and general directions are given for a careful study of bacteria The common bacteria pathogenic for man are described in turn, and attention is paid

to the differential diagnosis of allied micro-organisms. Among the newer features of this edition are summaries of the recent work upon epidemic cerebro-spinal meningitis and dysentery; discussions upon the subject of tuberculosis, together with the group of bacteria in some ways resembling bacillus tuberculosis, and a review of the mechanism of infection and immunity. The portion which deals with the investigation upon dysentery is of special importance, since most of the knowledge acquired upon this subject is of such recent date that descriptions of the bacillary form of dysentery have not yet found their way into general text-books. The chapter upon the subject of tuberculosis is likewise valuable. Some confusion has arisen as to the identification on morphological grounds of bacillus tuberculosis and other acid-resisting bacilli, such as the timothy bacillus, etc. The methods for differentiating these organisms are discussed, and interesting descriptions are given of the pathological lesions produced by them in animals. Reference is also made to the subject of bovine and human tuberculosis, and other additions have been made in the part allotted to the pathogenic streptothrices. Such rapid advances have been made recently in our knowledge of the theories of infection and immunity, and so much work has been done in this branch of scientific medicine, that a complete survey of the subject would, of course, be out of place in a book of this nature. Nevertheless, the history of the development of this side of medicine is well reviewed, and the fundamental conceptions upon which Ehrlich's theory is based are well but concisely given. All confusing details are omitted, and emphasis is especially laid upon the most important points. In fact, the entire work is so written that the essentials are brought out clearly, while the details are sufficiently suppressed to avoid confusion, and the book thus makes a most excellent guide for the student of the subject as well as a useful manual for more advanced workers. W. T. L.

LAMARCK, THE FOUNDER OF EVOLUTION: HIS LIFE AND WORK. With Translations of His Writings on Organic Evolution. By ALPHEUS S. PACKARD, M.D., LL.D., Professor of Zoölogy and Geology in Brown University. New York: Longmans, Green & Co., 1901.

THE life of Lamarck, although not directly devoted to the advancement of medical science, has nevertheless influenced it as the work of Darwin did by its reflex upon all scientific methods of research and modes of thought.

In the preface to this book the author states that "this life is offered with much diffidence, though the pleasure of collecting the materials and of putting them together has been very great." Every page proves the truth of the latter statement, the entire book having evidently been written *con amore*.

Lamarck was born in a little village in Picardy in 1744, and died in Paris in 1829. His long life covered a period of thrilling interest in the history of France and of wonderful progress in the natural sciences. He was intended for the clergy, but being a young man of spirit he cast aside his bands after spending four years in the Jesuit College at Amiens, and entered the French army. He was promoted for bravery, but was obliged to retire from the army shortly afterward because of

physical disability. He returned to Paris, and entered upon the study of medicine, eking out his meagre pension of 400 francs a year by working in a bank.

While pursuing his medical studies he met Rousseau, then living in the neighborhood of Paris, and from him probably received much impetus in his botanical studies. It is of interest, as the author suggests, to find Rousseau foreshadowing natural selection when he says that the weak in Sparta were eliminated in order that the stronger and superior members of the race might survive, and theorizing on the lessons to be derived therefrom in the improvement of the human race.

At the age of twenty-four Lamarck abandoned arms, medicine, and the bank, and commenced his exclusively scientific career. The *Flore Française* was the result of nine years' work, and instantly made him famous. It introduced him to the friendship of Buffon, and that all-powerful man was able to procure him government employment.

The author details the active part taken by Lamarck in having the *Jardin du Roi* changed by the National Assembly to the *Jardin des Plantes*, thereby preserving that most useful establishment from the fury of a mob bent on destroying everything associated with royalty. The organization of this museum is the same now as in 1793, and owes its chief features to Lamarck's genius.

The rest of Lamarck's life was passed in arduous labor in an official capacity in the museum. Successive chapters of the book are devoted to his work in meteorology, geology, invertebrate paleontology, botany, general physiology, and biology, in all of which his views were far in advance of most of those possessed by his contemporaries. The last ten years of his life were spent in blindness and poverty. Although his burial-place has been ascertained by diligent search, the facts revealed concerning his interment were most discreditable. His body was thrown into a trench somewhat apart from the other graves in the Cemetery of Montparnasse, from which the bones of those deposited there were removed every five years. As the author says, they are probably now in the catacombs of Paris, mingled with those of the thousands of unknown or paupers in that great ossuary.

Of course, the main interest in his life attaches to those views which are now embodied in the term "Lamarckism." He on numerous separate occasions promulgated and maintained the great influence possessed by environment in changes and alterations produced in animals, and that species were not immutable but variable. Owing to misinterpretation, to ignorance, and to lack of a proper appreciation, his views, instead of being hailed as those of a great scientific genius, were ridiculed by those who should have regarded them in a very different light. Darwin failed to realize their importance, and publicly decried them. Nevertheless, at the present time, it has become generally recognized that Darwin's theory of natural selection is not adequate solely to account for evolutionary progress, and the influence of environment is being more and more recognized as a necessary factor in conjunction with natural selection.

For one who is championing a cause the author is to be commended for the breadth of view, lack of prejudice, and judicial attitude which he maintains throughout the entire work. We trust that his labor will prove fruitful, and that the great French scientist, whose name and fame have fallen into such ill-deserved neglect, will assume his place as a recognized leader of advanced scientific thought. F. R. P.

OUTLINES OF ANATOMY: A GUIDE TO THE METHODICAL STUDY OF THE HUMAN BODY IN THE DISSECTING-ROOM. By EDMUND W. HOLMES, A.B., M.D. Second edition. Lancaster, Pa.: Press of the New Era Printing Co., 1902.

THIS little book certainly fills a want of every student in the dissecting-room, as it tells him in a simple and interesting way the direction and method which he should pursue in his study of anatomy. It is in no way meant to supplant the text-book or even the quiz compend, but rather to develop in the student a careful and methodical consideration of the subject. So systematic has the author been that the work is divided according to the days to be spent upon each part. To the beginner particularly we can commend this work as a valuable aid to the practical study of anatomy. J. H. G.

RATIONAL HYDROTHERAPY: A MANUAL OF THE PHYSIOLOGICAL AND THERAPEUTIC EFFECTS OF HYDRIATIC PROCEDURES AND THE TECHNIQUE OF THEIR APPLICATION IN THE TREATMENT OF DISEASE. By J. H. KELLOGG, M.D., Member of the British Gynecological Society, etc. With 293 illustrations, 18 in colors. Pp. 1193. Philadelphia: The F. A. Davis Company, 1901.

DR. KELLOGG'S work is an interesting contribution to the literature of hydrotherapy. The entire subject is presented in every phase that may be useful to the practitioner. The dependence of all hydrotherapeutic procedures upon physiological action is judiciously emphasized. The technique of hydrotherapy is described in detail. In the chapter on Hydriatic Prescription-making the author enlarges in a thoroughly practical manner on "procedures to increase and decrease vital resistance, oxidation, metabolism, blood movement, heat production and elimination." Under each caption full instructions with cross-references are furnished, which lead to enlargement of the volume to an unwieldy size. If the reader has the courage and perseverance to follow the numerous pages referred to in the index under each disease he will find guidance to many therapeutic resources when he has become disheartened by failure of drugs and other remedies.

A defect which the author would do well to remedy in future editions is the utter ignoring of his contemporaries in the building up of hydrotherapy in America. He implies that nothing has been done during the last fifteen years by American physicians, and that "we were much nearer the front of this line of progress half a century ago than we are at the present time." The well-informed reader will at once recognize and resent the groundlessness of this charge. Does the author expect his readers to believe that the one hundred and odd American contributors cited in his bibliography have been so barren of results? In defence of his American contemporaries the veracious reviewer would also advert to the author's deplorable unfamiliarity with the literature of his subject. No mention is made of Hiram Corson's earnest plea for cold water and ice in diphtheria and the exanthemata; of Mary Putnam

Jacobi's classical monograph on the wet-pack; of Fredrick Peterson's excellent essay on Hydrotherapy; of S. Solis Cohen's interesting papers; of Carl Seiler's convincing monograph on "The Brand Bath in Typhoid Fever;" nor of Hutchinson's novel views on the skin (peripheral) heart, which term the author uses without even mentioning the originator's name. All these and many other contributions to the advancement of hydrotherapy have appeared in our most prominent journals and have doubtless influenced its practical application enormously. The Montefiore Home for Chronic Invalids of New York and the German Hospital of Philadelphia have *for ten years* had a separate department for hydrotherapy equipped with a douche table devised by an American physician, and which has become part of the equipment of many other institutions. Peterson's essay in THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES gave an impetus to systematic hydrotherapy in asylum practice, the marvellous results of which are related in the reports of the St. Elizabeth Hospital at Washington, the Danvers Hospital for Insane, and other institutions. These and many other positive data may be cited to refute the author's unfounded reflections upon American physicians and to disapprove his contention that hydrotherapy has not been furthered by American physicians during the past fifty years. S. B.

EINFÜHRUNG IN DAS STUDIUM DER MALARIAKRANKHEITEN MIT BESONDERER BERÜCKSICHTIGEN DER TECHNIK. EIN LEITFADEN FÜR SCHIFFS- UND COLONIALARTZE. Von REINHOLD RUGE, Marine-Oberstabsarzt I. Kl., Kommandirt zum Institut für Infectionskrankheiten in Berlin. Mit 2 photographischen swie einer lithographischen Tafel, 19 Abbildungen und 27 Fiebercurven im Text. Jena: Verlag von Gustav Fischer, 1901.

ALTHOUGH small, this work is a storehouse of information. Beginning with the geographical distribution and history of the disease, it contains chapters on Epidemiology, Symptomatology, Pathogenesis, Pathological Anatomy, Diagnosis, Prognosis, and Treatment. The history of the malarial fevers is divided into three periods, the first extending from the time of Hippocrates to the year 1640, when the Countess Cinchon, the wife of the Viceroy of Peru, was cured by the use of cinchona bark, and brought the remedy back with her to Europe. The second period comprises the time between 1640 and 1880, when Laveran discovered the malarial parasite. The third period includes the discoveries that have been made since 1880, namely, the observations upon the development of the parasite in human blood by Golge (1885); the conveyance of the parasite to man by the mosquito (Ross, 1898); the work of R. Koch and many others. In this connection it is worthy of note that the ancient Romans were well aware of the more obstinate character of the quartan type of fever as compared with the tertian, and its greater tendency to recurrence—a fact exemplified by the malediction "quartana te teneat!"—"may the quartan fever seize thee!"

Our author does not believe in the independent existence of quotidian fever, for the excellent reason that the only malarial organisms thus far

discovered are those of tertian, quartan, and tropical or, as we call it, æstivo-autumnal fever. A quotidian fever must, therefore, either be a double tertian—*i. e.*, a fever caused by two generations of tertian parasites in the blood—or a triple quartan—*i. e.*, a fever caused by three generations of quartan parasites, in both cases the separate generations sporulating at intervals of twenty-four hours.

The section on treatment, and especially that portion of it relating to prophylaxis, which has acquired a new significance since the mosquito has been proved to be the *fons et origo mali*, is not inferior to the other portions of the work. This is equivalent to saying that it is concise and complete. Quinine is the remedy *par excellence*, with one exception, namely, in cases of "blackwater fever." When hæmoglobin appears in the urine, or when there is a history of hæmoglobinuria in previous attacks, methylene blue, the only remedy, besides quinine, which has a direct effect upon the malarial parasite, should be employed.

The only criticism we have to make of this excellent treatise is the absence of reference to the American savants who have contributed so extensively to the literature of malaria, and whose names should be, in Europe as they are here, "familiar as household words." This is in marked contrast to our custom, which is rather to exaggerate the importance of the work of foreigners and belittle that of our own countrymen. In this attribute, which partakes of false modesty rather than of generosity, we resemble the Italians, who, because of it, have just received a well-merited rebuke from Cesare Lombroso.[1] F. P. H.

STUDIES IN PHYSIOLOGICAL CHEMISTRY. Edited by R. H. CHITTENDEN, Ph.D. Sheffield Scientific School, Yale University, 1901.

THAT ancient and revered institution known as Yale University has just celebrated its bi-centennial. As a part of the celebration of this anniversary the University has published a series of volumes by a member of the professors and instructors of the faculty that serves as an indication of the extent and character of the work done and the progress that is being made, and of the wonderful growth of the University.

The volume before us is a thick 8vo. of 424 pages, giving reprints of some of the work recently done in the University under the able direction of Dr. Chittenden, Director of the Sheffield Scientific School, and his collaborators. It is prefaced by a bibliography of work done in the field of physiological chemistry at Yale since the establishment of the Sheffield School, in 1875, up to the present time, a list embracing 104 titles of papers published both in this country and in Germany.

The book contains reprints of twenty four previously published articles, and is the work of Drs. Chittenden, Mendel, McDermott, Van Name, Giess, Jackson, Richards, Henderson, Brown (E. B.), and Alice H. Albro, many of the papers being done in conjunction.

[1] "The Anti-Italianism of the Italians," Living Age, July 13, 1901.

The papers contained in the book are mainly technical, but there are some that will be of interest and value to the general practitioner.

Dr. Lafayette B. Mendel contributes an article on "The Chemical Composition and Nutritive Value of Some Edible American Fungi." The article contains a mass of detailed work, including many analyses and a number of artificial digestion experiments. Fungi contain from 75 to 90 per cent. (and sometimes even more) of water, and, as the greater part of the solid matter is carbohydrate, we can hardly speak of them as "Vegetable Beefsteak," as some enthusiasts term them. The total amount of proteid in them, as figured by modern and more correct methods, is strikingly small, not above 5 per cent. figured as "nitrogen" and on the dried substance. The carbohydrate is relatively high, but very little is known as regards the nature and digestibility of this constituent. The author sums up his work by saying: "The fungi thus form no exception to the ordinary classes of fresh vegetable foods; indeed, they take a decidedly inferior rank in comparison with many. . . . As dietetic accessories the edible fungi may play an important part; but investigation has demonstrated that they cannot be ranked with the essential foods."

Dr. Ernest W. Brown has a short but interesting contribution on "Cetraria Icelandica" (Iceland moss). He gives an analysis of the dried substance. The principal constituent is "lichinin," and from his experiments on living animals he finds it an excellent food and easily assimilated. The amount of the proteid material is extremely small, and the main bulk of the material (exclusive of the water present) is made up of the soluble carbohydrate, the so-called "lichin-starch."

An extremely valuable paper, and, perhaps, the most important in the volume, is one entitled, "A Further Study of the Influence of Alcohol and Alcoholic Drinks on Digestion, with Special Reference to Secretion." This is contributed by Dr. Chittenden in conjunction with Drs. Mendel and Jackson. The article, however, is too lengthy and too technical to admit of abstraction here. E. A. C.

Formulaire Aide-Memoire de la Faculte de Medecine. By Dr. Fernand Roux. Paris, 1902.

Dr. Fernand Roux has prepared a very valuable little book for the use, apparently, of hospital residents, who form, as is well known, a distinguished class in Paris. It consists of an alphabetical list of most of the known diseases and diseased conditions, with a synopsis under each of the treatment according to various authorities, including numerous formulæ. Naturally, as it is merely a collection of citations, there is nothing original, and, therefore, nothing to criticise except the method. This seems to be very good. The descriptions are very clear, and the formulæ sufficiently diversified. As an appendix there are some suggestions regarding the writing of prescriptions, and a brief note on some of the newer remedies. The latter does not seem to be as complete as one could wish. The book is compact in spite of its 538 pages, is substantially bound, and very clearly printed. J. S.

PROGRESS

OF

MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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On the Surgical Treatment of Ascites.—The purely medical treatment of ascites is, on the whole, so unsatisfactory that it is well for physicians to be familiar with the results of surgical procedures up to date.

MONTGOMERY (*Medical Chronicle*, April, 1902, p. 15) gives a brief historical sketch of the steps which led up to the adoption of surgical measures for the treatment of ascites. Hale White, in 1893, showed that the average duration of life of cirrhosis patients, from the necessary first tapping until death occurred, was sixty-three days; while in cases which were not subjected to paracentesis the average length of life from the beginning of enlargement of the abdomen until death was sixty days. In other words, paracentesis had practically no effect in prolonging life. He believed that when ascites is survived for a much longer time it is due to a coexistent chronic peritonitis and perihepatitis, with the consequent establishment of a collateral circulation between the portal and systemic circulation.

Talma, of Utrecht, was the first to suggest that such an artificial anastomosis be brought about by operation. Following this suggestion the first operation was performed by Van der Meule in 1889, the patient dying of shock. The third case was operated on by Lens in 1892. This is the first reported case. The patient recovered from the operation, but his symptoms were not relieved.

Drummond and Morrison appear to have independently conceived the same idea as Talma. In 1894 and 1895 Morrison operated on the first two cases in England. The first case was not benefited, and died nineteen months later. The ascites in the second case entirely disappeared, but the patient died two years later from a hernia operation. At autopsy it was shown that extensive omental adhesions had resulted from the operation.

The operations for the relief of ascites all have for their object the establishment of a collateral circulation between the portal and general venous systems. This is produced through the establishment of peritoneal adhesions. To effect this result the omentum is generally utilized in one or other of the following ways: (1) It may be sutured to the parietal peritoneum alone. (2) It may be fixed under the skin of the abdominal wall. (3) It may be sutured between the liver and diaphragm. The parietal peritoneum may be separated from the muscles around the abdominal incision and the omentum grafted into the prepared space. At the time of the operation it is customary to scrub the surface of the liver, diaphragm, and spleen to promote their subsequent adhesion.

Montgomery reports two cases on which he himself has operated. In one case the ascites apparently was cured, as it had entirely disappeared six months after operation. The other case was only slightly relieved.

Since the analysis by Packard and Le Conte of 22 cases collected from the literature, Montgomery has found records of 16 others, including his own, making a total of 38 cases. The result in these cases was as follows: 10 deaths, or 26.3 per cent.; 9 unimproved, or 23.6 per cent.; 4 improved, or 10.5 per cent.; 15 recovered, or 39.4 per cent.

On Adrenalin Glycosuria and Other Forms of Glycosuria Due to the Action of Reducing Substances and Other Poisons on the Cells of the Pancreas.—Some months ago the experiments of F. Blum on adrenal diabetes were noted in this department. Blum found that the subcutaneous injection of an aqueous extract of adrenal glands produced glycosuria in twenty-two out of twenty-five animals experimented upon. Recently Herter (*American Medicine*, May 10, 1902, p. 771) has carried out some instructive experiments showing the effect that adrenalin chloride and solutions of other reducing substances have when painted over the surface of the pancreas.

Commercial aqueous solution of adrenalin chloride 1 : 1000 was used in the research. Herter first showed that the subcutaneous, intravenous, and intraperitoneal injections of adrenalin chloride into dogs were almost invariably followed by glycosuria. Peritoneal injection, other conditions being equal, produced the most marked glycosuria, 10 per cent. or more of sugar not being uncommon. The glycosuria lasts usually somewhat less than twenty-four hours. It was important to find whether the more marked results following intraperitoneal injection of adrenalin chloride were due to the opportunity for more direct action of this substance on the pancreatic gland. Accordingly the pancreas was exposed in a number of normal dogs and adrenalin applied directly to the presenting surface by means of a brush. It was demonstrated that marked glycosuria follows the application of small quantities of adrenalin to the pancreas, quantities which, when applied locally to other parts of the body, either give rise to no excretion of sugar or to a trivial glycosuria.

The next problem was to determine how the local application of adrenalin to the pancreas produced glycosuria. It was first shown by experiment that it was not due to vascular disturbance. Adrenalin chloride is known to be a very powerful reducing substance, and it was decided to ascertain the effect that other reducing substances had when applied directly to the pan-

creas. The thought suggested itself that the use of such reducing substances might interfere with oxidation within the pancreatic cells. Local applications of potassium cyanide were first tried and constantly produced a glycosuria. Similar results were obtained with sulphurous acid, ammonium sulphide, sulphuretted hydrogen, illuminating gas, carbon monoxide and several other reducing substances. A number of similar experiments were carried out with substances which do not reduce, such as sodium chloride, sodium hydroxide, ferric chloride, hydrochloric acid, bromine water, etc., without the production of glycosuria in any instance.

Herter concludes from these experiments that there is a close relationship between the reducing power of a substance and the capacity of this substance to induce glycosuria when applied directly to the pancreas. He believes that the amount of oxygen which these substances remove from the cells of the pancreas is sufficient to cause a disturbance of the function of the gland.

Histological examination of the gland tissue at the height of the glycosuria fails to show any recognizable lesion. Herter does not believe that the glycosuria is due to disturbance of the function of the islands of Langerhans.

It is pointed out that these experiments are of clinical importance, in that they probably throw considerable light on several varieties of human glycosuria and diabetic cases. Herter suggests that the glycosurias following conditions of asphyxia, as after epileptiform seizures, may be due to interference with oxidations in the pancreas. So also with the glycosuria following carbon monoxide poisoning.

Contribution to the Study of the Myospasms: Myokymia, Myoclonus Multiplex, Myotonia Acquisita, Intention Spasm.—Walton (*Journal of Nervous and Mental Disease*, July, 1902, p. 402) draws attention to the fact that there is much confusion in certain text-books, and often on the part of writers, in the classification of the various anomalies of the neuromuscular mechanism which gives rise to involuntary spasmodic movements. The writer endeavors by means of the reports of illustrative cases to clear up certain misconceptions which have led to error in the classification of these interesting cases. His conclusions are as follows:

(1) The term *myoclonia*, as a collective designation for the unrelated disorders, should be discontinued.

(2) The term *myokymia* should be limited to cases showing, without hereditary or congenital history, widespread muscular quivering, without atrophy or other indication of progressive degeneration of the nervous system, without constitutional symptoms, and without sign of present infectious or other acute disease. Cases should not be excluded, however, on account of preceding or introductory symptoms pointing to disease of the lower neurons, if such disease has either disappeared or come to a standstill.

(3) The term *myoclonus fibrillaris multiplex* should not be applied to such cases, since it suggests a relationship between myokymia and the paramyoclonus multiplex of Friedreich, with which it has nothing in common.

(4) *Myoclonus multiplex* (the prefix para seems superfluous) should be used to designate bilateral clonic spasms involving whole muscles or groups of muscles, generally those attached partly or entirely to the trunk.

(5) The term *myotonia acquisita* should be limited to non-heredity and non-congenital cases, in which otherwise healthy individuals present the typical motor disorder or the typical reactions of Thomsen's disease. This term should not include the rigidity accompanying marked intestinal disorder or pronounced psychopathic states, even though the rigidity in the latter conditions may be increased by involuntary movement.

(6) The tendency to spasm on attempted voluntary movement, unless accompanied by the typical motor disorder or the typical reactions of Thomsen's disease, should be classed as *intention spasm*.

(7) The term *myospasm*, clonic or tonic, may be used instead of myoclonia and myotonia when it is desirable to include under one head the various forms of involuntary muscular contraction without known organic basis.

Concerning the Benzoyl Esters of the Urine in Diabetes Mellitus, and the Clinical Significance of an Excess of Glycuronic Acid.—EDSALL (*University of Pennsylvania Medical Bulletin*, April, 1902, p. 34) points out that Mayer has shown that glycuronic acid is a normal constituent of the urine, and that it can be easily recognized by the orcin test, if the glycuronic acid compounds be previously split up by heating with dilute sulphuric acid. Mayer believes that glycuronic acid is one of the steps in the normal oxidation of sugar, and, owing to the close chemical relation between glycuronic acid and glucose and the frequency with which he found glycuronic acid in cases where there was suboxidation, he believes that he has demonstrated definitely that diabetes is due to suboxidation. The clinical importance of the presence of glycuronic acid in the urine is that it is probably more frequently mistaken for glucose than any other carbohydrate. Glucose and glycuronic acid are then both found normally in the urine, and under certain conditions both are increased. According to Mayer, it would appear that glycuronic acid had much the same significance that glucose has.

Rosin and v. Alfthan demonstrated that the benzoyl esters are increased in diabetes mellitus. Mayer believed that this increase was due to an increase of the glycuronic acid, and not to an increase of the unfermentable carbohydrates, as Rosin and v. Alfthan believed. Edsall agrees with the latter view, and found in three cases of diabetes in which glycuronic acid was absent that the benzoyl esters amounted respectively to 12.56, 13.43, and 13.88 grammes. The normal is less than 5 and not more than 2 or 3 grammes.

The importance of an increased elimination of glycuronic acid and of the benzoyl esters in diabetes mellitus is, considering that both belong to the carbohydrate group, that it demonstrates that the metabolic disturbance in diabetes does not involve the dextrose alone, but that there is in this disease an actual disturbance of the whole carbohydrate metabolism. Edsall has shown that the source of the benzoyl esters is chiefly the proteid elements of the food, and that the amount varies directly with the variations of the diet.

Eosinophilia Associated with Hydatid Disease.—SELIGMANN and DUDGEON (*Lancet*, June 21, 1902, p. 1764) report an instance of marked eosinophilia in association with hydatid disease of the liver in a young woman, twenty-two years of age. The disease was probably contracted as a result of fondling a pet dog which constantly licked her hands.

The first symptoms of the disease began in December, 1900, with pain in the right side. In December, 1901, she was admitted to St. Thomas' Hospital with marked enlargement of the right lobe of the liver and a friction rub in the right axillary region, which led Dr. Hector Mackenzie to suspect hydatid disease. On December 27th the blood examination gave the following results: Red cells, 6,290,625; leucocytes, 17,000; hæmoglobin, 70 per cent. A differential count of 500 leucocytes was as follows: Polymorphonuclear neutrophiles, 22 per cent.; eosinophiles, 57 per cent.; lymphocytes, 20 per cent., and basophiles, 1 per cent.

On January 10, 1902, the patient was operated on, ten ounces of clear fluid containing hooklets being removed. After the operation the percentage of eosinophiles gradually returned to normal.

The writers state that the percentage of eosinophiles in this case is only exceeded by Brown's 68 per cent. of eosinophiles in a case of trichinosis. It is approached by Billings' findings of 53.6, 38.2, and 33.9 per cent. respectively in three cases of bronchial asthma.

SURGERY.

UNDER THE CHARGE OF

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The Treatment of a Case of Scirrhus Recurrent Five Years in a Patient Aged Ninety-three Years; Improvement.—Peters (*British Medical Journal*, March 1, 1902) reports the case of a woman, aged ninety-three years, who had a recurrent slow-growing spheroidal-celled carcinoma. The original growth had been removed thirteen years ago, but eight years later recurrence took place, and at the date of the commencement of the Röntgen treatment the growth, which was adherent to a rib, measured 3 by 2¾ inches. It had a well-raised margin, covered by thin, red epidermis, while the centre was an irregular ulcer. There was also some ulceration of the raised margin, with large tender glands at the edge of the lesser pectoral muscle. The exposures were made two or three times a week for from ten to twenty minutes. The distance of the tube from the skin varied from two to four inches. Unfortunately the patient died from pneumonia after ten exposures had been given. Improvement was noticeable at the end of a week's treatment, and on examination after the last treatment it was found that the character of the growth had completely changed. It then measured 1 by ¾ inches, the margin was only slightly raised, and the central ulcer had markedly decreased in size.

Suture of Heart Wounds.—(The Oration on Surgery at the 1902 Meeting of the American Medical Association.) SHERMAN (*Journal of the American Medical Association*, June 14, 1902) states that thirty-four operations have been recorded in the six years which have elapsed since the date of the first operation.

As regards the manner of wounding, all these cases, except two, were due to punctured or incised wounds, the two exceptions being bullet wounds. The particular injury to the heart was inflicted on the ventricles thirty-two times, the left ventricle being implicated seventeen times and the right thirteen times. In two cases only were auricles opened, once the right and once the left, and there are three cases in which my information is incomplete. In most of the cases where details are given the pleura is reported wounded, and usually there was a hæmothorax, the collection representing, in large part, the overflow from the pericardium.

The practical questions which usually come to the mind of a surgeon in planning an operation to meet these conditions relate to the method of exposure of the heart, the detail of the treatment of its particular condition, and the method of closing and dressing the wound of the operation.

In the cases reported the heart was reached variously, depending on the location of the original wound in the skin and the choice of the operator, but either a flap or all of the tissues of the thoracic wall was turned up, or a resection of two or more ribs was practised. The particular detail is of no great moment, provided that the heart is properly exposed. The special method of treating the heart wound is of interest, for it involves the choice of suture material for a novel situation, the time at which the suture is introduced and tied with reference to the heart-beat, and the depth of the stitch in the heart muscle. In our cases three operators are recorded as having used catgut, Fontan, of Paris, Marion, and Launay; in all other instances where the suture material was specified silk was used, and in most cases the sutures were interrupted, though in a small number a continuous suture was practised. It is of interest to note that these operators particularly avoided including the endocardium in the suture. One of them definitely reports introducing and tying the suture during diastole.

As regards the closure of the wounds—the tissues involved in the flaps or incisions were, of course, replaced; in seven instances drainage of the pericardium and pleura was practised, and in four the pleura alone was drained. The other cases are said plainly to have been closed without drainage, or nothing is said of the matter at all.

Now, of the total number of these cases, five died on the operating-table of hemorrhage, and ten died very soon afterward of the effects of hemorrhage or the shock of the operation; so that nearly half of the cases that survived the injury long enough to be subjected to operation died during or very shortly after that operation. The other group, nineteen in number, had various results, but thirteen of them recovered, and only six died. I think it is fair to stop a moment and consider these facts. Surely, the fifteen who died of hemorrhage or shock with operation would probably have died of hemorrhage exactly the same without operation. No fatal traumatism is inflicted by exposing the heart; and stopping the hemorrhage from an incised or punctured wound in the ventricles is a simple matter when the heart

is once exposed; indeed, pressure with the finger or a tampon will stop it temporarily. At all events, the operation and suture did not add materially to the amount of blood lost, and so cannot be counted as having hastened the death from hemorrhage, and the average amount of shock I cannot estimate. But I believe that it is fair to say that these patients had, from the first, practically no chance to recover, and that, if this had been known, the operations need not have been done; but I say this with full appreciation of the fact that the inevitable fatality could not have been definitely predicated in any case. Of the other nineteen, the comment is, plainly, that they had a chance to recover. In each of them the suture of the heart was a successful procedure; in not one instance was the fatal outcome due to a secondary hemorrhage. The six who died succumbed to the common matter of an infection sequent to wound and operation. Of the thirteen who recovered four did so in spite of a concurrent infection. But the point is that of these thirty-four cases, fifteen had really but very slight expectation of benefit from the operation, and died probably neither in spite of it nor because of it—nineteen had expectation of recovery from operation, and in thirteen that expectation was realized.

Analysis of Ninety-six Operations for the Relief of Tuberculosis of the Testicle.—Horwitz (*Journal of the American Medical Association*, June 21, 1902), after a detailed review of this interesting condition, states in conclusion:

1. A primary tubercular infection of either the epididymis or testicle may occur, the former being by far the more common.

2. A primary infection of the epididymis, secondarily that of the testicle, is more common than the descending one.

3. Primary involvement of either the epididymis or testicle usually takes place through the circulation, the soil being predisposed to the location of the tubercle bacillus either by a slight traumatism or by some infective condition which has given rise to inflammation of the organ, most commonly an attack of gonorrhœa.

4. Secondary tubercular involvement of the epididymis or testicle sometimes follows a primary focus of the disease in other portions of the body, more commonly in those organs that are in direct anatomical connection with the sexual glands, such as the seminal vesicles, prostate, urethra, bladder, ureter, or kidney.

5. The invasion of the testicle may be rapid, associated with acute inflammatory symptoms, an abscess soon developing; or the onset may be slow, the symptoms simulating those of either chronic syphilitic orchitis, or malignant disease of the organ.

6. The tuberculin test should always be employed in doubtful cases where only one focus of the disease is known to exist.

7. In doubtful cases associated with hydrocele, the fluid should be examined for the tubercle bacilli and inoculating experiments made.

8. The injections of either emulsions of iodoform or of sulphate of zinc into the diseased part are not to be recommended.

9. In all cases of encapsulated caseous nodules quiescent in the epididymis, epididymectomy should be performed.

10. Epididymectomy, together with resection of the vas deferens, is not attended by either atrophy of the testicle or sexual weakness.

11. The drainage of tubercular abscesses followed by the use of the curette is only to be employed where radical treatment is not permissible, as it is attended with more or less danger, and is generally unsatisfactory in its results.

12. In instances where the epididymis alone is involved, a resection of the diseased structure is all that is required; whether a partial or complete resection of the vas deferens is to be undertaken is still undetermined.

13. Double orchidectomy should be performed when both glands are diseased, provided there is not extensive co-existing tubercular infection of other organs.

14. Whether infected seminal vesicles should always be removed at the time that the epididymis or testicle is resected is a question open for discussion. From the fact that in a large majority of cases the removal of the primary seat of the disease is followed by a subsidence of the tubercular involvement of the vesicles, it is deemed wiser, as a rule, to wait and remove the vesicles later, if necessary.

15. Hygienic and climatic influences play as important parts after operations in fortifying the constitution against further invasion as they do in other tubercular conditions.

16. The anti-tubercular remedies are of great value in controlling the disease, and should always be employed in conjunction with whatever surgical procedure may be deemed necessary.

External Œsophagotomy for Cicatricial Strictures of the Œsophagus.—Lambotte (*Journ. de Chir. et Annales de la Soc. Belge de Chir.*, March–April, 1902) states that the treatment of these strictures is full of difficulty, and that complete recovery, when possible, can only be obtained by prolonged treatment. The situation of the thoracic œsophagus, which is the usual site of these strictures, makes their approach a matter of danger and difficulty. The resection of the stenosed portion has been proven impracticable by actual experience. The method of treatment by internal œsophagotomy presents such dangers as to preclude its use. Dilatation is in some cases the only resource at the surgeon's disposal, but the improvement under this method is usually slow, and much time of necessity must elapse before a definite result is obtained, and even then it is necessary to pass a sound at intervals in order to prevent further contractions. External œsophagotomy has proven in the author's hands to be the best method of treatment of this obstinate and distressing affection, and, in conclusion, he reports two successful cases with the technique in detail.

Muscular Contraction in the Secondary Stage of Syphilis—Begot (*Gaz. Hebdomadaire de Med. et de Chir.*, June 5, 1902) states that the muscular contraction occurring during the secondary stage of syphilis usually affects the biceps muscle. They are sudden in onset, and are characterized by an inability to fully extend or flex the affected arm. The course of the lesion is variable; it may last several days or several months. It is not the result of any local lesion in the muscle, but is purely a nervous phenomenon. The best treatment consists in injections into the affected muscle of distilled water.

THERAPEUTICS.

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A Substitute for Iodoform.—DR. A. FROMMER has employed bone charcoal in a series of cases including bone and joint tuberculosis and suppurating lymph nodes, as it has been asserted that the specific action of iodoform on tuberculous tissue was not peculiar to that drug, but that like properties were possessed by other substances, among them bone charcoal. A 10 per cent. sterilized glycerin emulsion was injected. The results obtained afforded no encouragement. The injection in pure bone and joint cases was always followed by a painful swelling, with rise of temperature, which lasted several weeks and sometimes resulted in acute abscess formation. The only evidence of value was found in the after-treatment of atypical resected joints and of excised lymph nodes, but even here the granulations formed were pale and flabby. Another objection is the subsequent pigmentation of the skin. The author concludes that there is nothing to warrant the substitution of bone charcoal for iodoform. The toxic effects of the latter, he claims, are due to use of an emulsion which has not been sterilized or else exposed to the action of sunlight. In 1000 parenchymatous injections only a slight infection of the needle track had been noted in a few cases. The presence of free iodine in the urine for two or three weeks the author cites as proof that the iodoform is broken up and distributed through the system, thus having a general as well as a local effect. This fact can also be taken as grounds against the substitution of iodoform by a chemically indifferent substance, such as charcoal.—*Deutsche medicinische Wochenschrift*, 1902, No. 12, p. 203.

Pharmacology of Iron.—DR. J. AULDE believes that attention to certain combinations of iron with other drugs will much enhance its value as a tonic. The indiscriminate use of iron as a tonic without attention to the particular indication results in many unsatisfactory effects which are charged to the account of iron. As a hematinic it must be recognized as a superior remedy, but it must be given in small doses, so that the degree of irritation shall not exceed that of gentle stimulation. When impaired nutrition is the dominant factor, it may be used in nearly all cases. The addition of nuclein from animal sources is recommended in acute as well as in chronic cases of dyscrasia, thus favoring cell activity. This is especially valuable in cases of catarrh of the mucous membrane, and stress is also laid upon the use of the arsenate in these cases on account of the influence which arsenic has upon

systemic metabolism. Attention is called to the exceptional value of iron in combination with zinc as a protoplasmic stimulant.—*St. Louis Courier of Medicine*, 1902, vol. xxvi. p. 224.

Poisoning from the Application of Carbolic Acid to the Unbroken Skin.— Dr. J. W. Wainwright reports the case of a patient who had previously used a 2 per cent. carbolic acid solution for pruritus, and who changed the strength of the solution to 4 per cent. to get a more satisfactory anæsthetic effect. After a bath at midnight the solution was freely applied over the abdomen, pubes, thighs, and lumbar region. Seven hours later intense pain was felt, apparently in the bladder. There were frequent chills, profuse cold perspiration, vertigo, vomiting, and a desire to evacuate the bowels. The eyes were prominent and fixed. Vertigo increased, with an appreciable paralysis of the lower extremities and complete cessation of the functions of the stomach, bowels, and kidneys, no urine being excreted for eighteen hours. Four hours after the beginning of the attack the patient became drowsy and was awakened from time to time by recurrent lancinating pains. Enemata of hot water were retained. The urinary secretion gradually returned after a hot bath and compresses. Examination of the urine showed it to be smoky and to contain carbolic acid and abundant albumin. The appearance of the urine led to the discovery that the patient had used a carbolic acid solution as described. There was great depression for three days, with evidences of highly inflamed kidneys. In ten days the patient was entirely well. The carbolic acid was evidently absorbed more readily because of the ideal conditions following the hot bath.—*Boston Medical and Surgical Journal*, 1902, vol. cxlvi. p. 361.

Narcotics in India.—Dr. Kailas Chunder Bose reports a series of such cases, most of which had a fatal termination. The sensitive, high-strung Hindu, far more excitable than Europeans psychically, naturally falls an easy prey to the various narcotics. Cannabis indica, as is well known, produces in the marvellously refined nervous economy of the Indian ecstatic dreams of a type which cannot be awakened in the clumsy mechanism of the Occidental. Cocaine, which has but recently been introduced in India, has taken very largely the place of the less harmful gapja or alcohol or bhang. Unlike these, it requires but a simple preparation. It is generally taken in the form of powder sprinkled on a paste of slaked lime, which is buttered on a betel leaf. The mass is rolled up and chewed for about fifteen minutes. The first symptom of the so-called hilarity is a heaviness of the head. Then quickly follow a wild throbbing of the arteries of the neck and palpitation of the heart. The pulse never exceeds 110. The inebriate wishes to be left alone; he will not speak lest saliva escape from the mouth. The ears become hot, the cheeks pale, the nose pinched and cold. The height of intoxication is marked by coldness of the finger-tips and dilatation of the pupils. This stage lasts from thirty to forty-five minutes, when the victim longs for a fresh dose. The teeth and tongue of old habitues turn absolutely black. The craving for an increased dose is pronounced. In one case it was so marked as to cause a jump from one to twenty grains in a month. The worst sequelæ are very obstinate forms of

diarrhœa and dyspepsia. Of the mental derangements, hallucinations, and delusions causing dejection and fear are common. A more miserable object than a confirmed Hindu cocaine-eater cannot be pictured. The drug is altogether more disastrous in its effects than is opium or any other narcotic used in India. To quote the words of a victim, "To eat cocaine is to court misery." It has none of the joys of opium, and is infinitely more destructive.—*British Medical Journal*, 1902, No. 2156, p. 1020.

A New Arsenic Preparation (Atoxyl); its Use in Skin Diseases.—Dr. W. Schild has been studying this drug before attempting its use in practice. Atoxyl is a white, odorless powder containing about 37 per cent. of arsenic and soluble in five parts of warm water. In its effect upon animals the toxicity was found to be only one-fortieth that of the quantity of arsenic which it contains. Hence it affords, according to the investigator, a means of introducing into the system a larger quantity of arsenic than can be introduced safely by other means. Small doses by mouth readily produce gastric disturbance. Hence the author decided to administer the drug only by hypodermic injection. Beginning with two-thirds of a drop of a 20 per cent. solution, the dose is gradually increased until it reaches five times this quantity, at which point it remains during the remainder of the period of treatment. Temporary discontinuance of treatment is occasionally necessitated by the appearance of chills, dizziness, and headache. Favorable results were obtained in cases of psoriasis, lichen ruber, and other chronic dermatoses. While atoxyl will not effect a complete cure of psoriasis unaided by external treatment, neither will other forms of arsenic. It, however, materially aids and quickens the action of external treatment. In fourteen cases of lichen ruber treated exclusively by atoxyl injections complete cures were obtained without a single exception. The average duration of the period of treatment in these cases was fifty days.—*Berliner klinische Wochenschrift*, 1902, No. 13, p. 495.

Influence of Alcohol on Metabolism in Fever.—Dr. A. Ott has found by careful analysis, as have others, that alcohol in fever prevents proteid dissolution to about the same degree as an isodynamic quantity of carbohydrates. The conclusions to be drawn are that, though alcohol should not be thus employed as food, no contraindications exist as to its use in fever in moderation, and especially in the chronic fevers of pulmonary diseases its general stimulation is but desirable.—*Archiv für experimentelle Pathologie und Pharmakologie*, 1902, vol. xlvii. p. 267.

Blood Poisons.—Dr. A. Keil has studied one of the phases of this subject. The various drugs which have a deleterious effect upon the blood may be conveniently divided into six classes. The first comprises the agglutinins, which act by changing the physical conditions of the red blood cells so that they adhere to each other and thus occlude the vessels; ricin and abrin are the two best-known examples. Hæmolysins form the second group; these dissolve out the hæmoglobin which deposits in the liver and kidneys, while the stromata of the cells form multiple capillary emboli; arsenuretted hydrogen, phallin, helvellic and quillajic acids, senegin, sapotoxin, and

solanin belong to this group. Potassium chlorate, pyrogallic acid, and chrysarobin constitute the third class, which is characterized by the formation of methemoglobin. Hydrocyanic acid and carbon monoxide belong to the fourth, in which special hæmoglobin compounds are formed. Fifteen metals are capable of entering into union with hæmoglobin, thus giving rise to the fifth group, while the sixth is made up of substances such as phenylhydrazin and aniline, which are capable of producing partial necrosis of the erythrocytes. The author has studied the effects of the metals on the blood as revealed by the microscope. Granular degeneration of the red cells was present to a marked degree in all animals, and in those with nucleated red cells it could be seen that the process was really a disintegration of the nucleus within the cell or after extrusion. In mammals, however, normoblasts seemed to play no part in the process. It is probable that the granules represent metallic hæmoglobin compounds.—*Archives International de Pharmacodynamique et de Thérapie*, 1902, vol. x. p. 121.

Poisoning by Mussels.—Dr. J. Thesen has been studying one of the phases of this subject. The symptoms following the ingestion of poisonous mollusks may assume one of three types, viz.: (1) The erythematous and least dangerous form, a rapidly developing exanthem of a very transient nature appears, and with it there is general malaise and headache. (2) The symptoms may be chiefly intestinal, and there may appear a more or less severe gastro-enteritis shortly after partaking of the mussel, or this comes on after a period of incubation and is accompanied by fever. (3) The most severe or paralytic type, characterized by acute, peripheral paralysis and resembling curare poisoning. The author has studied this last form. In the cases observed by him either death set in so rapidly through paralysis of respiration that no real dyspnœa was present or else the symptoms were very transitory. All the muscles of the body may be involved without any definite order, and psychical excitement and muscular ataxia may be pronounced. The mode of death, with intact consciousness, is also peculiar. Nausea, with vomiting, generally occurs, but the latter symptom is not forcible or characteristic. Constipation generally exists. With so rapid a course all therapy is worthless, but if seen in time the stomach must be washed out, the patient ordered to be as quiet as possible, and heart and respiration stimulated in the usual way, if flagging. Those patients who come to autopsy have shown some swelling of the spleen and lymph nodes of the intestines with slight gastro-enteric irritation.

To study the toxicity of the mussels they were removed from their shells, placed in cold 96 per cent. alcohol for twenty-four hours, dried on a water-bath comminuted by triturating with sand, and then extracted by boiling with alcohol, acidified with hydrochloric acid. The alcoholic solution was then evaporated and the residue dissolved in water, and this extract employed for subcutaneous injections into animals. Great variations were found in the degree of toxicity, for while the extract prepared from mussels from a neighborhood where fatal accidents had occurred killed mice, rats, and rabbits in a few minutes, those from other places, especially if collected later in the year, were much less poisonous, and even in some instances harmless. Where death occurred the symptoms were in general the same, the trunk

and the extremities quickly became paralytic, respirations were labored, and immediately before death clonic convulsions set in. If the doses were smaller the animals appeared normal for the first few minutes; soon, however, a peculiar motor unrest was evident; then the gait became unsteady, the animal fell, and the entire body lost tone. The extremities could still be moved volitionally, but with pronounced ataxia. There never was diarrhœa. In cats the pupils may become dilated, and the heart generally continues beating after the dyspnœa has led to respiratory paralysis. Examination of the different organs of the mussels showed that the poison is distributed over their entire body, but that the liver contains most of it. In a few cases the water in which the animals lived also proved toxic to mice. The chief factor which renders the mussels poisonous seems to be contamination of the sea in which they live. Either the impurities render the molluscus sick, or such impurities are stored up in them and are themselves the toxic agents. Sections made of the animals, however, failed to reveal any pathological changes in their organs, and the second supposition seems more probable, since the author found that the mussels would readily take up curare, strychnine, and the poisonous extract if added to their water without themselves becoming sick. It thus seems that they have a definite function in the stagnating water of harbors, and that by rendering harmful substances innocuous they purify it. The poison is readilysoluble in water and alcohol, decomposes with alkalies and by bacterial action, but it could not be isolated in pure form.—*Archiv für experimentelle Pathologie und Pharmakologie*, 1902, vol. xlvii., Nos. 5 and 6, p. 311.

GYNECOLOGY.

UNDER THE CHARGE OF

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Cancer of the Uterus.—Krömer (*Centralblatt für Gynäkologie*, No. 21, 1902) reports 102 cases of vaginal and 10 of abdominal hysterectomy, with a primary mortality in the former of 3.9 per cent., in the latter of 30 per cent.; 35 per cent. of the cases of cancer of the uterus examined by him were suitable for operation. The proportion of cures in the vaginal cases was 12.8 per cent.; after the abdominal four out of seven who survived were still free from recurrence. The writer rejects the latter method on account of the higher mortality and the impossibility of removing all the lymph nodes and vessels, as in the radical operation for cancer of the breast. So long as the difficulty of diagnosing infection of the glands exists, and the remote results are still uncertain, he will continue to perform radical vaginal extirpation.

Fibromata of the Ovary.—Rovtier (*La Gynécologie*, No. 6, 1901) reports six cases in his own practice, in all of which he diagnosed a solid tumor, but was unable to determine whether it was of ovarian or uterine origin. This doubt, he believes, should not influence the surgeon's decision, since the indication is clear to remove a pedunculated growth by the abdominal rather than by the vaginal route, in order to preserve the uterus.

In the cases reported ascites was noted only once, rather an exception to the fact that ovarian fibromata are usually accompanied by hydroperitoneum. It was evidently due to irritation. The patient was sixty-two years of age, but the five others were under thirty-six.

The benign character of these growths is shown by the fact that they are unilateral. Menstruation may or may not be affected, both menorrhagia and amenorrhœa being observed.

As in the case of all pedunculated abdominal tumors pain is variable, and seems to be due purely to mechanical causes.

Plastic Operations for Prolapsus.—Baumm (*Centralblatt für Gynäkologie*, No. 21, 1902) reports 86 cases from the Breslau clinic, extending over a period of three years. Recurrence occurred in 30 per cent. The writer performed amputation of the cervix with colporrhaphy and perineorrhaphy, but made no attempt to keep the uterus anteverted, believing that it makes no difference whether the organ is forward or backward, provided that the prolapsus is relieved. The after-results of vaginal fixation do not commend the operation to him.

Atmokausis in Hæmophilia.—Pincus (*Centralblatt für Gynäkologie*, No. 22, 1902) discusses the question whether "bleeders" ought to marry, which he answers positively in the negative. In order to obviate the necessity of enforcing this rule, he suggests that at the first appearance of the menses in a young girl, with such a loss of blood as to threaten life, the uterine cavity should be obliterated by atmokausis. If the patient survives the profuse monthly bleeding and marries a second indication may arise after labor or during the puerperium. At the climacteric in such a patient the indication is clear.

Intra-abdominal Pressure.—Meyer (*Centralblatt für Gynäkologie*, No. 22, 1902) considers this expression an erroneous one, and affirms that there is no such thing as a constant pressure which is the same at every point in the peritoneal cavity. The comparison between the difference in pressure in the pleural cavity and in the external air and that within the peritoneum is not justified on account of the elasticity of the abdominal walls. In the normal condition the equilibrium between the abdominal cavity and its contents is maintained, and when the air is allowed to enter at the operating-table the intestines, even when not previously emptied, protrude only to a slight degree. If they have been thoroughly evacuated it is even possible to establish a negative intra-abdominal pressure artificially by drawing up the unopened peritoneum, the muscular wall being thoroughly relaxed under anæsthesia Normally it cannot exist. That the pressure is never constant at all points is evident when one considers the variable conditions present in

the intestines and bladder, the peristaltic movements and those of the diaphragm, the contractions of the voluntary muscles, etc. The supposed variation in pressure due to different positions is also entirely theoretical.

Blood Examinations in Pelvic Suppuration.—Lavbenburg (*Centralblatt für Gynäkologie*, No. 22, 1902) repeats the observations of Ditzmann, with whose conclusions he agrees, adding some interesting deductions of his own. He finds that in cases of suppuration there is a diminution of the red corpuscles, with a rapid increase in the white. The latter gradually diminish in number after the acute stage, to increase with each exacerbation. The leucocytosis varies directly according to the intensity and extent of the suppurative process. If it is limited the number of white corpuscles soon sinks to normal; in protracted febrile cases the leucocytosis varies with the different phases of the disease, the red corpuscles behaving in the opposite way.

The influence of the patient's constitution upon the leucocytosis is quite striking. In a subject who is exhausted by a long illness, or by loss of blood, an increased leucocytosis may persist even after the pus focus has disappeared.

The possibility of mistaking true leukæmia for temporary increase in the white corpuscles must be borne in mind. The increase in eosinophile cells and the presence of large mononuclear cells with neutrophile granules, not seen in normal blood, would settle the diagnosis. Moreover, it must not be forgotten that increased leucocytosis may be present in connection with wasting diseases, fevers, cancer, etc., and that there are daily variations, especially during digestion..

Cystic Degeneration of the Ovary.—Kahlden (*Beiträge zur path. Anatomie u. zur allgem. Pathologie*, Band xxxi.) presents the results of his careful studies of an old subject, on which he throws new light. He divides the cases into three groups, viz.: 1. Those in which the ovary is filled with small cysts, showing various stages of degeneration, where it is difficult to decide macroscopically whether the condition is normal or pathological. It seems to represent essentially an increase in physiological processes. 2. In this group the changes are more evident, as some of the dropsical follicles attain a considerable size and others atrophy. Hyperæmia is more marked, with resulting hemorrhages, so that some follicles lose their lining epithelium and are filled with coagula. 3. In the third group the cystic formation is general, though ova can still be found in some of the follicles, even when they are denuded of epithelium. Degeneration of the ovum is often preceded by changes in the membrana granulosa.

Microscopically, the writer found that in the majority of the cases so-called *hydrops folliculi* was due to glandular formations following ingrowth of the germinal epithelium, and not to simple dilatation of a pre-existing follicle. Moreover, he demonstrated the fact that this mode of origin could be inferred in some cases of ordinary cystic degeneration. [The practical bearing of these observations will be evident when one recalls the frequency with which ovaries used to be sacrificed merely because a few cysts were observed on their outer surface. While this condition is no longer regarded as a proper indication for removal of an ovary, we may well ask whether the pendulum

has not swung too far in the opposite direction, and whether "conservative surgery" has not been practised in cases in which any interference with the normal organ was mischievous. We have always looked with disapproval upon ignipuncture and the excision of small dropsical follicles, and the custom of including such cases under the head of true conservative operations.—H. C. C.]

Radical Operation for Cancer of the Uterus.—In a recent discussion before the Dutch Gynecological Society (*Centralblatt für Gynäkologie*, No. 22, 1902) the consensus of opinion seemed to be against the abdominal operation. Kouwer affirmed that it had not been proved that it was radical in the sense of removing all the disease. He did not believe that it was often possible to tell whether the lymph nodes were affected or not. Of thirteen patients operated upon by himself within the past three years by the abdominal route, five died from the operation, two had ureteral fistulæ, and two had an early recurrence. Treub thought that with a mortality of 33 per cent. simple palliative treatment was preferable.

Treatment of Inoperable Cancer with Methyl-blue.—Cucca and Ungaro (*Rassegna d'ost e gin.; Centralblatt für Gynäkologie*, No. 22, 1902) use the following solution: Methyl-blue, 90 grains; 90 per cent. alcohol and glycerin, āā 3 drachms; water, 7 ounces. This is applied to the diseased cervix on tampons after previous curetting. A weaker solution is used for vaginal and intrauterine irrigation. The results have been quite satisfactory, patients being kept comfortable and free from hemorrhage and discharge for months, or even years. Pain was relieved so that morphine could be dispensed with, and the progress of the disease was evidently retarded. No unpleasant effects were noted after long use of the remedy.

Hæmatocele following Divulsion.—Carson (*Progrès Méd. belge*, No. 1, 1901) reports the case of a young woman in which divulsion and curettement were performed for menorrhagia. Three days later she had abdominal pain, elevation of temperature, vomiting, and tympanites. A hard tumor appeared on the left side, extending from the cul-de-sac to the umbilicus. As septic symptoms developed, a vaginal incision was made and a quantity of pus and blood was evacuated, the patient making a good recovery. The reporter suggests that there might have been a rupture of the veins of the pampiniform plexus. [Why not rupture of the cervix or perforation of the uterus?—H. C. C.]

Menorrhagia in Young Girls.—Sirdey (*Révue Gen. de Chir. et de Therapeutique; Der Frauenarzt*, 1901, No. 8) refers to cases of obstinate menorrhagia in which no local cause can be found. In consequence of modesty and ignorance the patient often becomes exceedingly weak and exsanguinated before the physician's attention is called to the condition, or else she is wrongly treated for anæmia. The flow is only increased by the tonics which are given, if no change is made in the hygiene or environment.

As regards treatment hot douches are seldom necessary. Hot rectal irrigation may be substituted. The patient should be kept absolutely quiet in

bed until a day or two after the flow has entirely ceased. In the intervals between the periods all violent exercise—dancing, cycling, etc.—should be interdicted, as well as balls and theatre-going. Cold douches and massage are beneficial. The diet should be simple, stimulants, tea and coffee being forbidden. Ergot and hamamelis are recommended during the flow.

OBSTETRICS.

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Suppression of Urine following Labor.—McKerron (*Journal of Obstetrics of the British Empire*, 1902, vol. iv. No. 1) contributes a paper upon this subject, with a report of six cases from his own observations.

His first case was that of a multipara who gave premature birth to a still-born fœtus at the eighth month. The urine had been examined at intervals of about a month, but showed no albumin. There is no statement regarding the specific gravity, quantity, percentage of urea, nor whether casts or epithelial débris was present. During her first pregnancy she had had œdema, scanty urine, with a large quantity of albumin. She had been delivered of a dead fœtus at seven months, after an easy labor. During the pregnancy under consideration she remained fairly well until she was seized with sudden pain in the lower part of the abdomen, followed by vaginal hemorrhage. This ceased, but a few hours afterward a seven-and-a-half months' fœtus, but recently dead, was suddenly expelled. The placenta was covered with adherent black clots. Following this labor the patient had complete suppression of urine, which very gradually gave place under appropriate treatment to a temporary polyuria. The patient made a gradual and apparently complete recovery. Complete suppression of urine lasted in this case about three and a half days. McFerron states that it is the sole recorded case which he has found in which recovery followed complete suppression of urine after labor.

The second case was that of a multipara who had much sickness and prostration during pregnancy, who had borne one living child and had lost two children at the sixth month. During the pregnancy in question the urine was not examined, because the symptoms were similar to those in previous pregnancies when the urine was found to contain no albumin. This patient was suddenly seized with severe pain in the epigastrium and discharge of blood from the vagina. She expelled a dead fœtus, had suppression of urine, and died on the fourth day.

Case third was that of a primipara who was under observation until she entered the hospital. She was delivered by forceps of a living child. This

was followed by partial suppression of the urine, from which she slowly recovered. It is thought that her improvement and recovery were largely due to her delivery instrumentally under anæsthesia.

Case fourth was delivered prematurely in her third confinement of a stillborn fœtus. She had suppression of urine, and died on the eighth day. This case is quoted, and did not come under the observation of the writer.

Cases fifth and sixth are quoted from the practices of others, case fifth being that of a primipara with stillborn child, and said to have had no symptoms during pregnancy. She died on the fifth day after delivery. Case sixth had suppression of urine following premature delivery at the seventh month. The child was stillborn, and the mother died on the fourth day.

(We are especially interested in the cases seen by the writer. The type of case is not at all an uncommon one—namely, of an acute and overwhelming toxæmia. It is extraordinary to notice that in few if any of these cases the patient had received careful observation during her pregnancy. In one case the urine had not been examined, because the symptoms were like those of a previous pregnancy in which the urine was examined. The disposition is to lay almost entire stress in examining the urine of pregnancy upon the presence or absence of albumin, and this has been shown to be a most unworthy reliance.)

The writer concludes from these cases that a pathological condition of the kidneys was present, resulting from pregnancy, but in some cases dependent upon a pre-existent defect of the kidneys. The question of the condition of the liver does not enter into his calculation.

He recognizes the influences of a neurotic temperament as producing hysterical suppression of urine, and infers that this may bring about the dangerous and fatal issue seen in these cases. In none of the fatal cases is there a report of an autopsy.

In the matter of treatment he draws attention to the injection of saline solution into the rectum. He believes that opium in the form of morphine does not further the suppression of urine, although he states in his closing sentence that opium should be rigidly withheld in cases where anuria is to be feared.

[While these cases are interesting as clinical reports, they are incomplete from the faulty or deficient study of the urine during pregnancy, the lack of post-mortem examination, and the failure to completely study essential phenomena of toxæmia. While the injection of saline fluid into the rectum is valuable, it is inferior in prompt and direct effect to intravenous saline transfusion or even to hypodermoclysis. Threatened death from toxæmia is so grave a condition that it fully justifies transfusion or any other rational procedure.]

Spontaneous Expulsion of a Dermoid Ovarian Cyst during Labor.—HAULTAIN (*Journal of Obstetrics of the British Empire*, April, 1902) reports a case of this rare condition and quotes four cases from the literature of the subject.

The writer's case was that of a woman in her third pregnancy who had been in labor for twenty-four hours. A slight swelling bulging through the posterior vaginal wall delayed the exit of the child. An attempt to deliver by forceps

had caused a mass to protrude from the vulva, which was pushed up into the vagina. Labor pains then ceased. On examination the mass was found in the vagina, and on pulling it down for inspection it became detached and was removed. It resembled an œdematous polyp about the size of a small cocoanut. The child was delivered with forceps without difficulty. On examination a rent was found in the posterior vaginal wall, through which the tumor had made its way. The tumor was examined and found to be a dermoid cyst containing hair and sebaceous material. The rent in the vagina was packed with iodoform gauze. The patient made an uninterrupted recovery, the gauze being gradually removed.

Cardiac Disease in Pregnancy.—Under this title JARDINE (*Journal of Obstetrics of the British Empire*, April, 1902) publishes notes of thirteen cases in which cardiac disease has complicated labor. Among these there are three cases of aortic stenosis, one of which terminated in premature labor and two in labor at full term. The mother made a full recovery, and two of the children lived. The remaining cases were those of mitral disease, in which the degree of incompetency varied, as did also the condition of the heart muscle. In some of the cases mitral stenosis was present, and two cases were complicated by tricuspid incompetence as well. Most of these patients went to full term. There was one death from cardiac failure. One patient had high fever, which fell after the bowels had been thoroughly moved, the patient discharging a large quantity of very offensive feces. Another patient after labor was seized by a rapidly increasing and most threatening anæmia, from which she made a very gradual recovery.

Jardine calls attention to the low death-rate in these cases—1 to 13. He calls attention to pure mitral stenosis as being the most deadly form of heart disease complicating labor. When labor ends in these cases the uterine vessels are cut out of the circulation, and if there has not been a free hemorrhage during the third stage of labor, blood is returned to the right side of the heart, which may become engorged and paralyzed. Hence, bleeding should be encouraged during the third stage of labor, and if it does not occur from the uterus, and the patient's condition is threatening, blood must be taken from a vein. Attention is called to Hart's illustration of a case of this sort, showing the distention of the right auricle.

Aortic incompetence is next in gravity, and mitral incompetence if the heart muscle is in good condition is less dangerous. Cardiac lesions do not show themselves during pregnancy until after the middle of this time. Then breathlessness, palpitation, cough, and œdema appear, with albumin in the urine. The patient may not be able to lie down.

The woman who has heart disease and who has suffered from failure of compensation at any time should be strongly advised not to marry. So far as treatment is concerned during pregnancy, the patient must be kept at rest, the bowels moved freely, the kidneys stimulated, the lungs relieved, and cardiac tonics freely given. Strophanthus is a better drug than digitalis in these cases. While the patient will probably improve, the cardiac tonic must be continued.

In a bad case the induction of abortion before the fourth month is permissible. In the later months labor should not be induced.

When labor begins large doses of strophanthus or digitalis should be given. As soon as the os is fully dilated labor should be terminated. The patient should never be allowed to bear down. If the heart begins to be embarrassed before the os is dilated the os must be stretched open or incised, chloroform given, and delivery at once effected. The uterus should be allowed to relax and bleeding encouraged after the birth of the child. Ergot is contraindicated unless in exceptional cases. If the patient did not bleed from the uterus and showed embarrassment blood should be taken from the arm. During the puerperal period free stimulation and cardiac tonics should be used. When patients die after labor it is from acute œdema of the lungs and cardiac failure. Nursing should be prohibited, as it influences the heart badly.

Blood-counts in the Newborn.—AITKEN (*Journal of Obstetrics of the British Empire*, April, 1902) contributes an interesting paper upon this subject based upon 300 counts and 100 stained films in 43 different infants. The weights of 200 children are also utilized for purposes of study. Aitken finds that the red corpuscles of the blood of the infant at birth are relatively more numerous than in the adult. During the first days of life, when the child is losing weight from urine, perspiration, and is fasting, the number of cells increases. From the second day the number gradually falls, so that by the tenth day the red cells are less numerous than at birth. During this time the child gains in weight. Soon after birth the corpuscles vary in size and shape, and there is deficiency in rouleaux formation. Nucleated red corpuscles are present at birth and as late as the ninth day after. Their numbers vary greatly. Hæmoglobin is relatively higher at birth than immediately afterward, usually over 100 per cent., individual cells being richer than those of the adult. At birth the white corpuscles are two or three times as numerous as in the adult, increasing during the first forty-eight hours of life. After the third day the number of white cells diminishes, and by the tenth day it is much less than at birth. After the first feeding leucocytosis accompanying digestion is very marked, and after a fast in the later days. At birth the lymphocytes exceed the neutrophiles. After the first feeding the latter increase considerably. This gain diminishes as the effects of digestion wear off and the blood becomes less concentrated, until in the second week, the lymphocytes are again increased as at birth. The percentage of eosinophiles is greater than with adults.

Ovarian Tumor Complicating Advanced Pregnancy Removed by Section.—In the *British Medical Journal*, April 5, 1902, DUNNE reports the case of a patient in her fourth pregnancy who had suffered from a rapidly-growing ovarian cyst. The abdomen was greatly distended, measuring 42½ inches at the umbilicus and 42 inches at a point higher up. Two distinct swellings were visible separated by a well-marked groove. On the right side the tumor was soft and fluctuating and on the left the uterus was smaller and hard. Fœtal heart sounds were heard at a point midway between the umbilicus and the anterior posterior spine on the left side. The os was patulous and the fœtus could be palpated within the uterus, the head presenting. As labor was imminent, operation was performed at once. The abdomen was opened on the right of the umbilicus. There were no adhe-

sions, and the cyst after puncture was easily drawn out, its pedicle was secured, and the abdominal cavity washed out with hot boric-acid solution. One-fourth grain of morphine was given hypodermically to delay labor, as uterine contractions were noticed during the operation. On the next day, when dilatation was complete, the membranes ruptured, and the child was delivered with axis traction forceps. The patient was not permitted to bear down. The placenta was removed digitally, and a copious douche of iodine solution given. Pressure was maintained above the pubes and a large pad and binder were applied. The intra-abdominal pressure was maintained by a tight binder over the dressings. The mother made a good recovery, but did not nurse the child.

OTOLOGY.

UNDER THE CHARGE OF

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The Significance of Lumbar Puncture in the Diagnosis of Intracranial Complications of Otitis.—IWAN BRAUNSTEIN (*Archiv. f. Ohrenheil.*, Band liv., Heft 1–2.) (Published from cases in Schwartze's clinic in Halle A. S.) For the lumbar puncture in the Halle clinic an ordinary hollow needle is used, without aspiration. The puncture is made just below the fourth lumbar vertebra, with the patient lying on the side, scrupulous asepsis being observed. The fluid is allowed to flow until generally about 30 to 40 c cm. are collected, as this quantity ensures that some of the fluid comes from the cranial cavity. Only the following points in regard to the cerebro-spinal fluid obtained are considered of diagnostic worth: 1. Clearness (normal cerebro-spinal fluid should be as clear as water). 2. Presence of leucocytes in the fluid (normal fluid contains very few). 3. Presence of bacteria in the fluid (cover-glass preparations, cultures, and animal inoculation are necessary to prove the sterility; normal cerebro-spinal fluid is sterile).

Unpleasant experiences are found to follow the lumbar puncture very rarely if the puncture is carefully carried out. Two cases of death following closely on the puncture are reported; one due to aspirating the fluid with a syringe after it had ceased to flow, and the other quite as likely due to the chloroform narcosis (autopsy showed fatty degeneration of the heart). Sixty-seven lumbar punctures carried out on 48 patients are reported. Of these, 6 were meningitis purulenta, 10 were meningitis purulenta with brain abscesses, 3 were meningitis purulenta with sinus thrombosis, 1 was probable epidemic cerebro-spinal meningitis, 1 was meningitis serosa, 7 were sinus thrombosis, 3 were perisinous abscess, 2 were sinus thrombosis with encap-

sulated meningitis and brain abscess, 4 were sinus thrombosis and brain abscess, 5 were tubercular meningitis, 6 were cases of intracranial pressure presenting meningeal symptoms.

Twenty-nine times the puncture gave normal fluid (negative result). Of these, 7 were in cases of sinus thrombosis, 3 were in perisinous abscess, 7 were in brain abscess, 5 were in sinus thrombosis with brain abscess, and 7 were in cases of intracranial pressure with meningeal symptoms. On the other hand, in those cases where a general purulent meningitis existed, either alone or as a complication, the cerebro-spinal fluid showed the above-described abnormal conditions. The cases of cerebro-spinal meningitis and meningitis serosa reported are so few in number that the conclusions drawn from them have little worth.

As to the tubercular meningitis, Braunstein believes that the opalescent cloudiness of the fluid gives a fair presumption that the intracranial trouble is meningitis tuberculosa, even when the microscopical examination fails to show the presence of the tubercle bacillus.

As to the diagnostic worth of lumbar puncture in intracranial complications of otitic diseases, Braunstein concludes:

1. Obtaining by lumbar puncture normal cerebro-spinal fluid, when from its amount you can conclude that a part comes from within the cranium, rules out with great certainty a general purulent meningitis.

2. Obtaining by lumbar puncture cerebro-spinal fluid which presents the above-described abnormal characteristics proves the presence of a diffuse purulent meningitis.

On the Pathology of Deaf-mutism and the Window Niches.—Prof. J. Habermann, of Gratz, divides deaf-mutes into two classes, hereditary and acquired. The percentage of each varies with different writers. Unchermann found in 1885 about 1841 deaf-mutes in Norway, of whom 51 per cent. were heredity, and the remaining per cent. were acquired, with the exception of 0.5 per cent., in whom it could not be determined. It is not always possible to determine, even by examination after death. Most cases of acquired deaf-mutism are caused by diseases of the labyrinth, most of which have spread from the brain or middle ear. Mygind, in his work in 1894, reported over 139 cases in which the middle ear only was diseased, but he stated nothing about the labyrinth or the histological examination of the labyrinth. Thus Matte could completely deny the occurrence of deaf-mutism due solely to middle-ear disease.

Habermann reports two cases in which the middle ear only was demonstrable as a cause of the deaf-mutism. He gives the gross and microscopical pathology. In the first case, a boy thirteen years, who died of general tuberculosis, two different pathological changes were found. First, a recent tuberculosis of the middle ear, which had nothing to do with the deaf-mutism. Second, in both middle ears changes of a chronic nature, which could have existed for some years. In the right middle ear great thickening of the lining, numerous adhesions binding down the ossicles, a bony closure of the round-window niche, and hyperostosis of the bone on the inner tympanic wall. On the right drum a scar, and on the left an old perforation and calcification were present—effects of a suppurative otitis media. This middle-ear sup-

puration must have occurred early in the first weeks or months of the child's life. No pathological changes were found in the brain or nervous mechanism of the internal ear. The auditory canal was normal. For the explanation of the deaf-mutism only the changes in the middle ear remain. Panse, after a study of all the cases in literature in which pathological changes were found in the windows, came to the conclusion that diseases of both windows caused a considerable degree of deafness. Habermann reported a case, with specimen, to the Otological Society in Dresden, where both windows, right and left ears, were closed by bone and connective tissue, with complete deafness on one side and nearly complete deafness on the other. The bony closure of the round window and the fixation of the stapes by bands of connective tissue is sufficient therefore to explain the deafness in this case.

The second case, a woman, thirty-eight years old, died of interstitial nephritis. The pathological changes have a similarity to those of the first case, and are also to be interpreted as a result of a suppurative otitis media—a great thickening of the lining membrane of the middle ear; hyperostosis and sclerosis of the bone, and almost bony closure of the round window by bone tissue. The left drum showed a large old perforation; the right drum was thin. The pustule on the left drum is hard to make consistent with the rest of the aural conditions.

Bleb formation and small abscesses in the drum are not unusual in certain forms of inflammation of the external auditory canal as well as in acute suppuration of the middle ear, with copious exudation in the tympanum; but in a chronic suppurative case with minimum exudation and a large perforation of the drum the bleb cannot be explained. We can only regard the general condition of the patient to account for these changes in the ear. The patient had uræmia, with neuroretinitis, albuminuria, and enteritis. It is known that patients with kidney disease are much inclined to inflammatory tissue changes. Thus diseases of the skin in Bright's disease are not rare, and in the beginning, according to Thursfield, patients have pruritus, urticaria, and eczema. In the final stages, and in anæmic patients, erythema, bullous, and desquamative processes; further, purpura and pus infections.

In consequence of chronic suppuration pus cocci were already present, and the uræmia of the patient explains the appearance of the pustule in the epidermis of the drum.

The results of the hearing tests of this case are important. Unfortunately the tests were taken late, and the patient was very weak. A part of the investigation is unreliable. The patient had nearly complete deafness on the left; heard the watch by contact on the ear; heard numbers loudly spoken 0.03 m.; also on stopping both ears. Right: numbers; voice, 1.20 m., and numbers, whispered voice, 0.15 m. As to these results no doubt can exist, and the assertion is, therefore, correct that the patient still possessed this acuteness of hearing with bony closure of the round windows and free oval windows.

Other writers have come to the conclusion that bony closure of the round window alone does not cause deafness. Mygind reports a case of a deaf-mute child who had some hearing in spite of bony closure of the round window, with masses of cholesteatomata pressing through the oval window into the

labyrinth. In the case described by me, could the objection be made that the window niches had not come to a complete bony closure, therefore, vibration of the membrane, at least of the posterior part, was yet possible? If we consider that the remaining space was not filled with air, but with a loose, wide-meshed connective tissue, and that these spaces were saturated with tissue fluids and completely closed off from the tympanic cavity by a new-formed thick bony wall, it is evident that a movement of the membrane outwardly by a movement of the labyrinthine fluid, due to the influence of sound, was impossible. This condition of the left ear makes it possible to consider the hearing acuteness of the right ear certain; then it is not a question of conduction from the nearly deaf left ear.

For good hearing the unhindered mobility of the membrane of the round window is necessary; that with bony closure of the round window one can even hear whispered speech close by; that with high degree of obstruction of the function of both windows speech-deafness had resulted in both ears in Case I. and in the left ear of Case II. From these cases and the case demonstrated in Dresden it is very apparent that under certain conditions deafness for the tuning fork by bone conduction can happen through complete closure of both windows.—"Zur Pathologie der Taubstummheit und der Fensternischen," *Archiv. für Ohrenh.*, 1901, Bd. liii., S. 52–67. Tafel I., II.

OPHTHALMOLOGY.

UNDER THE CHARGE OF

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Retention of the Pupil Reflex to Light after Intracranial Division of the Optic Nerve.—MARENGHI (Pavia) before the International Congress of Pathologists at Turin (*British Medical Journal*, October 26, 1901), stated as the results of his experiments, and demonstrated to the congress in a rabbit, that the iris of an animal whose optic nerve was divided at its point of departure from the chiasm responded to light; the reaction was slow and weak, but distinct. The result could be explained by the existence of a peripheral reflex centre within the retina. Further investigation is needed.

Primary Chronic Glaucoma.—LITTLE, London (*British Medical Journal*, October 26, 1901), in his Presidential address before the Ophthalmological Society of the United Kingdom upon some clinical experiences of primary chronic glaucoma and the value of iridectomy, lays down the rule that an operation should be done in every case in which the patient is strong enough

to stand it, and the earlier it is done the better; but he would never hesitate to operate on an eye even if the fields were contracted to fixation, provided that there was any vision worth saving; even in the premonitory stage he advocated operation.

Gonorrhœa and Diseases of the Eye.—LAWFORD, London, in a discussion on the relation of the gonorrhœa to diseases of the eye (*British Medical Journal*, November 2, 1901), after excluding purulent ophthalmia, considers the following ocular affection as known to occur in association with gonorrhœa; a form of mild conjunctival inflammation (not due to direct inoculation), scleritis and episcleritis, iritis and iridocyclitis, neuroretinitis. Suppurative keratitis has been described in severe pyæmic case; of these iritis is the best known.

The Diagnosis of Malignant Intra-ocular Tumors in Infancy.—SOURDILLE, Nantes (*Gaz. Med. de Nantes*, November 16, 1901), calls attention to the great difficulties frequently existing in making the diagnosis of retinal glioma. Transillumination should be practised in every case before surgical intervention. If a tumor is shown, and any doubt as to its nature be present, it becomes necessary to make a puncture and to examine histologically and experimentally (by inoculation) the elements of the neoplasm.

Malignant tumors of the retina are all gliomata, properly so called. Mistakes of diagnosis are frequent. These mistakes are masked under the specious name of "pseudoglioma," when enucleation shows that an entirely different disease is present; and "cryptoglioma" when the disease is overlooked. For a long time the amaurotic cat's eye was believed to be adequate for the diagnosis of glioma. This has been the source of numerous errors. The writer concludes from his own histological examinations, that of ten eyes enucleated for glioma three are found to be cases of pseudoglioma.

The amaurotic cat's eye is by no means pathognomonic of glioma; this is found in suppurating retinal hyalitis, purulent choroiditis, affections following infectious maladies of infancy, particularly the eruptive fevers, and, above all, tuberculosis of the intra-ocular membranes, the choroid and retina.

It has therefore been proposed to narrow the diagnosis of these tumors and to lay down an absolute rule following Lagrange; in glioma the eye is glaucomatous or tends to glaucoma; in pseudoglioma the tension is below normal and tends to phthisis. This rule holds in the majority of cases, but there are many exceptions. There are cases in which glioma evolves under the form of iridocyclitis instead of glaucoma, where there is no increased tension whatever. Other cases directly opposite occur presenting the syndromes of glioma, amaurotic cat's eye and increased tension without the existence of any tumor. Transillumination and puncture are alone adequate to assure the diagnosis.

Benign Gangrene of the Eyelids.—ROGER and WEIL (*La Presse Médicale*, No. 76, 1901) report the case of a healthy male adult who was attacked with idiopathic gangrene of the left eyelids. There was no preceding inflammation of the conjunctiva nor any lesion of the lids. The disease began insidiously in a spot of inflammatory œdema. At the expiration of four or five

days general symptoms made their appearance, fever at first high (39.5° C.), but lasting only four days. It was accompanied by feeling of weight in the head and tension in the face, but without actual pain. There was a saburral condition of the digestive tract. The urine was albuminous. There was no delirium nor marked depression. Gangrenous plaques made their appearance upon the reddish erysipelatous lids forty-eight hours after the outbreak of the disease. The mortifying plaques were blackish in color and of very irregular contours. Line of demarcation quickly formed, and repair proceeded very rapidly. Eschars separated in fragments. The upper lid was free thereof on the nineteenth day; the lower on the twenty-first day. Healing was complete less than a month after the outbreak. There was no atresia of the palpebral orifice, and the only permanent trace was a slight ectropion at the external angle of the eye.

This is a very rare affection, indeed. The authors were able to find but a single analogous case in literature. It seems to resemble the spontaneous gangrene of the external male genital organs described by Fournier, of which more than twenty cases have been published since attention was first called to it.

Bacteriological study of the fluid obtained by puncturing the œdematous region showed the presence of an anaërobic microbe having a decided pathogenic action upon certain animals (rabbits, guinea-pigs), inoffensive for others (rats and mice). In the former, sometimes lethal septicæmia was produced, in other instances local lesions, œdemas, or indurations, or cold abscesses. True gangrene never occurred; but this is generally the case with all gangrene-producing microbes which do not retain or rapidly lose the virulence acquired for man.

DERMATOLOGY.

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Soft Pigmented Nævi.—Fick (*Archiv für Dermatologie und Syphilis*, Bd. lix., Heft 111), who has studied the microscopical structure of eight pigmented nævi taken from various parts of the body, sums up the results of his investigation as follows: The pathological increase of pigment in a nævus is not the cause of the tumor formation. Nævus-cell formation and proliferation on the one side and increase of pigment on the other are two pathological processes running parallel courses, but also occurring separately. The nævus cells only contain pigment when they are found in close proximity to

melanoblasts, with which they are in many places in demonstrable contact. In many nævi, giant cells are present without the growth showing other evidences of excessive proliferation or inflammation. These giant cells are distinguished from the other nævus cells not only by their size, but chiefly through the deep staining of their nuclei and the presence of a basophile granular substance in their protoplasm. The latter peculiarity is not found in all, but in many of the giant cells. Processes from the melanoblasts penetrate between the epidermis cells, partly coalescing with them. These cells lie partly between the cells of the epidermis, partly in the boundary between the epidermis and the corium, partly between the nævus cells, and partly arranged around the vessel in the deep layers of the cutis. With regard to pigmentation, the nævus cells behave just as the epithelial cells. All the pigment demonstrable in the nævus is found in cells (epithelial, nævus, giant, and melanoblasts). The histological picture presented by pigmented, soft nævi speaks categorically for the correctness of Ehrmann's pigment theory.

Botryomycosis in Man.—Bodin (*Annales de Dermatologie et de Syphiligraphie*, 1902, No. 4) reports two cases of this curious affection which he has studied histologically and bacteriologically. The first case was observed in a woman, twenty-seven years old. The disease began as a small nodule upon the posterior surface of the right thumb at its base. For a month the little tumor remained stationary, then it began to grow rapidly and ulcerate. At its acme the growth was the size of a hazelnut, rounded and covered with small fissures. At its base there was a deep circular furrow, at the bottom of which was a smooth, short, rounded pedicle by which the tumor was attached to the skin. The tumor was excised with the scissors and a complete cure followed in a few days. The second case also occurred in a woman, and was precisely like the first, except that the tumor was situated upon the palmar surface of the first phalanx of the middle finger of the right hand. Histological examination of the tumors showed that they were composed of young connective tissue extremely rich in vessels running in all directions, having very slender walls, often consisting only of the endothelial layer. In the external parts of the tumor there were marked evidences of inflammation. Search for the mulberry-like masses supposed to be due to the parasite named botryomyces—the so-called castration fungus of the horse—was completely negative; nothing but an ordinary coccus taking the Gram stain was found. As the result of his study of these cases the author concludes that the micro-organism described under the name botryococcus, and which is claimed by Poncet, Dor, and Spick to be the cause of a peculiar neoplasm in man, is not a specific organism, but is identical with the yellow staphylococcus; and the botryomycoccic neoplasmata are only fleshy granulation tissue produced under the influence of the staphylococcus aureus.

Atoxyl, a New Arsenic Preparation, and its Employment in Diseases of the Skin.—Schild (*Dermatologische Zeitschrift*, April, 1902) reports his experience with atoxyl (meta-arsenacidanilid) in the treatment of various diseases of the skin in which arsenic has been found more or less useful.

This new arsenical preparation is a white, odorless powder with a weak saline taste, soluble in warm water up to 20 per cent., and contains 37.69 per cent. of arsenic. A series of chronic diseases of the skin, such as alopecia areata, dermatitis herpetiformis, sarcoma of the skin, dermatitis exfoliativa chronica, xanthoma diabeticorum, psoriasis, lichen ruber, were given hypodermic injections of a 20 per cent. solution of the drug, the dose varying from 0.04 to 0.2. In alopecia areata and dermatitis exfoliativa no result was obtained; but in a case of dermatitis herpetiformis a cure was followed in a remarkably short time. In a case of xanthoma diabeticorum improvement was noted after the fourth injection and complete disappearance of the eruption after the twenty-second. In three cases of psoriasis improvement was clearly apparent after five or six injections, but a complete cure was not obtained in any of the cases. Of fourteen cases of lichen ruber treated in this manner, nine were, at the time of writing, completely cured, and the remaining five were rapidly improving. In about 1500 injections no irritation or infiltration worth mentioning was observed. The author is of the opinion that atoxyl represents a decided advance in arsenic therapy.

PATHOLOGY AND BACTERIOLOGY.

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On the Multiplicity of Amboceptors and Complements in Hæmolysis.—H. WENDELSTADT (*Centralblatt f. Bakteriolog. u. Parasitenkunde*, 1902, No. 10, Band xxxi., p. 469), working on the lines suggested by Ehrlich and Morgenroth, again demonstrates the multiplicity of the amboceptors in hæmolysis. A goat was immunized against the red blood corpuscles of oxen, pigs, and sheep. After the serum of the goat had developed strong hæmolytic properties for red blood cells of the other three animals their red cells were added in turn to the goat's serum, and the mixture kept on ice. By this means the intermediary body (amboceptor) for each kind of red cell was bound to that cell, and the remaining serum was still hæmolytic for the other two varieties of red blood corpuscles. For the separation of the specific complements two methods were used: First, by heating the goat's serum to 49.5° C. from twelve to fifteen minutes it was rendered inactive for both oxen's and sheep's blood, but readily hæmolyzed pig's red corpuscles. The second method consisted in adding dilute hydrochloric

acid to varying amounts of goat's serum. Wendelstadt now found that the hæmolytic property of the serum for the different kinds of red blood corpuscles was not all lost at once, but disappeared for the different animal's corpuscles at different dilutions; that is, the complement for oxen's red cells was lost first, next that for pig's blood, and most resistant to the action of acids was the sheep's blood. That the complement and not the intermediary body was injured in these experiments was shown by adding small amounts of fresh complements to the mixture in which no hæmolysis occurred, when dissolution was rapidly complete. By this method Wendelstadt believes he can demonstrate the multiplicity and specificity of the complement.—W. T. L.

A Contribution to the Pathology of Glanders of the Lung.—W. G. MacCallum (*Beiträge zur Pathol. Anat. u. allge. Pathologie*, 1902, Band xxxi., p. 440) describes the lesions found in the lung of a man who died of glanders following an accidental infection with an attenuated culture of the bacillus. At autopsy the lungs were found to contain numerous small, grayish-red firm nodules, both over the pleural surfaces and throughout the lung tissue. Similar nodes were found in the spleen and kidneys. The bacillus mallei was recovered from the nodules in the lung, spleen, and kidney as well as from other situations. From a histological examination the author finds three stages in the development of the nodules in the lung.

In the earliest lesions the centre of the nodule is composed of masses of leucocytes, fibrin, epithelial cells, and débris, the alveoli immediately surrounding this central portion being filled with plugs of fibrin, and outside of this, again, the alveoli containing epithelial cells. Large numbers of bacilli were found in the central portion.

In the second stage the central necrosis was more marked, and the exudate in the surrounding alveoli showed beginning organization.

The last stage is represented by a complete central necrosis, practically surrounded by a capsule of organized connective tissue.

The author, from these studies, agrees with Wright, Ehrlich, and Johne, and considers the process as a localized necrotizing bronchopneumonia.

Observations were made further upon the process of organization in the exudate surrounding the necrotic nodule. Lindeman believed the connective tissue arose from the alveolar epithelium, and Aldnigt, Fraenkel, and others derived the connective-tissue elements from the alveolar walls alone; while Ribbert thought organization took place from the walls of the finer bronchioles. Still other observers consider the greater interlobular septa and pleura as the points of origin. The author found in this case that organization commenced usually by a growth of connective tissue from the alveolar walls, but occasionally the connective-tissue elements also arose from the walls of the small bronchi. In serial sections the fibrin plugs were found to extend from one alveolus into another, or from the finer bronchioles into the alveoli, and the process of organization was followed along the fibrin masses directly from one alveolus to another. Thus an entire system of alveoli might undergo organization, the connective tissue growing from the alveolar wall into the exudate only at one point, and thence extending from one fibrin plug to another.—W. T. L.

A Case of Epidermoid from the Callosal Region.—Blasius (*Virchow's Archiv*, 1901, Band clxv., p. 504) states that intracranial pearl tumors (cholesteatomata) are certainly of epithelial type (to use the term in a morphological sense). The question arises whether they are epidermal or entodermal in derivation. At Beneke's suggestion, Blasius seeks to differentiate the two by macerating in silver nitrate. The two types of reaction are seen in cases of cholesteatomata. In the one type the sharp and continuous linear impregnation suggests the reaction of true mucosa. In the other (found in a case of cholesteatoma affecting the callosum) Blasius finds an impregnation quite after the fashion of, say, *vernix caseosa*—a row of dots or lines, discontinuous, ill-spaced, and of uneven diameter. Thus, despite the absence of hair and glands from the tumor, the diagnosis of epidermoid is made; indeed, in virtue of their absence, the origin may be referred to a remote point in the history of the medullary groove. When the pearl tumor is of mucosa type (of entodermal derivation) it lies usually at the base, perhaps derived from the anlage of the hypophysis. Blasius notes the frequency with which a meningeal nidus is reported for these tumors, but is inclined to regard the association as incidental to the development of an originally intracerebral (non-meningeal) focus. The pial or dural attachments would on this hypothesis be due to the pressure-atrophy of true brain elements which lay between tumor and meninges.

Remarks are appended upon granular ependymitis and upon multiple herniæ cerebri.

Weigert has held focal loss of ependyma as the first step in the onset of granular ependymitis. Blasius suggests, further, a mechanical origin for this loss (multiple ruptures consequent upon internal hydrocephalus), and regards the outgrowth of neuroglia following as a case of scar formation rather than as a reawakening of hitherto confined idioplastic tendency of glia cells, as suggested by Weigert.

Blasius adds four new cases of multiple herniæ cerebri to the four already in the literature. All four occurred together with intracranial tumors, and as a consequence of internal hydrocephalus. The herniæ sometimes occur into Pacchionian granulations, but they have usually a wider and different distribution.—E. E. S.

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TWO CONDITIONS SIMULATING ECTOPIC GESTATION.[1]

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Our constantly extending knowledge of ectopic gestation leads us to believe that most cases of pelvic hæmatocele are the result of this condition. That this is not invariably the case has been shown, and at times conditions other than hæmatocele may simulate ectopic gestation. These remarks are suggested by the following cases:

Case I.—Mrs. ——, aged twenty-nine years; good family history; married ten years. Had one miscarriage followed by sepsis, a child at term, a second miscarriage at six months, and a child at term, then five years old. Had always menstruated regularly. Was seen in January, 1900, and at the time when she should have menstruated was exposed to cold and wet, with wet feet, followed by attacks of pain over the left ovary and abdomen, extending to the right upper portion of the abdomen. She made a gradual recovery. At this time there was no shock or evidence of depression from hemorrhage. The day before the patient was seen she had severe pain in the abdomen, for which morphine was given. Her husband, a physician, introduced a sound into the uterus, finding it four inches in length. But little oozing followed the introduction of the sound.

On examination there was tenderness over the left ovary and on the right side over the appendix. The abdomen was soft, not distended. On vaginal examination the cervix was small and long, not softened, and no tumor and exudate could be found. There was no sign of pregnancy. This patient remained in bed for a short time, menstruated after a slight delay, and was seen but a few times. She apparently recovered from the condition present.

Three months after this attack intra-uterine applications were made for some supposed disease of the pelvic viscera. The sphincter of the bowel was stretched to relieve irritation in that region. There was a

[1] Read before the American Gynecological Society, May 27, 1902.

vague history of intermittent attacks of pain at irregular intervals. She was seen the second time nine months after the first visit. She had just recovered from a normal menstrual period. She complained of pain over the left ovary, and this pain, paroxysmal in character, had been treated by hypodermic injections of morphine. Her pulse and temperature were normal. There was vague and indefinite tenderness over the abdomen, which was not rigid or distended. On vaginal examination the womb was almost fixed by a mass of soft material in the pelvis which gave no distinct fluctuation. The size, contour, and consistence of the uterus could not be accurately appreciated because of this mass. There were no symptoms of pregnancy, and the menstruation which had just ended had been typical. The pelvic tumor became softer, and finally gave obscure fluctuation. The pulse and temperature remained almost normal. After the patient had been under observation for some time a request was made to perform abdominal section. This was positively declined, and I left the case. A week afterward I was informed that the patient was at a hospital, awaiting my pleasure. Abdominal section was still declined, but vaginal section was permitted. The general condition had remained about the same.

On incising the posterior cul-de-sac, blood which had been clotted for some time emerged, and the finger passed into a large clot, apparently well shut off from surrounding tissue. The incision was enlarged as much as possible, the clot washed out, and the cavity packed with iodoform gauze. The patient reacted well from the operation, and at the usual time had a discharge, resembling menstruation, from the uterus. The gauze was gradually removed, and ten days after the operation all had been taken away. The patient gradually developed symptoms of septic infection, and was seen in consultation, abdominal section urged, but positively declined. She died with symptoms of acute peritoneal infection, and autopsy was refused. The material obtained after incision of the vagina was examined in the Pathological Laboratories of the Jefferson Medical College, and found to be blood clot. No evidence of decidua or embryonal tissue was present.

During my acquaintance with this case it was at no time possible to obtain from either husband or wife, or both, an accurate and coherent history of the patient's illness. It was impossible to tell how frequently the husband had made intra-uterine applications, or upon what indications this had been done. The husband is an anatomist, and the character of his work would make it difficult for him to remain aseptic.

Experience has shown that irritation of the pelvic peritoneum from various causes may be followed by the formation of hæmatocele. Kober[1] has recently reported two cases of retro-uterine hæmatocele in which a diagnosis of ruptured ectopic gestation was made, and in which abdominal section proved the absence of this condition. The first was that of a multipara, who, after violent interference with the pelvic organs, was taken with pain, hemorrhage, and prostration. Upon examination a semi-elastic tumor was found in Douglas' cul-de-sac,

[1] Centralblatt f. Gynäkologie, 1901, No. 39.

characteristic of ruptured ectopic gestation. Upon abdominal section the tubes and ovaries were normal, nor was there any pathological condition in the abdominal or pelvic organs. The posterior cul-de-sac was filled with blood clot, which was readily removed. The peritoneum was pale, and the uterine substance more friable than normal. A small portion of the uterus was excised for microscopic examination, but no abnormality was discovered. The patient made a good recovery.

His second case was that of a multipara, who, after a hard day's work, was taken with pain, sensitiveness in the abdomen, and the gradual development of weakness. An elastic tumor gradually developed behind the uterus. Upon abdominal section the left Fallopian tube was removed, as it contained a tumor the size of a hen's egg. The entire tube was removed by a V-shaped incision into the body of the uterus. The right tube showed its abdominal end entirely obliterated and the lumen of the tube filled with an odorless pus. There were several small abscesses in the right ovary. This was also removed.

The gross examination of the specimens indicated very strongly an ectopic gestation of the left tube. Upon microscopic examination, however, not a trace of evidence pointing to pregnancy could be discovered. The tumor contained serum, and had nothing to do with the pregnant condition.

In both cases the formation of the hæmatocele occurred just before menstruation, when the condition of congestion usual at this time was present. Both cases seemed to have resulted from mechanical violence, followed by the extravasation of blood from tissues altered by anæmia or previous inflammation. Experience shows that hemorrhage may occur from pelvic tissues altered by disease without the occurrence of ectopic gestation.

In this connection the possible presence of hæmatoma of the abdominal wall in pregnant women must not be forgotten. Stoeckel[1] reports two cases, and Sänger[2] reports one case in which collections of blood formed in the abdominal wall during the pregnant condition. While such tumors would not obscure vaginal examination, they would interfere with the results of bimanual examination.

Case II.—Somewhat emaciated, anæmic woman, aged twenty years. Some months previously she had an abortion between three and four months, accompanied by very profuse bleeding, which was controlled with great difficulty. She recuperated slowly for three months, and then her general condition and nutrition began to fail. She had not menstruated for several months, and showed signs of pregnancy. Two weeks before she was seen she had intermittent hemorrhages from the womb, with attacks of abdominal pain.

On examination the patient was exceedingly pale, her pulse 120 to

[1] Centralblatt f. Gynäkologie, 1901, No. 10. [2] Ibid., 1897, No. 16.

144; and upon vaginal examination the cervix was small, not much softened or shortened, and the pelvis was filled with a soft, boggy tumor, completely occupying the posterior cul-de-sac. The body of the womb could not be distinctly outlined, but was somewhat enlarged. A discharge of dark fluid blood was coming from the vagina. The breasts gave the characteristic signs of early gestation. The most probable explanation of the patient's condition seemed to be ruptured tubal ectopic gestation. Her profound anæmia and rapid pulse urged the necessity for complete diagnosis and control of the condition.

She was immediately transferred to the Jefferson Maternity and abdominal section performed. Upon opening the abdomen the tubes and ovaries were found to be normal. The uterus was completely retroverted, very soft in consistence, resembling a cyst, and filled the posterior cul-de-sac. There was no evidence of exudate or adhesion about the uterus, and it was raised to its normal position without much difficulty. The abdomen was closed, and the patient received intravenous saline infusion. The vagina was tamponed with gauze, raising the uterus and carrying the cervix backward. The pregnancy continued, and the patient speedily improved in condition until she became well enough to go to her home. She had felt fœtal movements, and the uterus had grown larger and harder.

Soon after leaving the Maternity she returned with uterine pains, and was delivered of a six months' fœtus, which moved but did not breathe. Upon examining the uterus it was found to be completely lined with a mass of clotted blood which required a blunt curette for its removal. This patient made a somewhat tedious recovery, retarded by pain in the left sciatic nerve, for which no anatomical cause could be found in the pelvis.

Shortly after the case just described came under my observation a second was seen in consultation, upon which section was done and the same condition found to be present. In this case there was more resistance and pain, suggesting pelvic peritonitis, than in the first, and the anatomical conditions found by vaginal examination were typical of ectopic gestation.

In the recent literature of the subject Ségond[1] reports the case of a patient who had borne one living child and had suffered from metritis. A diagnosis of ruptured ectopic gestation was made from combined examination, and the patient was operated upon. The uterus was found in early pregnancy, retroflexed, and partially fixed upon the left side of the pelvis. It was brought into normal position and the abdomen closed. The patient recovered from the operation and left the hospital, but aborted at six months. Routier[2] reports a case in which a retroflexed uterus adherent upon the left side of the pelvis was thought to be an ectopic gestation. The uterus was replaced after abdominal section, but abortion followed the operation.

That a retroflexed pregnant uterus may simulate other pelvic tumors

[1] Compt. Rend. de la Soc. de Obstét., de Gynecologie et de Pædiatrie de Paris, 1900, vol. ii.
[2] Ibid., 1901, vol. iii.

receives illustration in Varnier's case.[1] He opened the abdomen to remove an ovarian cyst, finding, instead, a retroflexed pregnant womb. The patient went to full term, and was delivered of a living child. Boldt[2] reported at a recent meeting of the New York Obstetrical Society a case of gonorrhœal pyosalpinx simulating tubal pregnancy. These examples from the recent literature of the subject illustrate the fact that these cases are not exceedingly rare.

The diagnosis of ectopic gestation is a subject of constant interest, and one which at times presents considerable difficulty. Aside from the anatomical features of the diagnosis, Weindler,[3] Veit, Martin, Olshausen, and others have drawn attention to the relation between the occurrence of rupture in ectopic gestation and the character of the menstruation shown by the patient. A further study of the subject from this standpoint may assist us in diagnosis.

A positive diagnosis can in almost all cases be immediately made by abdominal section. So grave a condition justifies, we believe, abdominal section, if this be necessary for accurate diagnosis. Even if the enlarged tube when removed does not prove to be the site of an ectopic gestation, the patient has suffered in no way from the operation. In cases of retroflexion and retroversion of the pregnant womb simulating ectopic gestation, abdominal section and the replacement of the womb are safer from all standpoints than the continuation of the condition. In good hands pregnancy is prolonged and hemorrhage and septic infection are prevented.

A RAPID REACTION FOR BENCE-JONES ALBUMOSE.

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During the past two years the writer has found opportunity to employ repeatedly the various tests now in use for the recognition of Bence-Jones albumose when present in the urine. A detailed account of these reactions will not be given, and let it suffice to say that the vast majority of them are caused by the presence of other of the albumoses, as peptone, histon, and globin. Indeed, but few of these tests distinguish clearly between peptones and Bence-Jones albumose; and these differences are commonly but a variation, in intensity or degree, of one and the same reaction.

The reaction which is probably most reliable is that with lead acetate and caustic soda for the detection of sulphur. Many chemists regard the presence of loosely combined sulphur as a pre-eminent feature

[1] Compt. Rend. de la Soc. de Obstét., de Gynecologie et de Pædiatrie de Paris, 1900, vol. ii.
[2] American Journal of Obstetrics, April, 1902. [3] Archiv f. Gynäk., 1900, Bd. lxi., Heft 3.

which distinguishes Bence-Jones' albumose from other albumoses. The methods suggested by the different writers for the application of this test, while practical, necessitate considerable time for execution. The following described method has proven to be of value in economizing both time and labor; and the reactions obtained by it were equally decisive with those displayed by the more complicated methods when used as controls:

Method for Application. 1. Fifteen to twenty c.c. of the filtered urine are placed in a test-tube, and to it an equal quantity of a saturated solution of sodium chloride is added, and the tube shaken to effect a perfect mixture.

2. Two or three c.c. of a 30 per cent. solution of caustic soda are now added, shaking vigorously.

3. The upper one-fourth of this column of liquid is gradually heated over the flame of a Bunsen burner to the boiling point, when a solution of lead acetate (10 per cent.) is added, drop by drop, boiling the upper previously heated stratum of liquid after each additional drop.

4. When the drop of lead solution comes in contact with the liquid a copious pearly or creamy cloud appears at the surface, which becomes less dense as the boiling point is neared; and when ebullition is prolonged for from one-half minute to one minute the upper stratum shows a slight browning, which deepens to that of a dull black, as shown by the accompanying illustration (1).

The lower portion of the heated liquid displays less marked blacking, and below this point for some distance there is seen a variable degree of browning (2). Standing intensifies the reaction; but if this be prolonged for several hours the black precipitate falls through the clear stratum of liquid (3), collecting as a coarsely granular pigment in the bottom of the tube (4).

This reaction has been studied in the urine of a case of myeloma—dilution, one part in ten; and often a much higher dilution gave positive results. It depends upon the presence of loosely combined sulphur—a constituent of Bence-Jones albumose—which when treated as above outlined causes the lead to be precipitated in the form of lead sulphide. Phosphates when present in excess may cause a slight, flocculent, brown precipitate upon addition of the soda solution; but this browning is not of sufficient intensity to be mistaken for that of albumose.

A CASE OF ADIPOSIS DOLOROSA (DERCUM'S DISEASE).[1]

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As Professor Dercum has stated in a recent paper, only twenty-five cases of adiposis dolorosa have been placed on record. I have no doubt myself that the disease occurs much more frequently than this number would lead us to believe. The limited number of cases reported is due to the fact that the general practitioner, and even neurologists, frequently fail to recognize it. The case that I have the pleasure of reporting this evening, though not as marked as others that I have seen, is, I believe, sufficiently characteristic to merit attention.

The case is that of Eleanor G., aged fifty-six years; white; married; housekeeper; American by birth.

Family History. Both parents dead—father of unknown cause, mother of heart disease. Had two brothers; both dead—one in infancy, the other at sixty-five years, of apoplexy; also had four sisters—three died in infancy, the other living and in good health.

Personal History. At the age of twelve years had scarlatina, and made a good recovery. Was married at the age of nineteen years, at which time she weighed less than one hundred pounds. Had eight children, five of whom are living. One child is an inmate of the Home for Feeble-minded Children, at Elwyn. Two died in infancy—one of cholera infantum, the other of marasmus; and the third, at three years of age, of diphtheria.

Shortly after her marriage she noticed an accumulation of fat over both hips and over the upper parts of her arms and legs. Passed through the menopause six years ago.

Seven or eight years ago she noticed that she became easily bruised, a blow of the slightest intensity causing pain, attended by black-and-blue discolorations. For over a year past she has suffered from sharp, shooting pains in the arms and hands. Was treated for neuritis for over a year at one of the Philadelphia clinics.

Status Præsens. On February 8th of this year (1902) she weighed 229 pounds; her present weight is 236 pounds. Complexion ruddy; has traces of arterio-sclerosis; complains of constant, sharp, shooting pains in the arms and hands. She is quickly fatigued, and presents symptoms of a neurasthenic character. There is a fatty deposit the size of an egg under the chin, which is painful to pressure. In both arms, near the axillary region, there are masses of pendulous, putty-like fat, decidedly painful to pressure. The arms below the elbows, though stout, are well rounded and proportioned. The wrists and hands are small and well formed. Pain on pressure over the back is also present. Over the hips and abdominal region the fat hangs in folds, and, as in the other regions, every slightest touch is attended with pain. The thighs, compared with the legs below the knees, are unusually large. Pressure over the fat on the inside of the thighs causes the patient to cry out with pain.

[1] Patient shown and paper read at March meeting of Philadelphia Neurological Society.

Her memory is impaired. There is no tremor of the tongue, lips, muscles of the face or hands. Pupillary reflexes are normal. The knee-jerks are plus. Romberg's symptom is absent.

The case presents the four cardinal symptoms noted by Vitaut, viz.: the enlargements, the pains, the neurasthenia, and the psychic symptoms, which here assume the form of impairment of memory and mental hebetude. The case must be classified in the group termed by Vitaut the localized diffuse form. The case is further typical in that the pains present are both spontaneous and induced. The pains are more or less constant; spontaneous exacerbations apparently do not

occur. Exacerbations are, however, provoked by pressure. The asthenia is typical in degree, ready fatigue upon exertion being very marked. The mental symptoms are also typical, though they are not pronounced. Secondary symptoms are not present. The case justifies the diagnosis of adiposis dolorosa, and is important because it presents the form with which the disease is commonly met, and which so often escapes recognition. The case before us, as we have already stated, was under observation in a public clinic for over a year without being recognized.

A FURTHER CONTRIBUTION TO OUR KNOWLEDGE OF THE HISTOLOGY OF THE GASTRIC MUCOSA IN PATHOLOGICAL CONDITIONS OF THIS ORGAN.*

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In 1896 I published a paper under a similar title.[1] For the sake of convenience I divided the pieces of gastric mucous membrane that are found in the wash-water or in the chyme according to their microscopic appearance into the following groups:

1. N.—*Normal.* Glands and interglandular tissue exist in normal proportions.

2. C.—*Connective Tissue.* While there is a normal proportion between the glands and interglandular tissue, there is a marked proliferation of connective tissue around the glands.

3. P.—*Proliferation.* There is a marked proliferation of the glands; they are nearer each other, and sometimes have an elongated and curved shape.

4. B.—*Beginning Atrophy.* The glands exist in smaller numbers and are sometimes also smaller in size, the interglandular spaces being quite large and filled partly with small-cell infiltration, partly with connective-tissue formation.

5. A.—*Atrophy.* Complete atrophy; no glands visible; only indications of their previous existence; round-cell infiltration.

6. V.—*Vacuolization.* Within the glands exist vacuoles of different shape, being the result of a mucoid degeneration of some glandular cells.

It is quite evident that this classification does not exhaust all possibilities that may be observed in pathological cases. My idea was only to furnish a foundation which may form a common basis upon which we can build further.

In my former article, to which I will again refer later, I have touched upon the older literature, and will at present cite only the more recent investigations relating to our subject.

Cohnheim,[2] in Boas' clinic, examined a large number of fresh pieces of gastric mucous membrane found in the wash-water, and came to the following conclusions: In cases of hyperacidity parenchymatous changes principally are found, consisting in a disappearance of the principal cells and proliferation of the parietal cells. In cases without hydrochloric acid the principal changes take place in the parenchyma, especially in the vestibular layer. The changes represent a mucoid degeneration of the normal cylindrical cells, and correspond to Hayem's "gastrite parenchymateuse muqueuse"—*i. e.*, the mucous catarrh of

* Read before the American Gastro-enterological Association, at Washington, D. C., May 1, 1902.

authors. In the glandular layer proper we find a disappearance of the parietal cells, with a normal amount of principal cells, as in Case XVIII., in whom the interstitial changes are only slight, and variations from the normal chemistry of the stomach are caused by these. In no case, however, is there a parenchymatous gastritis pure and simple, interstitial changes occurring everywhere to a greater or less degree, beginning with round-cell infiltration and going on to complete atrophy of the glandular layer.

In another paper,[3] dealing more with the diagnosis of cancer of the stomach, the same author arrives at the following conclusions:

1. The only absolutely conclusive sign of cancer that excludes every other doubt is the occurrence of small tumor particles found in washing out either the empty or filled stomach.

2. Nearly as pathognomic—at least according to our present experience—is the development of protozoa on the stomach mucosa.

3. The constant occurrence of pus in fetid or non-fetid stomach contents has up to now been observed only in cancer, although occasionally it may occur when a perigastric abscess breaks into the stomach, but then there is usually no mucus present.

4. All the symptoms may occur before a tumor can be palpated; they are therefore "relatively" early signs.

5. They are principally of importance in the diagnosis of carcinomata of the stomach not situated at the pylorus, since with those situated at the orifice other important signs occur earlier; occasionally, however, they are also observed in these cases.

Strauss and Myer[4] describe a case of hypersecretio continua chronica that came to autopsy. All the glands (both in the fundus and in the pylorus) can be plainly differentiated, but are coiled at their basal extremity. In some places the glands are cystically dilated. Parietal cells are increased. In the connective tissue there is round-cell infiltration, penetrating to the submucosa. In the glandular cells as well as in the gland lumen there are no leucocytes.

Martius and Lubarsch[5] give more exact numbers regarding the distribution of the glands in the stomach. They say in their book:

"I will say right here that in cross-sections of the mucous membrane of the stomach, measured just below its surface, we can see, on an average, twenty to twenty-five glands in one field (Zeiss obj. B.; Oc. 3), the number twenty corresponding about to the pyloric region, where normally the interglandular tissue is somewhat larger than in the other parts of the stomach. Corresponding with these conditions we find that the interglandular connective tissue in its broadest places has a width of five to seven rows of cells at the highest, and these places are found only directly under the surface epithelium. The nearer we approach the gland region proper the less interglandular tissue is found, consisting sometimes only of a few cells, gland lying

close to gland. If with the above-mentioned magnification the number of glands is around eighteen, and if there are found ten or more rows of cells in the connective tissue, we can with certainty speak of a proliferation of the connective tissue, even if we are unable to determine whether we have to deal with a piece from the pylorus or the fundus."

Hemmeter[6] has minutely examined the pieces of stomach mucous membrane in a large number of patients. He used my classification given above, and supplemented the same. This author says: "The objection that may be made against this is the fact that Einhorn seemingly had based his classification upon the condition of the glands and the interglandular tissue, regarding the state of the cells themselves only once in his six types. For this reason I will supplement his divisions by adding the appearance and condition of the vestibular cells and the appearance and numerical relations of the principal and parietal cells."

I would like to call attention to the fact that in these examinations we have to deal with small pieces only, where often, especially in cross-sections, it is difficult to say whether only the mouths or the deeper parts of the glands have been cut. For the same reason, numerical data relating to the principal and parietal cells would not be conclusive. Moreover, the significance of the latter has not yet been established.

The result of Hemmeter's investigation was as follows: Ten healthy persons: perfectly normal in eight; proliferation of glands in one; proliferation of connective tissue in one. Hyperacidity in twenty cases: normal in four; atrophy in two; gland proliferation in six; proliferation and hypertrophy of the parietal cells in eight. Anacidity or achylia: normal in two; gland proliferation in one; atrophy in nine.

Leuk[7] gives the following data regarding the relation between the glands and interglandular tissue in the normal human stomach:

In the fundus:

1. The number of gland openings in 1 mm. of mucous membrane (linear measure only) is about sixteen to eighteen.

2. The interfoveal connective tissue lying between two gland openings has a width of about 25 to 30 microns, measured directly under the epithelium.

3. In the middle of the mucous membrane the connective tissue between the glands has a width of 10 to 20 microns.

4. Connective tissue width in the deepest quarter of the mucous membrane, 5 to 10 microns.

5. Width of glands, 30 to 40 microns.

In the pylorus:

1. About nine, distributed regularly.

2. 25 to 30 microns.

3. 25 to 40 microns.

4. In places the same as in the fundus, but between single glands, the connective tissue may be up to 50 microns in width.

5. 45 microns.

Regarding the diagnosis of carcinoma, Leuk expresses himself as follows: "For an absolutely certain diagnosis of carcinoma from small pieces of stomach mucous membrane we must prove an atypical epithelial proliferation from the mucosa into the submucosa. Glands in the submucosa even without mitotic figures must not necessarily be the result of carcinomatous proliferation. Accessory Brunner glands in the pylorus, or simply ends of glands that have been cut off by a branch of the hypertrophic muscularis mucosæ, as I have often seen it in complete sections, might simulate a carcinoma.

"Taking it all in all, I think that our diagnostic knowledge based on the examination of chance pieces of stomach mucous membrane may be enlarged only in especially fortunate cases; in those where we intentionally try to obtain pieces for examination the condition may be somewhat more favorable."

Boekelman[8] examined pieces of stomach mucosa which he was enabled to obtain during gastro-enterostomy. He arrives at the following conclusions:

"All cases of gastric ulcer coincide in the fact that the glands lie closely together, the connective tissue being very narrow. Hyaline bodies are not ordinarily found. Many parietal cells are present, but their number is hard to estimate."

He finds:

1. The openings of the glands of normal length.
2. No goblet cells or ciliary epithelium.
3. Small diameter of the glands.
4. Little or no interstitial tissue.
5. Small round-cell infiltration in the superficial layers.
6. Few or no eosinophile polymorphonuclear leucocytes.
7. Few or no hyaline bodies.
8. Many capillaries and hemorrhages.
9. Many parietal cells, often more than normal.
10. The principal cells usually more affected than the parietal cells.

With carcinoma after ulcer the mucous membrane did not suffer much; in carcinoma without ulcer atrophy was frequently found.

The relation of atrophy to carcinoma ventriculi is described in an older paper by Rosenheim[9] in the following words:

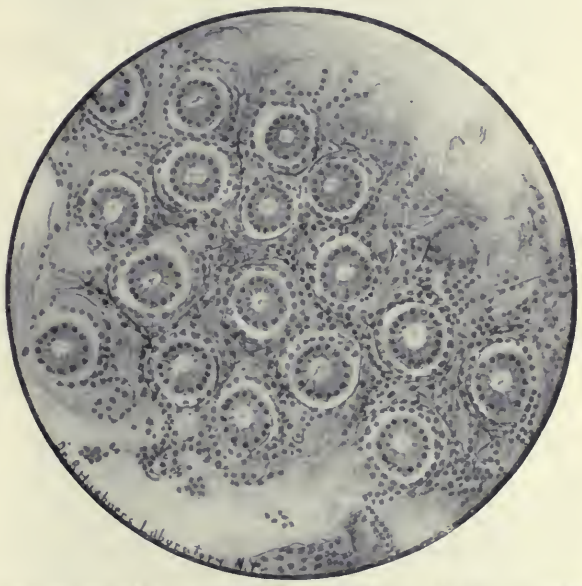
"Atrophic processes in the stomach mucous membrane have a far-reaching influence upon the body economy. They occur more frequently than has been assumed, and not only relatively frequently with carcinoma, but also as a disease of the stomach for itself. They are without doubt important factors in the development of the so-called essential anæmia—more so than they have up to now been credited

with." "From our investigations it is evident that atrophy is the result of catarrh and inflammation, and we thus may see the most frequent and benign affection of the stomach converted into a destructive process that threatens life."

Mathieu[10] is also of a similar opinion when he says: "Interstitial gastritis with atrophy of a considerable number of glands is often met with. Not only at the border of the tumor, but also at a distance from it, the glaudular elements have most often undergone a retrogressive modification which recalls that seen in gastric polyadenoma." "However that may be, interstitial gastritis and cancer go side by side or follow one another, just as in certain cases of primary cancer of the liver nodular carcinoma and cirrhosis develop simultaneously or successively."

All these authors agree with me in the main that the condition of the stomach mucous membrane in the different secretory states of the stomach is not a constant one.

FIG. 1.



Normal mucous membrane of stomach, showing relation of glands to interglandular substance. Obj. 3; Leitz eye-piece 4.

Having had the opportunity during the last six years, after the publication of my first article, to examine pieces of stomach mucous membrane in a large number of patients, it seemed to me worth while to publish the results of these more recent investigations and to enter more minutely into the details of the histological findings as well as their significance.

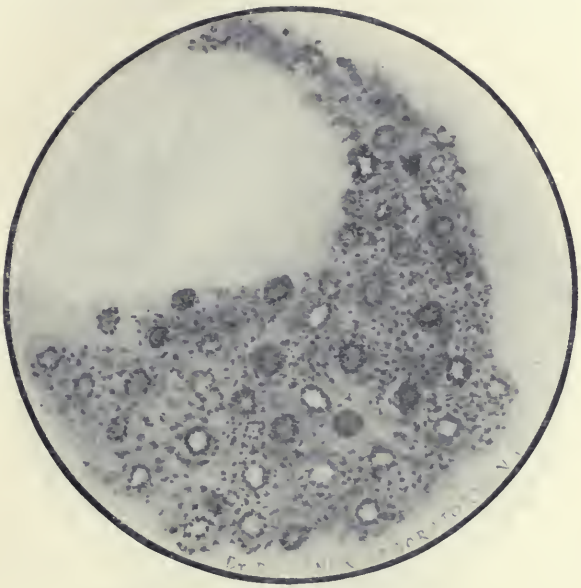
We have tabulated these new cases (thirty-four in all), and designated

Table of New Cases in which Small Pieces of Gastric Mucosa have been Examined, and the Result (1896–1902).

No.	Date.	Name.	Age	Diagnosis.		Gastric secretory function.		Anatomica state.	No. glands per sq. millimetre.	Remarks.
						Free HCl.	Total acidity.			
1	Feb. 22, 1896	Mr. H. C.	45	Gastritis chronica.	Euchlorhydria.	+	40	P. B.	64	Atypical glands.
2	Dec. 30, 1897	Mr. W. P.	45	Dilatatio ventric. ren mobil. dexter.		+	44	P.	44	
3	Oct. 31, 1900	Mr. C. D.	55	Gastritis chronica, hepatitis, icterus.		+	46	P. V. (?)	80	Mitoses; piece of submucosa visible.
4	Nov. 28, 1900	Mr. W. P.	44	Atonia vent., enteroptosis.		+	50	N. V.	80	Extravasations of blood; mitoses musc. mucosæ visible.
5	June 25, 1899	Mr. W. H. R.	53	Hepatitis.		+	56	P.	68	Blood extravasations; mitoses; small-cell infiltration; peptic glands.
6	Dec. 11, 1897	Mr. Alf. H.	38	Ructus, erosions.		+	56	N.	100	
7	April 4, 1898	Mr. Geo. F.	42	Erosions.	Hyperchlorhydria.	+	64	P. C.	72	Glands small in places; peptic glands.
8	Oct. 21, 1898	Mr. E. St.	27	Attacks of vomit'g, hyperchlorhydria.		+	70	C. P.	48	Large plaques of pavement epithelium.
9	Feb. 10, 1901	Mr. B. P.	36	Beginning stenosis of pylorus.		+	70	N. P. C.	88	Extravasations of red blood cells.
10	Apr. 29, 1899	Mr. M. W.	28	Dilatatio ventr., ren mob. dext.		+	72	C. P.	36	
11	Apr. 14, 1898	Miss M. W.	28	Gastroptosis, hepatoptosis, ren mob. sin.		+	72	N. C.	60	Peptic glands.
12	Feb. 3, 1896	Mr. G A.D.	32	Hyperchlorhydria.		+	76	C. P.	44	Peptic glands.
13	.....	Mr. Z.	50	Atonia vent. hyperchlorhydria.		+	80	B. C.	136	Glands small (38 microns).
14	Dec. 21. 1899	Miss A. E.	33	Gastralgia.		+	84	P. C.		
15	.....	Mrs. A.	44	Hyperchlorhydria, erosions.		+	84	C.	76	Round-cell infiltration in places.
16	Feb. 20, 1896	Mr. E. H. C.	40	Gastrosuccorrhœa contin. chron.		+	92	P. C.	128	
17	Jan. 30, 1896	Mr. W. W. S.	46	Gastrosuccorrhœa contin. chron. ulcus vent.		+	140	A.	...	No glands; fine connective tissue, probably from base of ulcer.
18	Nov. 16, 1901	Dr. D.	35	Enteritis chronica subacidity.	Hypochlorhydria.	+	26	P. V.	160	Connective tissue scanty; glands atypical.
19	Nov. 19, 1899	Dr. O. F.	42	Atonia ventric. erosions.		+	28	C. B.	52	Glands small; connective tissue rich in cells; mitoses; hyaline bodies.
20	Feb. 23, 1898	Mrs. F. L. S.	45	Dilatatio ventric.		+	28	B.	60	Glands small, indistinct; peptic glands.
21	Feb. 11, 1896	Mrs. J. S. H.	35	Erosions.		+	30	N. B.	104	Mitoses (diameter of glands 74 microns.)
22	Oct. 13, 1900	Mr. L. C.	30	Gastritis chron. erosions.		+	30	C. V. A.	48	Cell proliferation; in some cases complete atrophy; numerous capillaries; hemorrhagic infiltrations; hyaline bodies.
23	Aug. 17, 1901	Mrs. B. K.	48	Dyspepsia nervos. ventriculi.		?	?	N. C. V.	52	Some small glands; rich in cellular elements; mitoses; hyaline bodies.
24	Sept. 14, 1899	Mr. J. G. D.	40	Hyperæsthesia ventric. vomitus, achylia.	Achylia.	0	...	C.	60	Extravasations of red blood cells; glands small.
25	Jan. 14, 1897	Mrs. J. B.	60	Gastritis, enteritis, achylia.		0	...	P. A.	40	Interstitial hemorrhages.
26	Jan. 27, 1898	Miss P. F.	24	Achylia.		0	...	B. V.	120	Glands small (52 microns).
27	Jan. 10 1896	Mr. D. S.	48	Achylia.		0	...	A.	...	Some remains of glands.
28	Nov. 12, 1898	Mr. D. K.	34	Gastritis chron., splenic tumor, carc. ventr. (?)	Carcinoma ventriculi.	0 Rennet +	12	B.	40	Small round-cell carcinoma?
29	Jan. 18, 1896	Mr. M. W.	42	Carcinoma vent., ischochymia.		0	60 lactic +	C.	100	
30	Mar. 21, 1898	Mr. J. D. N.	65	Carcinoma vent. et hepatis.		+	36	C.	44	Large epithelial cells.
31	Dec. 4, 1899	Dr. W. H.	68	Carcinoma vent.		0	...	C.	...	Large spindle-shaped cells.
32	Nov. 14, 1899	Mr. M. K.	48	Carcinoma vent.		0	...	C.	20	Glands much enlarged (160 microns), filled with small round cells; epithelium of glands small; mitoses; interglandular hemorrhages.
33	Jan. 9, 1896	Mr. R. H. A.	62	Carcinoma vent., achylia.		0	...	A.	...	No glands visible, only traces of destroyed tubules can in some places be discovered.
34	Sept. 3, 1901	Mrs. P.	59	Carcinoma vent.		0	...	B.	32	Round-cell infiltration; in places more connective tissue; half-destroyed glands; hyaline bodies.

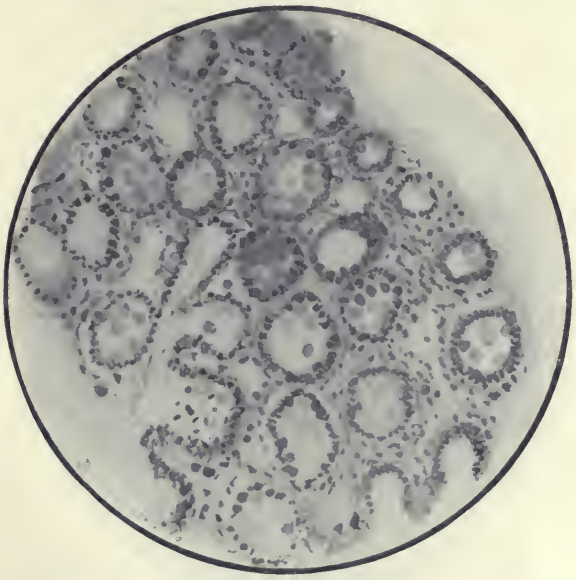
their microscopic appearance by the letters given to the various groups as described above. Before discussing the table we will first

FIG. 2.



Small glands. (Mr. Z.) Obj. 3; Leitz eye-piece 4.

FIG. 3.

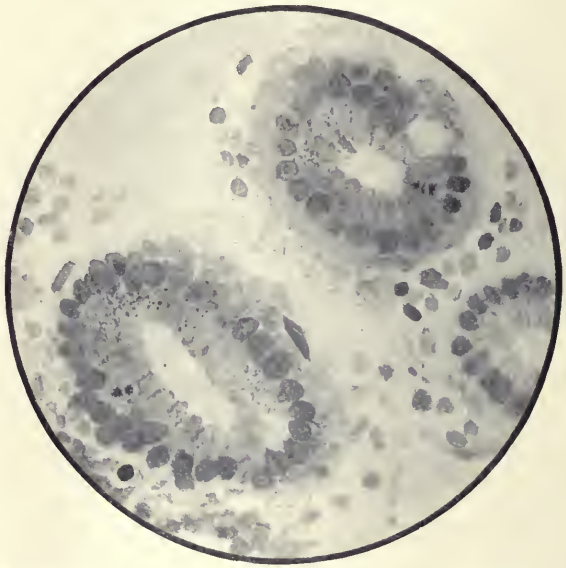


Large dilated glands. (Mr. K.) Obj. 3; Leitz eye-piece 4.

consider some peculiarities of the pathological histology that we have occasionally met with, and illustrate them by means of drawings.

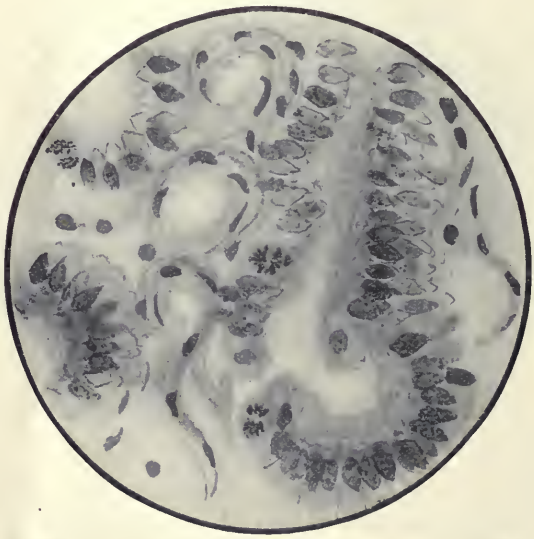
In order to emphasize the presence of abnormal conditions we will first illustrate the appearance of a piece of normal mucous membrane

FIG. 4.



Mitoses, one atypical. (Mrs. J. S. H.) Obj. $^1/_{12}$ oil; Leitz eye-piece 4.

FIG. 5.

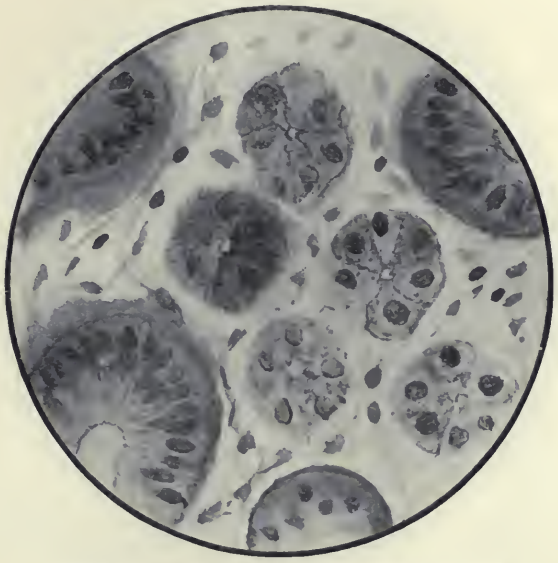


Mitoses, one atypical. (Mr. R.) Obj. $^1/_{12}$ oil; Leitz eye-piece 4.

(Fig. 1), the glands being cut transversely. This specimen was taken from the stomach of a murderer immediately after his execution, and was placed at my disposal through the kindness of Dr. R. Huebner.

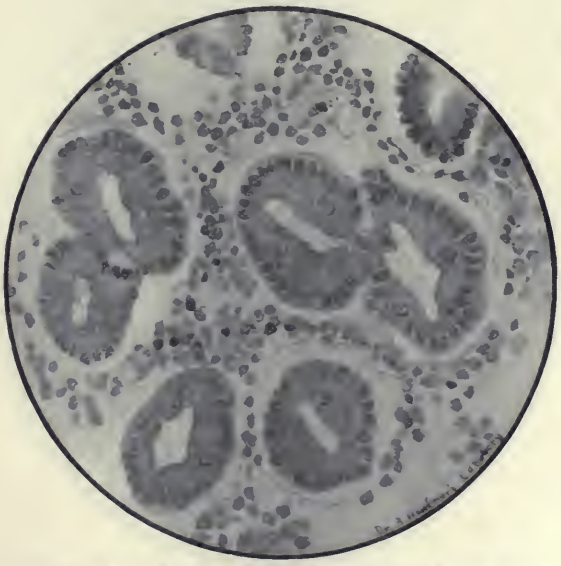
If we take the diameter of a cross-section of a normal stomach gland

FIG. 6.



Parietal cells. (Mr. R.) Obj. $^1/_{12}$ oil; Leitz eye-piece 4.

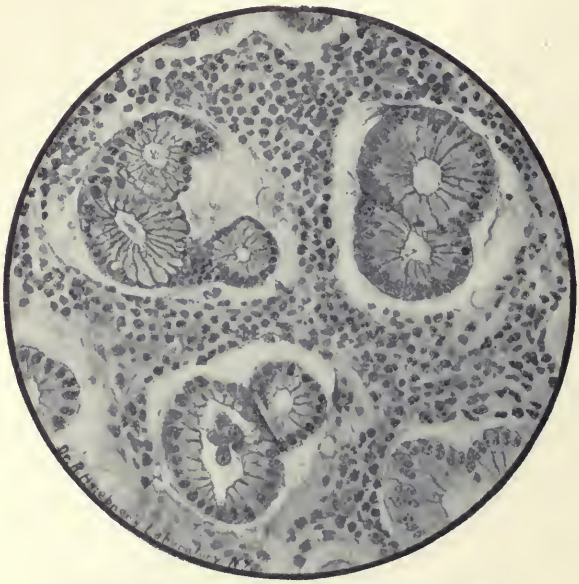
FIG. 7.



Atrophy, vacuole-like spots. (Mrs. K.) Obj. 7; Leitz eye-piece 4.

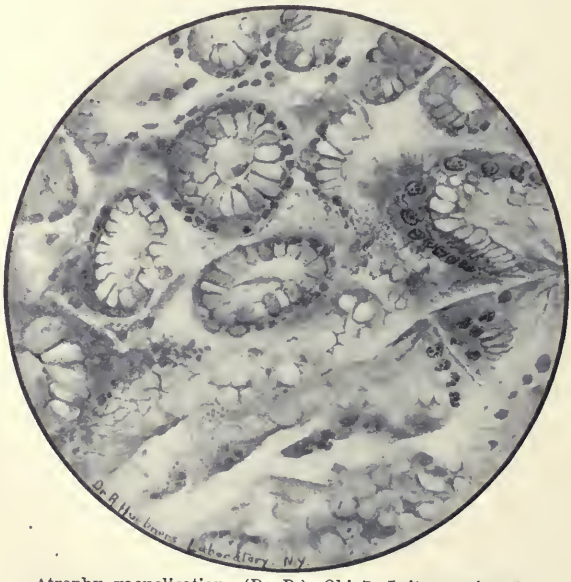
to be about 74 microns, we will find variations from this standard both above and below. Occasionally we observe exceedingly small glands, 38 microns and smaller, occurring sometimes with glands of normal size. They may be found present throughout the whole specimen. (Fig. 2.)

FIG. 8.



Fusion of glands. (Mrs. K.) Obj. 7; Leitz eye-piece 4.

FIG. 9.



Atrophy, vacuolization. (Dr. D.) Obj. 7; Leitz eye-piece 4.

On the other hand, we sometimes find especially large glands (160 microns and larger). The glandular epithelium is usually not enlarged, but there is a marked dilatation of the lumen; we would probably

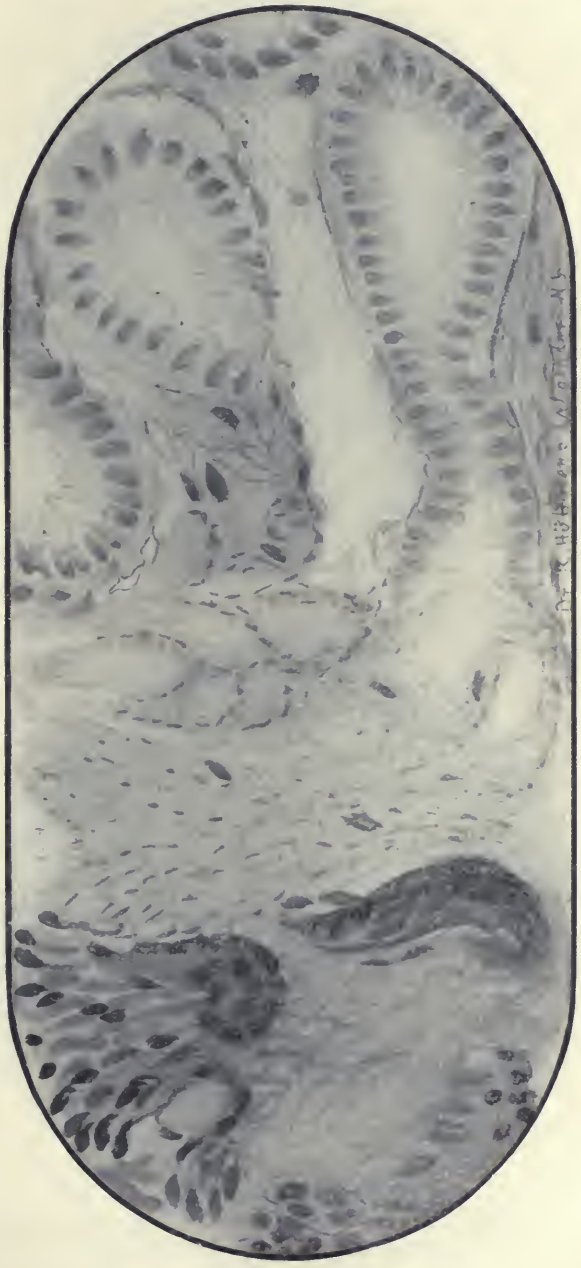
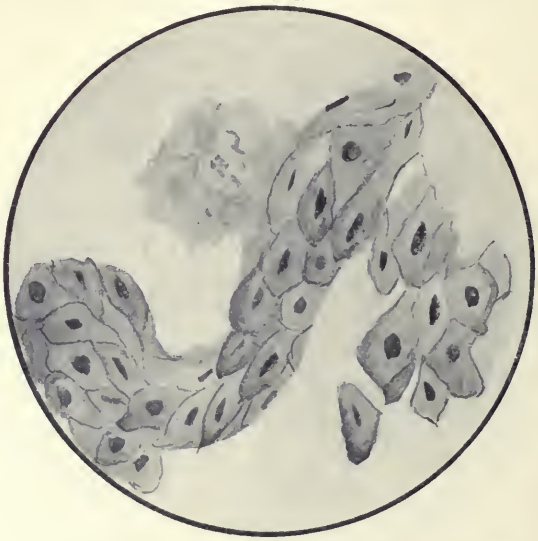


FIG. 10.

A piece of gastric mucosa, showing also submucosa and a portion of the muscular layer of the stomach. (Mr. Wm. P.) Obj. 1/12 oil; Leitz eye-piece 4.

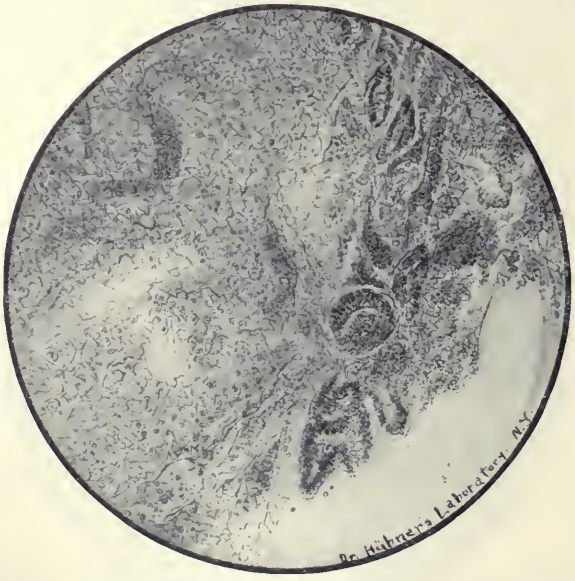
better call them dilated glands. We have met with marked cases of this kind twice. (Fig. 3.) In most places the lumen of the gland is

FIG. 11.



Pavement epithelium. (Mr. R.) Obj. 7; Leitz eye-piece 4.

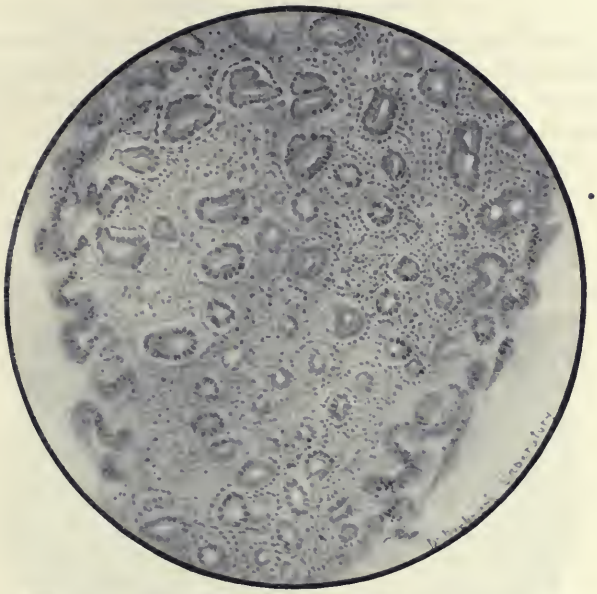
FIG. 12.



Interglandular tissue replaced by epithelial cells, which also invade the glands. (Mr. J. D. N.) Obj. 3; Leitz eye-piece 4.

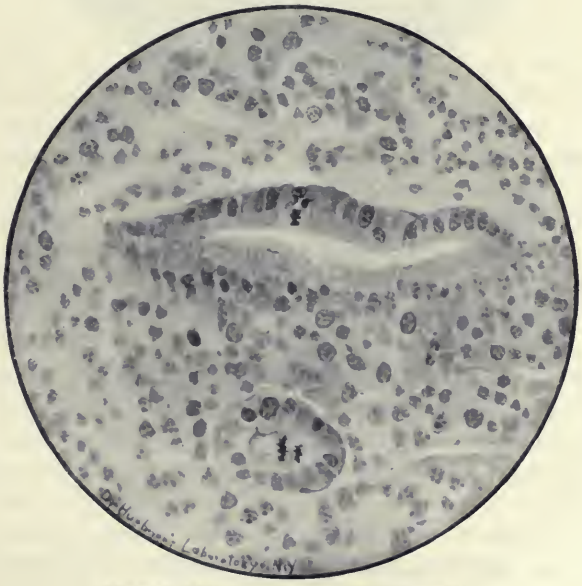
filled with cells, only occasionally the lumen being free, which may be explained by assuming that the contents have dropped out.

FIG. 13.



Atrophy; mitoses; interglandular tissue rich in cells. (Mrs. P.) Obj. 3; Leitz eye-piece 4.

FIG. 14.



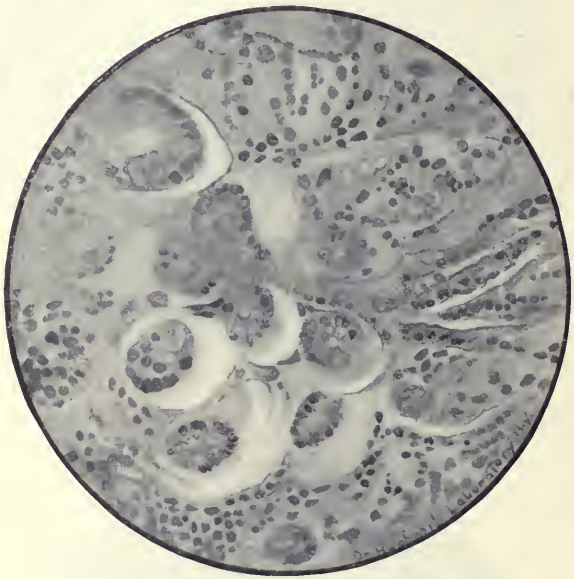
Mitoses. (Mrs. P.) Obj. 7; Leitz eye-piece 4.

An infiltration of leucocytes is often observed in the interglandular structure, more rarely in the glands themselves; the latter condition may be noted in Fig. 4.

Mitoses have been observed in several of the cases; they are by no means typical of neoplasms. Figs. 4 and 5 show karyokineses in typical and atypical form, although in neither case was a neoplasm present.

An increase in the parietal cells of the glands has been observed only a few times. Fig. 6 may serve as an illustration.

FIG. 15.



Atypical glands. (Mrs. P.) Obj. 7; Leitz eye-piece 4.

In some specimens showing evidences of atrophy (increase of interglandular connective tissue, small glands, etc.) we can often observe a kind of blending of the glands, as if they were destroying one another partially. Thus we find two, three, or more glands joined to one another, parts of each gland having disappeared.

In patient K. these conditions are pronounced, and are well shown in Figs. 7 and 8. There are also present in this case vacuole-like formations in the glandular epithelium, stained light blue with hæmatoxylin and showing a fine granulation.

Atrophic conditions may be associated with real vacuolization of the glands. Both conditions are especially marked in the case of Dr. D. (Fig. 9.)

Atrophic processes may also be combined with a tortuous course of the glands and apparent increase of the glands. We find this in the case of Mrs. John B.

The pieces of gastric mucosa that are occasionally found while washing the stomach, and which form the object of our investigations, represent usually only a part of the glandular surface of the stomach. Sometimes, however, the whole mucous membrane, and in rare cases the muscularis mucosæ, or even the submucosa and pieces of the muscular layer attached, are encountered. In the case of W. P., we can plainly observe this rare condition. (Fig. 10.)

Detached shreds of pavement epithelium may be observed off and on in cases that have nothing in common with cancer. Fig. 11 represents such a condition from the specimen of patient R., with slight hyperchlorhydria.

In cases of gastric cancer we may sometimes find signs of a neoplasm in the piece of mucosa, even if the latter does not directly originate from the involved area. In the case of N., with carcinoma ventriculi, there is an extensive epithelial proliferation between the glands. Besides we may be able to demonstrate the invasion of the glands by epithelial (cancer) cells in certain parts destroying the glands. (Fig. 12.)

Patient P., also suffering from cancer of the stomach, shows the signs of atrophy, fusion of the glands (Fig. 13), numerous atypical mitoses and collections of epithelial cells between the glands (Fig. 14); also the encroachment of epithelial cells upon the glands, and, finally, atypical shape of the glands. (Fig. 15.)

(For the beautiful execution of these drawings I am indebted to Dr. R. Huebner.)

Hyaline bodies, or so-called Russell's bodies, have been found in four specimens (one case of carcinoma and three of non-malignant disease). Several of the specimens had been cut too thick, and are unsuitable for the examination of hyaline bodies, otherwise we might have found these elements more frequently. They do not seem to have any pathological significance, although they point to degenerative processes.

If we now return to a consideration of the table we find that for the various secretory states (and also organic diseases) of the stomach there is no constant condition of the mucous membrane—a fact to which we have called attention in our first article.

Even in the group of euchlorhydria (six cases) the structure of the mucosa is not always the same. A proliferation of the glands was found in three, proliferation with beginning atrophy in one, normal in one, and vacuolization in one.

In the eleven cases with hyperchlorhydria we encounter normal conditions of the gland twice; proliferation seven times, either alone or in conjunction with increase of the connective tissue; once beginning atrophy and once absolute glandular atrophy.

Five cases of hypochlorhydria without organic disease showed in one normal conditions, with beginning atrophy; proliferation, with

vacuolization, in another; beginning atrophy in two, and increase of connective tissue, with vacuolization, in one.

Four cases of achylia gastrica simplex (without organic lesion) show connective-tissue increase in one; proliferation, with atrophy, in another; beginning atrophy and vacuolization in a third, and complete atrophy in one.

Cases of carcinoma of the stomach: In one case (David K.) the diagnosis of cancer was not absolutely certain, but was very probable; in all the other six the diagnosis of carcinoma at the time of the examination was positive.

In four connective-tissue proliferation was found, in two beginning atrophy, and total atrophy in one. A growth of epithelial cells into the gland lumina was found twice.

From the varying conditions of the mucous membrane of the stomach in the same secretory anomalies we may conclude that the pathologic-anatomical state of this organ is probably not the cause of the affection. In the article above cited I have tried to apply Edinger's[11] theory for nervous diseases to affections of the stomach. I called attention to the fact that increased functional activity of an organ leads to an increased development of the apparatus kept in activity. Corresponding changes will therefore be produced in the various organs by an increase or decrease of the functional work if continued for any length of time. In the stomach with an increased secretion (hyperchlorhydria, hypersecretion) a glandular proliferation would be expected; whereas, on the other hand, in cases of diminished gastric secretion or total absence of gastric juice (hypochlorhydria, achylia, etc.) a disappearance of the glandular element would be observed.

As a matter of fact, we find this principle indicated on looking at the table. With hyperchlorhydria frequently proliferation is observed, and with hypochlorhydria or achylia frequently beginning or complete atrophy.

The reason why these changes do not always occur I have tried to explain in my former paper by the supposition that the increased or decreased functional activity had perhaps not lasted long enough to produce these changes throughout the entire organ. In addition I would like to remark that, as long as with an increase of functional activity the nutrition of the organ is good, it will hypertrophy; but if the blood supply is inadequate the organ, in spite of increased work, will show the signs of atrophy or degeneration, an exhaustion of some parts occurring, which later perish. In some parts of the stomach similar conditions may at times be present, and thus atrophic states in hyperchlorhydria may be explained.

Why do we find glands in achylia, even if the condition has been present for a long time? Each organ has a certain inherent tendency

to retain as much as possible its normal condition, even if not called upon to do much work. The glands will try to perpetuate themselves, even under the most disadvantageous conditions.

According to this explanation, extensive changes in the mucous membrane of the stomach may take place without representing any primary disease of this organ; they may be the result of functional secretory disturbances of long standing.

It is well understood that the pathological processes need not on that account always be of a slight nature, but may show the signs of grave changes.

Although from a diagnostic standpoint the microscopic examination of pieces of mucous membrane of the stomach is inferior to the examination of the gastric juice, yet it may furnish a few prognostically important points. If, for instance, marked proliferation of the glands is found, an existing hyperchlorhydria may be considered to be of a more severe character. In the same way a marked atrophy of the glands in achylia would also be considered of importance.

Martius goes perhaps a little too far when he says: "I believe that as far as the prognosis of a certain stomach trouble is concerned, the result of a histological examination would be of significance. If in a case of achylia gastrica, in spite of subjective euphoria, we should find the anatomical lesions of gastritis progressiva atrophicans, we must bear in mind that a total atrophy of the mucous membrane of the stomach, with subsequent anæmia and cachexia, will be the sad outcome."

I have seen two patients with achylia gastrica (one of whom is David S., in the above table) in whom the examination of the piece of mucous membrane showed a complete atrophy of the glands, and who, in spite of this, have enjoyed the best of health for years. Microscopic examination shows only how far the changes have taken place in the mucous membrane, but gives no hint as to the general bodily condition (how long the body may still exist, etc.). Fortunately, the human organism possesses numerous mechanisms, by means of which even grave functional disturbances with subsequent tissue changes may be compensated.

In carcinoma, also, the examination of pieces of the mucous membrane of the stomach may occasionally be of value, especially when we can demonstrate a direct invasion of the glandular tissue by epithelial cells, as this apparently seems to speak positively for carcinoma.

Footing upon the above theory that the secretory disturbances of the stomach are not dependent upon a primary disease of the mucosa, but are of a purely functional nature, caused by abnormal nerve influences, the following points would suggest themselves in the therapy of these affections:

1. Our therapeutic measures must not be directed against the stomach alone, but must take into consideration the entire bodily state. Any anomalies in the blood or nervous system must first be corrected. Everything must tend to apportion work and rest for the principal organs in an even manner, and bring them into harmony with each other. In this relation the well-known hygienic principles of a correct mode of life are of great importance.

2. Any anomalies should be corrected as far as possible. If this is not possible, everything should be done to make it easy for the anomaly, so that the organism suffers as little as possible.

As to the first point (the improvement of the general bodily condition), we must attempt to establish a correct mode of living, give tonics (iron, arsenic, strychnine, etc.) if needed, or perhaps sedatives for the nervous system (bromides, zinc valerianate, etc.). Hydrotherapeutic measures (massage, gymnastics, general electricity) and change of climate (mountains or seaside) are also of importance.

Regarding the second point (special measures directed against any anomaly of secretion that may be present), we must pay attention to a suitable diet and to direct treatment of the stomach.

In all secretory anomalies as well as in all chronic ailments the principle of giving sufficient nourishment is the main one. We must, therefore, see that the patient eats enough.

In cases of hyperchlorhydria a diet comparatively rich in proteids and poor in carbohydrates will be chosen. Albuminous substances unite with the free hydrochloric acid, thus using up some of the concentrated juice. The subjective feeling of the patient is better, and the strong acid will not so readily injure the mucous membrane of the stomach.

It has been proposed not to give any meat diet in hyperchlorhydria, as this, according to Pawlow, would tend to increase the secretion. We ought, however, not to lose sight of the fact that Pawlow's experiments, interesting as they may be, relate only to normal conditions, and cannot at once be applied to diseased states. In our cases we have to deal with persons whose stomach (probably through abnormal nerve influences) yields a very concentrated stomach juice. Here the meat diet will probably not cause an increased flow of secretion, but rather make good use of the acid, uniting readily with it on the one hand, and on the other hand being more easily digested by the excess of acid. Practically, a diet rich in proteids has stood the test of usefulness in hyperchlorhydria, and there is no reason why we should give it up.

In cases of hypochlorhydria and achylia the food ought to be rich in carbohydrates, and the amount of albumin should be decreased. A fine subdivision of the foodstuffs also is essential here. The reason for both these rules is that with the lessened secretion of the stomach

albuminous substances are digested in the stomach either not at all or only with difficulty, and in consequence mechanically irritate the bowel, causing discomfort.

Butter is not only permissible, but even indicated in all secretory anomalies.

Should there be periods of rest—*i. e.*, fluid diet—in the regimen? Although this may be resorted to for a short while, it hardly seems to be of much value, for in all these cases the primary seat of the disease is not in the stomach, and very little would be gained by special resting of the stomach. On the contrary, it seems to be more rational to regulate the diet in such a manner that it will gradually increase the work of the organs of digestion, so that the system becomes accustomed to digesting the usual foods.

The direct therapeutics of the stomach (medicaments, electricity) are generally well known, and need not be referred to here. They serve the purpose of alleviating the ailments of the stomach or to remove them.

As the result of this paper the following conclusions might be formulated:

1. The secretory functional disturbances of the stomach are not based on a primary change in the mucous membrane of the stomach. They rather produce, if they last for a longer time, lesions of the mucosa of greater or less extent.

2. The diagnosis of carcinoma of the stomach may, under specially favorable conditions, be made from a piece of gastric mucosa if a direct invasion of the gland substance by epithelial cells can be observed.

3. Therapeutically, attention must be directed principally toward the improvement of the general body state, and only secondarily by means of special measures against any secretory anomalies that may be present.

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INFECTION OF OVARIAN CYSTS DURING TYPHOID FEVER; REPORT OF TWO CASES; OPERATION; RELAPSE; RECOVERY.

By Morris J. Lewis, M.D.

and

Robert G. Le Conte, M.D.

These two cases seem to us worthy of report for the following reasons:

1. The condition is a rare one, for it of necessity implies the previous existence of an ovarian cyst in a woman suffering from typhoid fever, and the combination is, perhaps, not common. When such a cyst does exist in a typhoid case we have no means of judging how frequently it will become infected during the course of the disease, for statistics are not obtainable on this point. We have been able to collect from the literature only six similar cases, five of which were observed in Germany; but if we remember that the recognition and cultivation of the typhoid bacillus has been possible only during the last ten or twelve years, the apparent rarity of the condition is readily explained. Several cases are on record previously to 1890 where operation was undertaken for the relief of suppurating ovarian cysts, and in which an antecedent attack of typhoid fever had been noted, and it is certainly probable that some of these suppurating conditions were due to the typhoid bacillus, although the bacteriological note is wanting.

2. They are the only cases we can find in which a relapse in the fever occurred immediately following the surgical procedures. In the other recorded cases the convalescence was uneventful.

3. With the exception of Sudeck's case they are the only ones that were operated upon within a few weeks of the beginning of the typhoid fever. In the other cases three to eight months elapsed before operation was undertaken.

Case I. (Dr. Le Conte's case).—S. N., aged twenty-eight years, Russian, married, housework, admitted to the Pennsylvania Hospital September 10, 1901.

Family history negative.

Personal history negative. Has given birth to four children, one dying at the age of four months.

Present Illness. Five weeks before admission was delivered of a full-term child, and nursed it at the breast for twelve days. She was then very wretched and sick with fever, and had been confined to bed for three weeks.

On admission, temperature was 104.8° F., pulse 120, respiration 32. Color pale; tongue coated, red edges and tremulous; heart and lungs

[1] Read before the College of Physicians of Philadelphia, June 4, 1902.

negative; liver dulness extends one and a half inches beyond edge of ribs; spleen large and palpable a finger's breadth beyond edge of ribs; abdomen soft, not distended, with several rose spots, some of which look typhoidal; leucocyte count 2600; urine reddish-yellow, flocculent sediment, specific gravity 1020, acid, albumin, granular and hyaline casts; diazo reaction positive. A vaginal examination was made, as the case was admitted under the diagnosis of puerperal sepsis, but, unfortunately, the resident physician made no note of the findings. A Widal test taken the day of admission was suggestive, and two days later it proved positive. For three weeks the patient presented symptoms of a moderately severe case of typhoid fever; the delirium and stupor were at times marked, and bronchitis developed, with some dulness at base of right lung. The pulse at times was very irregular, and always weak. The temperature averaged about 101° F. to 102° F., with occasional rises to 103° F. and over, and falls to 99° F. A blood count, September 21st, showed 5450 leucocytes. During the fourth week the character of the temperature changed, and it began to assume a hectic type. At this time also the patient began to complain of pain in the pelvic region, with slight tenderness. Dr. J. A. Scott, one of the hospital staff, who had the patient in charge, called one of the writers (Le Conte) in consultation. A vaginal examination revealed a large, exquisitely tender, fluctuating mass in Douglas' cul-de-sac, which bulged in the posterior wall of the vagina and pushed the uterus up behind the pubis. The extent of the mass could not be well outlined, owing to the patient keeping the abdominal muscles rigid, but it was estimated that the cyst contained from one to two pints of pus.

The patient was transferred to the surgical wards, but for one week refused all surgical interference. Then she agreed to a simple vaginal puncture to evacuate the pus. A blood count showed 10,400 leucocytes, with 55 per cent. hæmoglobin.

Thirty-seven days after admission the patient was etherized and the abscess opened with a knife through the posterior wall of the vagina. About a quart of fetid greenish pus with many cheesy particles was evacuated. On introducing the finger through the opening, cartilage and bone were recognized in the cyst wall. The diagnosis of a suppurating teratomatous cyst was then assured. The pus removed was examined by Dr. Longcope, and showed the bacillus typhosus in large numbers and in pure culture. For the next three days the temperature for the first time went below normal, and did not go above 100.2° F. Pus was freely discharged from the vagina, and she received vaginal douches, 1:5000 bichloride of mercury. During the next week the temperature gradually rose until it reached 104.4° F. This rise was continuous and not of a hectic character, but as the discharge from the vagina was considerably less in amount, it was feared that the pus was being retained in the cyst. A drainage-tube was introduced through the vagina into the cyst, and this was flushed out twice a day with 1:10,000 bichloride solution. This, however, had no effect on the temperature, which continued to rise. The leucocytes at this time numbered 5500, and the Widal reaction was positive.

The spleen, which had retracted behind the ribs, again became palpable, and rose spots appeared upon the abdomen. A diagnosis of relapse in typhoid fever was made, and the patient again removed to the medical wards under Dr. Scott's care.

During this relapse the patient was very ill, the temperature reaching 106.4° F., and the pulse frequently being 140 to 160 and very weak. Twenty-seven days after the evacuation of the cyst the temperature reached normal, and soon thereafter became subnormal for the most part. Convalescence was uninterrupted, but a moderate discharge from the cyst continued. She left the hospital fifty-two days after operation, refusing further surgical interference, but promising to return in a few weeks for the removal of the teratomatous cyst.

Readmitted to the hospital March 12, 1902. Vaginal examination showed that the left ovary was the seat of the disease, and that the tumor was about the size of a small orange. It still occupied a position behind the uterus. March 14, 1902, ether was administered, and the cyst, together with the left tube, was easily removed through a median abdominal incision. It was lightly but universally adherent to the surrounding organs. A wick of iodoform gauze was passed through the vaginal sinus and the abdominal incision closed without drainage. The recovery was uneventful.

The following pathological report was kindly furnished by Dr. Longcope:

Macroscopic Appearance. The specimen consists of the left ovary and Fallopian tube.

Fallopian Tube. The Fallopian tube measures about 5 cm. in length. The surface, although somewhat injected, is free from adhesions, and the fimbriated extremity is open, the fimbria being delicate. The wall is not thickened, and the mucosa is normal.

Ovary. Occupying the position of the ovary is a mass the size of a lemon, which measures approximately 6 cm. in diameter. The surface is infected and contains adhesions. The mass is irregularly lobulated and feels as though composed of hard cartilaginous portions, varying with soft cystic areas.

On section, the tumor appears as a cyst containing grumous, foul-smelling pus, and its cavity is almost completely filled with irregular growths and projections from the walls. The walls, excluding the outgrowths, are about ½ cm. in thickness and covered with a reddish, velvety membrane. The largest outgrowth is about the size of a walnut. It is hard, and appears to contain cartilage and bone. Its surface is irregular and presents small, velvety cauliflower excrescences, which are sprinkled with minute yellow calcareous plates. Often smaller outgrowths project from the wall, being, in general, similar to the larger one. On section of these masses they are found to be composed of bone, cartilage, fat, and glandular spaces, all of which tissues are mixed indiscriminately together. The bony areas are, however, usually confined to the superficial portions.

Microscopic Appearance. Sections are made through different portions of the cyst wall, and the wall is found to contain many varieties of tissue. The cyst is lined by stratified squamous epithelium, with exaggerated papilla formation. No pigment is present, and the horny layer present in skin is likewise absent. Below the epithelium is a fairly dense connective tissue representing the corium. Many sebaceous glands are seen immediately below the epithelium, some of them opening through ducts upon the surface. No hair follicles are found. The

greater portion of the corium presents a marked round-cell infiltration. In the deeper portions of the wall, which is composed of a loose connective-tissue framework, several large areas of cartilage are found. In these there can be seen irregular masses, taking a deep eosin stain and containing a few contracted nuclei, evidently areas of beginning bone-formation. Small ducts and cysts are also met with, being lined by a single layer of high columnar ciliated epithelium. Their lumina contain an irregular stringy substance, which stains blue in hæmatoxylin. In one area they are very numerous, widely dilated, with low cuboidal epithelium, and give the appearance of a multilocular cyst. They are filled with a homogeneous yellow substance. The area is bordered on two sides by cartilage. In other sections masses of cartilage appear surrounded by ducts and glands, and in one place a large tubule lined with high columnar epithelium cells, with cartilage just below it, closely resembles a bronchus. In some sections the wall is filled with small round cells, lying between greatly congested vessels, and in others fat is present in large amounts. Frequently long bundles of spindle cells, which cross and interlace, are seen, suggesting smooth muscle. Occasionally an irregular mass of bone is present, or a large striated homogeneous mass, taking a deep eosin stain, probably calcified material. Surrounding the vessels are many cells of an epithelial type. In one section a large cyst is found, lined by several layers of columnar epithelium, and filled with granular material and red blood corpuscles. The Fallopian tube is perfectly normal, there are no adhesions about its surface, and the walls are thin and the mucosa is delicate.

Diagnosis. Teratoma of ovary; Fallopian tube of same side normal.

Perhaps the most interesting clinical features in this case are: 1. The question of diagnosis between puerperal sepsis and typhoid fever at the time the patient was admitted to the hospital. 2. When convalescence should have been established the fever did not touch normal, but assumed a hectic character, with coincident abdominal pain and enlargement. The leucocytes, which had previously been subnormal, doubled in number. 3. After the pus was evacuated the question of whether the steadily rising temperature was due to retained pus or a relapse. This was positively cleared up in a few days, when the leucocytes again returned to a subnormal number, the spleen again became palpable after having returned to a normal size, and the appearance of a new crop of rose spots. 4. To what should the relapse be attributed? This will be discussed further on.

Case II. (Dr. Lewis' case).—Mrs. ——, aged thirty years, family and previous personal history negative. Patient was married in September, 1900, and in May, 1901, had a miscarriage in the third month of gestation, apparently caused by overexertion in packing trunks, etc., preparatory to moving.

Curettement was performed, under ether, by Dr. B. C. Hirst, and the patient made an uneventful recovery. An examination made one month later showed the pelvic organs to be in a perfectly healthy condition. During the following summer the patient was said to be not quite in her normal state of health, although she menstruated regularly,

CHART I.

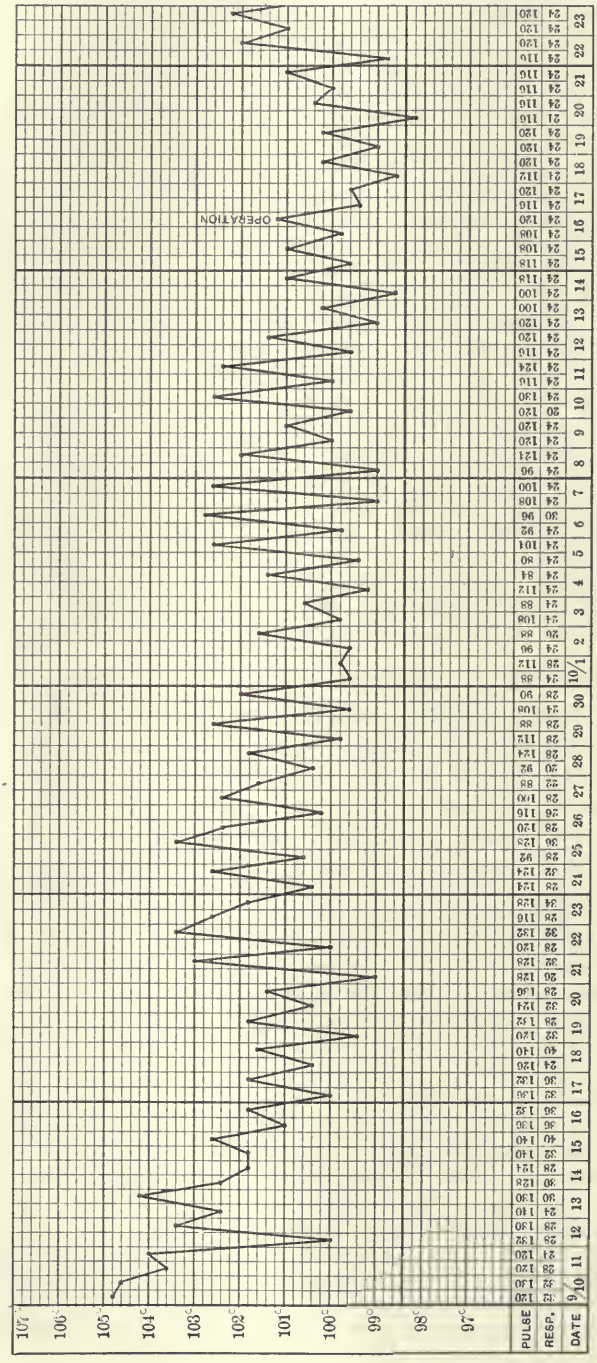
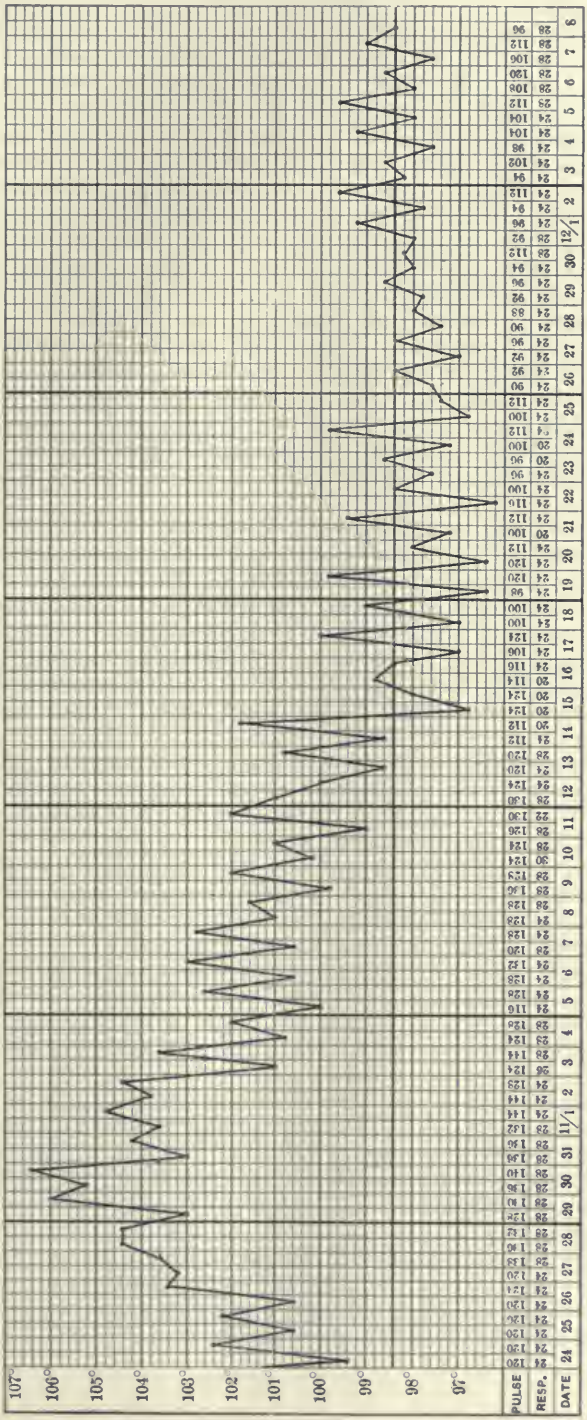

OPERATION
107°
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°
PULSE
RESP.
DATE

CHART I. (Continued.)



and considered herself well. On December 1, 1901, she contracted typhoid fever while in Philadelphia. The temperature by the end of the first week registered 104° F. and over, and the case assumed all the aspects of typical typhoid fever. Spots appeared, and Widal reaction was prompt and positive, and the spleen was slightly enlarged.

Nothing unusual occurred during the course of the fever, except that it was of long duration. For eighteen days the average temperature was about 103° F., after which there was a gradual decline until January 5th was reached, a period of thirty-six days. The treatment was sponging and ice-bags to the abdomen; β-naphthol was administered during the whole course of the disease, and whiskey, strychnine, and digitalis were given as seemed called for. The bowel movements, which for the earlier portion of the attack were typical in character, now began to be formed and normal in appearance, but the patient was far from well; she was occasionally slightly delirious and had persistent mild delusions. On the thirty-seventh day, when it was hoped that the patient was entering upon convalescence, the temperature rose to 102.2° F. in the evening, to fall to 97.4° F. by the next morning. There was no chill, and, with the exception of slight nausea, the patient felt fairly comfortable. Examination of the abdomen was absolutely negative.

During the next two days the temperature oscillated greatly, falling as low as 97.6° F., and rising once to 103.6° F. No chills accompanied this, and no true sweating, although there was rather free perspiration. Dr. Robert N. Willson's report of the examination of the blood on January 9th, the fortieth day, is as follows: "Blood flows easily and is of good color. Hæmoglobin, 95 per cent. Coagulability normal. Red corpuscles, 4,962,000; white corpuscles, 7800. No malarial plasmodia. No pigmented leucocytes. No poikilocytosis." No differential count was made.

On the seventh day of the supposed relapse one doubtful spot was seen, and by this time the temperature range averaged over 103° F. She began to complain of pain in the legs, and by the tenth day had for the first time a decidedly chilly sensation. No cause for this condition could be detected. There was neither cardiac nor pulmonary complication, nor could careful search determine any spot of tenderness in the abdomen, although the latter was somewhat tympanitic. An examination of the urine showed specific gravity 1009, acid, amber, turbid, sediment abundant, white, flocculent, albumin none, sugar none, urea 0.972 gm. per 100 c.c. Microscopically, full of bacteria in active motion (typical motion and shape of typhoid bacilli), full of leucocytes, very few scattered renal cells, no casts, no crystals, few squamous cells.

By the twentieth day the temperature averaged a little over 100° F., and a second examination of the blood revealed "blood rather pale, coagulation normal, hæmoglobin 70 to 75 per cent., red corpuscles 3,832,000, white corpuscles 4800, polymorphonuclear cells 90 per cent., no evident poikilocytosis." On the next day some pain in defecation was noted and also a slight asymmetry of the abdomen, the lower portion of the left rectus apparently bulging a little. No tenderness could be elicited on palpation; no mass was noticed, and the percussion-note was tympanitic, the whole abdomen being somewhat tympanitic.

On the twenty-fourth day there was some diarrhœa and acute pain

in the epigastrium, which, however, entirely disappeared after the escape of a large amount of flatus. There was now considerable distress in the rectum. Feeling sure that some serious complication existed, a vaginal examination was made, not because the patient complained of abdominal or pelvic pain, but purely for purposes of investigation.

The examination revealed bulging in Douglas' cul-de-sac on the left side, quite sensitive to pressure. A sense of fluctuation was conveyed to the examining finger when percussion was made over the left lower quadrant of the abdomen.

A third examination of the blood revealed " blood fairly good color, coagulation normal, hæmoglobin 78 per cent. (color muddy, as of leucocytic influence), red corpuscles 4,264,000, white corpuscles 9200, polymorphonuclear cells 92 per cent., no poikilocytosis."

Dr. Richard H. Harte was called in consultation. The diagnosis of pelvic abscess was confirmed, and operation immediately urged. The patient was at once conveyed to the Pennsylvania Hospital, and in one hour after admission was etherized and the operation performed by Dr. Harte. The abdomen was opened in the median line, and immediately underlying the peritoneum a large cystic tumor appeared, which was adherent to the rectum and to the left Fallopian tube. In attempting its removal entire it ruptured and a large quantity of coffee-colored, rather grumous offensive material escaped, soiling the peritoneum. Owing to its close adhesion to the bowel all of the cyst could not be removed, although most of it was cut away, and the tube and remnant of ovary removed. The ovary and tube on the right side were normal. A small fibroid tumor on the fundus of the uterus was not removed, as the patient's condition did not warrant it. Gauze packing was introduced for drainage.

A culture was made at the time of operation, from the pus from the ovarian cyst, by Dr. Longcope, and this showed subsequently pure culture of typhoid bacilli. The patient reacted well from the operation, the temperature rose during the next twelve hours from 100.2° F., which it registered immediately before, to 103.4° F., and then gradually fell to 99° F.

On the morning of the fifth day the temperature rose to 104° F., and subsequently remained at about 102° F., and the question arose as to whether there was further trouble in the abdomen or whether it was a relapse of typhoid fever. The abdominal condition seemed to be perfectly satisfactory, and after consultation it was decided that the patient was having a relapse of typhoid fever, a decision which was verified by the subsequent progress of the case.

A blood examination made at this time revealed red corpuscles 4,320,000, white corpuscles 7900, hæmoglobin 60 per cent., polymorphonuclear cells 72 per cent. A rose spot was noted on February 11th, seven days after the secondary fever. The surgical progress of the case was uneventful. After the fourteenth day of the relapse the temperature remained normal, and the patient made a perfect recovery, and is, at the time of making this report (June 4, 1902), enjoying apparent perfect health.

The following pathological report was furnished by Dr. Longcope:

Macroscopic Appearance. The specimen consists of the left ovary and Fallopian tube. Springing from the ovary is a cyst which has

CHART II.

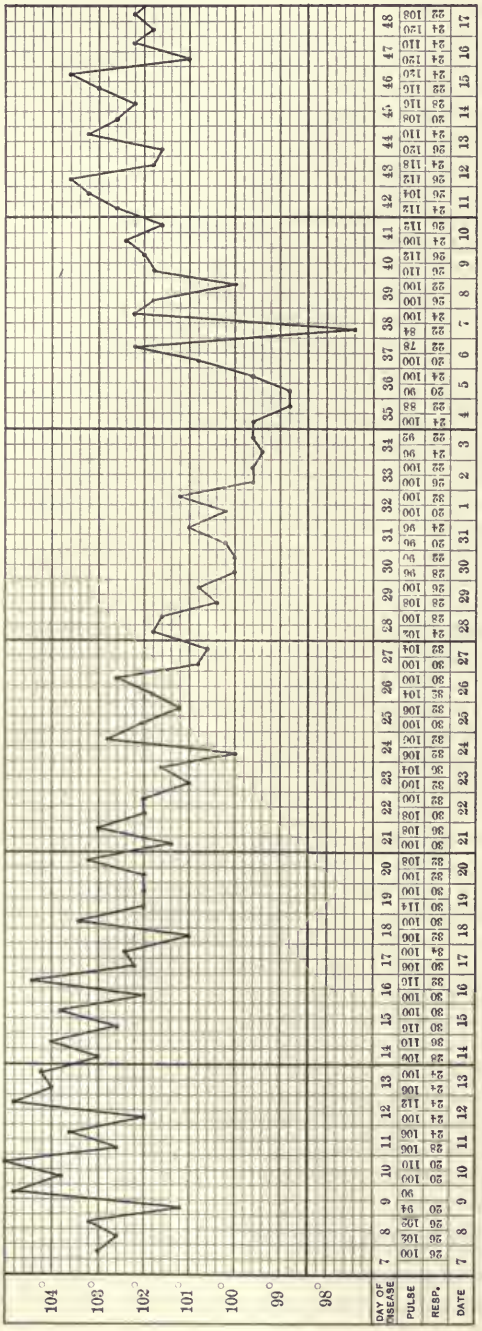
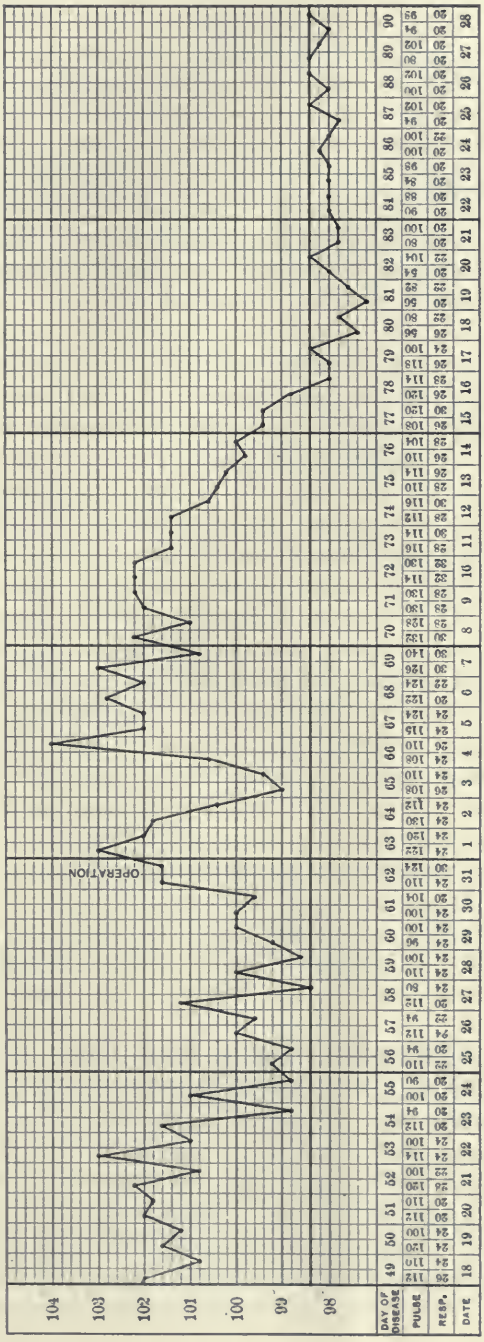

104°
103°
102°
101°
100°
99°
98°
DAY OF DISEASE
PULSE
RESP.
DATE
Dec., 1901
Jan., 1902

CHART II. (Continued.)



been opened; it apparently was the size of a small orange. The wall averages about 5 mm. in thickness and is covered by old adhesions; its inner lining consists of a soft, deeply injected tissue. The Fallopian tube is normal; its fimbriæ are delicate.

Microscopic Examination. The cortex of the ovary contains many young follicles and one large follicle. The deeper layers of the cyst wall are composed of fairly dense connective-tissue. The superficial layers consist of young granulation tissue, made up principally of large cells of an epithelial type, many of which are phagocytic. Large amounts of yellowish-brown pigment and hæmatoidin are scattered through the middle portion of the wall, and a few polymorphonuclear leucocytes are found usually in the capillaries. The Fallopian tube is normal. Cultures from the ovarian cyst give bacilli typhosus. No other organisms found. Cultures from the Fallopian tube give negative results.

That relapse should occur five days after the operation in both of these cases is interesting, and the question as to whether the operation held any causal relation to the subsequent relapses was seriously entertained. At first the question arose as to whether it was possible that the operation might have liberated the imprisoned bacilli, like the lifting of the lid of Pandora's box, and reinfected both cases, for it will be remembered that the opportunity for infection was present, in the first case through the vaginal wound, and in the second on account of the rupturing of the cyst during its removal; but further study showed this to be unlikely, and that the relationship was probably coincidental. In Werth's case the cyst, containing thin, foul pus, was ruptured and a part of its contents spilled in the peritoneum, and in Sudeck's case part of the foul pus escaped and soiled the wound, and from an abscess of the wound which occurred later typhoid bacilli and staphylococci were recovered, and yet no relapse occurred in either case. This explanation of the relapse, therefore, does not appear probable, particularly when taken in connection with the short period of time elapsing between the operation and the time of onset of the relapse, and especially as it is believed that the typhoid bacillus must gain entrance to the intestines in order to infect specifically. We are still, unfortunately, much in the dark as to the cause of relapse in typhoid fever.

The blood examinations in both of these cases is of much interest, but in neither did the findings modify the views held as to the necessity of operative interference; they served merely as corroborative evidence. In the second case the leucocyte count was 4800 on January 24th, only seven days before the operation and just before the discovery of the abscess. This count is below the average count of the leucocytes in typhoid fever, which is placed by Thayer at 5860 ("Studies in Typhoid Fever," *Johns Hopkins Hospital Bulletin*, 1901, p. 500), while the percentage of the polymorphonuclear cells was above the average of health,

viz., 90. Six days later the white corpuscles had risen to 9200, and the polymorphonuclears to 92 per cent., a relative leucocytosis. A week after the operation the leucocytes had fallen to 7900, and the polymorphonuclears to 72 per cent.

Cabot (third edition, 1898, p. 107) states in substance that in some cases in which the absolute number of leucocytes is not increased we see a relative increase in the polymorphonuclear cells, pointing to the fact that influences are at work similar to those which produce an absolute increase; and again, on p. 195, he states that this increased percentage of polymorphonuclear forms generally betrays the presence of some complication, though no increase in the total leucocyte count is present, since during typhoid fever, if uncomplicated, the polymorphonuclear forms are diminished. This case is an interesting corroboration of these statements. In the first case the leucocyte count two days after admission was 2600, and ten days later 5450. Just before operation the white cells rose to 10,400, and a few days after draining the cyst they were down again to 5500. We regret that a differential count was not made in this case.

There can be no question as to the entire recovery of the second case after the miscarriage, and the theory that the ovarian trouble could possibly date from this event is not tenable. First, as the patient was carefully examined one month after the miscarriage, and found to be in an absolutely normal condition, nor had there been any sign to indicate infection, and second, the examination of the Fallopian tube after its removal proved it to be normal, and cultures from it gave negative results. The cyst in Case II. must have existed previously to the typhoid fever, and then have become infected and grown rapidly in the short time elapsing before the operation, or it may possibly have been an infected Graafian follicle.

The six cases that have been previously reported are appended.

Case I. Werth (*Deutsche med. Wochenschr.*, 1893, No. 21, p. 489).—Woman, aged twenty-nine years; typhoid fever without complications, in October and November, 1891. In January, 1892, pain in lower abdomen began, and shortly afterward noticed swelling of the part—fever not mentioned.

Operation. June, 1892, eight months after beginning of fever. Large dermoid cyst, many adhesions and firmly bound to transverse colon. Cyst contained thin pus with foul odor. During removal the cyst ruptured and part of its contents was spilled in the peritoneum. This was sponged out, but not flushed. Recovery without relapse. Pus showed pure culture of typhoid bacillus.

Case II. Sudeck (*Münchener med. Wochenschr.*, 1896, No. 21, p. 498).—Multiparous married woman, aged thirty-two years. Seven weeks before admission to the hospital the patient had typhoid fever. Three weeks before admission noticed swelling of the lower abdomen, with pain and fever of a hectic type.

Operation. Cyst size of a ten-year-old child's head; light adhesions; fluid chocolate-colored and of a very foul odor. During the operation a small amount of fluid escaped from the cyst and soiled the wound. Abscess of the wound later developed, from which staphylococci and typhoid bacilli were recovered. From the cyst fluid pure cultures of typhoid bacilli were obtained. On section, the cyst wall showed many single and diplococci, but no bacilli.

Case III. Pitha (*Centralbl. f. Gynäkologie*, 1897, No. 37, p. 1109).—Woman, aged twenty-five years; typhoid fever in October, 1896. Five weeks later noticed a painful swelling in right lower abdomen; no fever.

Operation. February, 1897, four months after fever. Cyst punctured through vagina. Contents, thin yellow pus, without odor. Cyst was found to be a large multilocular dermoid, and could not be thoroughly evacuated through the vagina. It was immediately removed through an abdominal incision; many strong adhesions; recovery uneventful. Cyst gave pure culture of typhoid bacillus. Sections of the cyst showed the inner wall to be necrotic in places, but no organisms were demonstrable.

Case IV. Wallgren (*Archiv f. Gynäkologie*, 1899, Band lxix., p. 15).—Married woman, aged thirty-nine years. In 1893 patient noticed a fist-sized, movable tumor in lower abdomen, which very slowly increased in size, but never caused any particular inconvenience. During June and July, 1898, patient was in bed for six weeks with fever, but no physician was in attendance. After getting about again the tumor rapidly increased in size and became very painful. Irregular fever, with frequent chills.

Operation. September, 1898, three months after beginning of fever. Dermoid cyst containing one and a half litres of yellow-green fluid with stale odor; light adhesions, peritoneum œdematous and thickened. Recovery uneventful. Cyst fluid gave pure culture of typhoid bacillus. Sections of cyst wall also showed bacilli.

Case V. Englemann (*Centralbl. f. Gynäkologie*, 1901, No. 23, p. 633).—Married woman, aged thirty-eight years. Typhoid fever in November, 1900; four weeks in bed; relapse in January, 1901, with great weakness, loss of flesh, vomiting, and abdominal pain. Later fever became irregular.

Operation. March, 1901, four months from beginning of fever. Dermoid cyst size of seven months' pregnancy, containing one and a half to two litres of thin yellow-green fluid; few adhesions; recovery uneventful. Cyst fluid showed a pure culture of typhoid bacillus.

Case VI. Widal and Ravant (*Bull. et Mém. de la Soc. Méd. des Hôpitaux de Paris*, January 30, 1902, p. 45).—Married woman, aged thirty-four years. Entered hospital on the tenth day of typhoid fever. For ten days fever ran a normal course, then vomiting appeared, with a disteuded, tender abdomen. For four weeks these abdominal symptoms persisted, with fever, and then gradually disappeared. Fifty days after admission the temperature was normal, and the patient seemed convalescent. Three weeks later patient was out of bed, and abdominal symptoms reappeared, with fever. Abdominal section revealed a right ovarian cyst containing one and a half litres of blackish fluid. This fluid gave a pure culture of typhoid bacilli. The recovery was uneventful.

NOTE.—Since the writing of this paper there has appeared in the *American Practitioner and News* of June 1, 1902, a report by Edwin Walker, of a case of typhoid infection of an ovarian cyst. The case is briefly as follows: A young married woman, aged twenty years, contracted typhoid fever in July, 1901, the temperature rising to 103° F. and 104° F., with diarrhœa and rose-colored spots. In the fourth week pain was complained of in lower abdomen, with chills, increase of fever, and tumor. Widal reaction was present when the patient was seen by the reporter, in December, 1901. At the operation, on January 4, 1902, a large dermoid cyst was found which contained a gallon or more of pus. The cyst was firmly adherent, and ruptured during the removal, one quart of pus escaping into the peritoneum. The peritoneum was wiped out with absorbent gauze, but no irrigation of any kind was used, and the abdomen was closed without drainage. The patient recovered after mural abscesses. The pus from the cyst gave a culture of typhoid bacillus.

CLINIC OF DR. JOSEPH D. BRYANT.

1. EXCISION OF THE BREAST. 2. HÆMOPHILIA. 3. EXCISION OF THE KNEE.

REPORTED BY WILLIAM C. LUSK, M.D.,
CHIEF OF CLINIC.

CLINIC I.—*Excision of Breast.*

GENTLEMEN: I wish to-day to call your attention to the operation of excision of the breast.

The method of operative practice which we shall employ is known as the radical method of procedure, which means the removal not only of all disease manifestations that appear on gross examination to be pathologically associated with the growth, but also those tissues which one is taught to know by experience and observation are subject to cancerous infection because of their continuity with the seat of the disease.

It has been found that the tissues associated with the disease in malignant development are as follows: first, the fascia associated with the pectoralis major and minor muscles, particularly that of the former; second, almost invariably the lymphatics associated with the diseased breast. The lymphatics that suffer most frequently are those of the axillary and cervical regions; and second in frequency, especially in cases of well-developed tumors, the thoracic lymphatics of the anterior mediastinum.

It is sometimes suggested that lymphatic nodes are not to be removed except they be enlarged. I desire to say now at once and finally that

no one can say by manipulative examination only whether the lymphatics are affected or not. There is but one certain test, namely, the microscopic test, and therefore no one is justified in saying that he will not attack the axilla because he cannot determine the presence there of glandular enlargement. I have subjected to microscopic examination more than once the lymphatic glands of the axilla, so little changed that the naked eye could not determine the presence of malignancy, and found, nevertheless, pronounced malignant involvement of them. There are two reasons why the axilla should always be attacked: First, glandular involvement almost invariably exists when the patient comes under notice; second, how soon after the occurrence of malignant affection glandular involvement occurs no one can tell. It may develop slowly after infection, being of ordinary, casual progress, or it may be virulent in its type and develop rapidly. I think in this connection I may say, with eminent propriety, that the soil in which the malignant disease has its inception and development has to do very largely, indeed, with the rapidity and virulence of its action. Without operation cases of carcinoma of the breast have been estimated by Gross to live from five months to six years, or to have an average duration of life of twenty-seven months. On the other hand, when operation is practised it adds at least from a year to two years to the patient's life, and may secure immunity thereafter. Speaking generally, about 40 to 50 per cent. of those who have prompt, wide, and careful removal of the disease are exempt thereafter from any infection for three years and more. Various operators report different results. The best results obtained in the treatment of this disease amount to about 52 per cent. of recoveries after three years' time, and are reported by Dr. Halsted, of the Johns Hopkins School, based on the method of practice established by him for the removal of malignant disease, this percentage comprising those cases in which the disease not only does not recur at the seat of removal, but also does not recur in any other portion of the body. Cheyne, an eminent English surgeon, has reported 99 unselected cases, of which 56 were free from disease from one to nine years; also that in 61 of the 99, 30 were free from recurrence at the end of three years. Dr. Warren, of Boston, reports 40 per cent. of recoveries lasting three years. The rate of operative mortality is small, equalling about 2 per cent. of the cases.

The fact that I wish to impress upon you, in order to secure successful treatment for malignant disease and to increase the percentage of recoveries above that already obtained, is that certain extended educated methods of action must be insisted upon. First, the patient afflicted with a tumor must early inform someone, competent to judge of its nature, of the presence of the growth—not do, as is too often practised, hide the knowledge from everyone, and only admit the

presence of the growth when it becomes a positive affliction. Until persons afflicted with malignant disease, or having tumor manifestation, will promptly consult a physician, asking him to determine "what is the matter, and tell me what to do," we will have little, if any, better results than are now secured. Second, physicians must be so constituted that when a patient presents herself inquiring whether or not she has a tumor of the breast, they should proceed at once to make a diagnosis rather than send her away with a prescription and the injunction, "Come back again in a month or so," or "Come back again if you find it is increasing in size." That is too often the result of consultations of this character, and it is to the shame of the profession that it happens at all. One sometimes meets a class of physicians who say: "Well, it may be malignant; but in all the patients that I have had submitted to operative procedure the growths have recurred, and the sufferers have died within a year or so. If I were in your place I would not allow it to be disturbed." You may, too, in this day and age meet a stranger form of advice—one that leads patients to believe that the disease cannot and will not be cancer if they are unwilling to admit that they have a tumor at all. Another manifestation is the encouragement of quackery. My late preceptor entered a cancer hospital, conducted by a cancer quack, for the removal of a malignant growth from the lip. Now when a doctor of sense—he was a man of more than ordinary sense—willingly seeks such a chaunel for relief, well may it require much urging and pronounced encouragement to forestall a resort to this kind of curative effort. So as physicians you should, whenever a patient comes to you with a suspicious growth, remember that any variety of tumor is a bad tenant, because it may assume malignant characteristics; and do not ever testify to its good character until you establish its innocence by thorough examination.

Treatment. In my judgment, there is no method or practice that can compete with that effected by a free incision with a sharp knife under aseptic surroundings. If practicable, operate at once, cutting wide of the disease, removing all present disease manifestations and sites of prospective invasion. As soon as the wound heals do not send the patient away, telling her to "come back when she has further trouble." Don't do that. Advise her to see you, or some other competent physician, every month or two and undergo examination, that the first presence of any return of the disease may be promptly detected; in other words, establish strict surveillance over the possible sites of return of the growth. I have patients in mind whom I have watched for years, seeing them once a month or so, to observe whether or not any manifestation of return was apparent. If return happens promptly operate again, as wide of the seat of the disease as is prac-

ticable. Fight the disease every foot of the way, remembering not to sacrifice needlessly the patient's life and comfort for the sake of the effort of securing them. If the disease be not cured by your efforts, certainly life will be prolonged and comfort gained during the time that the affection is in abeyance. I say to you very properly that not all the surgeons indorse what I have just said; but I am consistent enough to declare that anyone failing to concur could not operate for this infliction upon me or any member of my family.

Now let us get the history of this case. The patient's age is sixty-two years, a little over the average time when cancer occurs. She is German. While I do not care to be personal in my remarks, still, in some portions of this country, particularly in Buffalo, the rate of mortality from cancer in German people, recently determined, is largely in excess of that of the native born. This fact may have a bearing on the question of the cause and the nature of malignant disease, as to whether it be due entirely to tissue change or whether it be of infectious origin. The family history of this patient is good excepting possibly that part relating to one sister who vomited blood before death. That manifestation might mean cancer of the stomach. You are not, however, to understand by any means that all cancers are hereditary; on the contrary, only about one-third. Cancers may be regarded as hereditary not in the sense that cancer *per se* is transmitted from one generation to another, but that the tendency or the vulnerability is transmitted. The habits of the patient are good. She denies all venereal disease. There is no particular association between venereal disease and cancer. The personal history does not, therefore, point significantly to anything of a causative nature in the production of malignant disease. Now notice this statement: "One year ago I first noticed a small lump in the left breast, which was not tender or painful." Tumors distinctly painful and tender at the outset are not malignant, as a rule. "This tumor was about the size of a hickory-nut, freely movable, gave rise to no inconvenience, and grew slowly. Last September I noticed a marked enlargement; still no pain unless handled, then quite tender. About that time"—please notice the nipple of the patient while giving heed to this remark—"nipple began to retract." You are not to understand that retraction of the nipple means malignancy in all instances. You are to understand that the tissue changes in the gland have caused retraction of the nipple, and that such retraction is often attendant upon malignant disease; also that malignant disease is often present in the gland without retraction of the nipple. It is one of the symptoms worth heeding, but is not diagnostic. "And the skin seemed to become grown to the tumor." Please note that the skin is adherent to it because of cancerous involvement. Integumentary adhesion is of

more pronounced importance than is retraction of the nipple, but when the two are taken together they become very significant as indications of malignant disease. Notice there is no deep adhesion of the tumor. I have examined the patient carefully on two occasions and found no enlarged glands, and Dr. Dittrich, who has kindly presented the patient for operation, also tells me he found none. Shall we, therefore, let the axilla alone or shall we invade it?

Class. Invade it.

We will invade it, and I will speak to you of the procedure as we go along. There are many operative incisions recommended, but it is important always to make the incision to fit the case. The first proposition is that the incision should be so made as to cut wide of all disease—the wider the better consistent with proper closure of the wound. I should say in this connection, for fear of being misunderstood, that in large growths closure of the wound is of no significance compared to complete removal of the disease. In such cases as these, skin-grafting and plastic sliding of the skin should be employed to close the gaps. Remember that running out from the breast, usually toward the median line, often below it, are accessory portions of the gland. Here is a marked one. Unless careful, one will leave behind the accessory portions. Let me tell you something else: It is advised to remove the breast and lymphatics together, not to cut transversely and remove the breast and then clean out the axilla, the idea being that transverse division of the lymph channels means the escape from them into and upon the tissues of the infecting cancerous agents. This is carrying the danger of infection a step further than is ordinarily considered to be necessary. We will not divide transversely any of the tissues. Please note the pectoralis major muscle. I dissect back only the portion coming from the thorax, not disturbing in this instance that coming from the clavicle, which, when not diseased, should be preserved for its functional utility. Often the cancerous deposits are found lodged in the pectoral fascia, not yet having had sufficient time to extend to the muscle. Usually their presence here can only be determined by microscopic examination, so that if on later examination disease be found in this fascia we will know we have done right in removing it, as well as the muscle lying beneath, if it, too, is affected. If we do not find disease of the tissues we will, nevertheless, not regret their removal, since this precaution can at least cause no special harm to the patient. There, under the pectoralis major, is an axillary gland, big from disease, its presence not before detected. I now push aside the pectoralis minor, raising it up so that the fascia beneath it can be well seen and removed. Gentlemen, let me point out the fact that an enlarged gland is found very frequently on the upper surface of the first rib, and you should look carefully

for it. My finger now rests on the first rib, and a brief examination enables me to feel the enlarged gland. We usually find this gland enlarged, especially when the glands lower down are invaded. Please remember, however, that this disease not infrequently omits one gland or more in its progress and becomes lodged in a gland beyond.

We will now carefully isolate the vessels. In this matter the rule is to go down at once upon and expose them, as it is a much easier and securer practice than feeling the way unguided by a view of the vessels. I am sorry to notice that the disease is very close to the vein and perhaps adherent. No, it is not adherent. What would you do if malignant disease involved the vein? Would you leave it behind or would you remove it and the diseased segment of the vein?

Class. Remove it.

Yes. Is there danger attending a fractional removal of the vein or the tying of it at this situation? Yes; gangrene. A question is sometimes raised whether it is not quite as wise to tie the artery simultaneously with the vein, so as to prevent the arm from becoming overcharged with blood, as occurs in the instance of ligaturing the vein alone. In this connection the statistics of Niebergall relating to the ligation of the femoral vessels are instructive. In 16 cases when both common femoral artery and vein were tied during operations for removal of tumors of the thigh, 62.3 per cent. developed gangrene, and in 8 cases when both were tied for trauma 50 per cent. developed gangrene. On the other hand, in 25 cases in which the common femoral vein alone was tied during removal of tumors no case developed gangrene, and in 10 cases in which the vein alone was tied for trauma but 1 case developed gangrene. This one, however, occurred in 1813, and few details were known regarding it. These figures, therefore, show the undesirability of tying the artery simultaneously with the ligature or resection of a main venous trunk. Furthermore, in support of non-ligation of the artery when the vein must be tied is the demonstration of Niebergall of the utility of the arterial pressure to overcome the resistance of the valves in restoring the circulation through the collateral venous branches. In removal of the breast it should not be forgotten in this connection that many of the collateral vessels are already destroyed by the "cleaning out of the axilla." I am now separating the final part of the growth, and will wrap around its major portion gauze, to prevent tearing the separated portion and possible infection of the axillary wall. The tumor and axillary mass are now removed entire, and I will place them on a plate, so that you can feel the glandular enlargements. We find in the mass six, including the one high up. I wish you to feel and see them, and recall the fact that here is a patient in whom enlarged glands had not been disclosed by manipulation, yet there are six extensively diseased glands, the majority

of which are of considerable size—one the size of a small walnut. Please notice the large amount of fat contained in the axilla, which did much to disguise the ability to determine the presence of the enlarged glands by manipulation. What I wish to impress upon you is that, notwithstanding our careful examination at the outset—notwithstanding the physician of the case was unable to feel enlarged glands, or the house surgeon, or Dr. Lusk, or I—they nevertheless were present. Now how absurd it is to say one should not invade the axilla because one cannot feel enlarged glands there.

I have never yet experienced disease-return in the axilla, or, perhaps, to make a more sweeping statement, disease-return in a place accessible to removal after a complete dissection like the one you have just witnessed—which means, of course, that all the lymphatic glands, vessels, fasciæ, and structures in any way directly invaded, or prospectively so, by malignancy were removed; but I have had the disease too frequently recur in the thorax, either deep in the chest or in the anterior mediastinum—in the latter locality conveyed by the lymphatics that originate in the breast and pass through the intercostal spaces near the border of the sternum. There exists an involvement of the glands in the anterior mediastinum in a very small percentage of the cases, taking them as they go. Out of 128 autopsies, Dr. Samuel Gross—who wrote the first systematic, convincing work in modern times on this form of malignant disease—records an involvement of the intercostal muscles in 1.35 per cent., of the ribs in 2.8 per cent., and of the pericardium in 2.34 per cent. of the cases. Now as regards the glands above the clavicle, Gross determined some years ago by manipulation their involvement in 6.25 per cent. of the cases. However, when you notice that in this case I was quite unable by manipulation to find the enlarged glands in the axilla, you can readily understand that the actual percentage of occurrences above the clavicle must be in excess of Dr. Gross' figures. More recently Halsted has found by careful microscopic examination of the tissues removed from above the clavicle in these cases an involvement of 34 per cent. So you have, then, the glands above the clavicle, those in the axilla, and those in the thorax itself as the common seats of involvement. It is now generally conceded on the part of all experienced surgeons that the axilla should be thoroughly cleaned out. As regards cleaning out the space above the clavicle, there is probably a wider difference in opinions on the part of operators. If enlarged glands can be felt above the clavicle, nearly all, it seems to me, practice their removal; but whether or not this region shall be exposed, and all the tissues removed when glands are not discernible, there is a difference of opinion. The majority do not clean out the tissues above the clavicle unless there be palpable evidence of disease. I have practised both

methods, and whenever I have left the space uncleaned because no evidence of enlarged glands could be determined, there has not yet been an instance in which disease has subsequently manifested itself in that situation. Glands have in several instances been removed from the anterior mediastinum, but an operation of that kind is quite impracticable. I have never attempted it, nor do I now see my way clear to make a beginning. I certainly do not yet expect to teach it because an operation of that kind, indiscriminately practised, would beget discrediting operative disaster, and by reason of the association of the disease with the pleura and other important structures within the thorax, beyond the point of any benefit from reasonable operative interference would result in no commensurable advantage.

We will now examine above the clavicle. I pass one finger into the wound up under the clavicle. I place the fingers of the other hand on the skin of the neck above, and between the fingers of the two hands I can very readily palpate a large area of the included tissues. I feel nothing suggestive of disease, and in a patient of this age I am not disposed to prolong the operation by removing these tissues with a view of excluding any supposed infection that may be present. Instead, her physician will examine her carefully at stated periods, and if any enlargements occur above the clavicle they can be promptly removed.

The wound is washed out with hot saline solution. Be very careful that all oozing points are closed. I advise making dependent drainage, and I usually do it. It should do no harm if it does no good, and though it may do no good, harm might come without it. One hears sometimes that when one drains a wound he lacks confidence in his technique. That does not follow at all. It simply means that he throws around the patient every security, recognizing the possibility which every surgeon experiences now and then, of the miscarriage of his keenest efforts to prevent the occurrence of infection and its consequences. I protest against any imputation of having lost confidence in my technique because of draining the wound. We will sew the flaps together with silkworm-gut; then so apply pressure as to exclude all possibility of dead spaces. Do not bind the arm to the side; let the arm remain loose. One argument used against the operation you have just witnessed is that it maims and mutilates the patient without producing adequate return. It is said that one cannot properly use the arm. The delayed ability to use the arm is due, more than anything else, to its being confined to the side too closely. I expect a week from to-day that the patient will show you that she can move her arm without any special trouble whatever, except possibly because of tenderness.

CLINIC II.—*Excision of Breast (concluded).*

The highest temperature of the patient whose breast I amputated a week ago is 100.4° F., and these are all rectal temperatures. The patient has had no trouble whatever; has expressed herself as being entirely comfortable, which is really somewhat unusual, and contributed to, in my judgment, largely because of the fact that the arm was not bound to the side of the body. The wound has not been dressed, as the patient has been perfectly free from annoyance, and on removal of the dressing we find that union throughout has taken place by first intention. Note that the patient has considerable abduction as well as forward motion of the arm preserved, and that she moves the extremity freely, even placing it upon the head. I wish to call your attention to two signs suggestive of return of the disease not always considered. One is tenderness of the sternum, with possible projection or thickening of the bone, and the other is tenderness of the humerus. The glands have been reported by Dr. Dunham as being extensively disorganized by the presence of cancerous growth, including the highest one—the one taken from the first rib.

I think I should say to you, in connection with the topic of surveillance of patients after an operation, that they will ask you, as they have asked me many times, "How will I know when it is coming back?" Answer them as I do, "You will know when I tell you, or when some other physician tells you, when it is coming back." Don't tell them anything specifically about it. Should you do so they would promptly imagine themselves having in succession, if not all at once, everything suggestive which you mention, much to their loss and with no gain to anyone. No. Cause them to come to your office once in a month or so, and examine them carefully at the situations which you know for manifestations of recurrence. Only in case patients are going far away, and cannot, therefore, avail themselves of a periodical careful examination, may you tell them that they might find some change in this or that part of the body as suggestive of recurrence.

HÆMOPHILIA. I wish incidentally to speak of another matter that seems to me of considerable surgical significance. There is at the present time in the hospital a patient requiring operation, but the patient objects, on the ground that he is a "bleeder." One should not always respect these statements. Patients are not always "bleeders" who pronounce themselves to be such. By way of illustration: Not many years ago a patient came into the hospital suffering from an acute attack of appendicitis, which, in my judgment, demanded a prompt operation. He objected, on the ground that he was a "bleeder," and had been warned by his physician by past experience to always make that statement to one who might purpose to

operate upon him, because he came near dying on some particular occasion in the past. I regarded that statement of course with profound respect, and declined any further to consider the question, and allowed him to pursue his course, so far as appendicitis was concerned, with simply expectant treatment. Not long thereafter an abscess pointed, and the question of opening it or of allowing it to pursue its way came up, and it occurred to me that the best plan to settle the "bleeder" question was to make a slight incision through the skin over the abscess, relying on pressure to control any tendency to undue hemorrhage. This was accordingly done, and the hemorrhage was controlled as easily as in any other patient with a more favorable history. In other words, if this patient had been a "bleeder," he had recovered from the predisposition or the causes that gave rise to it. Now the present case that we have has led me to suggest the same line of treatment—endeavor to prove whether or not the patient is correct in his assumption or opinion before acting on the proposition that undue hemorrhage will happen as the result of a necessary operation. The trial incision in this case has also shown that the blood clotted as promptly as could be wished.

Excision of Knee. The patient on whom I operate to-day is M. C., aged twenty-eight years. Family history negative; drinks moderately; denies venereal history; never sick. About eight years ago he received an injury to his left knee while playing football, from which he at first apparently recovered. However, soon afterward the leg began to flex, and we now find it ankylosed in a position at right angles with the femur. You will notice here a complete posterior displacement of the head of the tibia. This will be the twenty-fourth or twenty-fifth excision of the knee which I have practised, and of that number one only has died, she having died from sepsis, being septic at the time of the operation. One patient lost the limb as the result of the operation, due I won't say to my carelessness, but rather to my misfortune in having cut a hole in the popliteal artery while dissecting it off from the posterior ligament in the presence of badly diseased tissues. I promptly amputated the limb. This case presents the worst deformed limb I have ever had to deal with. Having applied an Esmarch bandage, I now begin with a transverse incision in front of the knee and reflect upward the flap. The idea is to excise the joint and bring the bones together in such a way as to make the limb straight. I am dividing the external hamstring tendon, taking care not to cut the external popliteal nerve. We next saw the lower end of the femur, which is the bone that should be sawn first, and the question is how to do it. First place the saw so that its cutting edge is parallel with the inferior surfaces of the condyles; second, incline the blade so that it will cut in a direction from before backward at

right angles to the long axis of the femur. To guide me in determining the correct inclination, I place along the side of the thigh a straight instrument in a direction corresponding to the long axis of the bone. Having established the proper position of the saw, I cut through the condyles. We will now saw squarely off the upper end of the tibia. It can be readily seen that the plane of section through the femur is so cut in an antero-posterior direction as to enable me to set the leg in the fully extended position, while at the same time it is so inclined transversely as to preserve the normal lateral obliquity of the tibia in its relation to the femur. How much I have to saw off I do not know. We save all we can of the ends of the bones composing the joint, saving in a young subject the epiphyseal cartilages, if possible, so that the limb may continue to grow. This man is past twenty-eight years, and therefore the epiphyseal cartilages play no part in the operation. . . . I am not heedlessly using a knife around the popliteal space—you remember the accident that happened to me a long while ago. I am hugging very closely the posterior surface of the tibia. . . . Now, having sawn both bones, let us see if we can get their surfaces together. You notice, gentlemen, we cannot bring them together suitably because of too great tension, but if they had come together readily their relations would be all right. We have got to saw off more bone. Now you might be prompted, rather than to remove any more, to bring the bones together as best you could. Let me say to you that an action of that kind would be followed almost invariably by backward displacement. They must go together pretty easily in order to avoid subsequent flexion. I remember very well my first case of excision of the knee. I met with a condition of things not as obstinate as this exhibits, but the coaptation was not suitable. I endeavored to hold the leg forcibly extended, and the result was a failure. I have now removed more from the femur, and there is still a strain on the posterior tissues; not much, however. The question is whether, when we extend the limb, we make the tissues of the leg so tense as to interfere with the circulation; that happens. I am disposed to take off a little more. . . . With the removal of this last slice the bones can be brought perfectly together. They go together firmly, not overfirmly, and hold themselves in place. Gentlemen, you see how much trouble the excision requires. Now the question arises, Shall we dress this before we take off the Esmarch bandage or not? I have on a number of occasions dressed the limb, taken off the Esmarch, put the patient to bed, and never had any significant hemorrhage whatever. On the other hand, suppose I had done so to the patient in whom I cut the popliteal vessel some years ago: What would have been the outcome then? What vessels can bleed in this case? The articular branches only. However, I will do

here the way I wish you to do, namely, remove the Esmarch before applying the dressing and attend to hemorrhage. I have removed all the pressure, and you see the hemorrhage is very slight. This is just about the amount of hemorrhage that one has in these cases; so I am warranted in saying to you that I could have closed the wound and dressed the limb immovably before relieving the constriction without any need whatever of opening it subsequently. But let me instruct you to always examine the wound. The bones need not be fastened together, because they are held firmly in place by the extended position of the leg.

Now it remains to drain posteriorly with silkworm-gut, to sew the wound with the same material, wrap around the limb aseptic gauze, so as to hold the tissues firmly in place, and put a splint upon it. The limb should be elevated to encourage return circulation. At the end of three days it is better to dress it. I should feel that one dressing was quite sufficient for this, assuming that it goes as nicely, as we hope it will.

Result. Primary union of the deep structures, delayed union of a limited portion of the wound because of feeble circulation, no suppuration. After three months very firm fibrous union, allowing only exceedingly slight mobility, evidently undergoing bony change.

KERATOSIS OF THE PHARYNX.[1]

By Charles W. Richardson, M.D.,
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The investigation and study of that interesting pathohistological change characterized by the formation of horny-like white tufts, occurring most frequently in and about the tonsils, in the lateral wall of the pharynx, at the base of the tongue, at the pharyngeal vault, known as mycosis pharyngea leptothricia, has, through late investigations, become a subject of great interest from an etiological and pathological point of view.

The disease under consideration is evidently not a new one, although the frequency of its discovery and the increase in the number of observed and reported cases within recent years would seem to indicate that such was the case. More exact and careful observation and greater thoroughness in differentiation is, no doubt, responsible for this increased number of reported cases. As the process of differentiation becomes more thorough, and as we add to our clinical observation, through the aid and assistance of the bacteriological and histological laboratories,

[1] Presented as candidate's thesis in the American Laryngological Society, May, 1902.

we may find that certain conditions existing in the pharynx, which on clinical examination appear to be alike, may be produced by entirely different etiological factors and give an entirely different pathological picture. Thus it may be that we have under the general term of mycosis of the pharynx been clinically including two different conditions, viz.: keratosis of the pharynx and true mycosis pharyngea leptothricia.

From the time of the presentation, by B. Fraenkels, of a case of pharyngomycosis before the Berlin Medical Society, in 1873, until the appearance of the excellent article by Siebenmann, in 1895, there appeared to be no diversity of opinion to the generally accepted theory that all forms of white spots, or tufts, occurring about the fauces, running a chronic course, without definite symptoms and evidence of local or constitutional disturbance, were due to the presence of the leptothrix buccalis, which, when searched for, was usually found in scrapings made from or adhering to the removed tufts. The investigation of the so-called mycotic disease of the pharynx can be traced from the description by B. Fraenkels and his successors, who satisfied themselves with the examination of the tufts for the existence of the parasite, in its progressive differentiation, through the work of Heryng, O. Seifert, Krieg, Colins, Garel, and Wright, who noted the pathohistological changes, as well as the presence of the leptothrix, to the more thorough study of the pathohistological changes and their relationship to the leptothrix by Siebenmann, A. Brown Kelly, F. Friedland, and D. Braden Kyle.

My object in considering this subject is for the purpose of adducing further proof to that furnished by Siebenmann, A. Brown Kelly, F. Friedland, and Kyle, that there is a condition of the pharynx which is a true keratosis, and that this condition is often described as a pharyngomycosis.

The leptothrix was first described by Leeuwenhoek in 1695. This parasite, as well as many others, invades the buccal cavity, and is usually present as a harmless guest.

The disease which we have been considering occurs in several forms, which are, no doubt, in part due to the location of the deposit and the age of the process. Thus we have minute, pin-point-like, intensely white spots, on a level with the mucous membrane, of which they seem to form a part; then the broad, plaque-like white masses, projecting above the surface of the mucous membrane, seen most frequently on the pillars and lateral walls of the pharynx; and, lastly, the conical or triangular-like horny projections from the mucous membrane, protruding from 2 to 8 mm. above its surface. This latter type is observed most frequently on the surface of the tonsil, on the surface of the lingual tonsil, and the epiglottis. These latter-described tufts, or

quills, are the most frequent and most characteristic manifest lesions of this disease. Quills so disseminated over the faucial and pharyngeal mucous surfaces, projecting out as distinctly bright white spots from the tonsils, pillars of the fauces, lingual tonsil, and the glosso-epiglottic folds, with the mucosa from which they grow showing no evidence of inflammatory activity, present a most characteristic picture. The tufts are small, tough to horny-like in hardness, firmly adherent to the mucosa, from which they can be separated only with difficulty, and when removed from the living tissue they do not undergo disintegration. One of the characteristic and peculiar features of the disease is the rapid reproduction of the tufts when forcibly removed. New tufts, on the other hand, are slow in their development. The firmest, hardest, and most elongated quills grow from the base of the tongue and the crypts of the tonsils. Those growing about the isthmus of the fauces are frequently surrounded with a soft, pultaceous substance; those found at the base of the tongue and the pharynx are usually without the addition. The most frequent seat of the presence of what is known as keratosis pharyngis is Waldeyer's lymphatic chain, although the condition is not limited solely to this region. The growth is most abundant on or about the tonsils and at the base of the tongue. Frequently the tonsil will be studded with a half dozen or more distinct tufts, while between the pillars and the tonsil and at the upper fornix will be found a continued succession of tufts, making almost a continuous white line. Over the base of the tongue they are often observed in ideal representation, which is, no doubt, due to their protection. Often we find tufts on the glosso-epiglottic folds and in the glosso-epiglottic fossæ. We have observed these, also, quite frequently on the lateral wall of the pharynx, on the epiglottis, and at the vault of the pharynx. Tufts have been observed by A. A. Gray and H. H. Curtis in the larynx. Gray states that the deposit observed by him was situated upon the left arytenoid. John Dunn, of Richmond, describes a case wherein he found the deposit on the pharyngeal tonsil, as have Garel, Strubing, Schmidt, and Labet. Jonathan Wright has observed the same condition in the nasal chamber, and Pooley has stated that he has observed this condition on the conjunctiva at the inner canthus of the eye. In Dulin's case the whole upper air tract seems to have been the seat of its invasion. Many observers state that the tufts vary in color from a white to a yellow. I wish particularly to emphasize the fact that in all of the cases in which I have observed these tufts they always had a distinctly pearly, clear white appearance. I have observed this condition most frequently in young adult life, thus agreeing with the observations made by others. I have never seen it present in a person under fifteen years nor in one over thirty-five years of age. Those in whom I have noticed this affec-

tion have been robust adults without any constitutional disorders. In several cases slight disturbance of the gastro-intestinal tract was noted, the correction of which seemed to have no influence on the local affection. Most writers state that the disorder occurs most frequently in the female sex, and such has been my observation. A. Brown Kelly places the ratio as three to one in favor of the female sex. Heredity, occupation, and hygienic surroundings seem to have no relation to the disease as producing agents. Most cases are observed in the well-to-do. It is possible that it may affect those in more moderate circumstances; but it is strange, if such be the case, that it is not more frequently discovered in dispensary and hospital practice. Climatic conditions seem to have no influence, and the season of the year to have no effect upon its prevalence. As I have already stated, the general health seems to be the most perfect in all those whom I have observed affected with this disturbance. Delavan, Mulhall, Wright, and others seem to believe that indigestion plays an important rôle; Glasgow, influenza; and Colins and Wright state that some general disturbance makes the patient susceptible to the development of the leptothrix or furnishes the proper nutrient material for the fungi present. It is impossible to state how far local morbid changes in the tonsil influence the production and course of the disease. A. Brown Kelly states: "In all the cases of 'pharyngomycosis' that have come under my notice chronic lacunar tonsillitis has also been present." Kraus and Garel believe that certain changes must take place in the mucosa before the development of the mycosis, this modification being brought about by some irritation, probably a catarrh.

The symptom which usually calls the patient's atten tion to the disease is the sensation of scratching, pricking, or stiffness about the region of the fauces. Some refer to more or less difficulty in deglutition. When the growths are prominent and come in contact with neighboring parts they may cause the sensation as though a foreign body were present. There may be, through the irritation of growths, more or less hawking and cough excited. Vocal fatigue is frequently mentioned. In one case under my observation, where the growths were situated at the base of the tongue, and so unusually prominent as to impinge upon the epiglottis, the scratching of that body caused its mucous membrane to be so inflamed as to give rise to exquisite pain in deglutition. Usually the condition is observed by the patient or his friends in the personal examination of the throat. When so seen it often excites considerable apprehension for fear that the lesion is diphtheria. On some individuals the discovery of the tufts makes no mental impression; others suffer great mental perturbation. There is no febrile reaction or disturbance of the general system.

An interesting feature of the disease is its tendency to undergo

spontaneous resolution, which occurs at a varying period from a few months to several years.

In considering the pathology of this interesting condition, and indirectly its etiology, it will be observed that from the earliest period of its known existence it has been supposed to be due to the presence of a parasite—varying types of the leptothrix buccalis. The early investigators seemed to be impressed solely with the finding of the parasite in the scrapings or the teased excrescences, not extending their investigations beyond this point. Efforts have even been made to produce inoculation, but without result (Heryng). A. Brown Kelly attempted to transplant the disease by direct inoculation of the crypts of his own tonsils, but without success. Decker and Seifert have claimed to produce the disease by the transplantation of the excresences. Heryng seems to have been the first who carried his investigation below the surface. He made sections of removed tissue and studied them. In this line of work he was followed by Colins and Garel. These investigators marked the transition period in the study of pharyngomycosis. Previous observers, satisfying themselves with the finding of an organism, proclaimed the disease without investigating the character of the surface exudation or the underlying tissues upon which it is implanted. Siebenmann, in his able exposition of the subject, carried us still further along this line of investigation. He made sections of removed quills, and also of tonsils with quills *in situ*. His examination showed the mass to be made up of a central narrow lumen containing bacteria, detritus, and mucous, surrounded by an epithelial wall, composed partially of layers of hardened, unnucleated epithelial cells and partially of a homogeneous, horny substance. On the outer surface of the quills which projected from the crypts were shown bundles of leptothrix. In the neighborhood there was absent every evidence of inflammation, such as hypertrophy of the connective tissue and small round-cell infiltration. In summing up his investigation he states as the result thereof that the process is an unusually intense cornification of the lacunar epithelium, which terminates in quill formation. He also states that keratosis of the tonsillar crypts in a mild form is not an unusual, but rather a common condition. He claims that the presence of the leptothrix is rather an incidental one, and bears no relation as a causative factor, as it is present in every mouth, and is usually deposited where the epithelial cells are the thickest. On account of the discovery of subepithelial buds, the absolute demonstration of the epithelial formation of the quills, showing only the manifestation of the spores on the outer surface, Siebenmann considers his case clearly demonstrated, and he desires that the name of the condition be changed to that of hyperkeratosis lacunaris.

Kelly in his paper, which was offered to adduce further proof of Siebenmann's contention, states that the disease known as mycosis leptothricia is, in reality, a keratosis; that the condition is more extensive than Siebenmann described; and offers the more adequate term to describe the condition—keratosis pharyngea. This paper by Kelly is a most able exposition of the subject, and well repays one for its perusal.

Among other things he states: "If one of the tonsillar or lingual excrescences be removed, when examined the surface is found to be soft, while the central part is tough and firm. Microscopically the soft substance is seen to be made of granular material, scattered through which are numerous long rods. The former are various micro-organisms commonly present in the mouth; the latter are leptothrix filaments." Later on he states: "While leptothrix filaments were abundantly present in the specimens obtained from the tonsils and tongue, and less so in those from the walls of the pharynx, they were never found in the excrescences taken from the nasopharynx." He also states that the excrescences examined showed that the disease in the nasopharynx and the oropharynx was identical.

"The excrescences in the nasopharynx presented a similar character to those situated elsewhere as regards appearance, firm adherence, tough consistency, and tendency to recur. Their structure was also essentially identical, namely, cornified epithelial cells, although the character of the cells differed in the two regions."

In summarizing he says: "First, nearly all the excrescences from the tonsil and tongue contain numerous leptothrix; second, the majority of the excrescences from the lateral wall of the pharynx contain no leptothrix; third, no leptothrix was found in any of the excrescences obtained from the nasopharynx; fourth, the abundance of the leptothrix in the excrescences varies considerably in different cases; fifth, when leptothrix filaments were present the first two varieties were usually found."

It seems hardly possible to think that a condition could exist in the nasopharynx and the lateral wall of the pharynx identical in the pathohistological changes to the disease which is also occurring in the tonsil and at the base of the tongue; and yet in one situation always showing the provocative, and in the other never showing this agent. I am more inclined to believe, with Siebenmann, Kelly, Chiari, and Kyle, that in the majority of cases of the occurrence the condition which we have above described—anywhere in Waldeyer's "chain of lymphatic glands"—is not due to the activity of the leptothrix, and that the leptothrix when present is simply an accidental deposit. Siebenmann has stated in his article, upon what authority I have no knowledge, that the leptothrix deposit is most pronounced where the

epithelial cells are more abundant. As I say, the above fact, which was brought out so strongly by Kelly and corroborated by all the other workers along this line, is, I think, the strongest point, independent of the histological change, that the condition is probably not due to the presence of the leptothrix. Another fact in favor of the condition not being dependent upon the presence of the leptothrix, and that it is a true keratosis, is the apparent subepithelial origin of the keratoid masses. Thus Siebenmann describes the subepithelial buds which are observed beneath the basement membrane, which, no doubt, by their growth push out toward the surface and develop the tufts. Such a condition has also been depicted by A. Brown Kelly, and he shows it in his article in an illustration. In this case there is a large empty cavity situated in the submucous tissue. The cavity is lined with epithelial cells, which apparently have no connection with the surface epithelia. At one extremity it shows cornified epithelial cells, and at the other extremity are congregated a number of round cells. Surrounding the cavity, and separating it from the epithelial layer, also, is an infiltration of small cells. An exactly similar condition has been observed in several of our specimens. In this the cornified epithelium is more marked than in the case represented by Kelly.

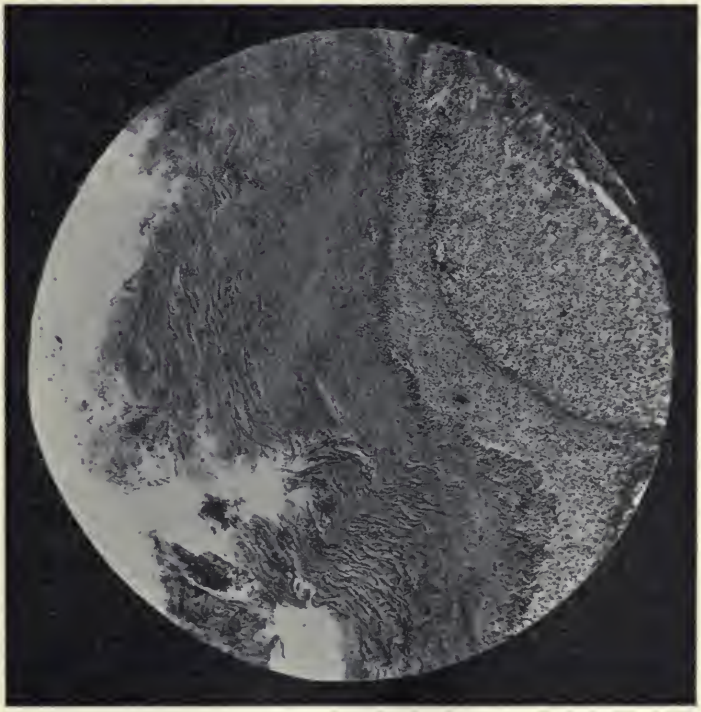
Kyle has also adduced facts to prove that the condition is a subepithelial one in that he has demonstrated that a peculiar fibrous band, extending from the subepithelial structures, penetrates and obliterates the basement membrane and extends out over the epithelial surface. This fibrous exudation, which forms on the surface, maintains its connection with the subepithelial structures, from which it obtains its nutritive supply.

Kyle states: "From the slides presented it looks as though whatever the pathological changes may be that they do begin from below and extend upward. The keratosis of the epithelial structures, whether it be due to some bacterial irritation as the causal factor, or whether it be associated with some epithelial change, at least is dependent upon the subepithelial structure, and the degenerative process, which takes place, as shown in the section, directly beneath the thickened areas on the epithelial surface, seems to affect these nodules, which, I think, furnish fairly reasonable ground for the deduction that the epithelial alteration is dependent upon the subepithelial change."

The description given by Heryng, Siebenmann, Kyle, Kelly, Tuttle, and Friedland, of certain histological changes in the epithelial structures, and confirmed by some desultory work on my part, seems to prove that there is a keratosis of the faucial and pharyngeal mucous membrane in the condition which is commonly known as pharyngomycosis.

It is also probable that the manifest changes begin in the subepithe-

lial structures. There seems to be no doubt that the change is identical whether appearing in the nasopharynx, pharynx, or faucial region. It is also apparent that the leptothrix is not a constant factor—*i. e.*, is most frequently found on tufts in the fauces, rarer on tufts from the pharynx, and never present on tufts taken from the nasopharynx. It is quite probable that the leptothrix is an accidental deposit, and has no causative relation to the structural changes. There seems to be no doubt that there is a condition in the pharynx, occurring in the very young and aged, attended with the presence of the leptothrix—a true mycosis; there is also no doubt that there is a condition occurring in



middle life which is not dependent upon the presence of the leptothrix —a true keratosis.

All the study I have made seems to correspond very closely with the reported work of the authorities quoted on keratosis. These facts so far adduced, while they clarify the atmosphere somewhat as to the condition of keratosis, have not been of much material aid as to the etiology of this condition. As it was apparent that the only way that satisfactory work could be accomplished along the line of a scientific study of the etiology and pathology of this disease was through the conjoint work of a clinician and pathologist, I have called

to my assistance, to do the most important part of the work, Dr. James Carroll. It would be impossible for me to offer any results of our work, so far made, without doing violence to their future value; therefore I am not able to go to any extent whatever as to our present findings. I add, as a present addition to this subject, a most excellent photomicrograph of one of our sections, which on study shows, without doubt, that however the change is brought about, the resulting pathological lesion is a keratosis.

These sections are all alike, except that some show the changes a little more perfectly than the others. This being one of the clearest specimens, I send it as an accompaniment to my paper.

On the surface of the mucosa will be seen the frequent piling up of the stratified epithelial cells, which evidently made up the tuft, which was broken at the apex by the pressure of the knife. Just below the stratified epithelial layer will be seen the thickened normal epithelial layer, and beneath that the tonsillar structure.

The photomicrograph demonstrates in a most perfect manner the actual keratoid changes which have taken place.

A PRELIMINARY STUDY OF THE OCULAR CHANGES PRODUCED BY THE INJECTION OF PURE CULTURES OF THE BACILLUS TYPHOSUS INTO THE VITREOUS CHAMBERS OF RABBITS AND GUINEA-PIGS.[1]

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of Philadelphia.

The results herein noted constitute but a portion of those that have been obtained by the writer during a series of experiments which have

[1] Read at the meeting of the American Ophthalmological Society, July, 1902.

Experimental work upon injections of chloride of sodium into the anterior chamber and into Tenon's space is now being tried in order to study the histological findings of any abortive effects that they may have upon the minor forms of bacteria invasion and inflammatory reaction.

General studies, both clinical and histological, to show the effects of vitreal colonization cultures upon other animals of similar kind and equal bulk are being prepared.

A series of experiments in an endeavor to show the routes of interocular lymph circulation are being made in a number of novel but strictly scientific ways. As early as is compatible for certainty of results the findings will be reported.

Culture studies from the mesenteric glands, the spleen, the liver, the bile, the bone marrow, and particularly the lymph channels of the cerebro-spinal system and its peripheral sense organs, will be made upon the visual structures.

Attempts at vitreous inoculation will be made upon animals which have been immunized as fully as possible in order to study the earliest and most minute evidences of local effects and thus to compare mere aseptic traumatic leucocytoses with pyogenic infections.

Instillations and injections of weak solutions of definite strengths of formalin, which drug is said to be a most excellent agent for killing the bacilli without disturbing the diagnostic qualities or the agglutinating signs, will be made upon induced mild cases of typhoid fever in the rabbit to determine whether the drug can be made of therapeutic value.

continued through a period of nearly three years' time.[1] In order to render the reading of the paper brief, logical, and intelligible, many details that are of value not only to the ophthalmologist, but also to the physiologist, the neurologist, and the general practitioner, have been omitted from the text of the report and relegated to foot-notes.

The type[2] of the bacillus employed was proved by the non-coagulation of milk with the ordinary tests; the inability to give rise to sugar fermentation with lactose agar; the absence of indol with and without the use of nitrites; and the production of alkaline reaction, or at least minimal degree of acidity, when associated with litmus milk before the micro-organism was used for injection purposes. To be doubly certain, the reactions to the blood serum of an immune animal and the agglutination tests were obtained.[3]

Pure cultures of the bacillus were injected aseptically into the upper outer anterior portion of the vitreous chamber of the animals, through a puncture made in the scleral coat, back of the ciliary region, mid-way between the insertions of the external and the superior rectus muscles.

The germ was inserted directly into the eyeball—ectogenously, as it were—a true primary bacillar infection, without any intermediate steps. The micro-organism was placed in a lymph organ which is in direct, close, and independent communication with the intracranial fluids.

The clinical expressions were rapid in their appearance. As a part of the general symptoms there were varying degrees of hyperpyrexia, lasting twelve to sixteen days. The animals soon refused food and lost weight, although carefully cared for. A number of them, particularly the rabbits, developed the characteristic signs of a true myelitis: some succumbed to toxin asthenia.

Locally, the iris became involved in from twenty to forty hours' time.

[1] Some of the primary work in these researches was done in the Pathological Laboratory of the Philadelphia Hospital, some in the Pathological Laboratories of the Department of Medicine of the University of Pennsylvania, and some at Wills Hospital. Many of the later experiments were performed in the private laboratory of the writer and at the home of one of his former assistants and friends, Dr. Van Schoick, of Hightstown, N. J.

In all, fifty-four healthy animals were studied; some twenty privately, twenty-four at the University of Pennsylvania, and the remaining number at the Philadelphia Hospital: of these, forty-six were rabbits.

The writer is under obligation to Dr. Simon Flexner, Napoleon B. Boston, Richard M. Pearce, and William F. Hendrickson for many suggestions throughout the studies. To Dr. I. L. Van Schoick and Clarence Van Epps he is grateful for assistance during the experiments. He is indebted to Dr. John T. Krall for most conscientious research work. He also desires to express his gratitude to Miss Mary C. Koonce, Miss Paula B. Himmelsbach, and Miss E. C. Potter for the execution of the many water-color sketches that have been rendered necessary in the proper pursuance of the work.

[2] For all of the primary experiments the human bacillus carefully obtained in pure cultures, and in some instances grown through several generations and proven to be still virile and able to reproduce the general disease, was used; rabbit cultures were employed in some of the later experiments.

[3] The cultures of these injection materials were kept *pari passu* with the series made from the intra-ocular fluids that had been aspirated at varying periods of time.

The primary manifestations consisted in a thickening of the stroma, the appearance of numerous radially arranged vessels, and the development of a number of clump-like hemorrhages at the major and minor circles. Scattered throughout the posterior chamber, and in the pupillary area, free erythrocytes mingled with fibrin and polymorphonuclear leucocytes could be seen. The retinal pigment layer of the iris was but little disturbed. The bloodvessels of the chorioid evidenced considerable injection, and in some situations the tissues of the membrane were œdematous. At this period a few deeply seated chorioidal and probably retinal hemorrhages, with fibrillary bands and dust-like opacities in the vitreous humor could be recognized.[1] The cornea was infiltrated in its deeper layers, and new blood channels sprang from the limbal series, penetrating the membrane in all manner of fantastic ways, but more often ranging in straight radial lines. In this stage, Descemet's membrane was found to be intact.

In a more pronounced stage, or as a separate condition, the conjunctival membrane and the subconjunctival tissues, especially around the corneoscleral junction, became œdematous and swollen, until in many instances the cornea was set in a deep and sharply circumscribed pit. The palpebral conjunctiva was but slightly affected, and the eyelids apparently did not participate actively in the process. The tissues around the point of inoculation were never more involved than were the other areas of inflammatory reaction. In many instances the vitreous chamber was in great part occupied by broad, yellowish masses, which reached almost as far forward as the posterior capsule of the lens. A number of these cases showed a beginning increase in intraocular tension. Early in this stage the retina evidenced such extensive infiltration with leucocytes of polymorphonuclear type, that all appearance of retinal structures often was obliterated. Considerable extravasation of red blood cells into the tissues could be determined in some situations.[2] There were many accumulations of inflammatory exudate, serum, leucocytes, and erythrocytes.

Grosser forms exhibited an increase of all of the previous conditions, with a number of superadded signs of coarse, degenerative type. Portions of the corneal epithelium were denuded, the underlying lamellæ exhibiting minute areas of necrosis. The iris showed numerous thickenings, discolorations, and, rather infrequently, a few fine plastic lesions. The lens[3] and the capsules were opaque and tumescent in places. The

[1] No qualitative blood studies have been established as yet.

[2] In some places the amount of exudate of serum and corpuscular elements was so marked that the retina was found to be separated from the chorioid, giving an appearance resembling ordinary blisters.

[3] The crystalline lenses have been set aside for special study, though the presence of the bacillus in these structures has been proved by pure growths obtained in culture colonization.

external structures were much swollen and catarrhal. There was a true lessening of intra-ocular tension.

The last stages exhibited numerous atrophic signs. In many of the first cases studied, the eyeball had shrunk into a small, irregular, and hardened stump, fixed in a mass of coarse, fibrinous tissue. Over this crossed the remnants of a cicatrized and band-like conjunctiva, dragging the thinned and irregularly shaped lids against itself.

At varying periods during the many stages of these reactions, minute quantities of the infected vitreous humor were carefully aspirated and placed in various culture media. Most of these withdrawals were made through the corresponding inner sides of the anterior segments of the eyeballs.[1]

Cover-slip preparations of the withdrawn vitreous fluids showed motile typhoid bacilli, with peritrichially arranged flagella, these bacteria exhibiting their peculiar properties of not being able to retain aniline dyes when treated by the Gram or Weigert methods.[2]

In many, if not in all of the cases, the infected portions of the withdrawn vitreous humor were found to be translucent where filled with bacilli. Nearly all of the specimens of removed aqueous humor were more or less albuminous in character.

After preparation of the tissues in different ways several hundred sections showing the combined effects of the germ and the traumatism upon all of the ocular tissues were obtained. These specimens were studied in every detail.[3] The main characteristics were as follows: In sections of the early stage, portions of the ciliary bodies and adjacent uveal structures—probably the glandular tissues—were swollen, and in some instances were found to contain aggregations of typhoid bacilli. Penetrating and surrounding these tumescent parts were numerous dilated capillaries and newly formed bloodvessels, from which the typhoid bacillus could be isolated in a number of instances. In direct connection with the lymph organs there were numbers of large, free masses of the bacilli. Further back, the superficial layers of the retina were found to be richly infiltrated with polymorphonuclear cells and leucocytes. As early as the fourth day free hemorrhages were found irregularly distributed throughout the fibre layer and deeper

[1] The rule that was made was that, although different amounts of the material were injected, yet the most minute quantity possible was withdrawn.

[2] Attempts for agglutination processes within the ocular bulb (which is particularly rich in lymph glands), showing the effects of development, growth, and colonization modifications upon the already inflamed contiguous structures will be tried, not for diagnostic purposes, but for actual therapeutic gain. For this purpose variable strengths of dilute serum will be employed. Widal's reaction studies will be applied to this particular phase of the work.

[3] These studies have nothing whatever to do with the many post-febrile conditions which are so constantly quoted as being associated with and following typhoid fever, and which at best are merely concomitants and sequelæ of any form of continued hyperpyrexia. Such conditions cannot be considered as pathognomonic of the disease.

portions of the retina, particularly in the circummacular regions, just below the outer extension of the normally retained nerve sheaths of the animal.[1] Rather deeply placed and more forwardly situated hemorrhagic extravasations from the two inner vascular layers of the chorioid were found in two or three of the cases.

There were not any coarse indications of pyogenic infection in this grade of sections.

In the grosser stages, many of the sections showed an acute endarteritis in association with the bacilli.[2] Some of the specimens exhibited changes that indicated toxin action; others[3] evidenced signs of well-marked secondary infection. In the majority of the non-lethal cases sanguineous extravasations with some erythrocytic aggregations and leucocytic masses were seen. At times, hyperplasia and even degenerative changes in the adjacent tissues were manifest. In some of the cases, both arteritis and periarteritis and phlebitis and periphlebitis could be seen near the larger lymph cavities and main lymph channels.

In the coarser groupings, there were all the marks of erosion of the walls of the larger vessels, with gross signs of pyogenic invasion throughout the now greatly disorganized tissues. In the equatorial sections especially, secondary phlebitis with streptococcal and staphylococcal invasion of the clots and venous coats—true sepsis—could be determined. Many thrombi composed of fibrin-laden leucocytes, situated mostly in the lymphatic channels and main venous stems, could be seen, the containing walls in places being excessively attenuated. In the more marked cases there were localized abscesses. Pyogenic micro-organisms were obtainable in excessive amounts in nearly all of the ocular tissues.

The last stages showed all manner of connective-tissue growth. Well-pronounced foci of cell death—leucocytic in part—surrounded areas of necrotic tissue, which at times were almost indeterminable. The bacillus typhosus was now most difficult to find, only an occasional stray one being seen.[4]

[1] Rabbits.

[2] This finding substantiates Keen's belief in microbic invasion as the cause of retinal hemorrhage.

[3] Not many signs in this stage of the condition.

[4] True optic neuritis was often present in cases in which the eyeball was destroyed, but in most instances it was of pronounced type, and it never involved the fellow organ. Several times a very low grade of the condition, as secondary to uveitis, was seen ophthalmoscopically. In this connection it must be remembered that the primary invasion of the germ was through the eye.

The presence of the germ in the meninges and the linings of the lymph channels of the brain was more than once noted during the cursory examinations vouchsafed these structures by the writer.

In the vast majority of cases, oculomotor changes in typhoid fever are dependent upon intracranial disturbance, but it is conceivable, nay, probable, that a true peripheral neuritis from the actual presence of the bacillus typhosus and its frequent associates, particularly in the vascular and lymph channels of the muscular and other tissues of the orbit, can give rise to

Bacteriological examination of the inflamed conjunctivæ showed true secondary infection; pneumococci, staphylococci, and streptococci being present in the tissues, fluids, and secretions. Orbital involvement was not infrequent.

In one of the cases which had progressed from a slow form of suppurative panophthalmitis to a phthisical globe, the bacillus typhosus was found nested in the extra-ocular orbital contents in several situations, substantiating Swanzy's belief concerning the same and proving Panas' findings.[1]

In a word, every portion of the organ is affected.[2] The ocular expressions of the presence of the germ are protean and panophthalmic; the low-grade uveites, keratites, and retinites being principally primary, and the ophthalmites, gross conjunctivites, and orbital cellulites mainly secondary.[3]

Remarks. Presupposing that the tissues or "soils," as they are called, were as near alike as possible, the symptoms varied with the dosage.[4] The majority of the eyes perished with the amounts of injections at first used. Later, with the employment of lesser amounts and the same technique, most of the eyeballs, though ofttimes functionless, were saved. In a few, the symptoms subsided early, and the eyes were able to functionate.[5]

localized peripheral palsies and trophic changes. Of course, true extension of pyogenic inflammation along the nerve, vessel, and lymph channel tracts may take place from contiguous areas of primary bacillar inflammation, and as a result no bacilli be found in the extra-ocular structures.

[1] Since the time that the main experiments were made several cases studied by the writer showed that the other eye could be made to participate in the characteristic manner of typhoid inflammation by an injection of a slight amount of streptococcal matter into it, true typhoid germ colonization areas being found in the interior of the organ, thus proving in a measure the earlier finding, that a few stray bacilli from endogenous infection may produce fine retinal and chorioidal hemorrhages in the constitutionally affected organ.

[2] Traumatic infection during the experimental procedures, in the minor cases at least, can be set aside to some extent by the presence of the germinating bacillar colonies in the vitreous humor, the absence of pyogenic germs, and the distinct localization of the leucocytoses around the typhoid organism aggregations.

[3] In these two varieties there is merely an induced ocular type of the general disease. The fever may be induced by the primary entrance of the bacillus typhosus into the structure of the eyeball, not only giving rise to local effects, but also to general disturbances. This is particularly true in cases in which there is an already existent streptococcal invasion of the ocular bulb or surrounding lymph channels. It will thus be seen that it is possible to have a localized typhoid bacillus disease of the eye without general involvement. Introduced directly into an eyeball, either accidentally or intentionally, the micro-organism may germinate locally only and excite leucocytosis and bactericidal action of the serum and the blood to a sufficient degree to produce a primary infectious condition before being destroyed or rendered innocuous. Particularly is this so in cases in which lymph and consanguineous circulations are impeded, as, for example, in glycosuria and glaucoma.

[4] The bacillus typhosus belongs to what is known as the facultative anaërobic type—that is, it is a form of life which, while growing the best with a plentiful supply of oxygen, is able to exist with but a very small amount and even none at all.

[5] The well-known fact that typhoid fever bacilli can be carried within the human body for many years makes it entirely within the province of certainty that the germs may remain dormant, or even isolatedly colonizing very slowly and indefinitely in successive generations,

Experimentation showed that the bulk of the early intra-ocular conditions arose from the processes set into action by the actual presence of the typhoid bacilli themselves, and that they were not dependent upon a minor aseptic traumatism.[1] Vessel-wall erosion with hemorrhagic extravasation, lymph-gland infiltration with lymph- and blood-stream blockage, and increased leucocytosis with an abundance of the germ element were soon followed by the formation of bacillar colonization areas, giving rise to a punctate haze, with fibrillar opacities in the vitreous humor,[2] succeeded in turn by inflammation of the bacilli-laden coats of the ocular vessels. Thrombi appeared and leucocytosis became profound.[3]

The second stage—one of localized septicæmia in which suppurative processes, not only from the typhoid germs themselves, but also most probably from ectogenous inoculation through ruptured channels, ensued —pyogenic micro-organisms became prevalent and most virulent. At this period the bacillus typhosus began to disappear.

Later, the tissues degenerated; perforation through the ocular coverings, both from within and without, took place; the eyeball atrophied, and cicatrization bands of connective tissue, tying the organ into a motionless nodule, formed.[4]

Should the ocular conditions be less pronounced, and the lymph channels to the brain remain pervious and active, intracranial and spinal infections from the passage of the germ and its associates will early ensue, giving rise to all manner of coarse clinical signs of central disease.[5]

The minor degrees of endogenous type—in which there are slight and at times undisturbing and unsuspected retinal and uveal symptoms, as so frequently seen in the primary intestinal forms of the disease—are interesting, and prove what has been claimed ophthalmoscopically by a few competent clinicians.[6]

within the eyeball for long periods of time. In such situations they may remain harmless until discharged into seral circulation by some traumatism or secondary degeneration of the surrounding tissue. For aught the writer knows the bacillus may yet be present (seven months at present writing) in the shrunken eyeballs of two rabbits which are being kept alive for other purposes.

[1] Coarse pathological examination cannot explain the etiology of the condition. Careful histological and bacteriological research, as in these studies, must always be instituted. The best results are obtained in cases in which there has been but a moderate degree of reaction

[2] Both Bull and Hansell describe this condition clinically.

[3] About this time general leucocytosis is most marked.

[4] In cases in which the animal had recovered from the gross local and general clinical signs of the primary vitreous infection, the second eye, when experimented upon, did not behave so badly as its fellow, this probably being due to the presence of germicidal serum in the vascular channels, or possibly even in the serum of the tissues of the animal.

[5] This may not be an infrequent cause for lethal result. The effects of the bacillus upon the intracranial prolongations of the visual apparatus will be considered in another communication. Nissl's method will be employed in a part of this work.

[6] It is possible that some of the cases of suppurative ophthalmitis occurring during attacks of typhoid fever, or even when individuals are exposed to infection from others, have arisen

The external ocular signs, which have been not infrequently described as associated with the general disease, can all be placed under the same categories of cause and effect, and are mere expressions of the main conditions.

The position in regard to the pathology that may be taken is that when the bacilli-laden serum gets into the interior of the eyeball, agglutinative processes followed by bacteriolytic changes which remove the bacilli take place. This destruction frees the toxins, which are either carried away or neutralized by the antitoxins. During these changes the invaded structures of the eyeball lose a few or many of their component parts, with the final result of either a useful organ, a functionless one, or a mere mass of degenerate tissue.[1]

PERFORATED GASTRIC ULCER; PERITONITIS; DEATH; DIAGNOSIS AT AUTOPSY.

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For permission to report the following case I am indebted to my chief, Dr. D. J. Milton Miller, in whose service at the Episcopal Hospital it occurred:

Kate J., single, white, aged fifty-seven years, occupation governess and companion, applied on January 29, 1902, for admission to the Episcopal Hospital, complaining of general malaise and a cold on the chest. She had been much interested in the work of the hospital about

from the actual entrance of the bacterium into the eyeball itself through a break in the ocular tissue—a true ectogenous infection. It is probable, as hinted in another place in this communication, that the auto-infectious cases suffer the less—that is, if the general condition is relatively good.

[1] It is highly probable that the soluble toxins of the streptococcus diminish the protective leucocytosis of the organ. If not early destroyed by the bactericidal power of the serum and blood, they will permit a rapid growth with increased virulence of the typhoid germs, producing not only suppurative death of the organ, but also pronounced involvement of the cerebro-spinal cavities. Fortunately, in most cases of general typhoid invasion the streptococcal elements, unless locally introduced, are so frequent in the ocular bulbs that gross localized affections of the eyeball from the actual offensive presence of the typhoid germ are seldom seen.

It is probable that most of the reported instances of destructive eye changes in cases of typhoid fever have had previous or coetaneous breakages of the ocular walls, with the entrance of streptococcal material, the toxins of which have aided the bacilli to act much more decidedly, and thus give rise to expressions which could be recognized by coarse clinical study; conditions which perhaps have been simply superadded to existing signs of the disease, such as retinal and uveal hemorrhages.

In the intestinal type of the disease the micro-organism probably germinates in the lymphatic glands and then enters the lymph and blood circulation. In these researches the serum is thrown directly into one of the nearest, one of the most direct, and one of the largest lymph streams passing into those within the intracranial structures; thus probably giving rise to a more rapid and a more pronounced symptomatology of the nervous system than could be found in any other variety of ectogenous infection.

twenty-five years ago, and it was owing chiefly to her antecedents, and not because she seemed particularly ill, that she was admitted to the medical wards under the diagnosis of chronic gastritis and debility. She particularly requested that she should not be required to go to bed, as she did not feel sick enough for such confinement, but merely wished warm housing and good food.

Family History. Mother died of cancer of the uterus at fifty-six years of age; stepfather (with whom she had always lived) of "slow consumption," at about fifty years of age; one sister at the age of about forty years, of carcinomatosis; and another sister, at nineteen years, of consumption. Two brothers and two sisters are living and well.

Previous History. As a child she had measles and whooping-cough. Never had diphtheria, scarlet fever, pneumonia, typhoid fever, tonsillitis, or rheumatism, and was always considered the healthiest member of the family.

Present Illness. Patient felt perfectly well until Sunday, January 5, 1902, on which date she says she "gorged herself with roast duck." She felt, however, no immediate inconvenience; did not vomit, and had no particular gastric distress; but from that time gradually lost her appetite, and became unusually constipated, so that her bowels were not properly opened for a week. She then took some citrate of magnesia, and for several days had three or four quite normal movements daily. For the last few days the patient says she has had her bowels opened five or six times daily, the consistency of the fecal evacuations being normal. She complains now of flatus and of abdominal cramps; feels chilly; coughs occasionally, and is rather hoarse.

Physical examination shows a thin, slightly jaundiced woman, well past middle age, with dry, fissured tongue, covered with flakes of mucus. The throat is full of mucus; there are no patches; the tonsils are not enlarged. The chest is spare. There are no areas of dulness in the lungs, but expiration is slightly prolonged posteriorly. The heart is negative. The abdomen is held very tense, is tympanitic, slightly distended, and is tender in the hypogastrium. The spleen and liver are not palpable.

The urine was of specific gravity 1015, and was acid. There was a fair reaction for albumin; none for sugar. A few broad hyaline casts were present. Her temperature was 98.8° F.; pulse about 65; respirations, 28.

In making my rounds the next morning I found the patient upon her hands and knees in the bed; she complained of no pain, but said the wind in her stomach made it impossible for her to breathe comfortably while lying on her back. Her bowels had been partially checked by full doses of bismuth subnitrate. When I returned to her, after going through the other medical wards, she was able to lie down quite comfortably. There was no change in her condition to be detected, but she did not feel disposed to be out of bed. During the afternoon she rested comfortably and slept at times. In the evening she complained of cold feet, and was given hot-water bags. Her temperature was 98.5° F., her pulse was 60, and her respirations 30 per minute. The pulse in her left radial, which I had not noticed before, was very feeble, due, perhaps, to her position in bed, but that in the right was normal. She lay on her left side most of the time. I saw her again

when making my night rounds at a little before 1 A.M. on January 31. She complained then of having had some sharp pain in the stomach, but this was relieved by the next dose of bismuth. She said she had been sleeping and would soon be asleep again. Once after this the nurse took the patient some milk, but at her second subsequent visit found her apparently dead. When I reached her bed a few minutes after 3 A.M. she was lying on her left side as when I had last seen her; she had evidently been dead some time; her extremities were cold (although her body was still warm), and there was slight rigor mortis.

The autopsy was made about fifteen hours after death by Dr. W. E. Robertson, the pathologist of the hospital, who has kindly allowed me to abstract the following notes from his records:

The body is that of an emaciated woman; rigor mortis marked; subcutaneous fat and musculature much wasted.

Abdomen. Over two quarts of foul-smelling, greenish, purulent fluid in the peritoneal cavity; the small intestines are agglutinated by bands of lymph probably forty-eight hours old; the appendix is normal; there is no Meckel's diverticulum; the mesenteric glands are enlarged and hard. The stomach presents, high up in the lesser curvature, a perforated ulcer opening into a ruptured abscess cavity formed beneath the left lobe of the liver by adhesive inflammation; the lesser peritoneal cavity is full of this purulent fluid, and on the posterior surface of the stomach near the lesser curvature and close to the œsophagus there is a second perforated ulcer, separated by the lesser omentum from that first described; extending from these ulcers around the greater curvature of the stomach is a mass of cicatricial tissue dividing the stomach into two pouches, the pyloric being the larger. The liver is extremely pale, and in the right lobe there is a transverse constriction, forming one of the typical forms of corset liver; on section the liver is nutmeg in appearance. The kidneys are paler than usual, but normal in other respects.

Chest. The pleuræ present numerous bands of adhesions, well organized; the lungs show hypostatic congestion in the bases, and at the apex of the right lung is a healed tubercular area. The heart is normal.

The chief points of interest in any case of gastric ulcer, apart from therapeusis, are briefly—the possible causes, predisposing or exciting; the symptoms during life; the duration; the number, size, and site of the ulcers; the mode of death—by perforation or by hemorrhage; and if by perforation, whether previous adhesions had prevented immediate peritonitis.

Among predisposing causes, sex alone is typical in the present case—60 per cent. of all cases are said to occur in females.[1] The age is here distinctly atypical, although the ulcer may have first formed when the patient was young—gastric ulcers occur in women under forty years of age in over 77 per cent. of all cases,[2] the average age in one hundred and eighty-seven women thus affected having been twenty-seven and one-tenth years.[3] Occupation may be considered a predis-

posing cause, it being generally said that among women, domestic servants and dressmakers, and among men, cobblers and tailors, are most liable to the disease; yet, investigations upon this point have failed to confirm the accepted idea ;[3] but the physical habits of a governess are sufficiently near to those of dressmakers to render the occupation in this case worth observation. Tuberculosis was formerly considered a predisposing cause, and this patient had healed tubercular lesions in her lung; but, on the other hand, it has been shown that the incidence of tuberculosis among cases of gastric ulcer is not greater than among the community at large.[4] Disturbances of the menstrual function may in this case be excluded, as she had long since passed the menopause.

Other causes to be considered are a hyperacidity of the gastric juice, or an alkalinity of the blood less than normal; the possibility of thrombosis or embolism of the gastric arteries, or of extravasation due to portal obstruction. In the present instance no observations on the blood or the gastric juice were made; but the great deformity of the liver suggests the possibility of interference with the gastric circulation, either directly by pressure,[5] or indirectly through the medium of the portal vein. Chambers[6] calls attention to "those habits of half-civilized life which they (women) persist in, such as wearing ill-fitting stays, with rigid beams in front, pressing upon the viscera; leaning forward to work immediately after food; swallowing their food half masticated," etc. But if mere portal obstruction were a cause, as suggested by Virchow[7] might be the case, cirrhosis of the liver would not be such a rare complication as it is.[8]

In the present case there were no symptoms known to have existed during life, except anorexia for a few weeks immediately preceding the fatal termination. This is by no means an unusual experience.[9] Cruikshank[10] narrates a case in which a young lady died after two or three days of illness, having previously been in perfect health. "I was called in," he says, "but she was dead before I got to the house. From her history I was at a loss to account for her death; but on opening the abdomen . . . I found the contents of the stomach in that cavity; they had produced peritoneal inflammation, and killed. On examining the stomach, I found a hole in it large enough to admit the end of my finger. This hole had been formed by . . . ulceration; its edges had adhered by inflammation to the under surface of the small lobe of the liver . . . If no violent vomiting had taken place and torn this adhesion at this particular time, she might have lived for years, notwithstanding the ulcer."

The duration of this ulcer, from the partial cicatrization, with the thickening and induration, and the hour-glass contraction of the stomach, must have been for many years, but the history of the patient

throws no light on the subject. It is said by some authors that perforation is less usual in ulcers of long standing than in those of recent formation, inasmuch as the inflammatory reaction thickens the base as well as the walls of the ulcer,[17] and Welch speaks of the "acute perforating ulcers" as of a distinct variety.

TABLE I.—SHOWING SITE OF GASTRIC ULCER IN GENERAL.

Author.	Anterior wall.	Lesser curvature.	Posterior wall.	Pylorus	Fundus	Cardia	Anterior posterior walls.	Greater curvature.	Total.
Brinton[7]	10	56	86	32	0	4	13	5	206
Welch[1]	69	288	235	95	29	50	0	27	793
Per cent.	8	34.4	32.1	12.7	2.9	5.4	1.3	3.2	99.9/100

TABLE II.—SHOWING SITE OF PERFORATED GASTRIC ULCERS.

Author.	Anterior wall.	Lesser curvature.	Posterior wall.	Pylorus	Fundus	Cardia	Anterior posterior walls.	Greater curvature.	Total.
Bidwell[19]	36	2	8	0	0	0	1	0	47
Comte[19]	28	4	8	3	0	0	0	0	43
Per cent.	71.11	6.67	17.78	3.33	0	0	1.11	0	90/100

The number of ulcers is usually single, Brinton reporting multiple ulcers in 21 per cent. of a total of 536 cases;[18] and while the size is generally that of a pea or a dime, some very large ulcers have been recorded; that in this patient seems to have completely encircled the stomach, except beneath the lesser omentum, on each side of which a perforation occurred. Multiple perforations appear to be distinctly rare, probably because the patient either dies from the first, or has other threatening perforations invaginated at the operation undertaken for the repair of the first to perforate. In a case recently reported by Mayo Robson,[11] two perforations were found, that for which the operation was performed being found beneath adhesions on the anterior surface of the pylorus, while the second, discovered by accident, as it were, through the incision into the pylorus, was on its posterior wall, and had perforated into the pancreas. In regard to the site of the ulcer, various statistics have been published; but it is not always stated clearly whether the figures refer to all ulcers, or only to ulcers which have perforated, and even in regard to the last-mentioned class observations are not in accord—thus Welch quotes Brinton as stating that of 100 ulcers on the anterior wall of the stomach 85 will perforate; but, says Welch,[1]

on account of the infrequency of ulcers on the anterior wall, perforation actually occurs oftener in other situations, particularly in the lesser curvature and near the pylorus; yet it may be seen in the accompanying tables that, although ulcers most frequently are found on or near the lesser curvature, nevertheless, perforations are most frequently found in the anterior wall.

Although the numbers in the second table are less than one-tenth of those involved in the first, yet the difference in the results is so great that the relation could scarcely be materially disturbed, even were the number of perforations recorded to equal that of the total number of ulcers observed. The second table should prove of special interest to the surgeon.

Osler[12] says that when situated in the lesser curvature, or, more correctly speaking, near the lesser curvature, since, as remarked by Rokitansky, an ulcer is rarely directly upon this portion of the stomach, but usually to one side; when in this situation, ulcers are usually nearer the pyloric end than close to the œsophagus, as in the case now reported. Perforation is stated to occur in from 3 per cent.[3] to 13 per cent.[14] of all cases—it is to be hoped that the more recent smaller percentage shows an advance in treatment; and adhesions occur in only about two-fifths of the perforations;[14] moreover, perforation is much more apt to occur in women than in men, and in three-fourths of the cases the woman is under thirty-five years of age, while in males this accident appears to be equally divided among all ages, though less frequent after fifty years.[7] In the present case, therefore, perforation, had an ulcer been known to exist, should not have been anticipated. Adhesions form to the liver only about one-third as often as they do to the pancreas,[4] even when situated near the lesser curvature.

The latency of all symptoms in the present case, even after fatal peritonitis had developed, is not the least remarkable feature. It seems probable that the ulcer on the posterior wall of the stomach perforated first, possibly after the patient's heavy meal on January 5th, that she carried the abscess thus formed in the lesser peritoneal sac (which Welch speaks of as a rare occurrence) without much disturbance until after her admission to the hospital, the general peritonitis only forming then upon the rupture of the abscess formed beneath the liver by the anterior perforation. Possibly she had developed by this time a tolerance for peritoneal inflammation, through slow absorption of the toxins.

There was recently in this hospital another fatal case of peritonitis, from appendicitis in a youth, the inflammation having lasted probably a week, though the history was somewhat obscure, in which, although there was movable dulness in the flanks, and although other physical signs of a diffuse suppurative peritonitis were obtained, yet the tem-

perature, which was 98° F. on admission, remained at that point for over ten hours, when it first began to rise, never exceeding, however, 99.5° F.; and the pulse, full and strong, ranging from 78 to 88 per minute. There was also a case of fracture of the base of the skull, admitted last spring, in which at the autopsy was found a rupture in the stomach, with diffuse peritonitis, yet, through the four days before death the pulse had been about 90, and the temperature never above 99.5° F. Of course, in this last case the concomitant injury to the brain may have affected both pulse and temperature, yet it seems undeniable that too much reliance should not be placed on these as an index in cases of possible peritonitis, especially by hospital residents, but that more pains should be taken to make an accurate physical examination and to acquire the *tactus eruditus*.

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MALARIA: A SUMMARY OF RECENT PROGRESS IN THE KNOWLEDGE OF ITS ETIOLOGY AND PROPHYLAXIS.

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THIS disease, from its far-reaching effects, the most important we meet in tropical practice, is not limited by any geographical boundaries, but appears in all or nearly all parts of the globe.

In the temperate and far northern countries it is usually mild in character, and by far the greatest number of these cases are those of benign quartan or tertian infection.

It is only in tropical or subtropical countries that we see the ravages of this disease in its malignant and pernicious forms.

It undermines the health of millions of native inhabitants, stands in the way of European or American colonization, invalids the greater majority of those on the sick list of our army and navy, and is responsible, either primarily or secondarily, for a larger death-rate than any known disease of these latitudes.

History. It has been known and described for several thousand years; 100 B. C., Varro, a Roman physician, stated that it was produced by inhaling or swallowing a small animal which grew in the marshes.

Since that time, and until very recently, it has been regarded as a place disease, of typical miasmatic origin.

The first stride toward our present knowledge of the disease was made in 1880, when Laveran discovered in the blood of malarious patients the plasmodium which bears his name; that this organism is the cause of malaria was quickly verified by careful experiments made all over the world.

Later, in 1885, Golgi described the life-cycle of the organism in man, and pointed out its relationship to the periodicity of the febrile attacks.

In the *Lancet*, November 13, 1897, MacCallum, of Baltimore, described the function of the flagellum (migrogamete).

In the following year, 1898, Major Ross, of the Indian Medical Service, a pupil of Manson, who, for several years past, had been at work upon the latter's theory of the rôle played by the mosquito in malaria, was able to announce the life-cycle of the parasite in a certain species of mosquito, the Anopheles claviger.

Since then the work of Celli and others in Italy has substantially emphasized the value of these investigations; it is now a certain and generally accepted fact, that malaria is produced by the bite of an infected mosquito of the genus Anopheles.

The Malarial Parasite. In zoölogy the plasmodium of Laveran is classed among the Protozoa, of the order of Sporozoa, and is closely allied to the suborder of Coccidia.

They consist of true cellular elements, protoplasm, nucleus, and nucleolus; they are possessed of amœboid movement, and multiply by sporulation.

They are true parasites, and live at the expense of the red corpuscles.

Their life-history is divided into two cycles: one in the blood of their human host, which is asexual, and the other in the body of the mosquito, which is sexual. Judging from clinical observations, it is possible that there is a third state of their existence, a latent state within the human organism. If not, how can we explain the malarial manifestations which occur in those who have suffered from the disease, but from whose blood the parasite has been absent for months?

Celli recognizes but three distinct species of the malarial organism, the benign quartan and tertian, and the malignant tertian, or Æstivo-autumnal, of the Italians; Manson, on the other hand, describes five, which he classifies as follows:

Benign { Quartan / Tertian } do not form crescents.

Malignant { Quotidian—pigmented / Quotidian—unpigmented / Tertian } form crescents.

All these as a class have certain characteristics in common; beginning with the time they enter the red corpuscles and grow and live at the latter's expense.

At first the pigment is scattered through the protoplasm, the latter becomes agitated, the pigment arranges itself in the centre, the protoplasm arranges itself in stellate form about the centre, each filament containing a new nucleus, fission begins, the wall of the now destroyed red corpuscle is ruptured, sporulation is complete, the spores escape into the serum, and a new era commences.

Now and then you will see a large spherical parasite escape from a red corpuscle, some of which in a short time become violently agitated, finally throwing out flagellæ, others more granular in appearance remain spherical. The former are the microgametocytes, the flagellæ they throw out the microgametes, or spermoids; the latter are the macrogametes, or ovules, which later, in the stomach of the mosquito, become fecundated by the microgametes, or spermoids, thus continuing the life of the parasite in its extra-corporeal host.

Going into the specialization of the various forms of the parasite, we find that all of them observe this general procedure, differing only in detail.

Quoting Golgi, first taking the benign quartan, we find it to have the following characteristics.

1. It completes its asexual life-cycle in three days (seventy-two hours).

2. It invades nearly the whole red corpuscle, but does not enlarge or discolor it, even when it has almost entirely filled the red corpuscle.

3. The amœboid movement is rather sluggish; the form does not change much while under observation. The contours of the parasite are readily distinguished from the rest of the red corpuscle.

4. The pigment consists of coarse granules, having feeble movements.

5. Toward the end of apyrexia the pigment collects in the centre, and fission or formation of the amœbulæ begins. These are from six, twelve, to fourteen in number; frequently, when the pigment is in the centre, the amœbulæ are arranged around it in a daisy-like form.

The principal characteristics of the benign tertian are—

1. It completes its asexual life-cycle in two days (forty-eight hours).

2. It invades the whole of the red corpuscle, which becomes large and pale. Frequently it is rather difficult to differentiate the contour of the parasite from the edge of the red corpuscle which surrounds it, because of the extreme paleness of that cell. The loss of color of the red corpuscle takes place while the parasite is still small.

3. The amœboid movement is very active, the changes in form of the parasite are quite apparent, and, while watching it, pseudopodia can be seen to be rapidly protruded and retracted.

4. The pigment consists of fine granules, which move actively.

5. Toward the end of apyrexia, the pigment tends to collect in the centre, and multiplication begins.

The number of amœbulæ is usually greater than of the quartan, consisting of from twelve to twenty.

The Malignant Parasite. These are very much smaller that the benign parasites, and for this reason, and to the fact that their pigment is much finer, they are much harder to distinguish.

At first they display very active amœboid movement, but quickly quiet down, and appear as minute bright rings, frequently several in number in the red corpuscles; later in the disease it may be a difficult matter to find even these in the blood from a pricked finger or ear, and even more difficult to find the parasite in its later stages of development; it being necessary to get aspirated blood from the spleen for diagnostic purposes.

We also find in the blood of patients suffering from maligant malaria, crenated, warped, dark-colored corpuscles known as the "brassy bodies;" these are produced by the rapidly necrotic action of the parasite upon the red cell.

The most characteristic feature is the presence of crescents, which are only produced by malarial parasites of malignant type, and are, therefore, absolutely diagnostic. They do not appear in the blood during the early days of the disease, but usually only after the lapse of a week or more. After all traces of fever and the small parasites have disappeared, these crescents persist in the blood, sometimes for two or three weeks, and are usually associated with cachexia.

Some of these crescents develop in the following manner: first the crescent becomes an ovoid, with the pigment scattered through the mass; this in turn becomes more or less rounded, or spherical, then the pigment forms a ring about the centre, then finally approaches the periphery, the whole parasite becomes violently agitated, throwing out flagellæ, which have a wave-like motion, many of which break away, and we have the microgamete, or spermoid.

Others simply advance as far as the rounded or spherical formation; these are the macrogametes, or ovules.

The parasite of malignant quotidian malaria is very small, and consists of two varieties, pigmented and unpigmented, and develop much in the usual way; they occupy when mature about one-third or one-fifth of the red corpuscles, and sporulate in twenty-four hours, giving rise to six or eight minute spores.

Those of malignant tertian resemble in many respects the parasite of benign tertian, although much smaller, occupying about one-half to two-thirds of the red corpuscle; at the end of two days (forty-eight hours) they sporulate, in number about eight to twelve. The distinguishing features of the malignant parasites are the formation of crescents, and the small size of the parasites.

Life-cycle in the Mosquito. In the stomach or middle intestine of the mosquito, at a temperature of 86° F., the microgametocyte will throw out the microgamete, or spermoid, within the first twelve hours; numbers of these wriggle toward one of the macrogametes, or ovules, which upon their approach becomes violently agitated; finally one of the spermoids effects a successful entrance, and fecundation is completed.

These fertilized bodies, known as zygotes, assume various shapes, usually that of an elongated ovoid; they now penetrate the epithelial cells of the middle intestine; this, as a rule, takes about forty hours.

By a process of direct division, multiplication of the species takes place, and the zygote becomes greatly enlarged, and projects into the general body cavity of the mosquito. When this process is completed, taking about seven or eight days, the sac ruptures, discharging into the general body cavity, a large number, about ten thousand fusiform bodies, known as sporozoites.

These, by means of the lacunar circulation, find their way to the salivary glands of the mosquito, where numbers of them collect, and are injected into the blood of man through the insect's proboscis. Here they at once enter the red corpuscles, and complete the life-cycle we have already described.

The Genus Anopheles. As this is the only mosquito capable, by its bite, of producing malaria in man, a description of this genus alone is necessary here.

There are four varieties that are able to do this, viz.: the Anopheles claviger, the Anopheles superpictus, the Anopheles pseudopictus, and the Anopheles bifurcatus; the first and last varieties are abundant in all malarious localities, the two others are comparatively rare.

The distinguishing points of the adults of this genus are the buccal appendages and the wings, and the position they assume when at rest.

From the head projects a long proboscis and two palpi, the latter being of the same length as the proboscis in both the male and female.

Upon the wings of the Anopheles claviger are four black spots arranged in the form of a capital T.

The Anopheles superpictus has four black spots arranged in line along the anterior or external edge of its wings, with intervening spots of yellow.

On the wings of the Anopheles pseudopictus the black spots are not distinctly marked, while the yellow spots are the same as in the former variety.

The Anopheles bifurcatus has no black spots upon its wings.

Habitat. Mosquitoes live and thrive in low, moist localities, marsh lands, and the low lands covered with underbrush adjoining damp and dark woods, caves, stalls, etc., form their resting-place by day, whence they issue forth in the early evening, and inflict themselves upon man and animals.

As well as an aerial existence, mosquitoes have one in water; that is, the females deposit their eggs upon the surface of the water, where they develop first into larvæ, then into nymphæ, and, finally, the complete aerial insect is set forth.

This process involves from twenty-four to thirty-two days. The eggs of the Anopheles claviger, about forty to one hundred in number, are deposited upon the surface of the water in the form of a ribbon-like band, those of the Anopheles bifurcatus in a stellate formation; the waters preferred are stagnant, or semistagnant and clear; slow running ditches and canals, meadows, and rice fields are favorite places.

In about three days the larvæ are hatched; these have small heads and a short breathing-tube, and lie parallel to and just beneath the surface of the water, the breathing-tube and a portion of the head protruding above it. They feed in this position, and it is only late in the larval stage that they descend to the bottom for food, and this is done with great difficulty.

Comparison of Anopheles and Culex.

Anopheles.	*Culex.*
Selection of water upon which to lay eggs:	Selection of water upon which to lay eggs:
Clear, quiet, slow running streams.	Artificial pools, receptacles in which water is left standing, grassy streams.
Larvæ: Head small and breathing-tube short.	Larvæ: Head large and breathing-tube long.
Do not descend to bottom until late in larval stage.	Feed on the bottom, ascending to the surface to breathe.
Larvæ lie just below and parallel to the surface, with breathing-tube and portion of head protruding above it.	Larvæ, while breathing, assume a position of 45° to the surface, breathing-tube protruding.
Adult mosquito:	Adult mosquito:
Palpi of both male and female the same length as the proboscis.	Palpi of female much shorter than the proboscis.
Certain arrangements of spots upon the wings.	No spots upon the wings.
When clinging to horizontal surfaces, the body is almost at right angles to the surface.	When clinging to horizontal surfaces, the body is parallel to the surface.
Vertical surfaces, body at an angle of about 35°.	Vertical surfaces, body parallel.

Malarial infection does not extend far in any direction from given foci, being limited in horizontal, oblique, and vertical directions; this is readily explained by the life of the mosquito.

I cite the following conclusions reached by Celli:

1. The hours during which the malarial germs are most plentiful in the air are those of evening, sunset, and night.

2. They generally rise from limited foci, and are diffused to a limited distance in the horizontal, oblique, and vertical directions.

3. The winds, properly called, do not generally transport them; they tend rather to diminish their number in the atmosphere.

4. Woods, instead of filtering them, may be foci of malarial infection.

These axioms are thoroughly in accordance with the theory that the malarial germ is cultivated, transported, and inoculated by the agency of mosquitoes, which—

1. By day lie hidden and sheltered, while they come out to bite man in the evening and at night.

2. They do not wander far from the place where they are born, and especially they fly a little distance from the ground.

3. When the wind blows they do not, as a rule, come out of their hiding-places.

4. Shady and damp woods and trees in general are the nests of mosquitoes. The mosquito, besides being the source, is consequently also the carrier of malarial infection.

Prophylaxis. With the foregoing facts in view, it is obvious that two courses of action present themselves: first the destruction of the mosquito, and, second, the prevention of infection spreading to non-infected mosquitoes; both of these being of extreme importance, not only to the individual or to the community, but to the State as well.

For as the efficiency of a body of troops in the field is directly proportionate to the health of the command, so is the prosperity and happiness of a State dependent upon the health of its inhabitants.

Therefore, from an economic standpoint, as well as from that of the public health, the State should make every effort to free itself from this most persistent and dangerous pest.

What applies to the State applies with even greater force to the community, for the municipality being so much closer to the individual can, by a process of education, and the passage of proper laws, and a rigid enforcement of them, practically destroy the mosquitoes, bringing health and prosperity where formerly quite the reverse was the case. Witness the city of Havana, Cuba, under the able administration of Major Gorgas, Medical Corps, United States Army, Chief Sanitary Officer, and upon a smaller scale the town of Winchester, Virginia, under the wise and progressive administration of its Mayor, Mr. R. T. Barton.

The part of the individual grows more important as the population grows more scattered, and in the smaller towns and isolated places of residence, it will be the work of the individual that will have to be depended upon for results; but in the larger towns and cities much may be accomplished by the intelligent co-operation of the individual with the proper authorities.

Duties of the State. The State, through the channels of its Board of Health, or a body with similar authority, should publish a health bulletin, or a mosquito bulletin, setting forth in a plain, concise manner the relation mosquitoes bear to disease, and also the economic side of the question, showing the relative rise in value of real estate, and the increase in productiveness of lands, which by proper drainage, etc., can be reclaimed, and made not only productive but habitable, thereby producing a great advantage to the individual, as well as to the community at large, and indirectly increasing the wealth and prosperity of the State. Copies of these bulletins should be sent to all local Boards of Health and Boards of Trade, and active co-operation urged and solicited; where extensive swamp lands are a menace to a community and State, the State should render financial help in the reclaiming of such lands.

Copies of these bulletins, with printed instructions as to the best and most improved methods of destroying the mosquito and its breeding-places, should also be sent to all State institutions, with orders to those in charge, that every precaution should be observed for the destruction of mosquitoes and their breeding-places, and inspections made from time to time, by competent inspectors, to see that the orders have been intelligently carried out.

Duties of the Municipality. Similar bulletins should be published by all local Boards of Health, and the individuals of the community thoroughly posted as to the necessity and the methods to be employed for the destruction of the mosquito; also the necessity of protecting all cases of malaria from the bite of mosquitoes, so that non-infected insects will not become infected, thereby spreading the disease.

The following sanitary measures should be adopted and put in force:

1. All hollows within the city limits, and for a mile surrounding it, should be filled in and graded.

2. Marsh lands within the same territory should be properly drained, and, where practicable, filled in.

3. Ponds and streams that cannot be drained or filled in should have their surfaces covered with petroleum, which should be renewed every twenty-one days.

4. Where for any reason this is impossible, fish should be introduced, so that they may feed upon the larvæ.

5. All receptacles holding water should be made mosquito-proof, or where this is impossible the surface covered with petroleum. If this water be drawn, by means of a faucet, from the botton of the cask or tank, and not dipped out, it will not be unfitted for drinking or washing purposes.

6. Old cans and pans exposed so that they might collect rain-water should be carefully covered.

7. Householders should be advised to thoroughly screen their houses.

8. Thoroughly screened isolation wards should be provided in the hospitals.

9. All cases of malarial fever should be reported to the Board of Health, the same as other infectious and contagious diseases.

10. Where the patient cannot be properly isolated at home, he should be removed to the hospital.

11. The sick room should be thoroughly screened, completely isolating it from the other portions of the house, as well as from the outside.

12. The mosquitoes in the other rooms should be carefully destroyed.

13. When the plasmodium has disappeared from the blood, the patient should be removed to another room, and the mosquitoes in the sick room destroyed by fumigation.

14. Cesspools should have their surfaces covered with petroleum at least once a week.

Duties of the Individual. He should make himself thoroughly acquainted with the mosquito question, and do everything in his power to aid the authorities in their efforts to destroy them and to protect himself and family from infection.

He should thoroughly screen his house, fill in and grade all hollows on his property, see that all receptacles in which water is allowed to collect and stand are mosquito-proof, or that the water surfaces are covered with petroleum.

If living in the tropics, or in a malarious locality, he and his family should wear warm underclothing, woollens preferred; they should remain indoors as far as possible after nightfall, or if compelled to go out, to protect exposed parts by netting or by the use of such drugs as are known to repel the mosquitoes. Tonic doses of quinine or arsenic are of great value to those habitually exposed to infection.

Methods for Destroying Mosquitoes. This subject has been given considerable attention by investigators all over the world, and various substances have been suggested for use in or upon waters infested by larvæ, as well as for the destruction of adult mosquitoes.

Among the substances suggested as larvicides are the aniline dyes, permanganate of potassium, and petroleum; the latter has been proven to be the only practicable substance of the many named, and is very effective.

The grade of oil selected for the purpose should not be too heavy or it will not spread properly over the surface, nor should it be of such quality as to evaporate quickly; the "fuel oil" of the Standard Oil Company seems to give the most satisfactory results.

An ounce of oil to every fifteen square feet of surface should be used.

Where, for any reason, oil cannot be used, small fish, such as minnows or sun-fish, should be introduced, as these feed upon the larvæ.

In the destruction of the adult mosquito, rooms should be carefully sealed, and such insecticides as sulphur, pyrethrum powder, or formalin used.

Major Gorgas, in Havana, found that pyrethrum powder proved the most satisfactory agent, as it was less offensive to the household, did not destroy or injure fabrics, and was very effective.

One pound of the powder to every 1000 cubic feet of air space should be used; as this does not entirely kill all the mosquitoes, but at times only stupefies them, causing them to fall to the floor, at the end of three hours the room should be opened, and the mosquitoes swept up from the floor and burned.

Drugs, which when applied to exposed surfaces, such as the face, neck, and hands, sometimes prove useful; the best of these are the oils of citronella, lavender, eucalyptus, and pennyroyal; camphor-water is also valuable.

THE THEORY OF CROSS EDUCATION AS APPLIED TO THE AUDITORY APPARATUS.

SOME EXPERIMENTAL STUDIES.

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As long ago as 1836 the sympathetic relation of one ear with the other was recognized by Kramer, and since then varied physiological and pathological phenomena have directed the attention of careful observers to the apparent relation in functionating power exercised by one ear, upon the opposite side. As directly evident that such a phenomena exists, one has but to place a vibrating tuning-fork before one ear, and in the majority of instances the acuity of hearing in the opposite ear for a different sound, such as that of a watch, will be somewhat augmented.

In the so-called sclerotic or catarrhal otitis media, in which a trophic element undoubtedly plays an essential part, and in cases in which the hearing has been reduced in one ear to contact for the watch, a transient auditory stimulation may be produced by the sound-waves from a vibrating body, such as a Cii tuning-fork when placed near the

opposite ear, so that for a short time the hearing in what we may designate as the watch-ear will be increased, so that the high-pitched note of the watch will be heard at a variable distance, rarely exceeding, however, half of an inch. This gain in hearing apparently disappears when the sounding body is removed from in front of the meatus of the opposite side, but if the vibrations are allowed to continue for several minutes the hearing distance for the watch is diminished to the original contact, while from fatigue the hearing for the tuning-fork is also lessened. An analogous phenomenon is occasionally elicited under the same conditions in those cases where the watch is not heard on contact or is heard but faintly; the effect of the vibrating body of a dissimilar sound placed before the meatus of the opposite ear causing the patient to hear the watch when before such was not the case. The effect of the electric current when used to demonstrate this relationship between the two ears is not so well marked as the effects produced by sonorous bodies, but in some cases the electric stimulation of the auditory nerve of one side increases the susceptibility of the opposite nerve to the action of the current, while very infrequently under the same conditions the so-called paradoxical reaction may be elicited; this phenomenon consisting of obtaining the galvanic reaction in the ear to which the electrodes are applied, and at the same time there occurs an opposite result in the non-stimulated ear.

With the knowledge that such a relation existed between the two organs of hearing, and the apparent influence exerted one upon the other being capable of demonstration, it was but a step to apply the theory of "cross education," as enunciated by Scripture, to the aural apparatus in an endeavor to ascertain, as far as possible, the apparent cause of the relation existing between the two ears and which was concerned in the production of the phenomena previously described. Scripture's experiment consisted in squeezing the bulb of a mercury dynamometer as hard as possible with the left hand for a number of times, and the rise thus produced of the column of mercury was averaged. Immediately afterward the same process was performed with the right hand. Then on the following days, with some intermissions, the experimenter practised the right hand by squeezing ten times on each occasion. On the ninth and final day of the experiment the left hand, which had not received any practise in the interval, was again tested, and it was found that it had gained about 50 per cent. in strength through practise of the right hand. In other words, the original test on the first day showed on the dynamometer an average of 28.8 inches for the right, and 29.6 inches for the left hand, while during the course of the experiment from the exercise of the right hand the height to which the column of mercury could be raised gradually increased at each trial until the last day, when it reached an average of 48.6 inches. It

should be remembered, however, that during this time the left hand was not used at all for this purpose, yet at the termination of the experiment the increased strength in this hand had risen to 42.3 inches, as shown by the dynamometer. The peculiar phenomena thus produced of the transference of the effects of practise from one side to the other was called by Scripture " cross education."

To further demonstrate this another experiment was performed by trying to insert the point of a needle at the end of a rod into a small hole without touching the sides. At first twenty trials were made with the left hand, with a success of 50 per cent., and then the right hand was used in the same manner, with a success of 60 per cent. On succeeding days two hundred experiments were made with the right hand, with a final success of 88 per cent. Again the experiment was tried with the left hand, which had not been practised in the meanwhile, and a success of 76 per cent. was obtained, thus again demonstrating the results obtained from the original experiment. As corroborative evidence of the fact that cross education does exist, the experiments of Davis have a direct value, and, even further, they present features applicable to the synergy existing between the tensor tympani muscles of the corresponding ears. " The subject of this experiment began by raising a five-pound dumb-bell by flexing the arm at the elbow, this calling into play chiefly the biceps muscle for lifting and the forearm muscles for grasping. This was done as many times as possible with the right arm, and then, after a rest, with the left arm. The subject then entered upon a practise extending from two to four weeks, which consisted in lifting the weight with the right arm only. At the end both arms were tested as at the start." The results obtained from this experiment were exceedingly interesting, as, after careful measurements were made of the upper arm and forearm on both sides, it was found that the unpractised left arm had gained in power, as shown by the former experiments, and, in addition, it had also gained in size. As pertinent to the further elucidation of this subject, it is well to note here that Scripture considers the gain by practise, which shows itself by cross education, to consist in the development of the higher nerve centres connected with the two sides of the body.

With the results obtained by Scripture upon symmetrical parts of the body clearly established, and the knowledge of the so-called sympathetic relation existing between the two organs of hearing, I undertook to make a series of experiments upon the auditory apparatus to determine, if possible, what effect mechanical movements of the membrana tympani and, therefore, of the chain of ossicles would have upon the hearing power of the opposite ear. The cases selected for this purpose were those in which the hearing was defective from sclerotic changes in the conducting apparatus, but in which the percep-

tive portions were, as far as ascertainable by recognized auditory tests, not involved in the essentially chronic process. The method used in determining the effect of exercise of one ear upon the opposite one was to make the usual tests of hearing of both ears, the voice, watch, and tuning-fork being used for this purpose. Immediately thereafter movements of the membrana tympani and ossicular chain were made by rarefying and condensing the column of air in the external auditory canal by means of a ten-ounce Politzer bag and a Siegle otoscope tightly fitted, by means of a soft rubber tip, into the canal. The air in the canal was alternately rarefied and condensed for fifteen distinct times in the right ear, the pressure exerted upon the drum when the bag was forcibly compressed being sufficient to produce visible and well-marked to-and-fro excursions of the tympanic membrane, but not being forcible enough to cause any harm.

In order to eliminate as far as possible any extraneous sound waves, and especially the high-pitched sound caused by the escape of air between the wall of the external canal and the otoscope, special care was taken to have the ear-piece tightly in apposition with the canal wall, so that the production of any sound waves from this source could be entirely eliminated. These seances consisted of fifteen massage movements each of the drum and ossicles, repeated on the right ear on alternate days for ten times, and at the conclusion of the tenth seance the left ear was again tested, to ascertain if any change had occurred in the interval during which it had had no exercise. The results clearly demonstrated the phenomena of cross education, as shown by the following cases which were selected from a number performed, all with positive results.

The first experiment was performed on Mrs. L. A., aged thirty-eight years, who had complained of impaired hearing for one year. The membrana tympani were retracted and thickened on both sides; the Eustachian tubes were patulous, and she complained of tinnitus approaching a musical note. The Cii tuning-fork (512 vibrations) was used in testing, and Rinne was positive for both ears; Weber being positive for the left. The voice was only heard when loudly elevated for both ears, and the watch showed 0/54 for the right and c/54 for the left on the first day of the experiment, the "0" being equivalent to no watch hearing, while "c" meant that it was heard on contact only. The following table shows the result of the exercise and its effect upon the non-exercised ear:

	1st day	2d day	3d day	4th day	5th day	6th day	7th day	8th day	9th day	10th d'y
Right,	0/54	0/54	0/54	1/54	1½/54	¾/54	c/54	c/54	0/54	3/54
Left,	c/54	.....	.....	.....	.....	.....	.....	.....	.....	2¼/54

Thus, in the right ear the hearing increased from nothing for the watch to a fair hearing distance of 3 inches, while in the left non-exercised ear the hearing for the watch, which was originally only on contact, had increased to 2¼ inches, a most remarkable gain and one which clearly demonstrates the effects of cross education upon the auditory apparatus. In this case both Rinne and Weber tests remained the same after the experiment was concluded, but the gain in hearing for the voice was shown in both ears, and instead of a loud voice being necessary in order to make the patient understand, a slightly elevated voice only was necessary even in the left ear.

Another case upon which the experiment was performed, and which will be sufficient for illustration here, is that of O. K., male, aged fifty years, with impaired hearing and tinnitus for four years. The membrana tympani presented the appearances seen in the former subject, but to a more marked degree; Rinne was positive in both ears; Weber positive in the right; the watch was heard in both ears only on contact, while a moderate voice could be readily understood. The diagnosis of chronic otitis media was made, without marked changes of the internal ear or auditory nerves. The same procedures were adopted as in the preceding instance, with the following results, not so well marked, however, as in the former case, but of sufficient import to be of value:

	1st day	2d day	3d day	4th day	5th day	6th day	7th day	8th day	9th day	10th d'y
Right,	c/54	c/54	½/54	3/54	3/54	3¼/54	c/54	2½/54	3½/54	c/54
Left,	c/54	.....	.....	.....	.....	.....	.....	.....	.....	1/54

In this instance a gain of 1 inch in the left unpractised ear was obtained by the stimulation alone of the opposite organ of hearing. Rinne's test remained, like that of the voice, unchanged, while Weber's now became positive for both ears.

It will be noticed in both individuals that in the exercised right ear there were, from time to time, considerable variations in the hearing distance. These retrogressions are well marked in all cases of aural sclerosis, and may be the result of numerous extraneous causes, and in the particular cases under observation the temporary diminution in the auditory capacity was the result of two distinct causes, one being a temporary closure of the Eustachian tube from a transitory rhinopharyngitis, while the second factor was undoubtedly the result of overstimulation of the receptive portions of the auditory apparatus, with a subsequent transient fatigue and diminution of response to the usual stimuli. This factor was easily demonstrated by omitting the massage movements for a day, when the hearing capacity would again assume its acuity previously gained.

Another factor which was noted during the course of these experiments, and which also presents some features of practical import, was the effect of the passive movements of the right ear upon the tinnitus which existed in the left ear. In the first instance the subjective sounds were quite distressing in both ears previous to the tests, while after their completion the tinnitus appeared to be much better in the right ear, while on the opposite non-exercised side the improvement was marked, but not to the same extent. In the second case, however, in which the tinnitus resembled the sound produced by escaping steam, and while present in both ears, was worse in the left; yet as the result of the massage it slightly diminished in the right and improved to a considerable extent in the left ear. The phenomena observed in these and other cases of the effects of cross education were not only confined to an increase in the functional activity of the passive ear, but also influenced the pathogenic factors present to some slight extent, as shown by the partial subsidence of the tinnitus.

As but a minimum of direct sound is produced by the massage movements as employed under these circumstances, the influence exerted upon the auditory nerve and receptive centres is mainly that of mechanical stimulation, being obtained by the to-and-fro movement of the column of air in the external auditory canal and Politzer bag employed for this purpose against the more or less resisting drum membrane. The effect of this rarefaction and condensation of air being to alternately move the drum backward and forward and in turn producing a transmission of this energy through the ossicular chain to the perilymph in contact with the inner aspect of the oval window; the impulses so produced were transmitted through the natural paths of the internal ear to the delicate terminations of the auditory nerve, and thus acting as more clearly defined sound waves of measurable length.

That the stimulation so produced assumes a mechanical feature, more than a pure auditory aspect, I believe to be the correct interpretation, and that this is evident is well shown by some of the phenomena elicited in the study of the physiology of the auditory nerve and its end organs. It is a well-known physiological fact that the eighth nerve is capable of conveying other impulses than those purely of audition, and the presence of motor fibres here, as well as those of a sensory character, will admit of the transmission of impulses not especially concerned with audition. This is especially seen in the studies of the peripheral distribution of this nerve to the ampullæ of the semicircular canals, where the fibres partake essentially of motor activity, while those filaments which are distributed to the other portions of the labyrinth are sensory in their function. By direct experimental stimulation of the ampullar terminals it is possible to excite reflex motor activities, which are conveyed to the higher centres through the nerve trunk, and exercise

undoubtedly some control over equilibrium. This is especially prominent when non-auditory massage movements are applied for various reasons to the membrana tympani, for should the force be too powerful, an over-stimulation of these motor fibres in the ampullæ ensues and greater or lesser degrees of vertigo immediately occur.

The auditory nerve in whatever form the motion may originate from is excited by the mechanical stimulation of the wave motions of the labyrinthine fluids. And while it is not desired here to enter into the complex aspects of audition from this point of view, it may be noted, in order to more clearly indicate the nature of this aspect of cross education, that the fluid of the internal ear is moved apparently as a whole and not in molecular parts. In addition, it seems very probable, and to my mind, at least, conclusive, that the various forms of motion, whether concerned in pure audition or in other mechanical stimulation, are conveyed to the fibrillary terminations of the nerve, not only through the ossicular chain and oval window, but also by the movements of the air waves in the tympanic chamber, through the inner tympanic wall and fenestra rotundum, thus producing movements of the contained fluid by these dissociated routes. The action of these massage movements as used for therapeutic purposes, but which well apply to our subject here, were studied by Nuvali, who found in the dead body that by making apertures in the roof or sides of the tympanum the intratympanic structures might be observed while massage movements were performed. The vibratory motion of the intralabyrinthine fluid being ascertained by observing the movements of the membrane in the fenestra ovalis, it was also found by drilling a minute aperture into one of the semicircular canals that the fluid filling it also partook of the same vibratory motion.

An interesting hypothesis advanced by Gad in relation to the functions of the eighth nerve is also of interest in a study of cross education, as he considers that this nerve trunk not only transmits stimuli resulting from the analysis of complex sounds by the labyrinth, but it is also excited by the impulses of the vibrating body acting as a mechanical stimulus. As to the receptive centres with which the eighth nerve is in affiliation as regards the perception of the stimuli with which we are concerned other than those of purely acoustic origin, little can be said, except that they, undoubtedly like other centres, react to other stimuli than those for which they were especially designated, although, of course, certain centres are immediately concerned in the control of the sum total of those stimuli (some motor) which go to make up what we call equilibrium.

The anatomical relation of one auditory nerve to the other seems to show in a manner the relation existing between the two ears, and their synergy evidently is dependent to some extent upon these close relations.

An examination of the auditory nerves at their origin shows that a portion of their fibres is closely connected with a mass of motor cells in the bulb, and that these fibres pass into and are continued in the inferior peduncles of the cerebellum. Further than this there is a decussation of the fibres in the region of the trapezoid bodies, and this certainly suggests some correlation of auditory impressions or other stimulation in the higher centres of the two symmetrical organs. And this anatomical feature seems still more to be indicative of these cross educational features when it is considered that each nerve communicates with both centres, and that each contains a decussating and a smaller non-decussating fasciculus.

The influence of the auditory functions of one side upon that of the other in a retrogressive and passive sense, instead of active motion which has been dwelt upon, is illustrated in a case coming under the observation of Ouspenski, and which well shows this reciprocal influence. The case was one of acute unilateral otitis, in which there existed bilateral deafness. Examination showed the presence of a piece of wool in the inflamed ear, pressing tightly upon the membrana tympani, and when this was removed the hearing returned to normal in both ears. This same influence has been repeatedly noted in the opposite ear when one or more ossicles have been removed from but one tympanum only.

Similar to this are the results seen in those cases of sclerotic otitis media in which one or more ossicles have been removed. This beneficial influence upon the non-operated ear has been especially noted by Burnett, and as a result of his extensive experience with this operation he found that the results indicate that the progressive impairment of hearing, while being stopped in the ear operated upon by the removal of the incus, was similarly influenced in the opposite ear; and a case under his observation for six years showed this correlation in a most striking manner. Dench has also called attention to the improvement of the function of the non-operated ear, while in a case of progressive deafness seen by Alderton, in which he removed the incus and crura of the stapes, and later trephined the foot-plate of the stapes, it seemed to arrest the progress of the deafness in the ear operated on and improved considerably the hearing in the opposite ear not operated on, the result in the opposite ear being due to what was considered the synergy of the two sides. Miat has also noted this phenomena, and states that when in a patient affected with dry otitis the worse ear alone is operated on, the increase in auditory acuity is noted not only on the operated side, but also in the other ear, especially by submitting it to some form of electric stimulus. Under such conditions the correlation between the affected ears assumes a practical import, and while it would not be judicious to take into consideration improvement in the non-operated

ear as a part of the prognostic features of a case, yet this beneficial result has been noted by so many observers that it is worthy of more careful study.

As the study of cross education is best made in those cases where the auditory acuity has been somewhat dulled by sclerotic processes, so may the course of this morbid process strikingly suggest the interdependence of the organs of hearing. For the disease usually begins in but one ear, while the opposite cavum tympani remains apparently unaltered for a considerable time, and then later becomes involved much more rapidly than the originally affected ear. This effect is certainly not seen in non-correlated areas of the body under the same existing conditions. Various observers have noted the effect on increased labyrinthine tension from rigidity and displacement inward of the ossicular chain upon the function of the opposite ear, while Urbantschitsch urges that stimulation of the perceptive centres may follow the action of sonorous vibrations, even if the ear acted upon is so defective as to be incapable of transmitting impulses to the degree necessary for actual sound-perception on the part of the patient, and he considers that when the ear of one side has been rendered entirely useless by sclerotic changes in the conducting mechanism it is warrantable to relieve this abnormality before the influence which it may exert upon the opposite side can be decided.

As regards the correlation between the corresponding portions of the auditory apparatus on the opposite sides, various theories have been suggested to account for the phenomena, especially in pathological states. Dench considers that the relationship no doubt depends upon reflex action through the sympathetic and cranial nerves, and in many cases upon the decussation of the auditory fibres within the brain. Rhese, in considering the improvement following in the opposite ear after removal of the ossicles in two cases which came under his observation, states that it is probable that the removal of the malleus destroys the synergic action of the tensor tympani muscle in the opposite side, and thus accounts for the improved hearing and arrest of the subjective noises. Another theory which he considers is that by the anastomosis of the auditory nerves one with the other, inhibitory stimuli are transmitted through the tympanic plexus to the sound-perceiving part of the other ear, and Burnett offers as an explanation of the improvement in the opposite ear that the contraction of the tensor tympani being overcome by the removal of the incus in one ear, the synergetic contraction of the tensor in the opposite ear, induced by cross influence of the more diseased organ, was also overcome by a beneficial cross influence emanating from the operation in the diseased ear.

That the phenomena of cross education as related to the auditory

apparatus can be readily demonstrated, I am confident admits of no doubt, and that the correlation existing between the auditory apparatus of the opposite sides of the body is that of so-called cross education, seems probable in the light of my experiments. The relation of the fibres of one auditory nerve with that of the other and with the higher centres in intimate relation with the nerves from both sides evidently, in part, at least, indicates the paths by which stimuli applied to one side in turn influence the other correlated area.

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A CASE OF ACUTE LYMPHATIC LEUKÆMIA WITHOUT ENLARGEMENT OF THE LYMPH GLANDS.[1]

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The different forms of leukæmia, and especially the etiology of the disease, have formed a subject of great interest to the medical profession since Virchow's first publication in 1845. When we attempt to review the colossal amount of literature on this subject, in the endeavor to learn what has been discovered and to trace the genesis of the prevailing opinions, we are surprised to find how little is definitely known concerning the nature of the disease and how much remains to be elucidated.

The excellent papers of Müller[2] and Walz,[3] which almost completely cover the literature, greatly facilitate the review of the facts and opinions relating to various branches of the subject. I have depended largely on the article of Walz for the summary of the existing knowledge of the subject, and more particularly for references to the form of the disease to be considered in this paper.

The scope of this paper is to present some suggestive points which a study of a recent case of acute leukæmia has offered. The clinical

[1] From the Pathological Laboratory of the Johns Hopkins University and Hospital.
[2] Centralbl. f. allg. Path. u. path. Anat., 1894, Bd. v. pp. 553, 601.
[3] Ibid., 1901, Bd. xii. p. 967.

features, the autopsy report, and the microscopical findings of the case will be briefly presented.

Clinical History. Mr. C., a patient of Dr. Smart's, Baltimore, Md., to whom we are indebted for the notes of the case. Born in England, forty-seven years ago. A gardener by occupation. Always a very healthy man. Florid complexion. Digestion good. Heavy drinker. Denies venereal diseases. Fifteen years before had a protracted attack of malaria.

Six months before his death had a severe hemorrhage from the nose. From this time on became noticeably pale.

Called in a physician, three and a half weeks before his death, after having a second hemorrhage from the nose. His chief complaint was dyspnœa and great weakness. The change in complexion was startling, his pallor being extreme and increasing progressively up to the time of death. Over his left fibula there was a small area of subcutaneous hemorrhage. A hæmic murmur was heard over the præcordium. There was no fever, cough, or pain, or any other pronounced symptoms. The asthenia progressed. The urine appeared normal, except for an excess of uric acid.

The blood was examined twice microscopically, ten days and seven days before death. An enormous increase in the leucocytes was apparent, the white cells being about as numerous as the red blood corpuscles. No differential count or more accurate examination was made.

Four hours before death, some altered blood was expectorated, which presumably came from the nose and was swallowed.

The patient died at 2 A.M., March 15, 1902.

Autopsy by Dr. W. G. MacCallum six hours after death.

Anatomical Diagnosis. Lymphatic leukæmia. Bronchopneumonia. Œdema of lungs.

Body is that of a fairly well-built man of moderate size. The skin is extremely pale.

Peritoneal and pericardial cavities appear normal.

Thorax. The pleural cavities are almost free from adhesions, only a few being present over the apices of the lungs, where there are depressed scars on the surface of the lungs.

Heart. Over the epicardium are a few small hemorrhages, especially over the right ventricle. Upon opening the heart it is found that very little blood can be squeezed from it. The cavities are filled with a whitish chicken-fat clot in which there is only a little red color noticed in the more dependent parts. The clot is quite continuous and may be turned out as a mould. The tricuspid and pulmonary valves are normal. The mitral and aortic valves are also normal, although they are slightly thickened. The myocardium of the heart is very soft and flabby, and everywhere shows an extreme mottling with yellow patches, which stand out prominently in contrast to the pale brown of the heart muscle itself. On tangential section, this mottling is extremely well marked, especially in the papillary muscle, where it has the typical faded-leaf appearance. The anterior descending branch of the coronary artery shows quite marked patches of sclerosis. There is also a little sclerosis in the root of the aorta. There are no thrombi, and the endocardium is everywhere smooth.

Aorta. The aorta contains but very little blood, and that is coagulated into blood clots. The walls of the aorta are fairly normal.

Lungs. On removing the lungs the pleural surfaces are found to be smooth and glistening. The lungs are very voluminous and pale. Over the apices are found areas which are collapsed. On section the lung substance is found to be a little emphysematous, especially in the upper portions; they are extremely œdematous throughout. Only in the collapsed portions near the apices is there any evidence of consolidation, and here there are one or two small bronchopneumonic patches. The bronchial glands are deeply pigmented and only moderately enlarged.

Both lungs present practically the same appearance. The trachea is very pale, but apparently normal.

Spleen. Measures 13 x 10 x 6 cm. The surface is quite densely adherent to the diaphragm at one point. There is some thickening of the capsule and a few small hemorrhages show through. The vessels at the hilum are not especially thickened. The organ is firm in consistence, and on section the pulp is somewhat translucent, grayish-red in color. The Malpighian bodies are visible and are somewhat diffuse; they are not sharply outlined, although they differ very markedly from the red splenic pulp. The trabeculæ and vessels are moderately prominent.

Liver. Measures 25 x 18 x 9 cm., and extends 10 cm. below the ensiform cartilage. The surface is smooth and the lobulation is normal. The cut surface is pale brown in color, and there are many lobules with bright-red centres. There are some small, pin-head-sized areas which are translucent gray in appearance, and seem to be situated about the vessels. On the whole the liver substance has a normal appearance. The lobules are indistinctly marked out and the consistency of the organ is not increased.

Œsophagus, stomach, and intestine, except for a marked pallor of the mucosa, appear normal. The lymph follicles are nowhere enlarged.

Kidneys. The organs are about alike in general appearance. The capsule strips off readily, leaving an extremely pale surface which is quite smooth. The left kidney measures 12 x 6 x 3.5 cm. The cortex averages 5 mm. in thickness. The cut surface is also extremely pale, pyramids being especially white. The cortex has a grayish color throughout. The striations are just made out and only here and there can a glomerulus be seen. Scattered over the surface of the cortex and pyramids are opaque yellow-white specks of minute size, which are more abundant in the pyramids. The pelvis and ureters are apparently normal. Adrenals are normal in appearance. Bladder also apparently normal.

Lymph Glands. The bronchial and all the peritrachial and aortic glands, though deeply pigmented, are not especially enlarged and are rather soft and translucent. The mesenteric lymph glands are also not enlarged, are deeply pigmented, grayish-yellow, and translucent, and on section somewhat softer than normal. They are quite closely crowded in the mesentery. The inguinal lymph glands are not especially enlarged and are rather pale and soft, like those described in the mesentery. Along the retroperitoneal region the hæmolymph glands are very conspicuous, have a dull-red color, and are not especially enlarged.

Thoracic Duct. The thoracic duct is found not enlarged and contains a slightly blood-stained fluid.

Bone Marrow. The bone marrow of the femur is homogeneous, deep red in color and very soft and diffluent.

Microscopic Examination. Blood. At the autopsy blood smears were made from the heart and vena cava. The films were fixed by heating on the copper bar. The best nuclear differentiation was obtained by following Rubinstein's method of heating from thirty seconds to one minute at the spheroidal point. Ehrlich's and Biondi-Heidenhain's triple stains were used, also dahlia, eosin, and methylene blue, polychrome methylene blue, safranin, etc. In making several differential counts of these preparations, in over a thousand non-granular mononuclear cells, only three or four granular leucocytes were seen, and these were polymorphonuclear. Four normoblasts were seen in the count.

The uninuclear cells varied in size from cells almost twice the size to those considerably smaller than the normal red blood cells. The nuclei were round or slightly oval. In the large cells, the nucleus stained faintly, and showed a definite nucleolus and intranuclear network. These chromatin threads took a red stain in Biondi-Heidenhain stain. The protoplasm of the cell was considerable in amount, non-granular and took a faint acid stain in eosin and methylene blue. The protoplasm of the cells, in specimens stained by a single alkaline stain, showed no basic granules and were only faintly tinted. Lymphoid cells with double nuclei and nuclei showing constrictions were occasionally found, but no mitotic figures were observed. The small uninuclear cells had only a slight rim of protoplasm, which also took preferably a faint acid stain. The nucleus stained intensely and usually homogeneously; however, a single point or chromatin filament, which retained a red stain in Biondi-Heidenhain's preparation, was to be made out in good specimens. It was impossible to make a definite estimate of the relative number of these two varieties of cells, as the fragmentation of nuclei and distortion of cells from post-mortem changes was considerable.

The red corpuscles appeared normal in size, form, and staining properties. The nucleated red cells were of the normoblastic type. The number of red cells present was remarkably small, but no estimation of the grade of anæmia could be made, as the blood was not fresh.

A chicken-fat clot from the heart showed on section a meshwork of fibrin containing the blood elements. This furnished a very clear picture of the different forms of leucocytes present. The predominating cell, as in the blood smears, was a small lymphoid cell, with a small round or oval, densely staining, homogeneous nucleus. The amount of protoplasm of such cells appears greater than in the blood smears, and although containing no definite granules, had an irregular granulated appearance. Similar cells, with a faintly staining nucleus, taking a greenish color in methylene-blue preparations, were considered to be degenerating cells, although the resemblance to normoblasts was striking. A few typical lymphocytes were seen, having a relatively large deeply staining nucleus, with a well-marked chromatin intranuclear network and a small rim of protoplasm. Larger cells, often over twice the size of a red blood cell, having a large vesicular nucleus, either pale or heavily stained, were more abundant than the typical lymphocyte. The nuclei of these cells, which were usually round but

occasionally slightly irregular in shape, showed always chromatin threads, and granules at the intersection of these filaments, and stained, as a rule, more faintly than those of the smaller cells. The protoplasm was often considerable in amount, and took a faint acid stain in eosin and methylene blue. No granulations were demonstrable in any of these lymphoid elements.

Lymphoid cells with two nuclei, or nuclei showing a marked constriction, were occasionally seen, both in the small and in the larger forms.

A few cells were observed with a relatively small vesicular nucleus, and a large amount of protoplasm containing blue granules in the alkaline stains. The ordinary polymorphonuclear neutrophile and eosinophile were rarely met with. No definite myelocytes or normoblasts were observed.

Bone Marrow. The study of the bone marrow of the femur showed an almost complete obliteration of the normal appearance of the bone marrow. This was due mainly to the disappearance of fat, and to the increase in the cellular elements, which were noticeably of a small mononuclear form. The tissue consisted of an almost homogeneous distribution of cells and red blood corpuscles in a network made up of very fine reticulum fibrils. The bloodvessels were apparently normal, the venous sinuses were, however, conspicuously large and full of cells. The capillaries could not be traced for any distance in the parenchyma, but seemed to break up and opened directly into the tissue spaces. The connective tissue present was very small in amount and was represented by an occasional cell, belonging to the reticulum, by the remaining fat cells, and the perivascular tissue. Stars of fibrin radiating between the cellular elements were abundant. The tissue was very congested, the vessels were not only full of blood, but red blood corpuscles were found lying everywhere in the tissue spaces, between the nucleated elements. In several areas definite hemorrhage had occurred, and the corpuscles were degenerated and coagulated together.

Very few nucleated red cells were to be made out, and these were of the normoblastic type. Practically no megaloblasts were seen.

Of the colorless cells present, the predominating cell was the small lymphoid cell, described previously in the blood. Here also it was conspicuous by its dense, deeply staining nucleus, of a round or oval shape. The next most numerous cell was the typical lymphocyte, with a nucleus showing a network of chromatin threads. Both these varieties of small lymphoid cells were found frequently dividing amitotically. The distinction between the appearance of the nuclei was maintained in the daughter cells. The two separating nuclei were always either dense and homogeneous, or slightly vesicular, and with a well-marked chromatin network. Practically no karyokinetic figures or signs of mitotic division were observed. The protoplasm of these cells stained faintly in acid stain and had a somewhat indefinite granular appearance. No definite granules were made out in any stain.

Very small cells, half the size of a red blood corpuscle, were fairly abundant in the bone marrow. These dwarf cells had a round, very faintly staining blue nucleus, and a small amount of homogeneous protoplasm taking a faint acid stain. The nature of these cells was not determined. The possibility of their being normoblasts was considered.

Large uninuclear cells, about the size of a myelocyte, with large, oval vesicular nuclei, were frequently seen full of basophilic granules. Large lymphoid cells with rather pale nuclei and non-granular protoplasm were present in large numbers. Cells with irregular or indented nuclei and non-granular protoplasm were also seen. The myelocytes present were relatively greatly reduced in number, but otherwise showed no change from the ordinary eosinophilic and neutrophilic varieties normally met with. The polymorphonuclear leucocytes were extremely few in number. A peculiar cell as large as a myelocyte, having a rather small, oval, densely staining nucleus, and a large amount of deeply staining pink protoplasm, was occasionally found. A few typical plasma cells were seen.

The giant cells of the bone marrow appeared diminished in number. Large phagocytic endothelial cells, containing often vacuoles, lymphoid cells, or red blood corpuscles were quite abundant.

Smears from the bone marrow furnished the same variety of forms as observed in the sections and showed in addition some important points. Transitions between the large lymphoid cell with the pale, vesicular nucleus and frequently basophilic protoplasm to the myelocytes with neutrophilic granules were evident. The nucleus of the older, more densely granular myelocytes showed more irregularity and stained more deeply. Nucleoli were conspicuous in the large lymphoid cells; and the nuclei of all the myelocytes and leucocytes, except the polymorphonuclear leucocytes, the nuclei of the small lymphoid elements showed in the triple stain red threads, which Rubinstein thought the distinguishing characteristic of the lymphoid cell of the bone marrow. These were more abundant and brighter in the ordinary sized lymphoid cell, but were still perceptible though faint in the large lymphoid cells, and in the myelocytes. We do not believe that these red nuclear threads are characteristic of bone-marrow cells, as the same thing can be demonstrated in cells of the lymph follicles and in the lymphocytes of the blood, contrary to Rubinstein's assertion. It is true that these markings are best seen in the young lymphoid cell and in the immature normoblast. The pyknotic nucleus of the mature normoblast loses this distinctive staining property, and the older lymphoid cells or marrow cells only show it faintly, while it is not evident in the polymorphonuclear leucocyte. This peculiarity would seem then to be a property of young cells, and the fact that the young normoblast, as well as the young lymphocyte shows it, speaks possibly for the common derivation of the erythroblast and the leucoblast.

The marrow of the rib showed a similar preponderance of lymphoid elements, as described in the transformed yellow marrow of the femur.

Lymph Glands. Lymph glands were examined from the axillary, inguinal, bronchial, retroperitoneal, and mesenteric regions. The condition was practically the same in every situation. The glands were not enlarged. The distinction between follicles and sinuses was partially obliterated from the increase of cells in the sinuses and to a lesser extent in the follicles. The structure of the tissue thus became more uniform and less characteristic of the lymph gland. The large cells, "mother cells" of the follicles, did not appear to be increased in number, nor were many mitotic figures to be seen in such cells. There was no evidence of proliferation in the gland itself. On examining with the high power the cells which were infiltrating the gland tissue, the great

majority of them appear to be very small lymphoid cells, of the type previously described in the blood and bone marrow. The small, deeply staining homogeneous nucleus was easily distinguished from the large, heavily marked nucleus of the gland lymphocyte. This was sufficiently distinct in ordinary preparations, but in eosin and polychrome methylene blue these cells showed a pale robin's egg blue nucleus in contrast with the deep indigo blue of the lymphocyte, and the contrast was easily made out with the low power. The bloodvessels were crowded with such cells, they filled the sinuses along with proliferating endothelial cells, and lay among the cells of the follicles to a less extent. In the capsule, groups of such cells were readily distinguished.

Larger lymphoid cells were found abundant in the sinuses, and presumably many of these also came from the bone marrow by way of the blood, as was evident in the case of the small cells. However, morphologically and in staining properties these larger lymphoid cells were identical with the cells of the lymph gland itself. No evidence of direct division in these lymphoid elements, derived from the blood was to be seen with the exception of a few irregular nuclei.

The mesenteric glands contained a large number of mastzellen, and quite numerous eosinophilic cells. Large cells containing brown pigment granules were numerous in glands near the pancreas and about the cœliac axis. A good-sized hæmolymph gland from the tissue back of the aorta showed no unusual appearance.

Spleen. The most marked changes in the spleen were the extreme congestion, and the increase of nucleated cells in the splenic pulp. This gave the tissue the appearance of an almost homogeneous structure, although the Malpighian bodies were still plainly visible. The capsule and trabeculæ were not thickened. The cells present in such great numbers throughout the splenic tissue were for the most part small mononuclear cells. They were scattered almost uniformly through the tissue. Red blood corpuscles filled the venous sinuses, and were found in great numbers in the intercellular spaces. Quite numerous nucleated red blood cells were observed, many of them showing signs of degeneration. In the Malpighian bodies there was no evidence of proliferation, either in the presence of mitotic figures or in the increase in the size of the follicles, as would be expected if the lymphoid cells present were to any extent of splenic origin. In sections stained in eosin and methylene blue, the majority of the infiltrating cells appeared similar to the small lymphoid cell described in the bone marrow, and were easily distinguished from the other large lymphoid elements present by the dense, small nucleus, and relatively large amount of protoplasm, and by the peculiar shade of light blue which the nucleus stained. There was no evidence that these cells were actively proliferating as in the bone marrow.

It was impossible to tell the origin of the other lymphoid elements present, as their morphology and staining properties were identical with the ordinary lymphocyte of the blood. Many of them doubtless came from the bone marrow, where similar cells were found greatly increased in numbers, and actively dividing.

Liver. The liver showed a varied appearance microscopically. The veins and liver capillaries were much distended and full of blood. The mononuclear elements in the blood were in such great numbers that the liver lobules were injected, as it were, with lymphoid elements.

There was also a marked infiltration about the portal spaces of small mononuclear cells. Some of these areas were of such size as to form small lymphomatous foci. The two types of lymphoid cells described in the blood and bone marrow were easily distinguished. The greater proportion of the cells were of the small lymphoid type, with the deeply staining homogeneous nucleus.

The parenchyma of the liver showed widespread degeneration. There was a general cloudy swelling of the liver cells. Small and large areas of cell necrosis were present. In the large necrotic foci the liver cells had disintegrated entirely and were unrecognizable. Hemorrhages into such areas were common. The capsule was not especially thickened, but showed considerable infiltration with lymphoid cells.

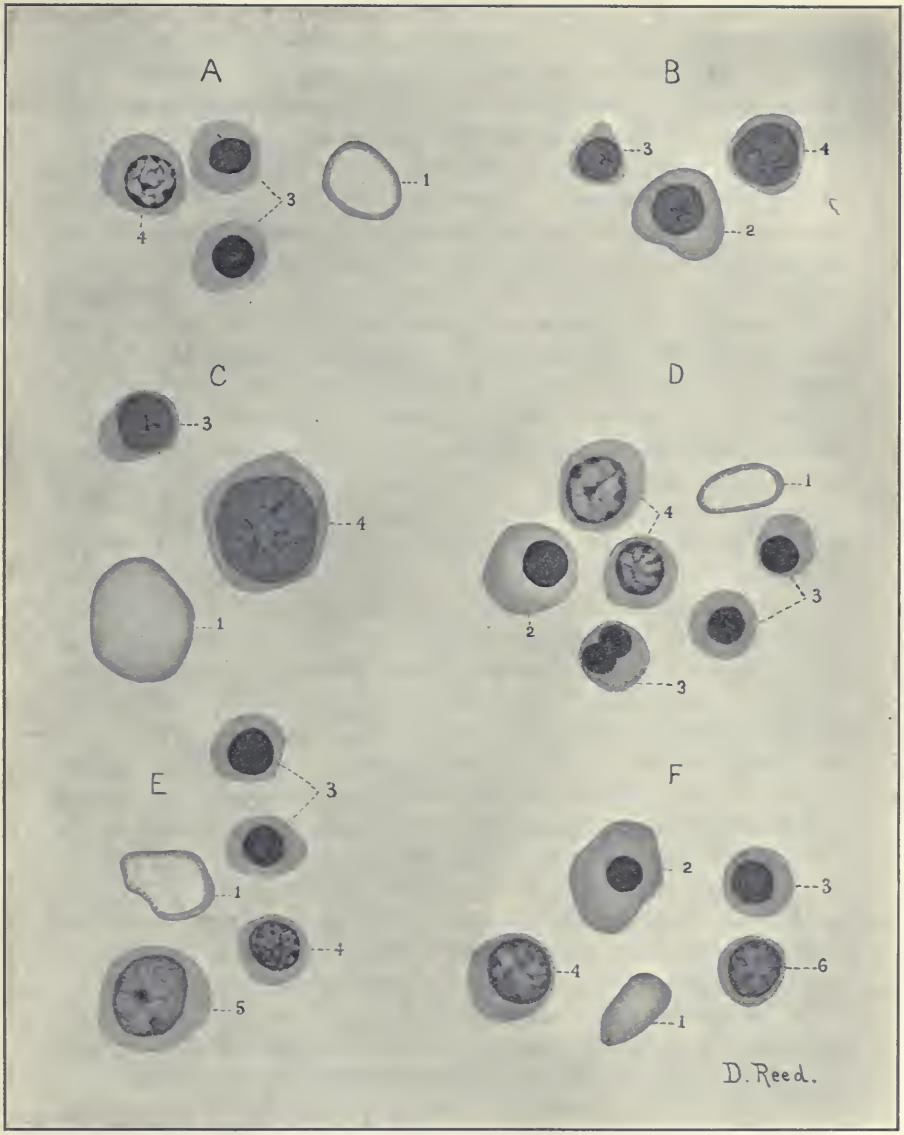
Lung. The sections of lung showed a marked œdema with a few areas in which the alveoli were filled with fibrin and red blood cells. The tissue everywhere was considerably congested. The bloodvessels, especially the veins, were distended with cells, among which small uninuclear lymphoid cells were the predominating form. Similar cells were also seen filling the capillaries and frequently in the alveoli. The pleura was delicate and not infiltrated to any extent by lymphoid elements.

Kidney. The cells of the kidney tubules were in a condition of acute parenchymatous degeneration. There was considerable congestion of the organ. Small foci of lymphoid cells in capillaries were visible through the tissue. No areas of lymphoid infiltration were seen. The capsule appeared normal, and there was no connective-tissue increase in the organ.

Heart. There was marked œdema and considerable fragmentation of the myocardium, otherwise the heart muscle seemed normal. The vessels contained as elsewhere a great number of lymphoid cells, but were not especially distended.

Muscle. The diaphragm and ileo-psoas muscles were examined, but without discovering any abnormal appearance other than the increase of the small mononuclear elements in the bloodvessels. The two different types of lymphoid cells spoken of repeatedly before were also easily distinguished here.

Before considering the details of this case, and its bearing on our knowledge of the nature of leukæmia, it may be well to review briefly the various opinions which have been held concerning this disease, and which, though widely divergent, have influenced our present conception of the subject. The early division of leukæmia, made by Virchow into the splenic and lymphatic forms, according as the spleen or lymph glands appeared to be the seat of the disease, is no longer in use. The enlargement of the spleen is not considered to be essential to the disease, and, indeed, there is much doubt if either of these organs is ever primarily involved. The idea that the origin of the disease lay in the hæmopoetic organs has prevailed since the publication of Virchow, in spite of considerable opposition from investigators who did not accept this view. Löwit's theory that leukæmia was a disease of the blood itself, the organs being only secondarily affected, has no longer any recognition.



Drawn with the camera lucida, Zeiss microscope, Oc. 4, Obj., oil immersion $^1/_{12}$.

Group A represents all types from section of a blood clot. Group B. cells from a blood smear. Group C. cells from a bone marrow smear. Group D, cells from a bone marrow section. Group E, cells from a lymph-gland section. Group F, cells from a spleen section.

Cell 1, normal red blood corpuscle. Cell 2, nucleated red blood corpuscle. Cell 3, small lymphoid cell, originating in bone marrow. Cell 4, lymphoid cell of bone marrow or lymphocyte of blood, and lymph gland. Cell 5, mother lymphoid cell of lymph gland. Cell 6, lymphoid cell of Malpighian follicle.

The similarity of the lymphoid cells from the different hæmopoetic organs is apparent. The nuclear framework of such cells is characteristic. The fact that the young normoblast has a nucleus in which chromatin threads can be demonstrated is shown in Group B, which was stained in the Biondi-Heidenhain mixture. The similarity between the normoblasts and the small lymphoid cells, which are in active proliferation in the bone marrow, is noticeable; the same chromatin threads are shown by the triple stain in the nuclei of these cells, which are usually so dense and homogeneous.

Neumann, in 1870, really strengthened Virchow's view that this was a disease of the hæmopoetic organs, by showing that in a number of cases a pathological condition of the bone marrow was present. This explanation cleared up several cases in which enlargement of the spleen or lymph glands had not been present or had been too slight to account for the symptoms. A myelogenous form of the disease was then added to the clinical divisions of leukæmia. His dictum that no case of leukæmia was on record in which a careful examination had failed to reveal changes in the bone marrow has had great influence on later work.

Ehrlich in introducing micro-chemical methods in the study of blood, gave a more definite means of diagnosing the different forms of the disease. To his teaching is due the prevailing view that leukæmia consists of two definitely distinct and separate forms, one arising from disease of the bone marrow, the other from disease of the lymph glands, the blood showing in one case the presence of great numbers of myelocytes, in the other an enormous increase in the lymphocytes. These types of the disease are known by the terms myelogenous and lymphatic leukæmia.

We might add here that to Ebstein's collection of the cases in the literature and to Fränkel's later work on the subject is due our conception of an acute form of leukæmia which is now generally supposed to be almost invariably of the lymphatic type.

The influence of Ehrlich and his school has been marked here, as in all diseases in which the blood changes are of especial importance. Unfortunately, the blood picture and not the pathological changes which caused these differences was emphasized in his teaching. The old school based their diagnosis on the organ especially enlarged, the Ehrlich school on the different form of leucocyte increased in the blood, neither one was especially concerned with the nature of the changes causing either of these conditions. Divisions of a disease based on clinical symptoms may be correct, but often only accidentally so.

In the last few years a new school, we might say, has arisen, which has endeavored to find out on what pathological foundation these clinical types rest. Walz,[1] Pappenheim,[2] Bradenburg,[3] and others have concluded from their investigations that the bone marrow in every case of leukæmia is the primary seat of the disease, and the origin of the cells which give the characteristic appearance to the blood. The other organs are only secondarily involved, in the general hyperplasia of lymph adenoid tissue which occurs. This is, of course, only a further development of the view set forth by Neumann, and rests on careful

[1] Arb. aus dem. path. Inst. Tübingen, 1899, Bd. ii. p. 1.
[2] Zeitschr. f. klin. Med., 1900, Bd. xxxix. p. 171.
[3] Charité Annalen, 1900, Bd. xxv. p. 85.

post-mortem examinations, and especially on the study of the bone marrow.

The important points in this case are that in a sudden and rapidly fatal illness, in which there were no especial features other than hemorrhage, anæmia, and a marked increasing weakness, there was present the blood picture of an intense lymphocytosis, establishing thereby the diagnosis of acute lymphatic leukæmia. At autopsy, as during life, there was no enlargement of either lymph glands or spleen, but the bone marrow showed macroscopically the features of lymphadenoid degeneration. Under the microscope, the bone marrow was found to consist mainly of lymphoid elements, the granular cells of the parenchyma being conspicuously few in number. These lymphoid elements consisted of two varieties of cells, one smaller than the red corpuscle with a densely staining homogeneous round nucleus and a small amount of clear protoplasm, the other, small and large cells of the typical lymphocytic type, the nucleus relatively large in respect to the protoplasm and showing always a nuclear framework. Both types of lymphoid cells were proliferating rapidly by direct division in the bone marrow. The blood was full of these elements, and all the organs examined were injected, as it were, by these lymphoid cells, which, however, showed no evidence of proliferation outside of the bone marrow. In the spleen and lymph glands the ordinary lymphoid cells of the lymphatic tissue could be easily distinguished from the small cells which had come from the bone marrow both by their morphological and by their staining properties. There was no evidence of hyperplasia in either the spleen or lymph glands. *This proves, it seems conclusively, that we have here a lymphocytosis arising from proliferation of lymphoid cells in the bone marrow, and death occurring before any other organ in the body showed involvement.*

We now wish to consider the nature of the changes in the bone marrow and the histogenesis of the cells proliferating in such instances.

The normal structure of the bone marrow is less well understood than any other tissue in the body. This ignorance is due partly to the complexity of structure, partly to the difficulties presented in attempting to make either smear preparations or sections of this tissue.

It seems strange that the school of Ehrlich which has so completely described the different cellular elements of the blood, has done so little in applying its staining methods to the bone marrow, which they themselves acknowledge to be the origin of most of the blood elements. Lazarus[1] dismisses the subject of the bone marrow changes in myelogenous leukæmia, with the statement that the pathological changes here are similar to those that occur in the blood. Ehrlich bases his claim

[1] Spec. Pathol. u. Ther. von Nothnagel, 1901, Bd. viii. p. 111.

that lymphatic leukæmia arises in the lymph glands by asserting that no lymphocytes occur normally in the bone marrow, and that, therefore, the process here is one of invasion or metastatic growth of lymph-adenoid tissue.

In the papers of Arnold,[1] Engel,[2] Pappenheim,[3] Nägeli,[4] Rubinstein,[5] and others, which deal with the structure of the bone marrow, we find unanimous agreement as to the normal occurrence in this tissue of lymphoid cells, practically identical morphologically with the lymphocytes. These cells are always present and in considerable number. The authors differ as to whether they are in reality lymphocytes. Nägeli prefers to call them myeloblasts, but his objections are trivial and cannot be sustained. Rubinstein also considers the bone-marrow cell different from the similar cell occurring in the blood and lymph gland, basing his statement on staining properties, which in our experience are not specific.

The whole question which has been of grave importance to histologists for years as to the dual origin of the blood leucocytes—granular cells coming from the bone marrow, and non-granular cells, lymphocytes, coming from the lymphatic tissue—pivots on this point. The summary of evidence seems to be as follows:

Contrary to the view of Ehrlich, bone marrow contains lymphoid elements, identical morphologically with the lymphocyte. Indeed, some authors emphasize the lymphadenoid nature of bone marrow, strengthening their claim by asserting that in certain diseases, such as lymphatic leukæmia, bone marrow reverts to the fœtal type and becomes lymphoid tissue, the mother cells or lymphoid cells losing their power to differentiate into granular cells. These lymphoid elements are believed by the best authorities on bone marrow to be the mother cell of all granular elements of the bone marrow, and through them of the transitional and granular cells of the blood. The question of the identity of the lymphocyte of the blood and the lymphoid cells of the bone marrow is not to be established as long as we are using two different standards in considering this point. Morphologically, they are identical. If, however, as Michälis and Wolff[6] suggest, the future of the cell is the criterion—that is, if we define a lymphocyte as a cell which cannot develop into a granular cell—the lymphoid cell of the bone marrow and of the lymph glands are presumably distinct. The lymphocyte of the blood which we know never develops into the older granular cells, is, perhaps, the only cell which deserves this restricted title.

[1] Virchow's Archiv, 1895, Bd. cxl. p. 411.
[2] Deutsche med. Wochenschr., 1898, No. 47, p. 745.
[3] Virchow's Archiv, 1899, Bd. clvii. p. 19; 1900, Bd. clix. p. 40; 1901, Bd. clxvi p. 424.
[4] Deutsche med. Wochenschr., 1900, No. 18, p. 287.
[5] Zeitschrift f. klin. Med., 1901, Bd. xlii. p. 161.
[6] Deutsche med. Wochenschr., 1901, No. 38, p. 651.

The question then is, does this true lymphocyte of the blood come from the lymph gland only, or from all the hæmopoetic organs. The weight of opinion derives it essentially from the lymph follicle. However, there is very little to establish this view, and the facts brought forward either allow of another explanation or need further confirmation. The gland origin of lymphocytes is based by Ehrlich[1] on the grounds that whenever we have increased function of lymphatic tissue, such as in active digestion, whooping-cough, hyperplasia of glands, etc., we have a resulting lymphocytosis, and also that destruction of lymphatic tissue as in malignant disease, or in the intestinal diseases of children causes a lymphæmia. The action of tuberculin and pilocarpin in increasing the lymphocytes in the blood he traces in an obscure way also to the hyperplasia of the lymphoid tissue. He asserts that an increase in the lymphocytes in the blood is always a passive leucocytosis, due to an over-production of these elements, and a mechanical overflow of them into the blood. The interesting observation of Hirschfeld[2] on the amœboid action of lymphocytes in a case of lymphatic leukæmia is of importance in the question of the essential difference between active and passive leucocytosis.

Of late considerable doubt has been thrown on these alleged facts substantiating the origin of lymphocytes from the glands. Knox and Warfield[3] have shown that in intestinal diseases of children a true leucocytosis usually occurs. The existence of a constant digestion leucocytosis is rendered doubtful, and when present may not consist in an increase in lymphocytes.[4] The lymphæmia in malignant diseases if present may have several explanations. In sarcoma of the lymph glands and in Hodgkin's disease, where there is enormous hyperplasia of the lymphoid cells, the lymphocytes are practically never absolutely increased, and even a relative increase, as claimed by Pinkus[5] as invariable in Hodgkin's disease, is not constant. Moreover, it is difficult to understand the mechanism regulating the overflow of the lymphocytes either temporarily or permanently from the gland into the blood. The anatomical structure does not permit these elements, if they are non-amœboid, to pass into the circulation from the lymph gland except through the medium of the thoracic duct; while in the bone marrow, where the lymphoid cells are normally present, the parenchyma and bloodvessels are in more or less free communication.

We cannot state positively that the lymphocyte of the blood comes from the bone marrow, but we would urge to the attention of the medical world

[1] Spec. Path. u. Ther. von Nothnagel, 1901, vol. viii. p. 67.
[2] Berl. klin. Wochenschr., 1901, No. 40, p. 1019.
[3] Johns Hopkins Hospital Bulletin. In press.
[4] Japha. Jahrbuch f. Kinderheilkunde, 1900, Bd. lii. p. 242.
[5] Spec. Pathol. u. Ther. von Nothnagel, 1901, Bd. viii. p. 3.

that we have no proof that the lymphocyte comes from the lymph gland alone, and that all the other colorless cells of the adult blood originate in the bone marrow from lymphoid cells.

Our knowledge of the structure of bone marrow is greatly increased by the study of certain diseased conditions where we find various reversions to a fœtal type of tissue, which if correctly interpreted must help elucidate the histogenesis of the normal structure. In inflammations and new-growths little is to be learned along these lines. In Rubinstein's[1] interesting work on experimental leucocytosis, and in the numerous studies in the changes in anæmia, we find an interesting picture of functional hyperplasia. In one case the blood-forming organ is attempting to make up for the continuous drain of leucocytes, and in the other case of erythrocytes. In both instances, the lymphoid elements of the bone marrow show considerable increase.

Rubinstein emphasizes the possibility of a forerunner of both the white and red cells in a colorless mother cell. This identity of the leucoblast and erythroblast (Löwit) is not a new idea, but one which is as yet undetermined. Pappenheim believes that in embryonic bone marrow direct changes from basophilic lymphocytes to nucleated red cells may be observed. *In our case, the similarity in form of the small lymphoid cells with the normoblasts, which were conspicuously few in number, was suggestive. It is not impossible that the increase here was in a mother cell, from which the lymphoid cell and the hæmoglobin-containing cell are normally derived.* In normal bone marrow we are always able to find a few cells apparently identical with the small lymphoid cell described in this case, and differing sharply from the other lymphoid cells present. In different diseased conditions of the bone marrow, with the exception of grave anæmia, there was no increase in the number of these cells. In several cases of pernicious anæmia examined, such cells seemed to be present in greater number, but it was extremely difficult to tell them from the young normoblasts, which were also abundant. The color of the protoplasm of a hæmoglobin-containing cell, especially in stained sections, is a slight and variable criterion on which to base such a distinction.

In leukæmia we undoubtedly have in the bone marrow a hyperplasia, differing from that in leucocytosis and anæmia qualitatively. In the cases in which myelocytes are the predominating feature of the blood, the elements of the bone marrow are all increased, but the myelocyte is the prevailing cell type. Our own observation confirms the descriptions in the literature on this subject. In leukæmia where the lymphocytes of the blood are increased, there is always a corresponding increase in the lymphoid cells of the bone marrow, the other elements

[1] Loc. cit.

being relatively diminished. In both forms of leukæmia, then, we find an increase in the parenchyma cells of the bone marrow, but a proliferation differing qualitatively in the type of cell especially increased. In one case we have a reversion of yellow marrow to red, with an increase in the older elements of the organ; in the other we have a reversion of all the marrow to a lymphadenoid condition—presumably a fœtal stage—in which the young, undifferentiated elements are predominant.

To explain these changes, if we assume the process to be similar in both cases, we find in Rubinstein's work suggestive lines of thought. Acute leukæmia always resembles strongly an acute infectious disease; indeed, all forms of leukæmia admit of some such explanation. Rubinstein proved by injecting a substance chemotactically positive for polymorphonuclear leucocytes, that these were drawn forth from their reservoir in the bone marrow, and that by continually draining this supply, a proliferation of the elements from which these cells arose would occur. It is possible that in leukæmia there may be a similar chemotaxis from some diseased condition in the body, which calls forth certain elements from the bone marrow, and also accounts for the proliferation of these elements to make up the deficiency which their constant drain must otherwise cause in the bone marrow cells.

That hyperplasia of the bone marrow alone even with qualitative changes in the relation of the different cellular elements is not sufficient to account for the change in the blood picture, is shown by the microscopic examination in lymphosarcoma, myeloma, etc. In such conditions, if the increase of the blood cells depended only on mechanical over-production in the blood-forming cells, there would be no explanation for the fact that the blood, as a rule, shows no particular change. Some such influence as chemotaxis must be admitted to explain a leucocytosis, whether it consists of polymorphonuclear elements, or of more unusual forms.

We must now consider the unity of the two forms of leukæmia which hitherto we have assumed. Myelocytic leukæmia is now granted by all to be of primary bone marrow origin. The case reported by Hirschfeld[1] of acute myelogenous leukæmia, confirming two similar cases cited by Cabot,[2] furnishes the evidence which has long been awaited, that myelocytic leukæmia may also appear as a fulminating disease.

In the so-called lymphatic leukæmia, there is almost unanimity of opinion that the blood is not leukæmic until the bone marrow is involved. Cases such as the one here reported, where the bone marrow was extensively involved without enlargement of the lymph glands, have

[1] Berl. klin. Wochenshr., 1902, No. 11, p. 231.
[2] Boston Med. and Surg. Journal, 1894, vol. cxxxi. p. 507.

been recorded by Goldschmidt,[1] Körmözi,[2] Walz,[3] Pappenheim,[4] Hirchlaff,[5] and Spencer.[6] Quite a number of cases are to be found in the literature where the glands have been slightly enlarged, or at least the increase has been inadequate in relation to the marked blood changes. *We believe such cases go to prove that acute leukæmia, whether lymphoid or myelocytic, is due to changes in the bone marrow, the other hæmopoetic organs being involved, if at all, secondarily.* In chronic lymphatic leukæmia the evidence is less satisfactory. Here we may revert to Neumann's statement that no case in which the bone marrow was not involved is on record, and argue from analogy that, as in the acute form, the bone marrow is presumably the primary seat of the disease to which the clinical features are due.

The possibility of a pseudoleukæmic form of chronic lymphatic leukæmia is always being urged. The word pseudoleukæmia is a very loose term and must be strictly defined before being used. We[7] believe that Hodgkin's disease is a specific disease, with characteristic pathological changes, easily recognized, and never having the blood picture of leukæmia. It is as impossible to think of this form of pseudoleukæmia changing to leukæmia as to think of tuberculosis or sarcoma of the glands undergoing such a transformation. Leukæmia, of course, may be superimposed on any other specific enlargement of the glands, but such cases, if occurring, have no bearing on the question in point. Pseudoleukæmia, then, in the sense of a simple hyperplasia of the glands, preceding the bone marrow changes which result in leukæmic blood, has yet to be established. We cannot deny the possibility, although such a condition would be inconsistent with our conception of the nature of the disease, and if proven to occur would necessitate another explanation of the facts which now fit into our present view of the subject.

On the other hand, cases described by Michälis,[8] Hirschfeld,[9] and others, in which the blood shows a divergence from either of the well-established forms of leukæmia in presenting a mixed-cell leucocytosis, strengthens our belief that all leukæmias are due to the action of some unknown poison on the bone marrow. The myelogenous changes result in the blood differences by which the disease is recognized. The involvement of the other organs by hyperplasia or infiltration is secondary, and not essential to the disease.

We have no right, then, to apply the term myelogenous to one form of the disease. *We would suggest that there are three forms of leu-*

[1] Münch. med. Wochenschr., 1896, Bd. xliii. p. 714.
[2] Deutsche med. Wochenschr., 1899, No. 15, p. 238.
[3] Loc. cit.
[4] Loc. cit.
[5] Centralbl. f. inn. Med., 1898, Bd. xix. p. 856.
[6] Lancet, 1900, p. 926.
[7] Johns Hopkins Reports, 1902, vol. x. p. 133.
[8] Zeitschrift f. klin. Med., 1902, Bd. xlv. p. 86.
[9] Loc. cit.

kæmia, all due to myelogenous changes, and that these should be known as the myelocytic, lymphoid, and mixed-cell varieties, if we wish to make the blood picture the basis for clinical divisions. Any of these three forms may be either acute or chronic; the myelocytic is usually chronic, the lymphoid usually acute. The nature of the disease, the etiology, and the primary focus in the body we believe to be still undiscovered. Leukæmia as we know it is simply the manifestation of some poison which affects especially the bone marrow, the blood-forming organ in the adult, and ultimately causes death.

REPORT OF A CASE OF SEVERE, PROBABLY PERNICIOUS ANÆMIA, WITH MARKED GENERAL AND CORONARY ATHEROMA, IN WHICH MANY EVIDENCES OF ANEURISM WERE PRESENT WITHOUT ANATOMICAL EXPLANATION FOR THEM.

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Jessie W., a Canadian laborer, aged thirty-one years, married, entered Ward 6 in my Cook County Hospital service March 3, 1897. His previous history was somewhat meagre. Eight years previously he had a single venereal sore two or three months, after which he had rheumatism, and somewhat later an attack of pleurisy, the location of which he could not recall. An alcoholic and tobacco history was elicited.

As to his present history, he had grown weaker, but had not lost any great amount of flesh. Some pain had existed for weeks or months over the lower left chest. The appetite had declined, but anorexia was not absolute, nor did it concern any special variety of food. He vomited once, and eructations of gas were frequent. There had been some slight dyspnœa, increased by exertion and the erect posture. The skin for a week had been somewhat yellow, and the urine was dark, but the bowel movements were not noted. Direct questioning developed no other points.

Physical Examination. The patient lay in a somewhat listless state. His breathing was moderately accelerated, ranging between 25 and 32 respirations a minute. The skin and mucosæ were distinctly yet not deeply icteric. The tongue was covered with a yellowish-white fur. The hair was somewhat thin. Examination in other respects was negative regarding the head, scalp, ears, eyes, and throat. The lungs were wholly negative, except that respiratory excursion was absent over the left lower lobe, laterally and posteriorly. The peripheral arteries pulsated actively, yet arterial tension was low. The initial pulse-rate ran between 90 and 112. The radials and brachials alone were tortuous

and rigid to the finger. No inequality in tension nor in the size of the pulse-wave was noticed in any of the arteries, including the femorals.

The heart was normal in its outlines, save that the left border and apex-beat were found in the left nipple line. A soft blowing systolic murmur was heard with equal distinctness over the pulmonic and mitral areas, and the second aortic tone was loud and almost metallic.

Over the left lower chest was observed a diffuse and most distinct pulsation which, as the patient lay on his right side, extended horizontally from the lower angle of the left scapula around the chest into Traube's space and the epigastrium and in a downward direction to a point distinctly below the left costal arch. The pulsation was vigorous and distinctly expansile to both the eye and hand. A systolic bruit was heard over the pulsating area, but was most clearly audible over the left chest behind. No thrill was detected at any time.

The liver's edge was barely palpable on deep inspiration, was even and of normal resistance. The spleen could not be felt. Otherwise, the abdomen was negative. The urine was 1020 c.c.; specific gravity, 1016; a trace of albumin; urea, 1.07 per cent. No sugar, no peptone, etc.; a moderate number of small granular casts was found.

The nervous system was negative.

The stools were not acholic.

The patient was demonstrated in my clinic as aneurism either high in the abdominal aorta or possibly low in the thoracic aorta. Dr. Robert B. Preble, of the attending staff, also examined the case and demonstrated it as aneurism. When in clinic the pulsation could be clearly seen twenty or thirty feet and its striking expansile throb was demonstrated by pasting on the anterior and posterior surface of the lower chest small pieces of bent paper which were widely separated with each cardiac systole. This experiment was performed to demonstrate the expansion to the eye rather than to the hand of the student. The blood was not examined at first but a few days before the patient's death, his temperature, which had occasionally reached 100° and 100.6° F., fell to 97° F. by mouth, his pulse became thready and could scarcely be counted. The respirations became rapid and shallow, with all of the classical symptoms of collapse. Upon reaction the pulsation was less distinct and a decided anæmic appearance was then first noted, possibly having been obscured by the previously icteric hue, which had now largely disappeared. Examination of the femoral and other vessels was carefully made, with the thought that retroperitoneal or other rupture had occurred. The femorals were equal and synchronous with each other and the radials, etc. The blood showed 5000 leucocytes to the cubic millimetre, a differential count of which revealed normal relations. The red cells numbered 1,400,000, and the hæmoglobin by Fleischl's instrument registered 32 per cent. In the stained preparation the red cells varied but little in size and dimension. There was not much poikilocytosis. A large number of nucleated red corpuscles was seen, the great bulk of which were normoblasts, few megaloblasts being detected.

The patient collapsed again and died rather suddenly, March 21st, eighteen days after admission.

The clinical diagnosis was formulated as follows: 1. Arteriosclerosis. 2. Abdominal aneurism, probably pointing toward the diaphragm. Little stress was placed upon the mere fact of the pulsa-

tion, but the perfectly clear expansion of the pulsation seemed to establish the diagnosis of aneurism beyond doubt, with rupture explaining the collapse. 3. Dilatation of the left ventricle. 4. Catarrhal icterus. 5. Acute secondary anæmia. The possibility of pernicious anæmia was discussed and considerable uncertainty was experienced, still it seemed to all who examined the case that the evidences of aneurism, followed by collapse from rupture and sudden death, outweighed all other considerations.

Post-mortem. No. 104, March 22d, one day after death, attended by Drs. Preble, Brown, Hammond, Hunter, Champlin, Smith, Humiston, McGrady, Kirby, and the writer.

Some emaciation ; well-marked rigor mortis. The pericardium contained 4 grammes of clear serum. The heart weighed 600 grammes; the endocardium presented the tabby-cat appearance ; the myocardium was very pale. Very small yellow plaques were found at the base of the mitral valves and in the beginning of the aorta.

In the left coronary artery, one inch below its origin, was a long plaque or series of plaques of yellow color, hard, some elevated and the size of a pin-head, while others were diffuse and larger. Similar changes were found in the right coronary one and one-half inches below its origin. Over the entire length of the abdominal and thoracic aorta were scattered small yellow areas, some of which were hard, rough, elevated, and breaking with a distinct sound and almost nodular.

Nowhere were any bulgings nor aneurism of the aorta. Similar changes existed in the common iliacs, external and internal iliacs, the femoral arteries and a few of the larger branches of the latter. The nose, larynx, and trachea were negative. The bronchial glands were slightly enlarged and on section anthracotic. The mediastinum was negative. The right pleural cavity contained 300 c.c. of clear serum and no adhesions existed. A few old, thin adhesions were found over the left apex, and the base of the left lung was adherent by well-organized tissue to the chest wall and the diaphragm. The adhesions were œdematous. Above these basal adhesions was a small amount of clear serum. The right lung weighed 530 grammes, the left lung 660 grammes. The lungs floated, crepitated throughout, and on section appeared light gray, a frothy yellow serum being readily expressed, particularly from the left lower lobe. The tongue and the pharynx were negative.

The œsophagus and stomach were exceedingly pale, as was the mucosa of the small and large gut, save for some hypostatic post-mortem discoloration. Small, hard plaques similar to those found in the aorta were seen in the superior mesentery artery and its larger branches. The peritoneum was smooth, and the abdominal cavity contained no fluid. The bile-ducts were patent, and the gall-bladder slightly distended with somewhat viscid bile. The liver weighed 1940 grammes, and its surface was light red and mottled. No adhesions were found, and the liver's edge was smooth and sharp. Its consistence was firm, and on section contained but a moderate amount of blood. On section the lobular markings were fairly distinct, the centre showing red and the periphery light. The pancreas was negative, weighing 120 grammes. The spleen weighed 180 grammes, and there were some perisplenitic adhesions, but to the diaphragm only. The organ was dark purple in color, and the parenchyma soft and friable. The left kidney weighed

200 grammes, the right 160 grammes. The capsule was easily stripped, leaving a smooth, very pale, and slightly mottled surface. The section was very pale, the cortical markings were obliterated, and the cortex and medullary portion were as 1 to 3. The pelvis, ureters, bladder, prostate, seminal vesicles, and urethra were negative.

The brain weighed 1650 grammes, and its examination was wholly negative, especial attention having been directed to the bloodvessels. The spine and cord could not be examined.

The long bones could not be examined, but the section of the sternum showed the reddish jelly-like marrow seen in pernicious and other severe anæmias.

The anatomical diagnosis read: Atheroma of the coronary arteries, mitral valves, aorta and its main lower branches; left ventricle hypertrophy and dilatation; fatty degeneration of the myocardium; pulmonary œdema; partial left adhesive pleuritis; chronic nephritis; acute splenic tumor; perisplenitis; marked anæmia of the alimentary tract, etc., pernicious anæmia (?).

The case presents no remarkable pathological features. The vascular changes were very marked for a person aged thirty-one years, and may be referred with some degree of correctness to syphilis. While the blood findings were not exactly characteristic of pernicious anæmia, still they corresponded fairly well with the subacute or milder recurrent type of pernicious anæmia as described by Cabot and others. The exact cause of the collapse, considered by us as due to aneurismal rupture, which led to sudden death in its second occurrence, may have been due to extensive bilateral coronary disease or to this cause combined with the profound anæmia.

The chief clinical interest of the case centres in the pulsation. The pulsation was extensive, attended by a bruit, abdominal as well as thoracic, and markedly expansile.

At first thought it might seem that the pulsation resembled Broadbent's sign, but the pleural adhesion was purely basal, and there was neither pericardial synechia nor indurative mediastinitis. When a pulsable movement, says Broadbent, is seen in the lower posterior chest it may appear at first sight to be expansile, but on more careful scrutiny it is found that there is a tug upon the false ribs during the systole and a sharp rebound during the diastole, etc.

It has been impossible for me to look over the literature bearing upon this unique case, for a lack of a title covering its phenomena. Personal inquiry of a number of experienced clinicians, as Professor Osler, has not developed any similar instance.

The pleural adhesions and lack of respiratory excursion at the base of the left lung was noted clinically, but did not excite any remark, since among the lung changes incident to aneurism, pleurisy with effusion, adhesive pleurisy, lung induration, etc., have been repeatedly described by writers on aneurism since the classical work by

Stokes. The adhesions were thought to be either due (1) to aneurism near the diaphragm, or (2) to mere coincidence. Nothing suggested pulsating neoplasm of the lung or pleura. A pulsating pneumonia as described by Graves was merely mentioned in the clinic as one of the causes of thoracic pulsation, as were pulsations of the liver and spleen in Basedow's disease, aortic and tricuspid regurgitation as rare causes for abdominal pulsation. Mention was then made of the empyeme pulsatile (Aran), the pulsating empyema of Stokes, and the empyema necessitatis pulsans of MacDonnell.

Dr. J. C. Wilson has reviewed with great care the subject of pulsating pleural effusions.

The literature of pleuritis pulsans brings out the fact that most instances (about 92 per cent.) are left-sided. A review of the causes suggested concerns:

1. The theory of Traube, which referred the pulsation to the condition of the heart and pericardium.

2. Comby's theory placed stress upon adhesions to the pericardium and compression of the lung.

3. Féréol's explanation was pneumothorax with a large effusion, these conditions being imperative.

4. Wilson's conditions: (*a*) Some paresis of the intercostal muscles, as results from a long-standing pleuritis; (*b*) local necrosis and perforation of the parietal pleura (empyema necessitatis); (*c*) pneumothorax; (*d*) atelectasis of the lung, which is in relation with and adherent to the pericardium.

Aneurism has often been thought of, but the statement constantly recurs that it can usually be excluded, except when an encysted empyema lies close to the heart. Among the conditions just named practically the only one in our case was the pleural adhesions over the base of the left lung. I have been able to reach no satisfactory explanation of this pulsation, although the active arterial pulsation might have been propagated by means of the adhesions to the chest and by means of the perisplenitic connective tissue to the abdomen. This suspicion, however, in no way accounts for the *expansile character of the pulsation*, which of yore has been held to invariably (ref. 14 and 15) exclude dynamic pulsation.

In the discussion, Dr. Lafleur, of Montreal, recounted a case in which the pulsation was exactly similar to our case, and other signs, as hæmatemesis, paralysis of the left vocal cord, etc., were present. The pulsation was expansile, but the diagnosis of aneurism was incorrect, the autopsy showing gastric ulcer.

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THE PATHOLOGY OF PERNICIOUS ANÆMIA, WITH SPECIAL REFERENCE TO CHANGES OCCURRING IN THE HÆMO-LYMPH NODES (EIGHT AUTOPSY CASES).[1]

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The pathology of pernicious anæmia as given in the most commonly used text-books of to-day contains but scant reference to the lymph glands and no mention at all of the hæmolymph nodes. Though much attention has been paid in recent years to the changes occurring in the spleen and bone marrow, the lymphatic structures have been practically disregarded as a possible factor in the pathogenesis of this disease.

In Barclay's case of "Death from Anæmia" (1851) no mention is made of changes in the lymph glands.

The classical description by Addison (1855) states that in "idiopathic anæmia" there is no "renal, splenic, miasmatic, glandular, strumous, or malignant disease."

In one of Wilks' cases (1857) the lymph glands were described as "healthy." Lebert (1858) does not mention the lymph glands. Bristowe, in the same year, reported a case in which the bronchial, mesenteric, and other abdominal glands were described as "healthy." No mention of lymph-gland changes is made by Cazenave in 1860. In the same year Habershon states that there is no lymphatic disease in "idiopathic anæmia." Grohe (1861) does not mention the lymphatic glands

[1] Read by title at the meeting of the Association of American Physicians, Washington, D. C., April 29, 1902.

in the report of his case. Neither is there any mention of lymphatic-gland changes in the cases observed by Wagner (1864), Trousseau (1868), and Perroud (1869).

Biermer's celebrated observations on "Progressive Pernicious Anæmia" (1868–1872) contain no mention of the condition of the lymph glands. Likewise in the cases reported by King and Gusserow (1871) no mention is made of these structures. In an unpublished case of Pye-Smith, observed in the same year, slight enlargement of the lumbar glands was noted. In Sörensen's case (1874) no swelling of the lymph glands was noticed. Immermann, in the same year, does not mention the condition of the lymph glands.

In 1875 Pepper stated positively that in pernicious anæmia there is "no affection whatever of the lymphatic glands." Immermann, in Ziemssen's *Cyclopædia*, stated that "the spleen, the lymphatic glands, the marrow of the bones, show no signs of hyperplastic activity or of anything abnormal beyond extreme paleness." In the same year Krieg mentions the mesenteric glands in one case as atrophic; and Schumann found in one case that the "mesenteric glands were enlarged, grayish-white, spotted with red, and hemorrhagic." Two cases reported by Pye-Smith showed no change in the lymphatic nodes.

In 1876 cases were reported by Lebert, Burger, Scheby-Buch, and Bradbury without mention of the lymphatic glands. In the same year Ferrand reported a case with "swelling of the mesenteric glands," and Habershon one in which "no glandular enlargement was found." Quincke (1877) observed one case with "slight swelling of the lymph glands." Cases were reported in this year by Mackern, Stricker, Rosenstein, and Andrew without mention of the lymph glands; Bramwell, one case in which the mesenteric glands were somewhat enlarged, and Purser a case in which the bronchial glands were mentioned as normal and the mesenteric glands not enlarged.

Lépine's review of the fifty cases published up to this year contains the statement that under "essential anæmia" should be included also cases in which there was a decided affection of the spleen, lymph glands, or marrow. No details of these changes are given.

In 1877 appeared also the first monograph on pernicious anæmia—that of Müller. Sixty-two cases, with thirty-nine autopsies, were analyzed. In only one case was the condition of the lymph glands mentioned—Case XXXIV.—in which the mesenteric glands were of a striking bright-red color.

In 1878 the more elaborate work of Eichhorst—*Die Progressive Perniciöze Anämie*—was published. This work was based upon the analysis of eighty-four cases collected from the literature (including those of Müller) and seven cases of his own—eighty-nine autopsies in all. The changes occurring in the lymph glands were summed up by

Eichhorst as follows, and inasmuch as this summary forms the chief basis for the statements found in subsequent text-books, it is quoted in full:

"*Lymph Glands.* In the superficial lymph glands, which may be easily and thoroughly examined by the hand, no enlargement in pernicious anæmia has been found. In my fourth observation the glands of the groin were hard and scarcely larger than peas, yet any one who has examined many patients knows that this condition is a very common, almost normal occurrence.

"Even so rarely have I seen enlargement of the mediastinal and thoracic glands in my autopsy cases or have found such condition mentioned in the literature.

"From this the impression is gathered that the lymph glands in the above-mentioned regions are able to offer a greater resistance to the irritation caused by the changed quality of the blood than is the case with the spleen, although they correspond so closely in structure with the latter.

"Quite different is the case with the mesenteric glands. Repeatedly have changes been found in them in pernicious anæmia; and it is possible that the number of such observations would be greater if, as there is good reason to suspect, they had not frequently been left unexamined.

"Krieg found them atrophic in a man who had dilatation of the stomach.

"Müller observed in one case that they appeared very prominent because of the contrast of their bright color against the surrounding anæmic tissues.

"Ferrand and Quincke state that the glands were swollen. Schumann found likewise a swelling of the mesenteric lymph glands. On section they appeared of a grayish-white color, speckled and spotted with red. In the last three observations it is important to make prominent the fact that the swelling of the lymph glands existed independently of any splenic enlargement, the latter not being present in these cases. Moreover, disturbances of digestion were not present to any degree worthy of mention in the cases of Quincke and Schumann.

"Swelling of the mesenteric lymph glands was noticed in three of my five cases which came to autopsy. They reached the size of a hazelnut. The glands were of rather firm consistency, and on section appeared bright red. It seemed remarkable to me that the red color was not homogeneous, but spotted, without it being possible either with the naked eye or with the help of the microscope to discover true hemorrhages. No unusual cellular elements were found in the glands, and their enlargement depended upon a hyperplastic condition.

"With relation to the causes of this hyperplasia I might here assume the explanation which I have offered for the origin of the splenic hyperplasia. I take it that we have here to do with subsequent conditions and secondary changes dependent upon the abnormal constitution of the blood.

"In my fifth observation the simple hyperplasia was accompanied by another anatomical appearance: small caseous areas were found in the swollen glands. I have been able to collect from the literature many cases, from which it appears that even hyperplastic lymph glands

are inclined to other metamorphoses. Slawjansky, many years ago, described two cases of leukæmia lienolymphatica, in which the enlarged lymph glands showed in many places a pronounced caseous metamorphosis. Schnitzer has reported from Frerich's clinic a case of pseudoleukæmia in which the enlarged lymph glands in the neighborhood of the cardia appeared medullary infiltrated. Caton has under the same conditions observed amyloid change in the lymph-gland tumors."

In 1878 three cases were reported by Mackenzie, who summarized the clinical and pathological features of the disease, stating " that the lymphatic glands are usually not enlarged."

In 1880 Weigert reported a remarkable case, which is noteworthy as being the first case of pernicious anæmia in which changes of importance were noted in the lymph glands. As this case is constantly referred to in the subsequent literature, I quote in full those portions of his description relating to the lymphatic changes:

" The axillary and inguinal glands are swollen to red masses, and are surrounded by a delicate network of dilated lymph vessels filled with red, transparent fluid. . . . Cervical lymph glands swollen to red masses, surrounded, especially from above, by a very delicate network of greatly dilated lymph vessels filled with red, transparent fluid. On the right side of the same, lies a very rich, remarkable network of knobby lymph vessels filled with a clear, red fluid, these communicating frequently with the thoracic duct. The network has a breadth of 2 cm. . . . Mesenteric, retroperitoneal, portal, and omental lymph glands and vessels similar to the above. . . . The microscopical examination of the lymph glands showed a marked dilatation of the lymph sinus and the presence in the same of a lymph uncommonly rich in blood. A similar fluid was observed in the lymph vessels."

In explanation of this case Weigert ruled out the hemorrhages present as the causal factor, in that they were too small to account for the presence of so much blood in the lymphatics, and in many places no hemorrhages were present in the area supplying the lymphatics, though the latter were filled with blood. At first inclined to explain the process as due to an increased permeability of the vessel walls for red cells and blood plasma, but not to such a degree as to form visible hemorrhages, Weigert was led later to regard it as due most probably to a compensatory hæmatopoetic function of the lymph glands for the marrow. He was not able to make out the presence of nucleated red cells. The dilatation of the lymph vessels was, at any rate, not due to obstruction.

Hartshorne, in Reynolds' *System of Medicine* (1880), states that there is " no alteration of lymphatic glands " in pernicious anæmia Coupland, in the Goulstonian lectures on anæmia (1881), says that there are no changes in the lymphatic glands in this disease.

In 1883 Pye-Smith gave a clinical and pathological analysis of the

disease, based upon a study of 103 autopsy cases collected from the literature (including Müller's and Eichhorst's) and one new case observed by himself, concluding from this analysis that "in genuine cases of idiopathic anæmia the lymph glands are not enlarged, nor are the solitary or agminated lymph follicles. Slight swelling of the mesenteric lympharia has been occasionally noticed, due, perhaps, to precedent diarrhœa."

Osler, in Pepper's *System of Medicine* (1885), says: "The lymph glands are, as a rule, normal in size and appearance. In three instances I have found them decidedly smaller than normal, and in two they had a rich red color, and on section looked more like spleen tissue than lymph gland. Weigert has noticed the same appearance. In one of the cases there were nucleated red corpuscles in the glands, as has been observed by Rindfleisch in a case of rickets and more recently in tuberculosis."

In Fagge's *Practice* (1886) the lymph glands are not mentioned in the article on pernicious anæmia. In the same year Flint says: "The lymph glands, which are usually normal in appearance, may be somewhat swollen and of a deep red color, containing an unusual number of red blood corpuscles, among which may be nucleated red corpuscles." In 1887 Bartholow says that the "disease is distinguished from leukæmia by the normal condition of the spleen, liver, and lymphatics."

Eichhorst (1891): "Mesenteric glands often swollen, hyperæmic in places, and speckled with blood. In one case all the glands were swollen and red, the lymphatics dilated and contained bloody lymph."

Osler (Pepper's *American Text-book*, 1894): "The lymph glands may be unchanged, though in three of my cases they were of a deep red color, resembling spleen tissue—a condition which has been noted by Weigert."

Grawitz (1896) refers to Weigert's and Neumann's cases. Tyson, in the same year, says there is "absence of lymphatic enlargement or involvement of the spleen except in a small degree."

Anders' *Practice* (1897): "The lymph glands are often somewhat swollen and intensely red in color, owing to the unusual number of red corpuscles, some of which are nucleated."

Ehrlich and Lazarus (Nothnagel's *Specielle Pathologie und Therapie*, (1898): "In a fairly large number of cases which otherwise showed nothing characteristic, especially no splenic enlargement, the mesenteric lymph glands were found to be swollen (Eichhorst, Quincke, etc.). From the microscopic examination of the first-named observer the enlargement appeared as a pure hyperplasia; only in one case were the swollen glands caseous in the centre. What relation these enlargements of the lymph glands bear to the disease process, or whether they stand related to local disturbances in the intestinal tract, or to the dis-

turbed abnormal function of the bone marrow, cannot be decided. The blood findings give no evidence of increased activity of the lymph glands in so far as the production of lymphocytes is concerned."

Eichhorst (Eulenberg's *Real Encyclopœdia*, 1898): "Swelling of the mesenteric glands repeatedly found. Other lymph glands also sometimes enlarged. Weigert describes the presence of bloody lymph in the dilated lymph vessels."

Strümpell: "The lymph glands do not usually present any changes in pernicious anæmia. If they are much altered it is probable that the disease is quite a different one (pseudoleukæmia)."

In Bramwell's *Anæmia and Diseases of the Blood-forming Organs* (1899) no mention is made of changes in the lymph glands. Laache (Ebstein and Schwalbe's *Handbook*, 1900) states that the mesenteric glands are often swollen, and refers to Weigert's case.

Howard (*Reference Handbook of the Medical Sciences*, 1900): "The lymph glands are usually normal. In a few instances the lymphatic glands of the mesentery have been recorded as enlarged, this change being due, as Pye-Smith suggests, to a previous diarrhœa. In one case the lumbar lymphatic glands were enlarged."

Osler (1901): "The lymph glands may be of a deep-red color."

Cabot (*American Text-book of Pathology*, 1901): "The spleen and lymph glands show no changes in the majority of cases."

Hunter (*Pernicious Anæmia*, 1901): "Few or no changes have been described in connection with the lymphatic glands. The absence of any enlargement or other marked change is a notable feature (Addison), distinguishing this form of anæmia at once from leucocythæmia and other forms of glandular anæmia, and this observation has been confirmed by all subsequent observers.

"In some cases, however (Eichhorst's), the mesenteric glands have presented some appearances of redness and swelling. Another case is described by Weigert in which, along with dilatation of the lymphatics of the neck and of the mesenteric, portal, omental, and retroperitoneal lymphatics, there was also some swelling of the mesenteric glands, their sinuses being filled with lymph containing many red corpuscles. This case Weigert was inclined to regard as one of supplementary blood formation on the part of the glands; but it stands alone, and no great value, therefore, can be attached to it. No abnormal microscopic appearances have been noted, and as regards the importance to be attached to the appearance of redness and swelling, it is only necessary to state that precisely similar changes were found by Neumann in the case of anæmia resulting from severe metrorrhagia, already referred to. In this case likewise, with the exception of a very few nucleated red corpuscles, no changes were found microscopically."

In many of the text-books published within the last several years

(Schmaus, Kaufmann, Ziegler, Musser, Stengel, Coplin, Thompson, Ewing, Coles, *Twentieth Century Practice*, etc.) no mention is made of changes in the lymph glands in this disease.

Reviewing critically those statements above in which changes are said to have occurred in the lymph glands, it will be seen that practically, with the exception of Osler's observations, our knowledge of lymph-gland changes in pernicious anæmia is based upon Eichhorst's summary and the case reported by Weigert. The statements regarding the frequent occurrence of swelling of the mesenteric glands, when sifted down in the autopsy reports in the literature, are in reality based upon but few observations of this condition; and Eichhorst's statement that these changes have been repeatedly observed is not borne out by the autopsy notes of the cases upon which he bases his summary. I have analyzed, with respect to this point, 173 autopsy cases of pernicious anæmia collected from the literature since the appearance of Eichhorst's monograph. In 142 of these cases no mention of the lymph glands is made. In 14 cases the statement is "no enlarged lymphatics" in 4, "mesenteric glands not enlarged" in 4, "lymph glands normal" in 4, "mesenteric and lumbar glands all healthy" in 1, "of normal size and consistency" in 1 (cases reported by White, Axtell, Roosevelt, Musser, Smith, Fischel, Gottlieb, Sasaki). The positive findings are as follows:

In two cases reported by Kahler (1880) the mesenteric glands were somewhat enlarged, appearing as red bodies in the mesenteric fat; in another case they were described as red. Smith (1880) reported enlargement of the bronchial glands; in one case reported by Starr the mesenteric glands appeared smaller than usual. In the thirty-eighth case reported by Hobson "large lymphatics in the posterior mediastinum, pressing on the right vagus, thoracic duct, and splanchnics; glands in the neck and axilla much enlarged." In the forty-fifth case the mesenteric glands were very large, and Peyer's patches were marked.

Müller (1889): In one case of bothriocephalus anæmia the retroperitoneal glands showed some medullary swelling, and the jugular lymph glands were very rich in blood, resembling the spleen. In two cases with syphilitic history the lymph glands, especially the jugular, showed inflammation, reddening, and hyperplasia of the follicles. In a case of Holt's (1891) the "mesenteric glands were enlarged, not cheesy. The liver showed collections of spheroidal cells, presumably the hyperplastic lymph nodes of Arnold."

White (1890) reports one case with enlargement of the mesenteric glands and Peyer's patches; Klein, one case in which the right cervical and inguinal, and especially the left cervical, were enlarged, gray-red, or grayish-yellow. In the left axilla two glands the size of beans were present.

In a case of Hills (1898) caseating tubercles were found in the axillary and mediastinal glands. No enlarged glands in the abdominal or inguinal regions. Nammack (1900), a case in which the "axillary lymph nodes were enlarged; peribronchial lymph nodes enlarged and anthracotic." In a case reported by Henry in the same year tuberculosis of the mesenteric and retroperitoneal glands without tuberculosis elsewhere was observed. Grawitz (1901) reported one case in which the mesenteric glands were greatly swollen.

Eliminating accidental or coincident processes, such as tuberculosis, lymphadenitis, etc., the number of reported cases in which the lymph glands showed changes that might be regarded as belonging to the pathology of pernicious anæmia becomes very small, indeed. This paucity of observations may be explained by the assumption that lymph gland changes are of very rare occurrence in this disease, or that the changes are of such a nature as to easily escape observation at autopsy, or that in many cases no adequate examination of the lymph glands has been made. It is very probable that both of the last assumptions constitute the true explanation; in the absence of any marked changes it is very likely that in many, if not the majority of autopsy cases of pernicious anæmia in which no mention is made of the lymph glands, these were either superficially examined or entirely overlooked. I am led to this conclusion by my own experience. In every one of eight autopsy cases of pernicious anæmia the prevertebral lymph glands, particularly the hæmolymph nodes (cervical, thoracic, or retroperitoneal), showed changes, either gross or microscopic, which might be regarded as belonging to the essential pathology of the disease. In only one of these cases, however, were the gross changes so marked as to be noticeable without special examination of the retroperitoneal glands. Such special dissection is usually not a part of the ordinary autopsy technique. In my cases particular attention was paid to the lymph glands of all the regions for the purpose of collecting statistics of the relative occurrence of hæmolymph glands in the human body.

The reports of the cases which follow were from Dr. Dock's clinic of internal medicine, in the University Hospital, and I am indebted to the records of this clinic for the case histories and blood examinations, which are given here in a greatly condensed form.

Case I.—Mr. O. N. R., aged fifty-four years, American parentage, salesman by occupation, was admitted to the medical clinic May 26, 1898. Family history good; previous history negative; had usual diseases of childhood and an attack of typhoid fever at the age of thirty-four years. No history of venereal disease.

During the last three years he has had gaseous eructations, heartburn, and persistent constipation. For the last three months has been troubled with piles. He has noticed blood at nearly every stool, but

has never lost any large amount at any one time. In December, 1897, he first noticed a gradually increasing paleness, and at the same time began to be troubled with dyspnœa, palpitation, and general weakness. These symptoms are gradually becoming more marked.

Physical Examination at Time of Admission. The patient is five feet eight inches tall; his weight is 132 pounds (one year ago he weighed 143 pounds). Very cachectic and emaciated. Mind clear. Muscles very small and soft; panniculus very thin; marked œdema of ankles. Skin is pale sallow, with yellowish tint. Nails very pale. Mucous membranes and tongue very pale; connective tissue under tongue yellowish. Scleræ yellowish. Examination of lungs is negative. There is no apex-beat; the heart dulness is not enlarged. Heart sounds impure; pulse 88, dicrotic, regular. Examination of abdomen negative. Rectal examination showed a number of deeply congested papillomatous masses, about three-quarters of an inch in diameter, on the rectal wall just above the internal sphincter.

Blood Examination. Red blood cells, 960,000; leucocytes, 5672; hæmoglobin, 20 per cent.; specific gravity, 1027. The red cells show a marked degree of poikilocytosis. Differential count: normoblasts, 3; megaloblasts, 5; polynuclear leucocytes, 70; large lymphocytes, 7; small lymphocytes, 32.

Urine. Small amount; clear, dark reddish. Chemical tests negative.

On June 2, 1898, the patient was operated upon for hemorrhoids. After the operation all traces of blood disappeared from the stools, and the patient became somewhat less yellow, but remained extremely pale. At the same time the number of megaloblasts became diminished. His general condition improved; there was less œdema. He was discharged on the 27th of June, with advice to continue treatment of iron, arsenic, and hydrochloric acid, and to return later.

He was readmitted on January 6, 1900. For four to five months after leaving the hospital, in June, 1898, he remained in bed, getting up at short intervals. During this time he gained in strength, but was troubled with profuse sweating and swelling of the legs. Gastro-intestinal symptoms were marked. In October, 1898, he went to Texas for three months. There he continued to gain in strength, but at no time was he able to be up long. Breathlessness and palpitation continued. After his return, up to the fall of 1899, he remained about the same. At this time he began to grow weaker, and the symptoms of shortness of breath, palpitation, etc., increased, with severe pain in the heart region on slight exertion. Has irregular elevations of temperature. During the last six months he has noticed a gradual pigmentation of his body, first on his arms and over the inner surfaces of the thighs, and gradually appearing over the greater portion of his skin. Some of the areas have grown pale, while others have deepened in color. He has had no loss of blood from any part of the body. He has continued his treatment of iron, arsenic, etc., up to within a few weeks. The physical examination shows a marked melanodermia of the face, neck, back, thorax, buttocks, elbows, pubic region, inner surface of the thighs, knees, and ankles, the pigmented patches being arranged somewhat symmetrically, with lighter vitiliginous areas between. (A fuller report of the condition of vitiligo shown by this case will be made elsewhere.) Otherwise the physical signs were about as before. The blood examination, made on January 7th: blood thin,

watery, and coagulates slowly. Marked poikilocytosis; 1 nucleated red cell (degenerating normoblast) to 150 leucocytes. Red blood cells, 874,400; leucocytes, 2546; hæmoglobin, 25 per cent.; specific gravity, 1029.

The patient's condition became worse quickly. On the 8th small hemorrhagic spots appeared over the thorax and extremities. On the 10th his dyspnœa and sweating had increased; there were moist râles over both lungs, mind clouded, pulse very rapid, low tension. Died at 9.03 A.M., January 10, 1900.

Clinical Diagnosis. Progressive pernicious anæmia; vitiligo. Autopsy held at 11.30 A.M., January 10th, by Dr. Warthin.

Autopsy Protocol. Body well built, 171 cm. long. Muscles small, emaciated, very flabby; on section pale-brownish-red, moist. Panniculus in small amount; on section bright golden-yellow. Slight œdema over lower extremities. Skin over the greater portion of the body is pale, slightly scaly, and inelastic. Over the lower part of the femurs, patellas, flexor surfaces of both knees; over the penis, inner surfaces of the thighs, flexor surfaces of the thighs and arms; over the buttocks, shoulders, and thorax, there are irregular patches of brown pigmentation, arranged somewhat symmetrically. Alternating with these there are areas of lighter, smoother skin. In the majority of the patches there is an abrupt change from the pigment to the light areas, the edge of the pigmented portion just next to the light skin appearing much darker. The pigmented patches have a concave margin toward the light areas. In a few places there is an intermediate lighter zone between the darkest pigmentation and the white skin. Over the legs and trunk there are sparsely scattered ecchymoses, varying in size from a pin-point to half a pea. Hair is scanty and white over the head and face. The body hair is entirely absent over the white areas.

Brain and spinal cord very anæmic, otherwise negative.

Diaphragm at fifth rib, right and left. Mediastinal fat in large amount, bright yellow. Small amount of clear fluid in each pleural cavity. On the right side there are numerous small ecchymoses in the parietal pleura. Apex in fifth intercostal space, inside the nipple line; 150 c.c. of clear fluid in the pericardial sac. Pericardium negative. Large, irregular, tendinous spots on the anterior and posterior walls of the right ventricle. Heart weighs 416 grammes. Subepicardial fat increased; œdematous. Numerous small ecchymoses beneath the epicardium of auricles. Auricles filled with thin, watery blood; no clots. Ventricles not dilated. Left ventricle hypertrophic, cavity small, the papillary muscles hypertrophic, and the chordæ tendineæ thickened. Throughout the myocardium there are small fibroid areas. Tricuspid and mitral rings slightly thickened; mitral flaps thickened and slightly retracted. Aortic valves slightly thickened, edges recurved. Pulmonary valves negative. Arterio-sclerosis in the beginning of aorta. Coronary vessels sclerotic and calcified.

The left lung is free throughout, voluminous, especially the lower lobe. Visceral pleura smooth, moist, clear, shining. Beneath it are about a dozen firm elevations the size of a pea, heavily pigmented, and on section show calcification. Apex is slightly retracted. Several small, airless areas felt throughout lung. On section the upper lobe is pale gray, anthracosis moderate. Pressure yields an abundant foamy exudate. Lower lobe shows marked hypostasis. Foamy exudate

without pressure. The right lung is free except at apex, where there are many small, irregular adhesions containing adipose tissue. Lung not so voluminous as the left. Slight hypostasis in the lower lobe. Pleura smooth, clear, and shining; contains a few calcified nodules the size of a pea. Apex slightly retracted; contains small, caseating tubercles, and a number of smaller, non-caseating nodules. Cut surface yields abundant exudate on slight pressure, but œdema is not so marked as in the left lung. Pulmonary vessels negative. Bronchi contain grayish-yellow fluid. Bronchial glands heavily pigmented; contain small calcified nodules.

Thoracic aorta shows patches of sclerosis, not longitudinally arranged. Thoracic duct negative. Œsophagus contains a small amount of yellowish, foamy mucus; mucosa pale. Mucosa of the mouth and upper respiratory tract very pale. Thyroid small, on section negative. Cervical lymph glands not enlarged, but the majority heavily pigmented, deep brown.

No fluid in the peritoneal cavity. Omentum rich in fat. Spleen weighs 224 grammes, 12 cm. long, 8 cm. broad, 4 cm. thick. Capsule irregularly thickened; shows numerous hyaline, pearly, nodular thickenings. On section, is pale brownish-red. Stroma greatly increased. Pulp decreased, soft; follicles not visible. Bleeds freely; vessels contain thin, watery blood.

Left adrenal measures 5.5 cm. x 2.5 cm. x 2 mm.; right, 4.5 cm. x 2.5 cm. x 2 mm.; the periadrenal tissue shows no inflammatory thickening. Bloodvessels and plexus on both sides apparently normal. No inflammatory tissue about the semilunar ganglia. On section, adrenals show beginning post-mortem change in the lower portions of the medulla, the medullary substance in the upper part of both organs being grayish-white, firm, and showing no brown pigmentation.

The left kidney weighs 192 grammes and measures 11 x 6.5 x 2.5 cm.; the right one weighs 176 grammes and measures 11.5 x 5 x 3 cm. Fatty capsules of both kidneys well developed; fibrous capsule strips off easily. Surface slightly granular. On section, both kidneys are pale brownish-red, firm. Medullary pyramids pale. Cortex of left measures 6 mm.; of right, 8 mm. Pelvic fat in large amount. Mucosa of pelvis negative. Ureters negative. Wall of bladder thickened, muscle trabeculæ hypertrophic. Small hemorrhage at base of the bladder.

The stomach contains 300 c.c. of greenish-yellow fluid, with much whitish mucus. Mucosa covered with grayish mucus. In the mucosa there are numerous ecchymoses of small size. Mucosa atrophic. Pylorus negative. No post-mortem change in the stomach mucosa. Intestine contains soft, bile-stained fecal material. Mucosa swollen, very pale, containing small punctate hemorrhages. Numerous enlarged solitary follicles in ileum. Large intestine contains soft, pale yellowish feces. Mucosa very pale, containing small hemorrhagic spots and small areas of pigmentation. No free blood in any portion of the intestinal lumen. Small hemorrhoids just within the anus.

The liver weighs 1728 grammes; its greatest dimensions are 25 x 17 x 7 cm. The surface is granular; capsule thickened, especially about the ligaments and near the gall-bladder. On section, the surface is granular, slightly elevated, cloudy, and of a pale red chocolate color. Slight fatty smear on knife. Outlines of lobules distinct; central vein

a small red point. Glisson's capsule slightly increased. Bile-ducts dilated, filled with golden-yellow bile. On the under surface of the liver is a small, triangular anomalous lobe of liver tissue entirely separated from the tissue of the main organ by connective tissue. Its capsule is thickened and shows lines of contraction. Gall-bladder and bile vessels negative. Portal vein is also negative.

The pancreas weighs 136 grammes; its dimensions are 24 x 4.5 x 1.5 cm. The tail is unusually thick. On section, the lobes are clearly outlined; interlobular connective tissue increased; consistency normal. The splenic artery and branches are very sclerotic.

The mesentery is very rich in fat, its glands slightly enlarged. On section, pale pink. The retroperitoneal glands are also enlarged, and are heavily pigmented, brownish-red in color. The glands at the brim of the pelvis in particular show this change.

The prostate shows bilateral enlargement, the testicles slight fibroid change; otherwise the genitals are negative.

Bone Marrow. Red marrow deep red in color. The fatty marrow of the long bones contains dark reddish areas looking somewhat like blood clots. The peripheral lymph glands are very slightly enlarged; all more or less pigmented. Near the solar plexus a number of enlarged Pacinian corpuscles are found, having pearly centres and a clear periphery.

Microscopic Examination. Lung shows anæmia and marked œdema. Old and fresh hemorrhagic infarcts. Mucopurulent bronchitis. Healed tubercles.

Heart. Atrophy and hypertrophy. Fatty infiltration and degeneration.

Spleen. Atrophy, increase of fine stroma, chronic congestion; contains very little hæmosiderin.

Kidneys. Anæmic; atrophy of cortex, with localized areas of connective-tissue increase. Numerous obliterated glomeruli. Cells of convoluted tubules show cloudy swelling, and contain a diffuse yellowish pigment which gives the iron reaction.

Liver. Atrophy, increase of connective tissue, slight fatty infiltration and degeneration; chronic congestion. Liver cells heavily pigmented with brownish pigment, most marked at the periphery of the lobule. The pigment gives the iron reaction.

Pancreas. Atrophy and increase of interlobular tissue. Some of the areas of Langerhans appear enlarged.

Adrenals. Slight atrophy and marked hæmosiderosis. Collections of deeply staining small round cells found throughout both organs; numerous mast cells present.

Stomach. Chronic atrophic gastritis; small hemorrhages in submucosa.

Intestine. Subacute enteritis and colitis. Solitary follicles and Peyer's patches enlarged and œdematous; some hemorrhagic.

Prostate. Adenomatous hyperplasia; numerous corpora amylacea.

Aorta. Marked sclerosis.

Skin. Melanoderma and vitiligo. Pigment does not give the iron reaction. (The vitiligo of this case will be reported elsewhere.)

Bone Marrow. Red marrow contains increased number of nucleated reds and megaloblasts. The red areas in the fatty marrow are localized areas of congestion and hemorrhage.

Hæmolymph Glands. See below.

Lymph Glands. All lymphatic glands show hæmosiderosis.

Pathological Diagnosis. Pernicious anæmia; hæmosiderosis of the liver, kidneys, lymph glands, adrenals, and spleen; vitiligo; chronic atrophic gastritis; acute enterocolitis; multiple punctiform ecchymoses; general atrophy; arterio-sclerosis; healed tubercles of the lungs and bronchial glands; small-celled infiltration of the adrenals; hypertrophy of the prostate.

Case II.—Miss Sarah M., American, aged fifty-two years, housekeeper by occupation, was admitted to the medical clinic January 12, 1899. The patient came to the hospital because of shortness of breath, "jumping sensation" in the heart region, and general weakness. Her father died at the age of sixty-five years of a disease which the patient thinks was similar to hers. Otherwise the family history is unimportant. Patient had the usual diseases of childhood. There is a strong suspicion of syphilis. She has worked very hard; habits of eating have been very irregular. Menopause established three years ago. At this time she began to have pain and throbbing in the epigastrium after meals, and shortness of breath developed at the same time. Large "swellings" appeared on the face, lasting six to eight months. Her physician at this time said that her liver and spleen were very much enlarged. She improved under treatment, but six months later became much worse, being confined to bed for about four weeks. During this attack she several times, after meals, vomited a bloody looking material, which she described as "thick, livery matter." Four weeks ago the throbbing pain in the heart region and shortness of breath became much worse. She has been unable to sit up; mind not clear. During these attacks her skin is of a yellow color. During the last summer she gained forty to fifty pounds.

Physical Examination (January 13, 1899). Patient appears very ill, cachectic, mind clouded, very restless, face swollen; skin is very pale, sallow, and elastic. Slight œdema at the ankles. No enlarged glands. Examination of the lungs negative. Apex in fifth intercostal space, outside of the nipple line; heavy impulse with systolic thrill. Dulness enlarged to the left nipple line and to the right one finger's breadth beyond the right edge of the sternum. Loud, blowing systolic murmur over the entire cardiac region, loudest over the apex, and transmitted into the axilla. Second sounds weak. Pulse 112, low tension, somewhat dicrotic, irregular in volume and rhythm. Abdomen above the level of the ribs. Traube's space dull; lower border of the stomach two inches above the umbilicus. Liver dulness reaches to the edge of the ribs. Liver is palpable. Splenic dulness begins on the eighth rib and extends to the edge of the ribs. Spleen easily felt one to one and a half inches beyond the edge of the ribs.

Blood Examination (January 13, 1899). Red blood cells, 888,000; leucocytes, 4700; hæmoglobin, 35 to 40 per cent. Differential count (January 18, 1899): small lymphocytes, 33 per cent.; large lymphocytes, 7 per cent; transitionals, 1.8 per cent.; polynuclears, 56.2 per cent.; eosinophiles, 0.70 per cent.; degenerating leucocytes, 2.1 per cent. The red blood cells are large, as a rule; some microcytes, marked poikilocytosis. The cells are pale, with large, clear centres. Normoblasts, degenerating normoblasts, and megaloblasts are present.

There is a trace of albumin in the urine.

The patient failed very rapidly after admission. General weakness increased. Irregular fever; heart gradually became weaker; œdema of the legs increased. Died at 10 A.M., January 20, 1899.

Clinical Diagnosis. Pernicious anæmia; dilatation of the heart; relative mitral insufficiency.

Autopsy by Dr. Warthin, 11 A. M., January 20, 1899.

Autopsy Proctocol. Body well built, 159 cm. long. Muscles very soft and flabby; rigor mortis present only in the muscles of the jaw. Body heat present over the trunk. Panniculus very thin; on section, orange-yellow. Moderate œdema over lower extremities, slight œdema over the remainder of the body. Skin pale sallow, with a yellowish tint; numerous small, pigmented patches over both legs. Small ecchymoses in abdominal wall just below umbilicus. Small patch of ectatic veins on the outer surface of the right thigh. Slight hypostasis over back. Brain negative, except for anæmia and slight sclerosis of the cerebral vessels. Spinal cord not examined.

Diaphragm on the right at the third interspace; on the left at the fifth rib. Left mammary gland is negative; right one contains a small cyst. Position of the thoracic organs negative, except for the apex of the heart, which is in the fifth interspace in the anterior axillary line. Mediastinal fat abundant, bright yellow and moist. No remains of thymus.

Pericardial sac contains 100 c.c. of clear fluid. Pericardium pale, clear, shining. Large tendinous spot on the anterior wall, and smaller one on the posterior. Heart weighs 473 grammes, and is three times as large as cadaver's right fist. Subepicardial fat is increased. Beneath the epicardium there are numerous punctiform hemorrhages, the largest being at the apex. The apex is formed by the left ventricle. The right auricle is greatly distended, the muscle fibres separated. Right heart filled with thin, watery blood; no clots. Left side not dilated. Left ventricular wall measures 10 to 15 mm.; right, 2 to 5 mm. Mitral orifice barely admits two fingers; flaps thickened, posterior one shortened. Aortic flaps thickened, but adequate. Punctiform hemorrhages beneath endocardium. Heart muscle, pale yellowish-brown; soft; no sclerosis in the aorta.

Both lungs moderately collapsed, very pale, moderate anthracosis, moderate œdema. Small calcified nodules in the upper lobe of the left. Bronchi, bronchial glands, and pulmonary vessels negative. Upper respiratory tract negative except for extreme paleness of the mucous membranes. Tonsil contains a number of small scars. Small hemorrhage on the upper surface of the right vocal cord. Both lobes of the thyroid enlarged; in the left lobe there is an adenoma the size of a small pigeon's egg. Œsophagus, trachea, and thoracic duct negative. Cervical lymph glands enlarged, some of them showing anthracosis.

No fluid in the peritoneal cavity. Position of the abdominal organs negative. Omentum rich in fat; contains three small, firm, pinkish bodies, the largest the size of a bean.

The spleen weighs 570 grammes and measures 18.5 x 9 x 5.5 cm., about three times the normal size; edges thick and rounded. Capsule tense, thickened, and opaque. Cut surface is dark red; consistence firm, stroma increased, follicles enlarged, bleeds very little. Splenic vessels show marked sclerosis.

Adrenals negative; no post-mortem change.

Left kidney weighs 160 grammes and measures 12 x 4.5 x 4 cm.; right kidney weighs 146 grammes and measures 12 x 5 x 4 cms. Cortex of the left kidney, 0.5 cm. broad; that of the right a little less. Fatty capsule of both kidneys very large; fibrous capsule thickened and slightly adherent. Surface granular—that of the right more so than the left. Cut surface is pale brownish-red, slightly granular; consistency increased. Small, grayish areas in the cortex; waxy shine. Glomeruli plainly visible. Pelves and ureters negative. Bladder distended with clear urine; walls thin and pale. Stomach shows no post-mortem change. No atrophy or other pathological change. Contains about 500 c.c. of greenish fluid in which there is a whitish powder. Intestines filled with soft, greenish, fecal material. Mucosa pale, otherwise entirely negative. Appendix normal.

Liver weighs 2105 grammes and measures 30 x 23 x 10 cm. Lower edge is three finger breadths below the edge of the ribs, in the right nipple line. Left lobe is lengthened and flattened. On its upper surface is a depression corresponding to the position of the heart. Numerous adhesions over the anterior surface. Capsule thickened, especially near the ligaments. On section the organ is brownish-yellow; lobules not clearly defined, very little blood in the veins. Slight fatty smear on knife. Consistence increased. Gall-bladder distended and filled with dark brown, glairy bile; wall thin; bile passages and portal vein negative. Pancreas large; marked fatty infiltration. Vessels sclerotic. Three enlarged glands behind the pancreas; on section, pinkish-brown. The mesentery is very rich in fat; the mesenteric glands not enlarged. The retroperitoneal glands are not enlarged; many of them are pinkish or brownish in color. The abdominal aorta shows a moderate degree of sclerosis.

External genitals negative. Vagina negative. Cystic polypoid growth on the cervix. Cystic endometritis. Uterine wall atrophic. Left tube twisted, bent upon itself, surrounded by many adhesions; few adhesions about the right tube. Ovaries atrophic, the left one bound down by adhesions. Uterine ligaments thickened, show many adhesions; also adhesions between the uterus, ovaries, and the rectum.

Marked osteoporosis of the long bones; the medullary canal of the right tibia about twice the normal size. Marrow, bright red; no fatty marrow in the long bones. Hyperplasia of red marrow in the clavicle, etc.

The peripheral glands are not enlarged; negative.

Microscopic. Spleen. Fibroid hyperplasia; moderate hæmosiderosis.

Liver. Atrophy, fatty degeneration, hæmosiderosis of the peripheral zone of lobule, chronic endarteritis in hepatic artery.

Kidneys. Early stage of primary contracted kidney, chronic endarteritis, hæmosiderosis of convoluted tubules.

Pancreas. Fatty infiltration.

Lungs. Atrophy, œdema.

Heart. Atrophy, fatty degeneration, and infiltration.

Adenoma of Thyroid. Adenoma showing large myxomatous areas partly infiltrated with red blood cells.

Stomach and Intestines. Negative.

Bodies from Omentum. Hæmolymph glands showing pigmentation and active hæmolysis.

Bone Marrow. Fatty marrow transformed to lymphoid marrow containing many nucleated red cells.

Retroperitoneal Glands. See below.

Pathological Diagnosis. Pernicious anæmia; hæmosiderosis of the liver, spleen, kidneys, and hæmolymph glands; hyperplasia of the lymphoid marrow; fibroid hyperplasia of the spleen; general atrophy, fatty infiltration, and degeneration of the heart; cardiac dilatation; mitral insufficiency.

CASE III.—Mrs. H. E., aged fifty-eight years, American, housewife, was admitted to the medical clinic November 24, 1900. Patient comes to the hospital for general weakness, shortness of breath, and frequent hemorrhages from the nose, gums, and bowels.

Family history negative; previous history good. Has always been a very hard worker. Menopause began at forty-three years; flowed excessively at intervals up to the age of fifty-one years, when the flow suddenly ceased. The present trouble began a year from last August, when she contracted a severe cold, became very constipated and weak. Two months later she fell and struck her forehead. Six days later she had a severe epistaxis, lasting six hours. A month later she had another attack of epistaxis, of eight hours' duration. Periodical attacks of nose bleeding occurred every month until the following spring, the epistaxis continuing for seven to ten hours without apparent ill effects. For seven weeks previous to last May she was free from hemorrhage, but in May began to have hemorrhages from the nose and gums, continuing more or less for six weeks. During the greater part of this time she was confined to her bed, extremely weak, nauseated, and retained food with great difficulty. In July she had an epistaxis of thirty-six hours' duration. Slight one during August. In September she had another severe attack, and vomited a great deal of blood; cannot say whether the blood came from the stomach or nose. During the middle of October she had almost constant, though not profuse, hemorrhages from the nose, gums, and lips. During the last two weeks these have ceased, but she has had a bloody diarrhœa, the blood coming in a steady stream at times and apparently unchanged. During the period of hemorrhage she is very weak; staggers in walking, but has lost consciousness only once. Elastic swellings have appeared in various parts of her body, the first and largest, the size of two fists, on the right shoulder, gradually working down the right side to the right hip, where it ultimately disappeared. A similar mass on the left arm became harder. The skin over the abdomen became discolored, the discoloration gradually disappearing. Sight has become dim. Appetite remains good; has lost fifty pounds. Irregular fever.

On December 7th patient became comatose, but could be aroused easily. Face was very œdematous; marked œdema at the ankles. Pulse 110; low tension. Later in the day the coma deepened and breathing became more labored. Died suddenly at 5 A.M. December 8th.

Blood Examination. Red blood cells, 1,280,000; leucocytes, 3000 to 4000; hæmoglobin, 20 per cent. The differential count of 500 leucocytes showed: small lymphocytes, 40.4 per cent.; large lymphocytes, 3.3 per cent.; transitionals, 2.2 per cent.; polynuclears, 53.6 per cent.; eosinophiles, 0.4 per cent.; degenerating leucocytes, 0.2

per cent. One normoblast in two smears. (Smears given to the blood class in the pathological laboratory showed in some covers two to three megaloblasts and the same number of degenerating normoblasts.) The blood showed evidences of an extremely active hæmolysis. The red cells were nearly all round, some dark, many pale or shadowy. The plasma showed a tendency to stain around the red cells. The red cells are grouped two or three or more in a bunch. No particular changes in the leucocytes.

Clinical Diagnosis. Anæmia (active hæmolysis); hæmophilia.

Autopsy performed by Dr. Warthin, at 11.45 A.M., December 8th, at undertaking shop.

Autopsy Protocol. Body five feet six and a half inches tall; well built; abdomen distended above the level of the ribs; punctured by the undertaker. Muscles small and flabby; on section, very pale and soft. Rigor mortis present throughout. Panniculus in fair amount; on section, orange-yellow, moist. Skin dry, inelastic, pale sallow, with yellow tint. Numerous small pigmented nævi scattered over the body. Several angiectatic areas or subcutaneous hemorrhages. Over the forearm, face, neck, external genitalia, and knees the skin is moderately pigmented, the pigmentation less marked over the flexor surfaces. Mucous membranes pale yellow. Scleræ very slightly yellow. Pale hypostasis over the back. Hair of the scalp abundant, grayish. Marked œdema over the lower extremities; slight over the thorax. Body heat absent.

Head and spinal cord not examined.

Diaphragm, fifth rib on right; sixth intercostal space on left. Mammæ atrophic. Position of the thoracic organs normal. Mediastinum negative. Thymus fat in small amount. Pleural cavities filled with fluid smelling of undertaker's injection. Pleuræ negative. Pericardium negative. Heart larger than the right fist; weighs 186 grammes. Small, tendinous spot on the posterior wall of the right ventricle; no subepicardial ecchymoses. On section, heart muscle is pale brownish-red in color; subepicardial fat greatly increased. Left ventricle wall 12 mm. thick; right, 5 mm. Valve flaps and orifices negative. Both lungs entirely free; the right one partly collapsed, the left more voluminous. Pleuræ negative. On section, both lungs are pale pinkish-gray in color; yield abundant foamy exudate on slight pressure, emphysematous along the edges and at the apices. Pulmonary vessels negative. Bronchi empty; mucosa pale. Bronchial glands moderately enlarged, moderately pigmented. Arch of the aorta and thoracic aorta show beginning arterio-sclerosis. Upper respiratory tract negative. Thyroid enlarged; contains hyaline and calcified areas; cyst the size of a cherry in the lower part of the left lobe. Thoracic duct negative. Œsophagus negative.

Liver two hand breadths below the ensiform and a hand breadth below the edge of the ribs; otherwise the position of the abdominal organs is negative. The omentum is rich in fat, rolled up at the level of the umbilicus. Peritoneum negative; in the serosa of the small intestine there is a number of small, hyaline thickenings. No fluid in the peritoneal cavity.

Spleen weighs 208 grammes; about normal in size and shape. Notches on the anterior margin well marked. Capsule slightly thickened and wrinkled. Consistency soft. On section, the pulp is bluish-red,

stroma slightly increased, follicles somewhat diminished in number, but of fair size.

The adrenals show post-mortem change; otherwise negative. The left kidney weighs 240 grammes; the fatty capsule well developed. Kidney more plump than normal; fibrous capsule thickened and slightly adherent. Numerous retention cysts in the surface of the cortex, varying in size from a pin-head to a pea. On section, the surface is slightly granular, pale, firmer, and more translucent than normal. Labyrinth and medullary rays not well marked. Glomeruli not easily seen. Cortex measures ½ to 1 cm. Pelvic fat increased. The right kidney weighs 256 grammes; similar to the left, except that the lower pole is almost entirely replaced by a large retention cyst, having a clear wall, almost transparent, and containing clear fluid. In the upper pole there are other similar cysts of the size of a cherry. Both ureters dilated, the left more than the right. Mucosa pale, otherwise negative. Bladder greatly distended; wall smooth.

Stomach contains food remains and a small amount of mucus. Mucosa swollen; no evidences of atrophy. Mucosa of the small intestine very pale, otherwise no change. Neither the solitary follicles nor Peyer's patches enlarged. Appendix long, slender; has long mesentery, very rich in fat; no adhesions. Cæcum moderately dilated. Ascending colon empty; mucosa covered with mucus. Ascending colon contains pale yellowish unformed feces. Mucosa shows little change. Transverse colon is contracted; mucosa covered with tenacious mucus and small fecal lumps; no evidences of hemorrhage. Descending colon empty. Mucosa covered with a large amount of mucus; mucosa pale, thickened, no evidences of hemorrhage. Above the anus there is a ring of large, dark-blue, tortuous hemorrhoids. No evidences of recent hemorrhage from these.

The liver weighs 1920 grammes; much flattened, its sagittal diameter increased. Over the lower border of the right lobe, corresponding to the edge of the ribs, there are two shallow furrows, one-half finger breadth in width, over which the capsule is much thickened and opaque. The surface of the liver is more or less irregular, especially that of the left lobe and the under surface of the right one. The capsule is thickened throughout; more marked thickening over the depressions and furrows. Consistency decreased. On section, shows a well-marked nutmeg appearance; central portion of lobule deep red, peripheral brownish-yellow. Marked fatty smear. Gall-bladder filled with dark golden-brown bile; mucosa negative, wall somewhat œdematous. Bile passages patent.

Pancreas very small, flattened, consistency decreased. On section, lobules small and pale. Fat about the pancreas in large amount. No hemorrhage. Portal vein negative. Mesenteric glands not enlarged. Retroperitoneal lymph glands enormously enlarged, forming large, flattened masses lying along the vessels on both sides of the spinal column from the bifurcation of the common iliac to the solar plexus. Enlargement more marked on the right side than on the left. Glands around the solar plexus very large and firm. The glands are partly dark red, partly pale, showing a number of dark-red areas; consistency soft; cut surface somewhat granular; the scraping yields a large number of cells. Vessels greatly dilated and filled with thin blood.

The external genitals are pale; labia somewhat œdematous. Cervical

ectropion. Uterus enlarged, thick; irregular increase in size due to a number of myofibromata in the wall, from the size of a cherry to a walnut; tubes atrophic. Ovaries small and atrophic; show many hyaline scars. The right broad ligament is studded with numerous small hyaline bodies, the majority translucent and slightly yellow. Some are firm, others cystic; they vary in size from a pin-head to a small pea.

Red marrow dark red. Long bones show marked osteoporosis; medullary canal greatly enlarged, the fatty marrow replaced by dark red to almost black lymphoid (?) marrow containing small cysts filled with dark-red fluid blood. The firm portion of the bone forms a very thin shell around the canal, and is much softer than normal. Peripheral lymph glands not enlarged.

Microscopic. Heart. Shows marked atrophy, fatty infiltration, and moderate fatty degeneration.

Lungs. Very marked simple atrophy and emphysema and dilatation of the smaller bronchioles.

Spleen. Atrophy and chronic congestion; moderate hæmosiderosis.

Liver. Marked chronic congestion (nutmeg liver); slight hæmosiderosis of the peripheral zone of the lobules.

Kidneys. Early stage of chronic interstitial nephritis; numerous retention cysts; slight hæmosiderosis of the convoluted tubules.

Pancreas. Fatty atrophy, congestion, beginning post-mortem change.

Stomach. Chronic catarrhal gastritis, moderate atrophy.

Intestine. Negative.

Ovaries. Atrophy.

Cysts from Broad Ligament. Follicular cysts lined with large flattened or cuboidal cells; contain a mucoid or firm colloid substance.

Skin. Small hemorrhagic areas.

Bone Marrow. Contains many hemorrhagic areas and small, scattered islands of lymphoid marrow, these being made up chiefly of lymphocytes and numerous giant cells. Cysts, containing fresh blood.

Lymph Glands. See below.

Pathological Diagnosis. Anæmia gravis; active hæmolysis; lymphoid hyperplasia of the retroperitoneal glands lymphosarcoma (?), infective granuloma (?), early stage of leukæmia (?)); lymphoid and cystic changes in the bone marrow; fatty heart; atrophy, chronic congestion of the spleen, lungs, liver, etc.; early stage of chronic interstitial nephritis; myofibromata of the uterus; multiple ecchymoses in the skin.

Case IV.—W. M., aged twenty-two years, American, laborer, admitted to the medical clinic January 25, 1901. His family history is unknown. At twelve years of age he had an attack of "jaundice," lasting two weeks; otherwise has had fair health. He entered the army service April 29, 1898, and was sent to Porto Rico, where he almost immediately contracted malaria and chronic diarrhœa. Was discharged April 14, 1899; has not been well since. Has four to five stools daily; these are thin, watery, and passed with much gas and more or less pain. He has great thirst; drinks an average of two gallons daily; passes about one gallon of urine during the night, does not know how much during the day. Complains of great general weakness, constant pain in the lumbar region, and at times swelling of the extremities and face.

Physical Examination. Weight, 93¾ pounds. Very cachectic and emaciated. Skin and scleræ of a muddy tint; pigmented patches over the neck and spine. Examination of the lungs negative. Heart sounds weak; soft, blowing systolic murmur at the apex. Pulse rapid; low tension. Has irregular, low fever. No enlargement of the spleen, liver or lymph glands. Specific gravity of urine, 1003; chemical tests negative. Examination of the stools showed no protozoa, no worms or eggs, no blood, many leucocytes.

Blood Examination. Red blood cells, 960,000; leucocytes, 3172; hæmoglobin, 20 per cent.; specific gravity, 1027. Red cells show marked poikilocytosis; stain very poorly; few degenerating normoblasts.

The patient rapidly became very weak, attacks of faintness occurring. Died 8.30 A.M., January 29, 1901.

Clinical Diagnosis. Anæmia; chronic diarrhœa.

Autopsy by Dr. Warthin, 4 P.M., January 29, 1901.

Autopsy Protocol. Body measures 170 cm.; much wasted and cachectic. Muscles emaciated, very flabby; on section, brownish-red, dry; do not tear easily. Rigor mortis present throughout. Panniculus almost entirely absent. On section, pale orange-yellow, dry. Trace of œdema over the lower extremities. Skin dirty sallow; marked pigmentation in axillæ, around the nipples, over the abdomen, genitals, and thighs. Numerous small, pigmented moles scattered over the body; pigmented patch over the eighth rib, in the right anterior axillary line. Very slight pale hypostasis over back. Body heat present over the abdomen and lower part of the thorax. Body hair scanty; scalp hair dry and thin.

Brain and cord very anæmic; otherwise negative.

Diaphragm, fourth rib on right; fifth intercostal space on right. Apex in the fourth interspace, half-way between the left parasternal and nipple lines. Mediastinal fat in small amount; no enlarged glands. Thymus fat in small amount; no remains of thymus. Small amount of cloudy, yellowish fluid in both pleural sacs.

Pericardial sac moderately distended; contains 75 c.c. of pale yellow, slightly cloudy fluid. Parietal pericardium negative. Epicardium clear, shining, moist; a few small ecchymoses beneath the epicardium of the right auricle. Heart weighs 304 grammes; size of cadaver's right fist; soft; subepicardial fat in slight excess. On section, heart muscle is pale brownish-yellow, soft, tears easily. Right auricle and vena cava distended with thin, watery blood and large yellow agonal clot. Left auricle divided into a number of anomalous narrow lobules, slightly recurved on themselves. Left ventricular wall measures 10 mm.; right, 3 mm. Slight thickening of the proximal margins of the mitral flaps; otherwise the valves and orifices are negative.

Left lung entirely free, moderately voluminous. Pleura negative. On section, lung is extremely pale, almost bloodless; slight foamy exudate obtained by pressure. Right lung free, except for a tough band of adhesions at apex containing a calcified nodule. On section, similar to the left. Pulmonary vessels negative. Mucosa of bronchi pale. In the right peribronchial glands is a number of caseous and partly calcified areas. Thoracic duct negative. Mucosa of the upper respiratory tract very pale. Left tonsil enlarged; suppurating crypt. Left lobe of the thyroid moderately enlarged.

In the right side of the neck, along the anterior border of the sterno-cleidomastoid and just below the angle of the jaw, there is an elastic, lobulated body, about 4 cm. long by 2 cm. wide. Skin over the mass is pigmented, but freely movable; there is no external opening. On section, presents the appearance of fat tissue.

Small amount of clear yellow fluid in the peritoneal cavity. Omentum contains a small amount of fat; very anæmic; lower edge rolled to level of the umbilicus. Intestines uniformly distended; walls thin, dry, bloodless. Sigmoid flexure greatly distended, completely filling up the pelvis and inguinal regions. Colon also greatly distended.

Spleen weighs 240 grammes; somewhat enlarged, flattened, soft; anterior notches small. Near the upper pole there is a deep posterior notch. Capsule is slightly wrinkled. On section, the pulp is swollen, covering up the stroma; mottled pale red and darker red. Follicles easily seen.

Adrenals negative. Left kidney weighs 296 grammes; right, 240 grammes. Fatty capsule of both rather poor in fat; fibrous capsule slightly adherent. Both kidneys plumper than normal, surfaces slightly granular, consistency increased. On section, parenchyma very pale and firm; outline of labyrinth and medullary rays not very distinct; glomeruli barely visible. Medullary pyramids pale, glistening, almost white. Iodine test for amyloid negative. Pelves dilated; ureters greatly dilated. Bladder enormously distended; filled with pale urine. Mucosa pale, smooth.

Mucosa of stomach very pale, otherwise negative. In the ileum there are scattered erosions over enlarged solitary follicles. These increase in number and size toward the ileocæcal valve. In Peyer's patches are several small ulcers, the largest 15 mm. long and 5 mm. wide. Ulcers are excavated; have overhanging thickened margins; base covered with gray exudate; do not extend through the submucosa; are longitudinal and not circular. Serosa shows no change. No ulcers in the colon. Rectum negative.

Liver weight, 1792 grammes; rounder than normal; capsule negative. On section, color pale yellowish-brown; central veins congested, pale red. Surface cloudy; slight fatty shine and smear. Gall-bladder contains pale golden-yellow bile; negative. Bile passages normal.

Pancreas extremely pale; outlines of lobules sharply marked.

Mesenteric glands moderately enlarged; on section, pale, homogeneous; no necrosis.

Retroperitoneal hæmolymph glands greatly enlarged, especially on the right side of the spine, behind the vena cava, along the abdominal aorta, and near the left renal artery. Glands are of a deep brown color. Glands about the solar plexus are also enlarged and of a brown color, although not so dark as the hæmolymph glands.

With the exception of a large varicocele on the left side and thickening of the testicular tunics, the genitals are negative.

Bone marrow: Red marrow bright red; fatty marrow pale, shows no lymphoid areas in the long bones of the lower extremities.

Peripheral lymph glands negative.

Microscopic. Heart. Simple atrophy.

Lung. Atrophy; hemorrhagic infarction.

Bronchial Glands. Old, calcified tubercles.

Tonsils. Chronic tonsillitis.

Tumor from Neck. Lipoma.

Liver. Simple atrophy; slight fatty change; slight hæmosiderosis of the peripheral zone of lobule.

Spleen. Congestion; hyperplasia of pulp.

Kidneys. Atrophy; dilatation of tubules; slight hæmosiderosis of cells of convoluted tubules.

Adrenals. Pancreas and thyroid negative.

Intestinal Ulcers. Tuberculous (?).

Mesenteric Glands. One gland contains a number of tubercles showing caseation and large giant cells.

Hæmolymph and Retroperitoneal Glands. See below.

Bone Marrow. Red marrow shows a great number of normoblasts and megaloblasts. Fatty marrow shows no lymphoid change.

Pathological Diagnosis. Pernicious anæmia (?); tuberculous ulcers of the intestine; tuberculosis of the mesenteric and bronchial glands; acute congestion of the spleen; general marasmus and atrophy of all the organs; lipoma of the neck.

Case V.—O. D. C., aged twenty-five years, American, farmer, admitted to the medical clinic January 20, 1901. Comes to the hospital because of diarrhœa, gastric disturbances, shortness of breath, and yellowness of the skin. Family history negative. Had frequent "fits" when a baby; was not strong as a boy; had several attacks of vomiting. Habits good. In February, 1898, had an attack of "grippe," since which time he has not been well. Has had frequent attacks of nausea and pain in the stomach, in which he vomits; is better after vomiting. Under treatment with arsenic he became better, but is at present so weak that walking is fatiguing. Is troubled with palpitation. Has two to three loose, watery stools a day; no blood in the stools. Of late this condition has been improving. During attacks has sore mouth, fever, frontal headache, and feeling of numbness over the entire body. Has no appetite.

Physical Examination. Cachectic, but not emaciated; mind is clear. Muscles small and soft. Fair amount of panniculus. Skin is light yellow; mucous membranes very pale. Scleræ contain yellowish fat; no jaundice. No enlarged glands. Examination of the lungs negative. No apex-beat. Heart dulness not enlarged; first sound impure. Over pulmonary area there is a short, soft, blowing, systolic murmur. Pulse 88, regular, of low tension. Splenic dulness enlarged; spleen not palpable. Liver dulness not enlarged. Succussion in the stomach. Urine contains albumin and casts. No blood, mucus, parasites, or eggs in the stools.

Blood Examination. Red cells, 1,600,000; leucocytes, 4413; hæmoglobin, 35 to 40 per cent.; specific gravity, 1040. Red cells show marked poikilocytosis; no nucleated red cells found.

The patient remained in the hospital until March 7th. Improved greatly; hæmoglobin rose to 60 per cent. He was allowed to take medicine (iron, hydrochloric acid, etc.) and to go home, returning in a few months for further examination.

He returned April 17th, neither looking nor feeling so well as when he left. Has increased shortness of breath, loss of appetite, irregular fever; skin is more yellow. Red cells, 1,828,000; hæmoglobin, 40 per cent. From this time on he gradually grew weaker, with short periods of apparent improvement. Attacks of nausea, vomiting, and præcordial

pain became frequent; a number of attacks of nosebleed occurred. Red cells and hæmoglobin steadily went down, the blood count on May 3d being: red cells, 766,000; leucocytes, 8567; hæmoglobin, 35 to 40 per cent. Red cells showed marked poikilocytosis; degenerating normoblasts and megaloblasts present.

Died May 15, 1901, at 4.15 A.M.

Clinical Diagnosis. Pernicious anæmia.

Autopsy by Dr. Warthin, 9 A.M., May 15, 1901.

Autopsy Protocol. Body 167 cm. long; no anomalies or deformities. Abdomen below the level of the ribs. Muscles small, soft, and flabby; on section, pale brownish-red. Small amount of panniculus; on section, light lemon color. Slight œdema over the lower extremities. Rigor mortis present throughout. Body heat present in slight amount over the thorax and abdomen. Skin and scleræ of a dirty lemon color. Genitals are heavily pigmented; darker pigmentation on the under side of the penis. Skin over the abdomen and flexor surfaces darker than elsewhere. No hypostasis.

Inner surface of the skull-cap much eroded and roughened. Dura adherent over convexity, and thicker than normal. With the exception of extreme anæmia, brain and spinal cord are otherwise negative.

Diaphragm at sixth intercostal space on the right; sixth rib on the left. Position of thoracic organs negative. Examination of the mediastinum negative. No remains of the thymus. No fluid in the left pleural cavity; small amount in the right. Left pleura covered with small, delicate adhesions; right pleura smooth and shining. Pericardial sac distended. Pericardium negative. Subepicardial fat in excess.

Heart weighs 322 grammes; somewhat smaller than cadaver's right fist. Cavities contain pale, watery blood. Heart muscle very pale, brownish-yellow, very soft, tears very easily. Thickness of the left ventricular wall, 10 to 12 mm.; of right, 2 to 3 mm. of muscle, and 1 to 2 mm. of fat. Slight thickening of the proximal surfaces of the flaps; otherwise valves and orifices are normal.

The left lung weighs 490 grammes. It is adherent throughout by delicate, easily torn adhesions. Voluminous. On section, extremely pale. Slight hypostasis in the posterior portion of the lower lobe. On pressure, yields an abundant foamy exudate. Very slight anthracosis. Right lung weighs 360 grammes; entirely free; otherwise similar to the left lung. Mucosa of the bronchi extremely pale; they contain grayish, foamy fluid. Pulmonary vessels and bronchial glands negative. Mucosa of the œsophagus very pale. Thoracic duct and great vessels of the thorax negative. In the posterior mediastinum three small, deep-red glands were found (hæmolymph glands?).

Mucous membrane of the upper respiratory tract very pale. Teeth very poor. Thyroid very small; weighs 20 grammes. Two parathyroids on the left side, one larger one on the right side; all three very brown. In the deep cervical region about thirty small glands, the size of a pea or larger, red to deep bluish-red in color, were found (supposed hæmolymph glands).

Peritoneal cavity contains 1 litre of clear fluid (undertaker's injection). Liver two finger breadths below the edge of the ribs, in the right nipple line. Colon is distended; lies below the level of the umbilicus. Position of the abdominal organs otherwise negative. Omentum very rich in pale lemon-colored fat.

The spleen weighs 126 grammes and measures 11.5 x 7 x 3 cm. Rather flat; kidney-shaped. The poles curve anteriorly much more than normally. On the anterior edge are several deep notches; one very deep one near the upper pole. Capsule is thickened, and near the upper pole is covered with fine, stringy adhesions. On section, the pulp is a light brownish-red color; consistency firm; stroma relatively increased; follicles decreased in number and size. Very pale, watery blood in the larger vessels.

The left kidney weighs 140 grammes and measures 10.5 x 5 x 3 cm. The fatty capsule is moderately rich in pale yellow fat. The fibrous capsule strips off easily. Surface very pale; venæ stellatæ barely visible. On section the surface is very pale, moist, and shining. Pelvic fat increased. The right kidney weighs 156 grammes and measures 10 x 4 x 2.5 cm.; in all respects similar to the left. Both adrenals negative. Ureters and bladder negative.

The stomach is moderately distended; strong odor of H_2S on opening. Contains a small amount of bile-stained fluid. Walls very thin; mucosa very atrophic, covered with bile-stained mucus. Punctiform hemorrhages scattered throughout the mucosa. Mucosa of the duodenum very pale. About the middle of the ileum there is a small, superficial ulcer, apparently almost healed. Appendix negative. Large intestine contains pale formed feces. Mucosa very pale.

The liver weighs 1736 grammes; greatest dimensions, 34 x 18 x 7.5 cm. Capsule slightly thickened about the ligament. On section, very anæmic; light chocolate color; lobules distinctly outlined; central portion of lobules paler than peripheral, and slightly elevated; has "cooked" appearance. Gall-bladder adherent to the duodenum and pylorus by easily torn adhesions; distended with dark brownish bile. Bile passages patent. Portal vein negative.

Pancreas negative. Near its tail is a small body the size of a pea, pale brown in color, resembling the spleen.

The mesenteric glands are not enlarged; appear normal.

About fifty small glands, the largest the size of a bean, all red or bluish-red in color, taken from the retroperitoneal region.

Penis and scrotum deeply pigmented; testicles very small and soft; otherwise examination of the genitals negative.

The peripheral lymph glands are not enlarged and present no unusual appearance. Fatty marrow of the long bones contains lymphoid areas. Marked osteoporosis.

Microscopic. Heart. Atrophy and fatty degeneration.

Lungs. Œdema and a number of old, hemorrhagic infarcts.

Spleen. Atrophy, fibroid hyperplasia, chronic congestion, hyaline change in the walls of vessels, very slight hæmosiderosis.

Kidneys. Marked hæmosiderosis of the cells of the convoluted tubules.

Stomach. Atrophic catarrhal gastritis.

Pancreas. Slight atrophy.

Liver. Atrophy and fatty degeneration, the latter process being most marked in the central portion of the lobules. Marked hæmosiderosis of the peripheral zone of the lobules.

Marrow. Fatty marrow from the tibia contains a few points of red marrow.

Red Marrow. Megaloblastic in character.

Lymph Glands. No change in the ordinary lymphatic glands; one gland from the cervical region showed an apparent great increase in the number of bloodvessels, the walls of these being greatly thickened.

Hæmolymph Glands. See below.

Pathological Diagnosis. Pernicious anæmia; hæmosiderosis of the liver and kidneys; marked hæmolysis in the hæmolymph glands; chronic catarrhal gastritis; fatty degeneration of the heart; megaloblastic red marrow.

CASE VI.—R. C. J., aged thirty-one years, American, army service, was admitted to the medical clinic April 19, 1901. Comes to the hospital for chronic diarrhœa and general weakness. Family history negative; previous history good. Present trouble began March, 1899, while with the United States army in the Philippines. Had what was called dysentery; eight to fifteen bloody stools a day; usually in the morning he would pass about a teacupful of slime and blood, with a little fecal matter. This attack lasted a month. Since that time he has had diarrhœa and vomiting; has no pain at stool. Has lost fifty-five pounds. Has irregular fever. At times he is so weak that he is obliged to go to bed. Fainted while going from waiting-room to ward.

Physical Examination. Greatly emaciated; musculature very small and soft. Panniculus very thin. Skin pale sallow, with yellowish tinge. No pigmentation. Nails and mucous membranes very pale. No œdema; no enlarged glands. Examination of the lungs negative. No apex-beat. Heart dulness not enlarged; sounds weak; no murmurs. Pulse regular, small, low tension. Liver and spleen not enlarged, not palpable. Marked succussion in the region of the umbilicus.

Blood Examination. Red cells, 1,200,000; leucocytes, 5700; hæmoglobin, 25 per cent.

Patient improved for a few days after entrance, but complained of night-sweats and sore mouth. No protozoa, worms, or eggs found in the stools. On May 13th he complained of great pain from hemorrhoids. Referred on May 19th to surgical clinic for operation. Blood examination before operation, May 20th: red cells, 850,000; leucocytes, 5602; hæmoglobin, 30 per cent.; specific gravity, 1040.

On June 1st a small fistula developed near the anus, and a hard swelling appeared near this somewhat later. The patient gradually became weaker and more emaciated; pulse small and weak. Mind became clouded. On July 6th he became unconscious at 9 A.M., remaining so until death, at 12.45 noon.

Clinical Diagnosis. Pernicious anæmia; chronic dysentery; ischiorectal abscess.

Autopsy by Dr. Warthin, 2 P.M., July 6, 1901.

Autopsy Protocol. Cadaver 157 cm. long. Frame small; much emaciated. Muscles small; on section, brown in color, tear easily. Rigor mortis present only in the muscles of the jaw. Panniculus almost absent; on section, orange-yellow. Skin very pale, with light lemon tint; no hemorrhages. Sclerotics slightly yellowish. Slight œdema at the ankles. Very slight hypostasis over the back. No pigmentation. Brain and spinal cord not examined (no permission).

Diaphragm, fifth rib on the right, fifth interspace on the left. Position of the thoracic organs normal. Mediastinal fat in small amount; no remains of the thymus. No fluid in the pleural cavity; no pleural adhesions.

Pericardial sac contains 20 c.c. of slightly cloudy, yellowish fluid. Pericardium normal. Heart weighs 256 grammes; rather small. Epicardium somewhat opaque; subepicardial fat small in amount, fat tissue semifluid. Heart muscle reddish-brown; tears easily. Left ventricular wall, 15 mm. thick; right, 2 to 5 mm. Chordæ tendineæ somewhat shortened. Endocardium of the left auricle thickened. Mitral orifice somewhat thickened; otherwise valves are negative. Foramen ovale is closed, but in the auricular septum there are several small, communicating openings covered by a thin membrane on the right side.

Both lungs voluminous; moderate anthracosis; upper lobes pale, lower ones dark red; on pressure yield abundant foamy exudate. In the right lower lobe a small mass of calcification. Pleura entirely free; slightly thickened over the upper right lobe. Pulmonary vessels, bronchi, and bronchial glands negative. Small patches of sclerosis in the aorta. Thoracic ducts negative. Upper respiratory tract negative except for paleness of mucosa. Thyroids moderately enlarged; parathyroids small, brown. Cervical hæmolymph glands enlarged, brownish-red in color.

About 90 c.c. of fluid in the peritoneal cavity. Peritoneum negative. Omentum poor in fat, rolled up; fat of a clear, hyaline appearance. Position of the abdominal organs normal.

Spleen weighs 96 grammes; small, triangular in shape. Small notch at the lower portion of the anterior margin. Capsule thickened and wrinkled. Small white, pearly nodules scattered over the surface.

On section, stroma increased; follicles few, consistency soft, color brownish-red.

Adrenals negative, save for beginning post-mortem change.

Left kidney weighs 184 grammes; right, 176 grammes. Fatty capsule of both poor in fat. Fœtal lobulation of kidneys preserved to a slight extent. Color deep brownish-red. A number of small hyaline nodules, the size of a pin-head, found in the cortex of both kidneys; some of these have yellow centres. Ureters negative. Bladder greatly distended, filled with clear, yellow urine.

Stomach contains about 100 c.c. of greenish-yellow fluid containing milk curds and a large amount of mucus. Mucosa pale, thickened, especially toward the pylorus. In the fundus are two large ulcers in process of healing, and one completely healed. Mucosa covered with grayish mucus.

Intestines filled with soft, yellowish, unformed feces. Mucosa very pale; small, punctiform hemorrhages in the lower part of the small intestine. No ulcers. Colon filled with light yellow, unformed feces. Mucosa pale, containing small punctiform hemorrhages. No ulceration; no parasites.

Liver weighs 1136 grammes; small, rather round in shape, light chocolate color. Beneath the capsule a number of small cysts, the size of a pin-head to a small pea. Wall of cyst thick and hyaline. No pus, no parasites found in the cysts. On section, liver is anæmic, yellowish-brown; consistence firm, lobules fairly distinct. Gall-bladder, bile passages, and portal vein negative.

Pancreas firm, light brown in color. Near the head there is a small reddish body, the size of a pea. Several large Pacinian corpuscles near the pancreas.

Mesentery poor in fat. Glands greatly enlarged, not pigmented. On section, many are reddish or pink.

Retroperitoneal glands enlarged; the hæmolymph glands much enlarged and of a chocolate-brown color.

Genitals small, otherwise negative. Tissues about the rectum thickened and infiltrated. Rectal fistula opening through the perineum, near the anus, filled with gauze; purulent discharge. No tubercle bacilli in the pus.

Red marrow hyperplastic; no changes in the fatty marrow or the long bones of the lower extremities. Peripheral lymph glands not enlarged.

Microscopic. Heart. Brown atrophy and fatty degeneration.

Lungs. Atrophy, œdema, healed tubercles.

Spleen. Marked atrophy; no hæmosiderosis.

Kidneys. Atrophy; connective tissue increased; slight hæmosiderosis of convoluted tubules; small hyaline scars (tubercles?).

Stomach. Chronic gastritis, with hyperplasia; healing ulcers.

Intestines. Chronic enteritis.

Liver. Atrophy; hæmosiderosis of the peripheral zone of lobule; small degeneration cysts (?).

Pancreas. Fatty infiltration, slight hæmosiderosis.

Bone Marrow. Megaloblastic; no lymphoid areas in the fatty marrow.

Hæmolymph Glands. See below.

Pathological Diagnosis. Pernicious anæmia; chronic enteritis; healing gastric ulcer; rectal fistula; hæmosiderosis of the liver, kidneys, etc.; general atrophy; fatty degeneration of the heart.

CASE VII.[1]—J. L., aged sixty-one years, German, farmer by occupation, was admitted to the medical clinic December 5, 1901. Patient came to the hospital because of "gas on the stomach," vomiting at times; heavy pain in the stomach after eating; loss of weight and strength. Family history negative. Had good health up to the age of fifty years, at that time had a severe attack of "dysentery," lasting several weeks. After this his stomach began to trouble him; pain and shortness of breath until relieved by eructations of gas. Starchy foods gave the most trouble. Had a sour vomitus which "bit" his mouth. This condition lasted until one year ago, when he began to lose his appetite and strength. At times when he is feeling worse his skin becomes quite yellow. His mind has been much disturbed; has had persecution delusions, and at one time attempted to murder his family. Has had lumbago and slight attacks of "rheumatism." Bowels regular for the greater part of the time, but has attacks of diarrhœa lasting several days.

Physical Examination. Patient looks very ill; markedly cachectic; expression weary and drawn; active dorsal position. Height five feet nine inches. Present weight, 114 pounds; ten years ago weighed 156 pounds, one year ago 130 pounds. Limps in walking; has a slight lateral curvature, causing prominence of the left side and scapula. Musculature small and flabby. Panniculus absent. Skin loose, inelastic, dry, extremely sallow, with yellow tint. Scleræ white. Mucous membranes rather pale. Tongue small, smooth, without coat; papillæ very short. Teeth rotten; only a few snags in the mouth.

[1] Cases VII. and VIII. have been added since the meeting of the Association.

Slight soreness of the gums. No œdema at the ankles. Examination of the joints negative. Jugulars very prominent.

Lung boundaries, sixth rib on the right, sixth intercostal space on the left. Hyperresonance all over. Auscultation negative.

Percussion of the heart negative. Low-pitched, rather harsh, systolic murmur at the apex, scarcely heard in the left axilla. Second sound at the apex not made out. Pulmonary second not accentuated; aortic second negative. Radial artery shows diffuse hardening. Pulse, 52 to 54; regular, moderately strong.

Edge of ribs touches the iliac crest. Thorax appears pressed in at the sides. Double inguinal hernia, most marked on the left. Abdomen below the level of the ribs, slightly fuller below the umbilicus. Pubes very prominent. Abdominal walls very thin and lax. Liver dulness extends to the margin of the ribs; liver not distinctly palpable. Splenic dulness not enlarged; organ not palpable. Distention of the stomach not satisfactory. Digital examination of the rectum showed internal piles; prostate not enlarged.

Blood Examination, November 9th. Red cells, 1,626,400; leucocytes, 4838; hæmoglobin, 40 per cent. Differential count of 242 cells: lymphocytes, 14.5 per cent.; mononuclears, 8 per cent.; polynuclears, 54 per cent.; eosinophiles, 1 per cent.; degenerating, 22 per cent.; megaloblasts, 0.5 per cent. Poikilocytosis very marked; many megalocytes—about 33.3 per cent.

Examination of the stomach washing after a test-meal showed a moderate amount of mucus, a small amount of pus, no free or combined HCl, no starch digestion, positive lactic acid test. Urine contained numerous cylindroids and a few hyaline casts.

Patient's condition remained about the same for some time. On February 27, 1902, he was referred to the surgical clinic for operation for piles. On March 10th the lower extremities became œdematous. The last blood examination, made on March 25th, showed marked improvement; both hæmoglobin and the number of red cells increased. After this time he began to fail rapidly. Cystitis followed the operation for hemorrhoids. Condition of the mind worse; attempts starvation. Discharged April 24th. After leaving the hospital grew worse rapidly. Complete loss of mental powers. Skin very yellow at times, with small, scattered hemorrhages over the trunk and abdomen. Died May 17, 1902.

Autopsy at patient's home by Dr. Warthin, May 18th.

Autopsy Protocol. Body of medium build; slight posterior and lateral curvatures; lower edge of ribs touches the iliac crest; left side very prominent; musculature very small; great emaciation. No panniculus. Lower extremities œdematous. Skin dark sallow, with decidedly yellow tinge; dry and rough. Numerous punctiform hemorrhages over the trunk and thighs. Pigmented patches over the face and arms. Teeth absent; gums ulcerated. Rigor mortis present throughout. Abdomen scaphoid; much below the level of the ribs. On section, the muscles are deep brown in color and very dry. Fat tissue deep orange yellow.

Heart small, very soft, and flabby. Few small punctiform hemorrhages in the pericardium. Large tendinous spots on the anterior and posterior surfaces. Subepicardial fat greatly increased; light orange-yellow, near the apex showing serous atrophy. Large ante-mortem

clots in the auricles. Heart muscle pale yellowish, very soft, and easily torn. Right ventricle dilated. Slight calcification and thickening of aortic flaps; large patch of calcification in the endocardium of left ventricle; otherwise the heart is negative.

Lungs very voluminous. No fluid in the cavities. Few small adhesions. On section, very pale; slight anthracosis; much œdema. Areas of bronchopneumonia in the right lower lobe. Bronchial glands negative. No fluid in the peritoneal cavity. Large intestine moderately distended; stomach and small intestines collapsed; stomach lying almost vertically, the pylorus below the level of the umbilicus. Spleen large, extending below the edge of the ribs. Liver about a hand's breadth above the edge of the ribs, in the right nipple line. Omentum poor in fat, of a deep orange-yellow.

Spleen about four times the normal size; capsule stretched, smooth. On section, deep red in color, very soft. Trabeculæ and follicles covered up by pulp.

Adrenals slightly atrophic; otherwise negative.

Both kidneys smaller than normal. Fatty capsules well developed; fibrous capsules adherent. Cortical surfaces rough and irregular. In both kidneys numerous soft, yellowish elevations scattered over the cortical surface. Around some of these there is a reddish zone. On section, both kidneys show abscesses of varying size, extending from the pelvis to the cortex, forming the yellowish elevations seen on the latter. Kidney substance between the abscesses is pale yellow, cloudy, and softened, containing numerous hemorrhagic areas. Pelves dilated; mucosa thickened and covered with purulent exudate. In the exudate are numerous small gritty particles. Both ureters dilated; the mucosa thickened. Bladder wall greatly thickened; in the mucosa are numerous ulcers of varying size, having undermined edges and filled with pus and phosphatic sand. Prostate small. Genitals negative.

Mucosa of the small intestine atrophic, very anæmic. Large intestine filled with soft, pale yellow feces. Mucosa very pale. Internal hemorrhoids. Slight double inguinal hernia, the folds of the small intestine resting loosely in capacious shallow sacs, without adhesions.

Stomach very small; contains about 250 c.c. of thick mucus, with food remains. The shape of the organ resembles that of a long-handled gourd, the atrophic pyloric end forming the handle, the body being formed by the fundus and cardiac end. The diameter of the pyloric half of the stomach is less than that of the duodenum. The pylorus is free; admits the thumb. Mucosa of pyloric portion atrophic; no appearance of new-growth. Wall of pyloric portion thicker than that of fundus. Mucosa of the entire stomach covered with thick, grayish mucus.

Pancreas small; lobules atrophic; slight fatty infiltration.

Liver smaller than normal; rather round; left lobe atrophic. Capsule slightly thickened over the lower edge. On section, presents a nutmeg appearance, the general color being a deep reddish-brown. Bile-ducts patent. Gall-bladder small, filled with dark brownish bile.

Mesenteric glands somewhat more prominent than normally. On section, present no unusual appearance. Cervical, axillary, mediastinal, inguinal, and cubital glands not enlarged, apparently normal. At the brim of the pelvis, and extending upward along the aorta and vena cava, are about twenty enlarged and dark-red glands resembling hæmolymph

glands. The largest forms a cord 5 cm. long and 0.5 cm. in diameter. On section, these contain blood sinuses filled with blood. The other lymph glands in this region are pale or brownish, small, and on section appear atrophic. There is no hypostasis or hemorrhage in the neighborhood of these red glands, and they are found side by side with the pale glands. Around the renal vessels several similar deep-red glands the size of a coffee-bean are found. In many of the prevertebral lymphatics a pale red fluid is present; the lymphatics are greatly dilated.

The fatty marrow of the long bone of the lower extremities is deep red throughout, being apparently replaced by the lymphoid marrow.

The brain and spinal cord were not examined. (No permission. Owing to circumstances, no weights or measurements could be taken.)

Microscopic. Heart. Atrophy and fatty degeneration.

Lungs. Acute and chronic congestion, œdema, areas of bronchopneumonia.

Spleen. Atrophy, acute and chronic congestion, hyaline vessels, increase of the reticulum of pulp, great decrease of lymphocytes in pulp; the majority of the cells in the pulp are large mononuclear cells of varying size and shape. Many of these contain pigment, very little of which gives the iron reaction. They also contain red blood cells in different stages of disintegration. Larger cells containing two to three nuclei are also numerous in the reticulum and sinuses. A few large giant cells resembling those of the bone marrow also found. Many of the larger mononuclear phagocytes are colored brown or yellowish; in others the pigment is granular. Small collections of granular pigment of a brown color are found throughout the pulp. Only a small portion gives the iron reaction.

Adrenals. Negative; post-mortem change.

Kidneys. Cloudy swelling, atrophy, acute ascending pyelonephritis. Very little hæmosiderosis of the convoluted tubules.

Bladder. Chronic purulent cystitis.

Stomach. Chronic atrophic gastritis.

Intestine. Simple atrophy.

Pancreas. Atrophy, slight increase of interstitial connective tissue, moderate sclerosis of vessels.

Liver. Marked chronic congestion (nutmeg liver), lobules atrophic, marked hæmosiderosis of the peripheral portion of the lobules. In the cells of the central portion both hæmatoidin and hæmosiderin are present; many endothelial cells containing the latter are found.

Bone Marrow. Areas of lymphoid marrow in fatty degeneration; contain few nucleated red cells and few giant cells.

Lymph Glands. Atrophic; follicles of many glands contain hyaline masses; eosinophiles not increased. In the sinuses of many glands numerous red cells are found; also phagocytes containing red cells.

Hæmolymph Nodes. See below.

Pathological Diagnosis. Pernicious anæmia; hæmosiderosis of the liver; chronic cystitis; ascending pylonephritis; chronic atrophic gastritis; general atrophy and passive congestion; fatty degeneration of the heart; lymphoid marrow; hyperplasia of the hæmolymph glands.

CASE VIII.—Miss Mary McK., aged twenty-seven years, American, was admitted to the medical clinic June 7, 1902, complaining of "general weakness." Family history negative. Healthy as a child. Had

measles and whooping-cough. Three years ago had "malarial fever" while in Michigan; was ill with fever for about three weeks; no chills; never well since this attack. During the fever had pronounced epistaxis; this would occur without apparent cause. Has always had a tendency to nosebleed. Periods established at the age of twelve or thirteen years; regular; no unusual flow; continued regular up to one year ago, when they stopped entirely. Present trouble began three years ago. Became easily fatigued; at the same time she noticed that she was becoming pale. Appetite variable; sometimes has sharp pain in the stomach after eating; frequent nausea and vomiting. Vomitus always yellow, from bile; never dark. Is troubled with shortness of breath. Feet swell when she walks; last summer they were swollen all the time, the swelling extending as far as the knees. Often feels dizzy when walking. Has usually two to three loose stools daily. Since last spring has had hemorrhoids, which bleed occasionally but not profusely. Has frequent attacks of nosebleed, without apparent cause. Complains of blurring and "specks" before the eyes. Is better in winter.

Physical Examination. Patient looks very sick. Extremely pale and sallow. Very weak. Mind clear, but answers questions slowly. Voice weak. Mucous membranes very pale. Scleræ white, with a yellowish layer of fat beneath the conjunctiva. Teeth fairly good; several extracted. Height, five feet six inches; weight, 105 pounds (best weight, 140 pounds).

Auscultation and percussion of the lungs negative. Broad area of pulsation over the præcordium. Pulsation very rapid. Apex-beat best felt in the fourth intercostal space, in the nipple line. Distinct pulsation in the third intercostal space, in the nipple line, extending to the nipple. Distinct systolic thrill over the greater part of the præcordium. Dulness begins on the third rib, extends to within 1 cm. of the nipple, and extends a slight distance to the right of the sternum, in the fourth intercostal space. Loud, rather harsh, systolic murmur at apex, followed by a soft, distinct diastolic murmur, best heard inside and above the nipple, and well transmitted to the left axilla. In the fifth intercostal space, to the left of the sternum, there are loud, blowing systolic and diastolic murmurs; same in the left second interspace, much weaker in the right second interspace, but very loud in the middle of the sternum, opposite the third costal interspace. Pulse, 124; small, low tension; artery not thickened.

Abdomen, slightly below the level of the ribs, shows a prominence of the shape of the stomach just below the navel. Succussion sounds in this region. Right kidney distinctly palpable; left not satisfactorily felt. Liver dulness very broad, extending from the fifth rib to the margin of the ribs. Thin edge of the liver can be felt. Splenic dulness greatly enlarged, extending from the seventh intercostal space to the margin of the ribs and forward into Traube's space, combining with heart dulness to make this space completely dull. Spleen not satisfactorily felt.

Blood Examination. Red blood cells, 704,000; leucocytes, 2037; hæmoglobin, 13 to 15 per cent. (June 11, 1902). On the 20th the red cells were 546,000; hæmoglobin, 14 per cent. Poikilocytosis and endoglobular degeneration marked. Numerous normoblasts and megaloblasts.

Urine contained traces of albumin; no casts.

Patient rapidly grew worse, irregular fever, reaching 102° F. at times; vomiting, hemorrhage from the bowels, etc. Died June 25th, at 6.20 A.M.

Autopsy by Dr. Warthin at 7 P.M. of the same day.

Autopsy Protocol. Body slender; 157 cm. long. Thorax long and narrow below; the right side anteriorly more prominent than the left. Abdomen above the level of the ribs, the distention greatest just below the umbilicus. Musculature small; much emaciated. On section, muscles are pale and moist; do not tear easily. Fair amount of panniculus. On section, light golden-yellow, slightly moist. Trace of œdema over the ankles. Rigor mortis is present throughout. Trunk is slightly warm. Skin is very pale sallow, with slight yellowish tint. Very pale hypostasis over back. A number of bluish areas (angiectatic veins) about both ankles. Numerous small, pigmented lymphangiomata over the radial side of both forearms. No punctate hemorrhages found anywhere in the skin. Mucous membranes very pale. Teeth in good condition; upper molars absent. Slight layer of yellowish fat over sclerotics.

Brain and spinal cord not examined. (No permission.)

Diaphragm at the level of the fourth interspace, on both right and left. Mammæ negative. Apex in the left nipple line, fourth interspace. Heart extends a slight distance beyond the right sternal line. Mediastinal fat in fair amount; light yellow color. No remains of thymus. Pericardial sac lax; contains about 30 c.c. of clear fluid. Heart weighs 332 grammes; larger than cadaver's right fist. Both ventricles dilated. Small tendinous spot on the anterior wall of the right ventricle; otherwise pericardial surfaces are normal. Subepicardial fat greatly increased, completely covering the right ventricle with a thick layer. No hemorrhages beneath the pericardium. Heart contains pale, watery blood, and a very thin layer of whitish clot covers the endocardium of the right ventricle and auricle. Wall of the left ventricle measures 8 to 12 mm. Ventricular cavity greatly dilated, the muscle trabeculæ flattened. Heart muscle is a very pale yellowish-brown; cloudy, cooked appearance; is very soft and easily crushed. The columnæ carneæ show a moderate degree of "tiger heart." Right ventricle is greatly dilated; wall measures 6 to 8 mm., 3 to 5 mm. being of fat. The mitral orifice admits three fingers; valves normal. Aortic admits the thumb; semilunar valves negative. Tricuspid greatly dilated; admits the entire hand; flaps negative. Pulmonary orifice and valves negative.

Slight amount of clear fluid in both pleural cavities. Left lung weighs 54.5 grammes. Pleura entirely free; clear, moist, shining. Lung moderately voluminous; upper lobe very pale, moderate hypostasis in the lower. On section, the parenchyma yields an abundant fluid exudate on slight pressure. Slight anthracosis. No airless areas. Two small, pigmented healed tubercles beneath the pleura. Right lung weighs 52.8 grammes. Few old adhesions in the pleura. On section, similar to the left lung. Pulmonary vessels negative. The bronchi are filled with foamy fluid; mucosa very pale. Bronchial glands moderately anthracosed. Œsophagus and thoracic vessels negative. Cervical glands negative. Mouth and throat not examined. Thyroid small.

No fluid in the peritoneal cavity. Peritoneum moist, negative. Omentum rich in fat of a light yellow color. No subperitoneal hemorrhages. A number of small, pale-pink lymph glands in the omentum, near the greater curvature of the stomach. Position of the abdominal organs negative.

Spleen weighs 336 grammes and measures 15 x 9.5 x 4 cm.; enlarged. Capsule stretched; shows a number of patches of hyaline thickening over the anterior surface. No notches in either the anterior or posterior edges. Shallow furrow on the anterior surface, near the upper fourth. Consistency very firm; does not flatten. On section, very anæmic; pulp bluish-red, swollen, and granular, covering up the follicles. Pale-pink infarct near the upper pole, extending into the organ in wedge-shape. Consistency of infarct firmer than that of surrounding pulp.

Adrenals negative. Slight post-mortem change in medullary portions. Left kidney weighs 19.2 grammes; normal in size and shape. Right kidney weighs 17.6 grammes. Both kidneys present the same appearance. Fatty capsules very rich in pale yellow fat; fibrous capsules strip easily. Venæ stellatæ not shown. Consistency of kidneys very firm. Color, pale pinkish brown. Very anæmic; outlines of kidney structures not well marked. Surface very glistening, semitranslucent, suggesting amyloid change. Ureters and bladder negative.

Stomach rather large, dilated; contains about 200 c.c. of sour-smelling food-remains. Wall very thin. Mucosa white, smooth, and thin. Advanced post-mortem digestion. Duodenum contains yellowish fluid, with food-remains; sour odor. Mucosa very pale; thickened between the atrophic folds; appearance resembles the "état mammelonné." Ileum distended; contains very pale, soft fecal material. Mucosa atrophic; very pale. No enlargement of Peyer's patches or solitary follicles; no hemorrhages; no parasites. Appendix 10 cm. long, very slender; narrow lumen, containing light-colored fecal material; has large mesentery. Cæcum distended. Colon distended above the sigmoid, containing gas and soft, light-colored feces. No blood; no evidences of hemorrhage. Mucosa pale brown. Sigmoid contracted, empty. Upper portion of the rectum contains pale, putty-like feces. No signs of blood. Mucosa of the lower portion of the rectum injected. Just above the anus there is a ring of flattened hemorrhoids completely encircling the bowel. From these there is evidence of hemorrhage in the shape of fresh blood and small clots. On section, the tissue of the submucosa about the hemorrhoids is infiltrated with blood. Hemorrhage is apparently by diapedesis. Mucosa of the anus is contracted; covered with a whitish coating, as if from the action of some caustic.

Liver is enlarged, weighing 2624 grammes. Breadth, 27 cm. Right lobe measures 23 x 19 x 5 cm.; left lobe, 11 x 8 x 4 cm. Rather flattened; the sagittal diameters increased. Slight thickening of the capsule along the lower edge (slight corset liver). Anomalous furrow in the upper part of the left lobe. On section, very anæmic; central veins show only in the peripheral portions of the organ; here they are much dilated, giving a marked nutmeg appearance. Cut surface is pale yellowish-brown, the central zones of the majority of the lobules being a lighter yellow; peripheral portion browner. Slight fatty smear. Surface shows fatty shine. Gall-bladder is very small, not dilated.

Contains very thick brownish bile, with a small amount of coarse dark sand, composed of pigment; largest, the size of a mustard-seed. Bile passages patent. Pancreas very pale; shows beginning post-mortem changes. Portal vein negative.

External genitals negative. Uterus, 3.5 cm. long; breadth of fundus, 3 cm.; of cervix, 1.5 cm. Endometrium negative. Vagina very small; rugæ marked. Hymen apparently intact. Ovaries of normal size; ripe follicle on the surface of the left.

Peripheral lymph glands small and pale. Mesenteric glands not enlarged; very pale. No enlargement of the prevertebral glands; the lymph glands small and very pale; the hæmolymph glands not hyperplastic, and distinguished from the former only by their uniform pale pink color. Small amount of pale red fluid in the lymphatics.

Body contains very little blood.

Fatty marrow of the long bones completely converted into deep-red lymphoid marrow.

Microscopic. Lungs. Atrophy, acute congestion, and œdema.

Heart. Fatty degeneration, infiltration, and cloudy swelling.

Spleen. Marked congestion, atrophy of the lymphoid tissue of pulp, hyperplasia of the reticulum; blood spaces in many places appear gland like, lined by hypertrophic endothelium. Many cells along the walls of the sinuses show phagocytic action, containing red cells in various stages of disintegration, and a diffuse yellow pigment which does not give the iron reaction. No trace of iron reaction in the spleen. Follicles very atrophic, widely separated.

Adrenals. Negative.

Kidneys. Simple atrophy, great increase of interstitial connective tissue. Cells of convoluted tubules filled with coarse granules of yellowish-brown pigment, giving the iron reaction. Greater amount of hæmosiderin in the kidney than in the liver. Small nodules of calcification in the connective tissue. No amyloid.

Liver. Lobules atrophic. Marked fatty degeneration of the liver cells in the central portion of the lobules. Very little pigment in the degenerated cells, the hæmosiderin in the central portion of the lobules being almost entirely in the endothelial cells. Moderate hæmosiderosis of the liver cells of the peripheral portion. In some areas the capillaries of the central zone are greatly dilated. A few small collections of leucocytes in Glisson's capsule.

Stomach. Atrophic; shows complete post-mortem necrosis of the mucosa.

Duodenum. Chronic hyperplastic duodenitis.

Pancreas. Post-mortem change.

Lymph Glands. Atrophic; large masses of hyalin in the follicles of many of the glands. Bloodvessels dilated. Lymph sinuses dilated, containing many red blood cells; also phagocytes containing disintegrating red cells.

Hæmolymph Glands. See below.

Bone Marrow. Fatty marrow completely replaced by lymphoid marrow containing few nucleated red cells and few giant cells.

Pathological Diagnosis. Pernicious anæmia; hæmosiderosis of the liver and kidneys; fatty degeneration and dilatation of the heart; chronic duodenitis; general atrophy; lymphoid transformation of fatty marrow.

LYMPH GLANDS.—Gross Appearance.

Case.	Peripheral.	Mesenteric.	Prevertebral.	Hæmolymph.
1	Slightly enlarged; more or less brown pigmented.	Slightly enlarged; pale pink.	Enlarged; brownish-red.	Enlarged; brownish-red.
2	Not enlarged; negative.	Not enlarged; negative.	Not enlarged; pinkish or brownish.	Not increased in number; not enlarged; pink or brownish; three in omentum pink.
3	Not enlarged; negative.	Not enlarged; negative.	Greatly enlarged; red.	Enormously enlarged (lymphosarcoma?) red.
4	Negative.	Moderately enlarged; pale, homogeneous.	Greatly enlarged; brown color.	Enlarged; brownish.
5	Not enlarged; negative.	Not enlarged; negative.	Majority appear to be hæmolymph glands, red or bluish-red; largest size of bean.	Apparently greatly increased in number; red to blue-red; not enlarged; size of mustard-seed to pea.
6	Not enlarged; negative.	Enlarged; reddish or pink; not pigmented.	Enlarged; brownish.	Enlarged; chocolate-brown.
7	Not enlarged; normal.	Prominent; otherwise negative.	Atrophic; pale or brownish.	Enlarged; deep-red color; sinuses greatly distended with blood.
8	Small and pale.	Not enlarged; very pale.	Small and pale.	Not enlarged; pale pink; sinuses distended with pale blood.

Microscopical.

Case.	Peripheral.	Mesenteric.	Prevertebral.	Hæmolymph.
1	Deposit of hæmosiderin.	Congested; in many red cells and pigmented phagocytes in the lymph sinuses.	Moderate hyperplasia; hæmosiderin deposit; many congested, contain red blood cells in lymph sinuses.	Hyperplastic; sinuses dilated; increased hæmolysis; hæmosiderosis.
2	Negative.	Negative.	No hyperplasia: hæmosiderin deposit in some.	No hyperplasia, only slight increase of hæmolysis.
3	Negative.	Negative.	Extreme hyperplasia resembling sarcoma, but containing lymph sinuses filled with red blood cells.	Tumor masses of the nature of hyperplastic hæmolymph glands or hæmolymphosarcoma; marked hæmolysis; little hæmosiderin; increase of eosinophiles.
4	Negative.	Negative.	The sinuses of the majority contain phagocytes filled with pigment.	Sinuses filled with phagocytes containing red cells and pigment; increase of eosinophiles.
5	Negative.	Negative.	Apparently all hæmolymph glands; sinuses filled with blood and phagocytes.	Sinuses filled with phagocytes containing red cells and pigment; increase of eosinophiles.
6	Negative.	Lymph sinuses contain many phagocytes, disintegrating red cells, and pigment.	Majority apparently hæmolymph glands; sinuses filled with blood and phagocytes.	Sinuses filled with pigment containing phagocytes; much hæmosiderin; increase of eosinophiles.
7	Negative.	Negative.	Atrophic; hyaline masses in follicles; red cells and phagocytes in sinuses.	Atrophy of lymphoid tissue; sinuses dilated; many phagocytes; small amount of pigment.
8	Negative.	Negative.	Atrophic; lymph sinuses dilated contain red-cells and phagocytes.	Atrophic; increased hæmolysis; many phagocytes containing red cells, but little pigment; hyaline deposit; sinuses dilated.

General Summary of Cases. *Clinical.* The clinical features presented by these eight cases are very similar—progressive weakness and paleness, shortness of breath, gastric disturbances, diarrhœa, slight irregular fever, tendency to hemorrhages, low red blood cell count, relatively high hæmoglobin, presence of nucleated red cells, low leucocyte count, etc.

Pathological. In all eight cases no direct cause for the anæmia was found. The general pathological findings were the same—hæmosiderosis of the liver and kidneys, fatty degeneration and infiltration of the heart, general atrophy, passive congestion and œdema, punctiform hemorrhages, etc. In two cases no changes in the stomach were found, in four chronic atrophic gastritis was present, in one case chronic hyperplastic gastritis, and in one case simple atrophy of this organ. In three cases the fatty marrow showed no lymphoid transformation, in two cases small points of lymphoid change occurred throughout the fatty marrow, while in three cases the fatty marrow of the long bones was completely changed into lymphoid marrow.

The diagnosis of pernicious anæmia may be safely based upon the above characteristics in all of the cases with the possible exception of No. 3. Both the clinical symptoms and the pathological findings make this case unique. The marked tendency to hemorrhage, the active hæmolysis in the circulating blood as shown by the blood examinations, the sarcoma-like hyperplasia of the retroperitoneal lymph glands, make the diagnosis doubtful, and both Dr. Dock and myself have hesitated in classifying this case under any definite head. Since the hyperplastic changes in the retroperitoneal lymph glands appear to take their origin from the hæmolymph glands, I have included this case in this group, although the diagnosis of the early stage of leukæmia, lymphosarcoma, or hæmolytic poison must also be considered.

It will be seen from the above that the changes in both lymph and hæmolymph nodes vary greatly in degree. In one case only did the peripheral glands (axillary, superficial cervical, inguinal, and cubital) show any change that could be regarded as belonging essentially to pernicious anæmia. Likewise the changes in the mesenteric glands were not constant, occurring in but two cases. But in all eight cases changes were found in the prevertebral, retroperitoneal, and cervical lymph and hæmolymph glands, indicating a degree of hæmolysis greater than that found, either under normal conditions or in such diseases as chronic tuberculosis, typhoid fever, sepsis, etc., in which evidences of increased destruction of red cells are also found in these glands. These changes may be summed up as follows: Apparent increase in the number or hyperplasia of resting hæmolymph glands, dilatation of the blood sinuses, with increase of phagocytes containing disintegrating red cells and pigment; in the lymph glands, dilatation of

the lymph sinuses, presence of an inceased number of red cells in the latter, increased number of phagocytes, and congestion.

These changes differ so greatly in degree in the different cases as to suggest intermittent rather than continuous hæmolysis. In Case II. the evidences of hæmolysis were not much greater than normal; in Cases VII. and VIII. there was great increase in the number of phagocytes containing red cells, but little pigment; in Cases III., IV., V., and VI. the sinuses were filled with pigment-containing phagocytes giving but little iron reaction; while in Case I. the glands were filled with granular hæmosiderin, both free and in phagocytes. It seems reasonable to explain these various findings by the theory of intermittent or cyclical hæmolysis, death in the different cases occurring at different stages of blood destruction. This theory is borne out by the clinical history of exacerbations in the symptoms of anæmia, intoxication, etc. In three cases (I., V., and VI.) showing a more malignant and rapid termination, the patient dying during an exacerbation, the evidences of hæmolysis in the glands were more marked; in the cases dying of progressive weakness, cardiac dilatation, etc., without especial exacerbation, the findings are those of less active hæmolysis (Cases II., VII., VIII.).

There is also good reason to believe that in some cases the spleen is the most active seat of hæmolysis; in others the hæmolymph glands. This is based upon the fact that in some cases very little hæmosiderin or few phagocytes containing red cells are found in the spleen, while they are abundant in the hæmolymph glands. In other cases pigmented phagocytes are more numerous in the spleen. Either the poison causing pernicious anæmia acts differently at different times upon the hæmolytic organs, or more than one hæmolytic poison may lead to the disease by stimulation of either splenic, lymphatic, hæmolymphatic, or bone-marrow hæmolysis. In some cases splenic hæmolysis may predominate, in others hæmolymphatic. It may be possible that varieties of pernicious anæmia (splenic, hæmolymphatic, etc.) may be distinguished. At present nothing can be regarded as proved with respect to these points, inasmuch as we know nothing at all concerning the nature of the hæmolytic poison of this disease.

The human hæmolymph glands may be divided into three groups with reference to the relationship between the lymph and blood systems:

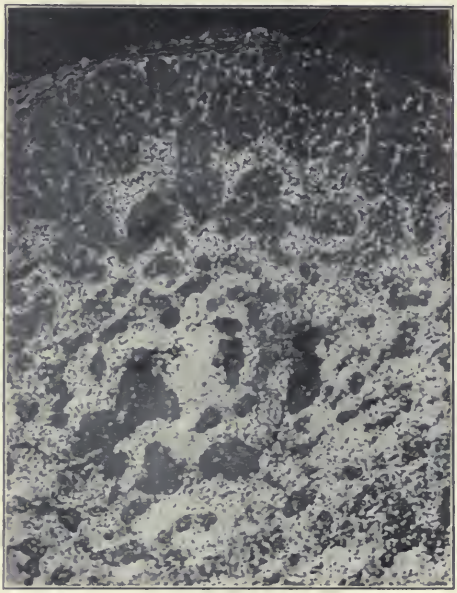
1. Glands with blood sinuses only.

2. Glands with blood sinuses communicating directly with lymph sinuses.

3. Glands with very slight capillary connection between bloodvessels and lymph sinuses.

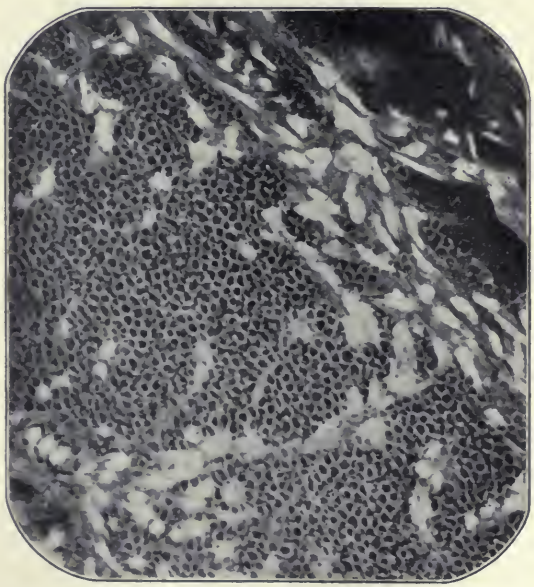
The second and third varieties are of most common occurrence in man; the first variety in the sheep, goat, and ox. Under normal conditions

FIG. 1.



Hæmolymph gland, showing dilated blood sinuses; dark areas = blood in sinuses; light areas = lymphoid tissue. × 150.

FIG. 2.



Higher power view of blood sinus from same gland as in Fig. 1, showing the sinus filled with red blood cells, and the delicate reticulum traversing the sinuses. × 750.

the amount of blood passing directly into the lymph is probably very small, and the majority of red cells are destroyed by the phagocytes in the lymph sinuses. A certain number of red cells escape these, so that the lymph from these glands always contains a certain number of red cells, this having been interpreted by some observers as proof of the formation of red cells by lymph glands. The majority of mesenteric and retroperitoneal glands probably belong to the third class.

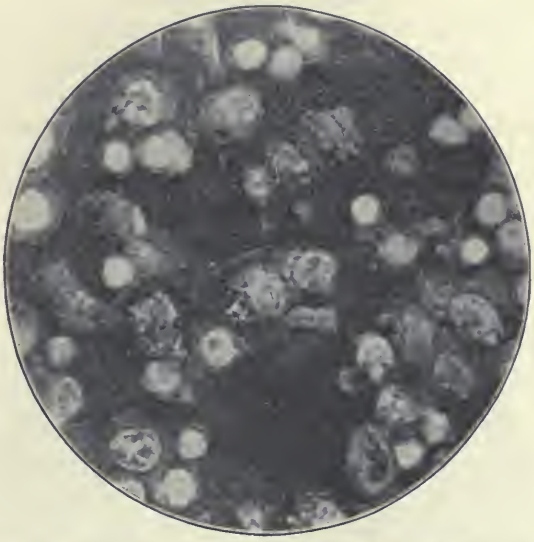
There is, therefore, always a certain amount of normal hæmolysis taking place in these glands. Under pathological conditions of congestion and inflammation the number of red cells passing into the lymph sinuses to be destroyed—in part, at least, by the phagocytes—is greatly increased, to such an extent sometimes that the lymph sinuses become filled with blood, and the glands come to resemble the hæmolymph glands of the first variety. The increased influx of blood into the sinuses leads always to an increased formation of phagocytes, these rising apparently from the endothelial cells lining the sinuses. The abnormal degree of hæmolysis thus produced occurs in the majority of infective processes, particularly in sepsis, typhoid fever, and chronic tuberculosis, and may be produced by certain poisons which cause congestion of the lymph glands. Further, lymphatic glands which are not hæmolymph glands may become so congested that diapedesis of red cells into the lymph sinuses occurs, the same phenomena of phagocytosis and hæmolysis taking place. This is particularly well seen in the regional lymphatics in the case of local infections. In infective diseases the specific poison when absorbed into the general circulation may stimulate the phagocytes of the spleen and hæmolymph glands to increased hæmolytic activity either directly or through injury of the red cells. The hæmolymphatic hæmolysis of pernicious anæmia is not specific in kind, and it is probable that other infections or intoxications may produce as severe a degree.

The hæmolysis of pernicious anæmia does not differ in kind from that occurring normally or in certain diseased conditions; the difference is one of degree only.

It is not the object of this paper to overemphasize the actual amount of hæmolysis occurring in the lymphatic and hæmolymphatic glands in pernicious anæmia; the main object is to call attention to the fact that hæmolysis may occur in this disease to a greatly increased degree in these structures as well as in the spleen. The conclusion to be gathered is that the hæmolytic poison does not confine its effects to the portal areas as claimed by Hunter, but is present in the general circulation. Further, as has been pointed out by Hunter, the hæmolysis of pernicious anæmia is a *cellular* process, and is performed by the phagocytes of the spleen, lymph glands, hæmolymph glands, and bone marrow, in response to the direct stimulus of the poison or of blood cells injured by the poison.

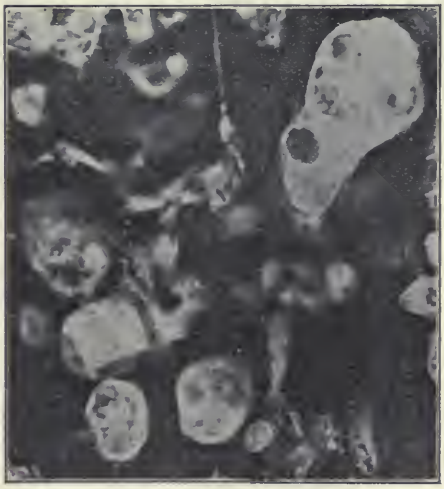
No evidences of the actual destruction of red cells are found in any organ or tissue except the spleen, lymphatic, and hæmolymphatic glands,

FIG. 3.



Large mononuclear cells containing hæmosiderin lying in meshes of the reticulum of the blood sinus. × 1000.

FIG. 4.

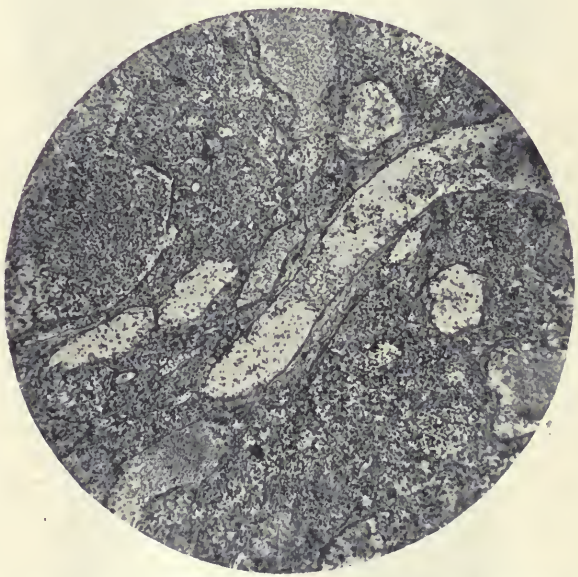


Phagocytes containing hæmosiderin from blood sinus of hæmolymph gland. × 1500.

and bone marrow. The hæmosiderin found in the liver and kidneys must exist in the circulating blood in the form of some soluble derivative of hæmoglobin which is set free at the seats of hæmolysis. This

is taken from the blood by the endothelial cells of the liver and kidney (rarely by those of other organs—pancreas, thyroid, adrenals, lymph glands, etc.) and transferred to the epithelial cells of these organs, thence to be excreted through the bile and urine. The occurrence of hæmosiderosis of the liver and kidneys in pernicious anæmia is therefore a secondary process only, and is characteristic of pernicious anæmia only in so far as the degree of hæmosiderosis is concerned. That the hæmosiderin is taken from the blood by the endothelial cells is well shown in Case VIII., in which in the majority of liver lobules the liver cells of the central portion of the lobules having disappeared,

Fig. 5.



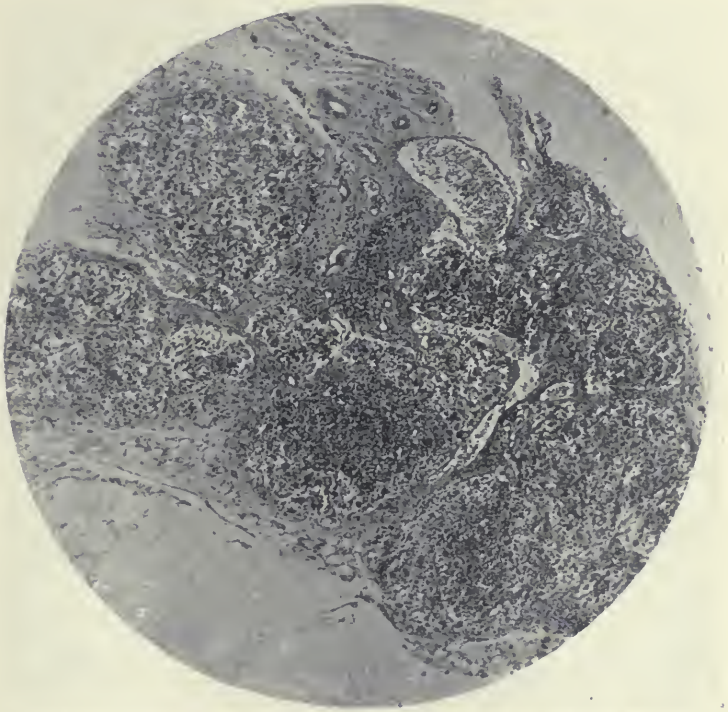
Section of tumor-like hyperplasia of retroperitoneal prevertebral glands in Case III. (angiectatic lymphosarcoma or hæmolymphosarcoma?). × 100.

as a result of chronic passive congestion, the pigment is found in the endothelium. Further, in animal experiments with toluylenediamine the hæmosiderin appeared first in the endothelium of the liver capillaries, and later in the liver cells.

In some of the cases there was an apparent increase of hæmolymph glands. At present it cannot be stated whether this is due to an actual new formation or to a hyperplasia of minute resting glands. It is more probable that the latter explanation is the correct one, the glands becoming more prominent as a result of their increased functional activity. The change in the lymphatic and hæmolymphatic glands to be regarded as many times, if not always, an important feature of the

pathology of pernicious anæmia, is *increase in the number of lymph glands showing diffuse red color, or spotting, or streaking with red.* That the changes described above occur in every case of pernicious anæmia cannot be proved by their occurrence in every one of my eight cases. The fact that such changes have been described so rarely might be explained by the rarity of changes in the peripheral and mesenteric glands, the likelihood of the retroperitoneal glands being left unexamined, the relatively insignificant character of the gross appearance,

FIG. 6.



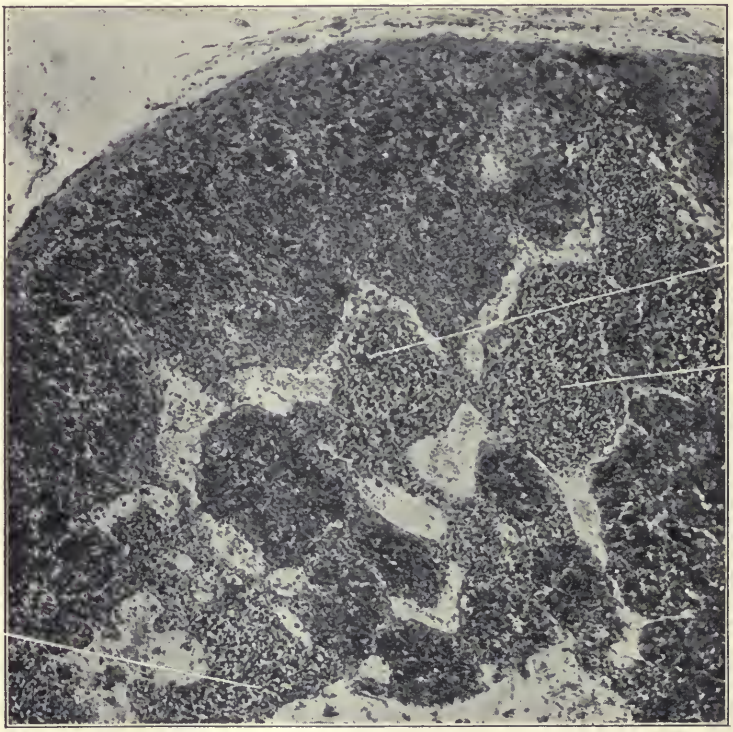
Cervical hæmolymph node from Case V. Peripheral sinuses filled with pigmented phagocytes. × 100.

and the fact that microscopic examination is necessary for the ultimate determination of the nature of the glandular changes. Increased hæmolysis may exist even in atrophic glands; hyperplasia is not an essential feature. The exact nature of the changes in the hæmolymph glands can be ascertained only by microscopic examination.

Weigert's case; the three cases, noted by Osler, of deep-red glands resembling spleen tissue; Schumann's case of enlarged and hemorrhagic glands; Müller's case of bright-red glands; the three cases of Eichhorst, I regard as resembling my cases, the red glands to be

hæmolymph glands or lymphatic glands showing increased hæmolysis. Three of my cases (V., VI., and VII.) were almost exactly like Weigert's case in the number of blood-containing glands and the large amount of blood in the lymphatics. *No evidence of red blood cell formation in the lymphatic or hæmolymphatic glands was seen in any of my cases. The presence of nucleated red cells in the sinuses is explained by their presence in the circulating blood.*

Fig. 7.



Retroperitoneal hæmolymph node from Case VII., showing great dilatation of blood sinuses. The dark areas are the blood sinuses filled with red cells and phagocytes; the light spaces are the dilated lymph sinuses containing lymph, but no blood. Example of gland with blood and lymph sinuses entirely separate. *a*, *a*, *a*. Small islands of lymphoid tissue. × 100.

Returning again to Case III., the great hyperplasia of lymphoid tissue containing blood sinuses apparently arising from the hæmolymph glands gives this case great pathological interest. The microscopic appearances suggest a direct conversion of fat tissue into lymphoid, and one is reminded of the new formation of hæmolymph glands ocurring after splenectomy, as described by Tizzoni, Winogradow, Mosler, and myself. The term "hemorrhagic telangiectatic lymphoma," as applied by Mosler to such new formations, could be used in this

instance with propriety. The designation of "hæmolymphosarcoma" or "hæmolymphoma" also appropriately applies to the histological findings. An increase of eosinophiles in the hæmolymph glands was noted in four of my cases—in three associated with the presence of much pigment, in one case with little pigment.

Experimental. Hunter having shown that toluylenediamine caused hæmolytic action of the spleen similar to that of pernicious anæmia, experiments were undertaken to show the effects of this poison upon the hæmolymph and lymphatic glands. The sheep was chosen for the purpose, inasmuch as the hæmolymph glands in this animal are very large and numerous. In two cases—one of acute and the other of chronic poisoning with toluylenediamine—the hemolymph glands showed increased hæmolysis, as shown by the increased number of pigment and cell-containing phagocytes. Extreme congestion of the lymphatic glands was also produced, leading to diapedesis of red cells and hæmolysis in the lymph sinuses. Increase of eosinophiles was also noted in some of the glands. In a third sheep, splenectomized two months previously, intense hæmolysis was shown by these glands, and hæmosiderosis of the liver resembling that in pernicious anæmia. The increased hæmolysis in this case may be explained by the compensation on the part of the hæmolymph glands for the spleen. By these experiments it may be taken as proved that toluylenediamine excites not only the cell of the spleen to phagocytic hæmolysis, but also those of the lymph and hæmolymph glands. The close similarity between the action of toluylenediamine and the poison of pernicious anæmia is thus further shown.

Conclusions. 1. Pernicious anæmia is essentially a hæmolytic disease, the hæmolysis being due to some as yet unknown poison comparable in its effects upon the blood and blood organs to the action of toluylenediamine—whether auto-intoxication or infection, remains yet to be determined.

2. The poison of pernicious anæmia stimulates the phagocytes of the spleen, lymph and hæmolymph glands, and bone marrow to increased hæmolysis (cellular hæmolysis). Either the phagocytes are directly stimulated to increased destruction of red cells, or the latter are so changed by the poison that they themselves stimulate the phagocytes. The hæmolysis of pernicious anæmia differs only in degree, not in kind, from normal hæmolysis or the pathological increase occurring in sepsis, typhoid, etc.

3. It is not improbable that from the destruction of hæmoglobin poisonous products (histon?) may be formed which have also a hæmolytic action—a vicious circle of hæmolysis may thus be produced. No proof of this exists at present.

4. The hæmolysis of pernicious anæmia is not confined to the portal

area, as according to Hunter, but in some cases at least takes place also to a large extent in the prevertebral lymph and hæmolymph nodes and bone marrow. In the majority of cases the spleen is the chief seat of the blood destruction. No evidences of hæmolysis in the liver, stomach, and intestinal capillaries were found in the eight cases. The hæmosiderin of the liver and kidneys is carried to these organs as some soluble derivative of hæmoglobin, is removed from the circulation as hæmosiderin by the endothelium, and then transferred to the liver or kidney cells. The deposit of iron in these organs is of the nature of an excretion.

5. In the majority of cases only slight reaction for iron is found at the sites of actual hæmolysis (spleen, lymph, and hæmolymph glands and bone marrow). The greater part of the pigment in the phagocytes of the spleen, lymph, and hæmolymph glands does not give an iron reaction while in a diffuse form. When changed to a granular pigment the iron reaction may usually be obtained. The change to hæmosiderin is for the greater part accomplished by the endothelium of the liver and kidneys.

6. The varying pathological conditions found in these different cases of pernicious anæmia can be explained only by a theory of cyclical or intermittent process of hæmolysis. This theory is also borne out by the exacerbations so frequently seen clinically. The autopsy findings, in so far as evidences of hæmolysis are concerned, will depend upon the relation between the time of death and the stage of the hæmolysis.

7. The changes in the hæmolymph glands found constantly in these eight cases were: dilatation of the blood sinuses and evidences of increased hæmolysis, as shown by the increased number of phagocytes containing disintegrating red cells and blood pigment. In some of the cases these changes were accompanied by great increase in size and apparent increase in number of the hæmolymph glands; in other cases there was no hyperplasia, the only evidence of the changes present being that obtained by the microscopic examination. The changes found cannot be regarded as specific of pernicious anæmia, since it is probable that they may be produced by other infections or toxic processes characterized by great hæmolysis.

8. The lymphoid and megaloblastic changes in the bone marrow do not form an essential part of the pathology of pernicious anæmia, and are to be regarded as of a compensatory nature—an increased activity of red cell formation to supply the deficiency caused by the excessive hæmolysis.

NOTE.—The full bibliography of the references in this paper is omitted, because of its great length. My thanks are due to Dr. Bond, of Richmond, Ind., for the photographs for Figs. 1, 2, 3, and 4.

REVIEWS.

A Treatise on Surgery by American Authors, for Students and Practitioners of Surgery and Medicine. Edited by Roswell Park, M.D., Professor of Surgery in the University of Buffalo, N. Y., etc. Third edition, in one royal octavo volume of 1350 pages, with 692 engravings and 64 full-page plates in colors and monochrome. New York and Philadelphia: Lea Brothers & Co.

This present edition, the third within five years, is much altered in appearance and also in the matter it contains. The form has been changed to one volume instead of two, and so much new material has been added that it appears more in the garb of a new work than as a new edition of an old and well-liked friend; and yet it has all the charm of clearness and the sequence in which the subjects are presented of the older volumes.

The publishers are to be congratulated upon the excellence of the paper, the clearness of the type, and the fineness of the illustrations, particularly the reproductions of the photomicrographs, which are exceptionally good.

The book is divided into six parts, with fifty-six chapters. Part I. deals with surgical pathology, and five of its six chapters have been written by the editor, who is peculiarly well fitted to present the latest and best theories on the subject. The pathology and examination of the blood as applied to surgery could scarcely be improved upon. Again, in Part II., which treats of surgical diseases, Park has written all the chapters but two, a guarantee of their clinical excellence and practical value. Part III. takes up the consideration of surgical principles and methods and minor procedures, including local and general anæsthesia. All of Part IV. is written by Nancrede, and treats of injury and repair. The chapter on gunshot wounds is particularly pleasing. In Part V. surgical affections of the tissues and tissue systems are considered. Perhaps the most interesting chapter here is on tumors, for Park presents the parasitic origin of malignant growths in a scientific and yet cautious manner, not forgetting to give the theories of Cohnheim their proper place and consideration. Knowing his decided views on this matter, we cannot but commend the modest way in which they are expressed, and the manner in which they are advanced. The chapter on the lymphatic system contains many new and excellent diagrams. The last part, on special and regional surgery, consists of more than half the pages of the book, and each article is written by a master of the subject. To pick out one chapter as more worthy of praise than another would simply mean that the subject chosen was more interesting to the reviewer than some other branches of surgery. For the same reason a just criticism could only be made in very minor

details, and this would scarcely be profitable when we consider how few surgeons are of one mind in minor details.

The book has been written for students, practitioners of medicine, and surgeons, and it accomplishes its purposes in a very commendable manner, for it is surely the most notable of all the single-volume surgeries. To the student it will prove of inestimable value on account of its clearness, conciseness, and logical sequence; to the practitioner of medicine it will be of great service, and for the accomplished surgeon it will have great interest and pleasure, for it will give him much food for careful thought. R. G. Le C.

The Artificial Feeding of Infants. Including a Critical Review of the Recent Literature of the Subject. By Charles F. Judson, M.D., Physician to the Medical Dispensary of the Children's Hospital; and J. Claxton Gittings, M.D., Assistant Physician to the Medical Dispensary of the Children's Hospital. Pp. 343. Philadelphia: J. B. Lippincott Co., 1902.

There is probably no department of medical knowledge in which doctors disagree so widely as in the science and art of infant feeding, and thus it is no cause for wonder that the student finds it a difficult subject to understand when every authoritative text-book presents more or less exclusively the personal views and favorite methods of its author rather than a broad, impartial discussion of the underlying principles. We know of no one book hitherto published that can be said to present the subject completely, if perhaps we except Marfan's voluminous *Traité de l'Allaitement*, which, however, barely outlines the principles of percentage feeding, but contains none of the later very important contributions of Rotch and his followers of the American school.

For these reasons the book before us is a most welcome résumé of the work of all those who have contributed in greater or less degree to the development of our present knowledge of the subject. The substance of the work, as stated in the preface, "has been gleaned from the periodical literature, monographs, and text-books of the past eight years (1894–1901), so that this treatise may justly claim to be an authoritative statement of the views of the leading pediatrists and scientists of Europe and America on the subject of artificial feeding at the present day," being presented largely as classified extracts of their writings. As might be expected in a work of this character, conflicting statements occur, but in each case these are given under the name and usually in the words of the authorities responsible for them, so that no confusion is likely to arise.

An epitome of the subjects previously discussed in abstract is given by the authors in Chapter XII.—"The Principles of Infant Feeding"—in which the methods advocated by various authorities are classified under the headings of (1) Whole Milk; (2) Moderate Dilutions (*i. e.*, High Proteids); (3) High Dilutions (*i. e.*, Low Proteids); (4) Top Milk Mixtures; (5) Whey Mixtures; and (6) Laboratory Milk. In Chapter XIII. the various methods of scientific home modification are reviewed at length, and all of the commonly employed formulæ are

explained. In Chapter XIV. the authors outline a set of practical rules for the guidance of mothers in preparing home-modifications, applicable to any method of feeding. The chapter concludes with the description of a "method for calculating milk percentages without formulæ," which is designed to appeal to the practitioner who abhors mathematics, though the method necessarily differs little from that previously in use, except that an arithmetical formula replaces the algebraical one.

The concluding chapter on Artificial Foods is rather disappointing, containing little more than a classified list of proprietary foods, according to Cantley, with short abstracts from various authorities, generally uncomplimentary to such preparations, and similar opinions on condensed milk and peptonized milk. It is to be regretted that the authors have not embraced this opportunity to discuss authoritatively the proprietary foods; for however strongly most of them may be condemned, on both theoretical and clinical grounds, as continued substitutes for fresh milk mixtures, some of them have a distinct value under certain conditions in which a fresh milk modification is not tolerated, or is, for the time, impossible. Such a discussion by writers whose experience in infant feeding has been as extensive as that of Drs. Judson and Gittings would be appreciated by physicians who are accustomed to mention proprietary foods with bated breaths, and to prescribe them with implied or expressed apology.

The volume terminates with a bibliographical list containing 261 references and an appendix giving various analyses and the usual recipes for broths and diluents.

This book must be accepted as a unique contribution to the literature of infant feeding, and will prove a valuable work of reference.

T. S. W.

Health, Speech, and Song: A Practical Guide to Voice Production. By Jutta Bell-Ranske. London: Swan, Sonnenschein & Co.; New York: E. P. Dutton & Co., 1902.

This little book, by a professional musician, possesses considerable interest and value for all students and teachers of vocal music, for whom it is intended more than for the physician. For those of the medical profession, however, who are engaged in a special study of laryngology its pages will repay perusal as an exposition of the views of an artist and teacher of high standing. The part of the book which deals with the technique of singing is accurate and interesting. Where the author trespasses upon the province of the physician, however, she lays herself open to considerable criticism, the anatomy and physiology which she presents being of the school text-book variety, and consequently presenting many remarkable statements and theories. Many of Madame Bell-Ranske's views and methods are sure to impress themselves upon the artistic public, and this little book possesses the great merit of being a frank exposition of the personal experience of one whose lifework has lain among the subjects which it considers.

F. R. P

TEXT-BOOK OF PHYSIOLOGICAL AND PATHOLOGICAL CHEMISTRY. By G. BUNGE, M.D., Professor of Physiological Chemistry at Bale. Second English edition, translated from the fourth German edition by FLORENCE A. STARLING, and edited by ERNEST H. STARLING, M.D., F.R.S., Professor of Physiology in University College, London. Philadelphia: P. Blakiston's Son & Co.

THE title of this book is a misnomer; true, it is a text-book of physiological and pathological chemistry, but it is much more beside. Whoever picks it up merely to gain information in regard to chemical data and experimental results will put it down dissatisfied. The volume is singularly free from that disconnected mass of detail that disgusts and wearies the beginner; it consists, moreover, of a series of connected lectures that in their entirety constitute a thoughtful disquisition on biological problems based on the latter-day revelations of bio-chemistry and bio-physics.

Bunge is a mathematician and a chemist by training and by education, by temperament a poet with a philosophical bent of intellect. The complex character of the man is reflected in the book he has written. His life has been spent in observation and in experiment—that is his work, and in dreams and speculation—that is his amusement; the reader of the book is invited to share in both. From the height of metaphysical speculation he carries the reader down to the prose-level of dry dissertation, from sentences weighty with philosophical meaning to flights of delicate poetic imagery.

A happy philosophy illumines the work. The phenomena of life cannot be explained by mechanical laws alone; biological problems can never be elucidated by the understanding of structure. The riddle will merely become more complex; nevertheless, we must endeavor to advance as far as possible by the help of chemistry and physics and the microscope, realizing all the while that the smallest cell exhibits all the mysteries of life, and that our present method of *its* investigation by mechanical methods have reached their limit, realizing, too, that all the laws we deduce from the phenomenal world must be ascribed to human conceit.

"We transfer to the objects of our sensory perceptions, to the organs, to the tissue elements, and to every minute cell something which we have acquired from our own consciousness." Biological problems must be approached from within—we must project the conceptions of our "inner consciousness" into the outside world, must start from what we know, the internal world, to explain what we do not know, the external world.

Bunge fully recognizes the difficulties of this physiological method of inquiry, the vagueness of our perceptions in this field, and the limits of our faculties—but his optimism rises supreme—we do not know, but coming generations will know—science has no impossible boundaries—the type will be ennobled, and "a race may dominate the globe as superior to ourselves in intellectual faculties as we are to the infusoria."

The author's chief aim is to awaken interest, to initiate the reader into the study of biological problems, and to acquaint him with the principal achievements of bio-chemical research as applied to the phenomena of normal and perverted function. This object has been attained in a masterful manner. The physician will find his medical

studies simplified by a perusal of this volume, and he will gain a more intimate and a more comprehensive insight into the revelations of the exact sciences that form the groundwork of medicine. A. C. C.

A Practical Manual of Insanity. For the Student and General Practitioner. By Daniel R. Brower, A.M., M.D., LL.D., Professor of Nervous and Mental Diseases in Rush Medical College, in Affiliation with the University of Chicago, and in the Post-Graduate Medical School, Chicago; and Henry Bannister, A.M., M.D., formerly Senior Assistant Physician, Illinois Eastern Hospital for the Insane. Octavo, 426 pages, with a large number of full-page inserts. Philadelphia and London: W. B. Saunders & Co., 1902.

The better medical schools have in recent years offered instruction in mental diseases to their students. This has led to the multiplication of text-books on insanity. The one under review is a safe guide for students. Almost every writer on insanity tries to do two impossible things—define it and invent a classification. The former cannot be done until we learn the processes of thought, nor the latter until we know the causes, not the occasions, and the morbid anatomy of mental disease. The things we call the causes of insanity are no more causes than is the lighted match the cause of the explosion of gunpowder. The real cause is inherent in the powder, the match is merely the occasion. The author's definition is no worse than those of other writers, and their classification just as good. The book is well and clearly written, and is purely clinical. There is an entire absence of metaphysics and theory. Students will find it useful. C. W. B.

Atlas and Epitome of Otology. By Gustav Brühl, M.D., of Berlin, with the collaboration of Professor Dr. A. Politzer, of Vienna. Authorized translation from the German. Edited by S. MacCuen Smith, M.D., Clinical Professor of Otology, Jefferson Medical College, Philadelphia; Otologist and Laryngologist to the Germantown Hospital, Philadelphia. With 244 colored plates on 39 lithographic plates, and 99 text illustrations. Philadelphia and London: W. B. Saunders & Co., 1902.

This little book, which is certainly the best of its kind yet published on otology, fills a useful place. It combines in a thoroughly practical manner accurate and beautiful plates and their explanatory notes, with a text unusually exhaustive for so small a volume. Many of the plates are veritable works of art, and taken as a whole they easily surpass any previous collection. The portrayal of growths and malformations of the auricle, and also of mastoid operations, is especially praiseworthy.

The text, with well-executed illustrations, is divided into four general divisions: (1) Anatomy, (2) Physiology, (3) Examination, and (4) Pathology and Treatment. The first division goes into the minute

anatomy of the ear sufficiently for the student to obtain a thorough working knowledge of the parts, the plates assisting most materially in elucidating the descriptions. The development and delicate structures of the internal ear are shown unusually well. The chapters devoted to Physiology and Examination are quite short, the latter, however, giving the modern methods of diagnosis in a very pleasing manner.

The subjects of Pathology and Treatment are, from the student's standpoint, especially well handled. The usual multitudinous and oftimes confusing references to various authorities and methods of treatment are here conspicuous by their absence. The author states clearly and concisely what a large experience has taught him, and outlines the treatments which he has found to be most efficient in his hands and in those of the best otologists of the world to-day. Mastoiditis, brain abscess, sinus thrombosis, and pyemia are well described, and the modern treatment of them given, while the accompanying plates show the pathological lesions and operative technique very clearly. Taken as a whole, the book is remarkably free from inaccuracies either of the plates or text, and well deserves a good reception. W. R.

Elements of Physical Chemistry. By Harry C. Jones, Johns Hopkins University, Baltimore, Md. New York: The Macmillan Co., 1902.

Any book from the pen of Harry C. Jones, of Johns Hopkins University is hailed by the scientific world as a welcome addition to our literature in modern chemistry.

This book of 565 pages is a particularly valuable contribution to the science of chemistry. The subject is dealt with from the physical standpoint, and the twin sciences of physics and chemistry are so closely related (often spoken of as the "twin sister sciences") that the title "Elements of Physical Chemistry" is particularly well chosen, for as modern knowledge of chemistry increases, physics and our understanding of its laws play a more and more important part in the proper understanding and interpretation of chemical phenomena.

The book is divided into ten chapters, which respectively deal with atoms and molecules, gases, liquids, solids, solutions, thermochemistry, electrochemistry, photochemistry, chemical dynamics and equilibrium, and the measurements of chemical activity. These interesting topics are dealt with in a most clear and logical manner, and the historical development of them is particularly dwelt upon.

This new science of physical chemistry has practically come into existence during the past fifteen years. But the foundations for this were laid many years ago by such men as Kopp, Bunsen, Gladstone, Regnault, and others, and this the author does not ignore, but emphasizes the great value of their work, which has been built upon so successfully by such modern workers as Lathar-Meyer, Nernst, and that most brilliant of thinkers of the present day, Van Hoff, one of the originators of the "ion" theory of solutions and of stereochemical or space relations of the atoms. E. A. C.

THE STUDY OF THE PULSE, ARTERIAL, VENOUS, AND HEPATIC, AND OF THE MOVEMENTS OF THE HEART. By JAMES MACKENZIE, M.D. (Edin.). New York: The Macmillan Co., 1902.

THIS work consists of a series of personal observations upon a large number of cases extending over many years. The conclusions, while of greater interest to the physiologist, should also prove of benefit to the practitioner. The text is profusely illustrated with original sphygmographic tracings, and is subdivided into chapters and again into numbered sub-headings, adding greatly to its value for reference. The author advances original theories which are, for the most part, logically supported by tracings from cases cited. As an instance, may be mentioned his division of irregular pulse into two groups: (A) the youthful type of irregularity, when the irregularity occurs through variation in the duration of the diastolic period of the cardiac cycle, and (B) the adult type of irregularity, when there is a variation in the duration of the systolic period as well as in the diastolic period of the cardiac cycle.

Particular attention is called to the value of venous and liver tracings, which heretofore have attracted but little attention from the diagnostician. While it is difficult in a short review to give an adequate idea of this most carefully prepared work, yet it may be said broadly that it would be a valuable addition to the library of one who would correctly interpret the various phenomena of the circulatory apparatus.

T. A. C.

PROGRESSIVE MEDICINE. VOL. II., JUNE, 1902. A Quarterly Digest of Advancement, Discoveries, and Improvements in the Medical and Surgical Sciences. Edited by HOBART AMORY HARE, M.D., Professor of Therapeutics and Materia Medica in the Jefferson Medical College of Philadelphia. Octavo, 440 pages, 28 illustrations. Philadelphia and New York: Lea Brothers & Co.

THE June issue of *Progressive Medicine* is particularly interesting. The first portion, which relates to Surgery of the Abdomen, presents abstracts of a number of instructive contributions to surgical literature with well-chosen comments upon them. The second portion deals with Gynecological literature; the third, with Diseases of the Blood and Ductless Glands, Hemorrhagic Diseases, and Metabolic Diseases, and the fourth portion with Ophthalmology.

Coley, Clark, Stengel, and Jackson are the contributors, and this fact alone would suffice to insure the value of the volume. To us this volume is one of the most interesting of the late issues of this important publication. The articles relating to the subjects under discussion have been well chosen and well abstracted. As usual the editors of the various sections have not confined themselves to merely abstracting the articles dealing with the subjects upon which they write, but they have elaborated them and illuminated the topics by their own views and observations. It is this feature of *Progressive Medicine* which pre-

eminently distinguishes it from the various year-books and compendiums of medical knowledge which pour in such a flood from the press at the present time.

The volume is copiously illustrated with handsome cuts. J. H. G.

A Reference Handbook of the Medical Sciences, Embracing the Entire Range of Scientific and Practical Medicine and Allied Science. By Various Writers. A new edition, completely revised and rewritten. Edited by Albert H. Buck, M.D. Vol. IV. New York: William Wood & Co., 1902.

The last volume of the new edition of this invaluable publication covers from Ergot to Infiltrations. Its encyclopædic character renders it difficult to write an analytical review, the immense number of articles making it impossible to review all of them. As of special importance, however, may be mentioned the article by Royal Whitman on Disabilities of the Foot and Congenital Dislocation of the Hip. The article on Fractures, by Edward L. Keyes, Jr., is exhaustive and presents the most recent views on the subject. Glanders is considered by W. T. Councilman. Goitre is ably treated of by Joseph H. Pratt. The article on Wounds of the Heart, by Dr. Roswell Park, is worthy of the high standing of its author. Several biological questions of great interest are discussed, namely, Heredity, by Adami, and Evolution, by Bigelow.

In reviews of the previous volumes of this revised edition of this encyclopædia reference has been made to the fact that all of the articles have not only been revised but practically rewritten, so that the views presented are in accord with the very latest advancement in medical science.

The present volume contains quite a number of excellent colored plates, and, like the others, it is profusely illustrated with excellent pictures. F. R. P.

Essentials of Obstetrics. By Charles Jewett, A.M., M.D., Sc.D. 12mo., pp. 386. New York and Philadelphia: Lea Brothers & Co., 1901.

This is the best epitome of obstetrics with which we are familiar. It is sufficiently illustrated to make clear its text. Its contents are well selected, and attention drawn to salient features by judicious paragraphing and heavy type. It can be recommended to students and practitioners, and to lecturers who need to review salient points of obstetrics in preparing their instruction. E. P. D.

PROGRESS

OF

MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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On Diabetogenic Leucomaines.—LÉPINE (*Berl. klin. Wochenschr.*, 1902, xxxix. 346), in a brief communication, reports certain recent observations which tend to show that the blood of normal animals contains leucomaines, which, dissolved in water and injected subcutaneously in very small quantities into guinea-pigs, result in a more or less durable glycosuria.

Lépine and Boulud have shown that if a guinea-pig of normal size receive hypodermically the alcoholic extract of 5 grammes of the blood of a normal dog which has been redissolved in water, a transient glycosuria results. The extract of the same quantity of blood, however, from a dog from which the pancreas has been removed results in a glycosuria of several days' duration. Lépine concludes: "These experiments are in favor of an idea which I expressed two years ago, namely: that the pancreas in a physiological condition acts, at least in part, by destroying toxic diabetogenic substances. The absence of function of the pancreas results in an accumulation of these substances. Such is one of the elements of certain cases of diabetes."

Cytodiagnosis of Pleural Effusions.—GULLAND (*Scottish Medical and Surgical Journal*, June, 1902, p. 490) has made a study of the type of cells present in the fluid in cases of acute serous pleurisy. He is able to confirm the findings of Widal and Ravaut in France and of Wolff in Germany.

He finds that in tuberculous serous pleurisies the lymphocyte is by far the preponderating cell, polymorphonuclears being present in very small numbers.

On the other hand, effusions due to the pneumococcus and streptococcus in the serous stage, and before the exudate has become purulent, show an entirely different picture. The effusions show at all stages a great preponderance of polymorphonuclears over lymphocytes.

In cases of hydrothorax due either to cardiac or renal disease the cells in the exudate are very few in number and are mainly endothelial cells.

Gulland does not attempt in any way to lessen the importance of bacteriological examinations in all cases of pleural effusions. He wishes to show what others have found: that a preponderance of lymphocytes in a serous exudate is almost positive proof of its tuberculous origin. This knowledge is important, because it can be obtained three to six weeks before positive or negative results can be secured from the inoculation of guinea-pigs with the exudate, and the proper climatic and hygienic treatment can be immediately instituted.

The Treatment of Exophthalmic Goitre with Antithyreoidin.—Schults (*Münchener medicinische Wochenschrift*, 1902, xlix. 834) says: Bearing in mind the probability that the symptoms of Graves' disease depend upon the excessive secretion of the thyroid gland, it occurred to Ballet and Enriquez that favorable results might be obtained by the introduction into the organism of such patients of the blood serum of animals from which the thyroid had been removed. They conceived it possible that such serum might contain an excess of poisonous substances normally neutralized by the thyroid secretion; that by the administration of such substances the harmful action or the excessive product of the thyroid gland might be neutralized. The use of the blood of patients with myxœdema was suggested by Burghardt, while Lanz suggested the use of the milk of goats upon which thyreodectomy had been performed. Moebius has used with success a preparation made by Merck, from the serum of sheep from which the thyroid had been removed. The author, shortly after Merck's remarks before the Society of Mid-German Psychiatrists and Neurologists, met with a typical case of Graves' disease with characteristic manifestations and serious mental symptoms. This patient was treated with rest and anti-thyreoidin in doses of from 0.5 to 4.5 grammes (gr. vijss–lxvij) three times a day. Forty-nine days after the beginning of treatment the patient was discharged from the hospital almost entirely well. The mental symptoms and the tremor had entirely disappeared and the goitre diminished materially in size. No unpleasant results were noticed from the treatment. In the same journal, Goebel (*Münchener medicinische Wochenschrift*, 1902, xlix. 835) reports a case in which favorable results were apparently obtained by the use of milk from a thyreoidectomized goat.

Blood Cultures in Pneumonia.—Cole (*Johns Hopkins Hospital Bulletin*, June, 1902, p. 136) made blood cultures in thirty cases chosen at random out of a total of sixty-three cases of pneumonia admitted to the medical wards of the Johns Hopkins Hospital during the session of 1901–1902. The object was to determine how frequently the blood was invaded with pneumococci during the course of the disease. The technique adopted in making blood cultures in typhoid fever was also followed here—that is, 8 to 10 cm. of blood was withdrawn and well diluted with bouillon so as to destroy the antibactericidal action of the blood serum. Several Erlenmeyer flasks containing 150 c.c. of bouillon were used in each case. Pneumococci grew from the blood in nine of the thirty cases in which cultures were made, all of

which terminated fatally. Altogether thirteen of the thirty cases died. Cole thinks that the taking of cultures is mainly of a prognostic value, the cases with pneumococcus septicæmia being much more likely to terminate fatally. Most other observers have obtained positive results in about the same percentage of cases in which cultures were made. Within the last year, however, Prochaska has published a series of fifty cases, in all of which he obtained the pneumococcus in the blood cultures. Of the fifty cases twelve died. This writer claims that there is no relationship between the number of organisms and the severity of the attack, but Cole challenges this view.

Peripheral Venous Thrombosis in Pneumonia, with Report of Three Cases and a Review of those Previously Recorded.—Steiner (*Johns Hopkins Hospital Bulletin*, June, 1902, p. 130) reports three cases of venous thrombosis occurring in a total of 500 cases of pneumonia at the Johns Hopkins Hospital. In the first case the right popliteal was involved. The patient had two attacks of pneumonia while in the hospital. The thrombosis occurred twenty-eight days after the crisis of the first attack and six days after the termination of the second attack. In the second case thrombosis of the right saphenous vein occurred on the sixth day of the disease, and death occurred on the twelfth day. The third patient had a thrombosis of the right popliteal vein, appearing six days after the temperature had returned to normal. Only one of the three cases died.

From the fact that he was able to collect only thirty-eight previously recorded cases in the literature, Steiner concludes that the condition must be rare, and remarks that this is surprising, considering the fact that the blood in pneumonia is so rich in fibrin. Thrombosis of the veins must be considered a sequel rather than a complication, as a vast majority of the cases occur after the temperature returns to normal. In all the cases the veins of the lower extremities were involved, and, as in typhoid fever and other infectious diseases, the left femoral is involved oftener than the right. Of the forty-one cases, death occurred in nine and recovery in twenty-five cases, no definite information being given in seven.

An Early Symptom of Pleurisy with Effusion.—On careful examination of the thorax in nineteen cases of pleurisy with effusion, fourteen serous, five suppurative, Przewalski (*Centralbl. f. Chirurgie*, 1902, xxix. p. 377) has observed, without exception, "a narrowing of the intercostal spaces and a more marked resistance to pressure in the spaces of the affected side." The symptom was most easily observed in children. "The drawing together of the ribs upon that side of the thorax which contains the exudation is wholly characteristic, and appears to offer a certain analogy to the muscular contractures in the extremities (attitudes fixes des membres) which is to be observed in the course of arthritides." The reason that this constant and typical symptom of pleurisy has never as yet been recognized lies in the fact, probably, that the change in position of each individual rib is so very slight. The author believes that this symptom depends upon the action of the internal intercostal muscles, and that it is probably to be regarded as a reflex contraction in the sense of Henle and Hunter.

[The observations with regard to the narrowing of the intercostal spaces is interesting. The increased resistance is familiar to most clinicians who have the good sense to use their fingers rather than a pleximeter and hammer.—W. S. T.]

Malarial Cirrhosis of the Liver of Splenic Origin; Indications for Splenectomy.—Cardarelli (*Rivista Critica di Clinica Medica*, 1902, iii. 175). As is well known, splenic tumor may be an important symptom of cirrhosis of the liver, the enlargement depending upon passive congestion resulting from portal obstruction. But the association of events may be different; the enlargement of the spleen and the cirrhosis may depend upon the contemporaneous action upon the liver and the spleen of the same morbific agent, and, indeed, in some instances the splenic affection may represent the primary process, the hepatic cirrhosis the secondary. The observations of Chauffard have proven the existence of hepatitis of splenic origin, while the course of events in Banti's disease is an excellent example of the deleterious influenceupon the liver of processes primarily manifesting themselves in the spleen.

It is easily conceivable that in the chronic splenic enlargement of malarial origin substances might arise which, passing by the natural course of the circulation to the liver, might exert a deleterious influence upon the latter organ. While the majority of instances of enlarged spleen of malarial origin yield more or less readily to antimalarial treatment, the author asserts that it is not infrequent in Italy to observe cases in which, despite all treatment, the spleen remains enlarged, and that in exactly such instances the subsequent development of an apparently secondary cirrhosis is not infrequently observed. In such cases as this Cardarelli believes that splenectomy may be of very great value. The indications for operation he states as follows:

1. When, after vigorous and protracted treatment of months' and sometimes even of years' duration, the general condition of the patient shows no improvement, his color, his weight, his strength gradually fail, the examination of the blood shows progressive diminution in the amount of hæmoglobin, while there is no leukæmia, nor are malarial parasites present in the blood.

2. When the splenic tumor has attained considerable volume so as to occupy all or a good part of the left half of the abdomen; when it presents a more or less increased consistency, or is of unequal firmness, or shows deformations upon its surface or in its border; when there are indications of perisplenitis; when there is ectopia, and when the tumor, with medicinal treatment, shows no reduction in size or a very slow and slight change.

3. When the clinician, studying diligently the condition of the patient and the possible manifestations of incipient hepatic affection, has no doubt of the harmful influence of the spleen on the liver.

The main contraindications are cachexia, a reduction in hæmoglobin to a point under 30 or 40 per cent., leukæmia or tendency toward hemorrhages. Extensive adhesions between the tumor mass and the abdominal wall would, of course, also be a contraindication. A moderate ascites and the suspicion of an incipient hepatic cirrhosis should not entirely contraindicate operation. Operation is directly indicated in cases of ectopia or twisted pedicle. Statistics of splenectomies for enlarged malarial spleens show relatively good results. The removal of the spleen itself exercises no deleterious effect upon

the organism. The author believes that chronic splenic enlargement of malarial origin is often followed by cirrhosis; that its possible dependence upon processes going on in the spleen, and the good results of the removal of the spleen in such cases, justify this operation in those instances where medical treatment is of little or no avail.

SURGERY.

UNDER THE CHARGE OF

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The Diagnosis and Operative Treatment of Prostatic Hypertrophy, with Remarks on the Complications before and after Operation.—GUITÉRAS (*Medical News*, New York, April 26, 1902) states that the principal symptoms indicating the presence of an enlarged prostate are frequency of urination, pain, and spasm, and it is for their relief that the surgeon is usually consulted.

Indications for Operation. If the kidneys be in very bad condition medically or surgically, and if they be not improved by treatment, an operation is contraindicated, as uræmia may follow, shortening life instead of prolonging it. If there be very little residual urine, and if the kidneys be in good condition, it may be well to try at first stretching the prostatic urethra, and washing out the bladder if cystitis be present; but if there be considerable obstruction, as shown by the amount of the residual urine, and if the kidneys be affected in a mild degree, it is better to perform an operation as soon as possible. It must be remembered that prostatic symptoms occur most frequently in the fall of the year, and that they may be relieved by appropriate local and general treatment.

Complications before Operation. Attacks of epididymitis, hæmaturia, and urethral fever are complications which urge a patient more than anything to resort to operative procedures. Stone in the bladder is a frequent complication of enlarged prostate, and should receive attention. If the prostate be large in a case of stone, it would perhaps be better to do a suprapubic lithotomy and a prostatectomy. If a Bottini prostatotomy be contemplated it may be better, however, to perform this operation first, and to take advantage of the increased size of the urethra thus secured for the manipulation of litholapaxy. One must not forget that stone in the bladder is a more frequent complication of enlarged prostate than it is thought to be, and that the reason why we do not find it oftener is because we do not like to introduce solid instruments into the bladder, fearing to wound the pros-

tatic urethra. Very often, in old men with slightly enlarged prostates, it is the stone, and not the prostate, that is the cause of the trouble.

If there be a stricture complicating hypertrophied prostate, the operation can be made to include both conditions at the same time. It is extremely rare, however, to find strictures in men of the prostatic age, and almost all cases of so-called stricture in old men are cases of prostatic impediment in the posterior urethra.

In regard to the condition of the kidney and bladder, it may be said that the bladder is the least important, because it makes no difference how badly involved it may be, it will be benefited by the use of internal antiseptics and by irrigations through the catheter. An involved bladder does not count so much against the operation as does kidney involvement. It is surprising to see how often the bladder can empty itself almost entirely after a prostate operation, even if it has been previously considered atonic and years have been passed in catheter life. Diseased kidneys, however, whether medically or surgically involved, are always contraindications to surgical interference upon the prostate, as in such cases a renal congestion, followed by uræmia and death, may take place. If, then, the kidneys be diseased and an operation be demanded, a prostatotomy should be performed as the operation of choice, inasmuch as statistics show that the danger from this operation is very much less than from prostatectomy.

Valvular disease of the heart and fatty heart are indications against operations on the prostate if the heart action be poor. In the first class of cases the operation may be borne if there be sufficient compensatory hypertrophy of the heart muscle; in the second class it is always exceedingly dangerous.

Choice of Operation. The indications which would determine a choice between prostatectomy and prostatotomy (Bottini's operation) are the age of the patient, the size of the gland, and the condition of the bladder and kidneys. It may be said in general that cases in which there are slightly diseased kidneys and prostates that do not feel large on rectal examination, although they cause considerable urethral impediment, are cases for prostatotomy. On the other hand, middle-aged men with large prostates, as felt through the rectum, with good kidneys and sound bladders, are subjects for prostatectomy.

Age is an important consideration, for the older the patient the more liable he is to die from shock and asthenia; therefore, in a very old man, if the prostate be of the right variety, a Bottini operation should be performed. Cases of men over ninety years of age have been reported as successfully operated upon by this method. Old age is, however, not an absolute contraindication to prostatectomy, as men over seventy-five years old, having good kidneys, non-infected urine, but very large prostates, have successfully undergone this operation.

Regarding the size and shape of the prostate as influencing the choice of operation, it may be said that cases in which the prostate feels very large by rectum are suitable for enucleation, while cases in which the prostate does not feel considerably enlarged on rectal touch, but which offer a distinct impediment to the introduction of instruments into the prostatic urethra, and in which there is consequently a considerable amount of residual urine,

are best suited for prostatotomy. In this class of cases are those that present the so-called "prostatic bar" which is so often spoken of in connection with the subject of prostatic hypertrophy.

Preparation of the Patient for Operation. If the kidneys and bladder be in good condition, and there is not much residual urine, but little time is required to prepare the patient for operation. If the patient have acute retention of urine he should be handled with great care, and no more than sixteen ounces of urine should be drawn off at the first catheterization. After a lapse of four or five hours twelve more ounces should be drawn off, and then finally eight ounces should be drawn off every two hours until the bladder is empty. In all cases of retention the catheter should be introduced as often as indicated by the amount of urine passed and the frequency of the desire to urinate. In cases of acute retention after the bladder has been emptied the catheter should be used at first once every four hours; then, after the bladder is more tolerant, every five hours; later every six hours. If cystitis be present the bladder should be washed out twice a day with boric-acid solution, and once every day with a solution of silver nitrate 1 part in 4000. In addition some urinary antiseptic should be given. Under such treatment the amount of residual urine will begin to decrease, and more urine will be passed spontaneously. The catheter may then be used with diminishing frequency. It may be said, as a rule, that no patient with a marked degree of retention should be operated upon until he has been broken into "catheter life."

If the kidneys be affected with nephritis they must be brought into as good a condition as possible by appropriate medical treatment. If the kidneys be surgically involved, as, for example, in pyelonephritis, they may be kept flushed out with large quantities of water, and the diuretics mentioned, as well as such urinary antiseptics as urotropin, salol, sodium benzoate, and others will find a place in the treatment of such cases. The bowels should be moved and the rectum and bladder well washed out just before the operation is commenced. It is unnecessary to consider in detail the technique, possible complications during and after the Bottini operation, as they are now very well known. The results of this operation are most favorable, as a recent summary of the literature gives the statistics of 753 cases. In 622 of these the operation was successful, and only 44 deaths, or 5.8 per cent., are recorded. The technique and the complications of prostatectomy are also well known and require no detailed mention, but it is of interest to consider the results of this operation and to compare them with the Bottini method.

In the literature of the last few years there have been reported 152 cases of prostatectomy by the suprapubic, peritoneal, and the combined methods. Of these 95 were suprapubic operations, and the remainder perineal or combined. Among these cases there were 25 deaths and 127 recoveries. Of the latter class of cases 17 are spoken of as failures, 27 as successes, and the remainder as good results, improved, or recovered. It is difficult to say, therefore, what the exact results were in the cases spoken of as recoveries, excepting in the cases spoken of as failures and in those recorded as cured or successfully operated upon. Recovery, it must be remembered, may mean that the patient has either recovered from the operation or recovered his former health.

In comparing the results of these statistics on prostatectomy with those of prostatotomy, it will be noted that in prostatotomy 86 per cent. of the cases were cured, 5.8 per cent. died, and in 11 per cent. failures resulted; while in prostatectomy 78 per cent. of the cases were cured or improved, 16.5 per cent. died, and in 3 per cent. failure resulted. It will be seen, therefore, that the mortality in prostatectomy is three times greater than that of prostatotomy. In those who survive prostatectomy the failures are not as frequent as in those operated by the Bottini method. It is difficult to say, in fact, what constitutes a cure in these Bottini cases. It seems to me that if a patient can empty his bladder of all urine, excepting perhaps half an ounce of residuum, the result obtained can be said to be very satisfactory, especially if the patient be relieved of all his symptoms. Of course, the surgeon and the patient look upon the result from different view points. If the amount of residual urine be very materially decreased, and if the condition of the urine be improved, the surgeon considers the result satisfactory. On the other hand, the patient does not consider the result to be good unless the disagreeable symptoms, such as the frequency of urination, pain, tenesmus, and burning be removed. It may be said that in those who recover from prostatectomy the results are much better and more permanent than in patients successfully operated on by the Bottini method. In prostatectomy we never have to perform the operation but once, while prostatotomy may have to be repeated.

Conclusions. To sum up the clinical and statistical data obtained upon the subject of prostatic operations during the last few years, we must conclude:

1. That the general practitioner should be educated to palpate the prostate and to use the other simple means of diagnosis employed in determining the shape and size of the organ. In default of previous training in rectal palpation, he should at every opportunity familiarize himself with the feel of a normal prostate, and should thus educate his touch for prostatic diagnosis.

2. That the prostate corresponds pathologically in the male to the uterus in the female, and that its examination is just as important as uterine palpation, in which the general practitioner is, as a rule, far more expert.

3. That in prostatics the care of the bladder before operation is a prime factor. The importance of training such persons to observe the minutiæ of catheter life, of making the kidneys as active as possible, and of rendering the urine as nearly normal as possible before prostatic operations, cannot be over-estimated.

4. That every prostatic operation should be preceded by a thorough general examination, including an examination of the heart, the arteries, the urine, the bladder (for possible presence of stone or tumor) and of the urethra (for possible presence of a stricture), as well as by palpation of the kidneys.

5. That the statistics of the results of prostatic operations demonstrate that the successful cases belong most frequently to the class having a small amount of residual urine and a moderate prostatic enlargement. An early diagnosis is, therefore, of paramount importance.

6. That the choice of the operation must be based upon the lines drawn here, according to the age, the resisting power of the patient, and the size and shape of the prostate, with special reference to the seat and extent of the hypertrophy, as well as the condition of the kidneys and bladder.

7. That in the conduct of prostatotomy as well as prostatectomy, the prime object is to avoid so far as possible the occurrence of shock and to prevent the congestion of the kidneys by proper precautions during and by proper treatment after the operation.

THERAPEUTICS.

UNDER THE CHARGE OF

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The Transplantation of the Adrenals.—DR. V. SCHMIEDEN, in spite of the limitations to which investigations in this field are subject, particularly in the field of the transplantation of parenchymatous organs, has succeeded in transplanting portions of the adrenal glands of dogs to various parts of the same animal experimented on. Of great interest is the possibility of transplanting tissues in warm-blooded animals from one part of the body to another. The work of Strehl and Weiss, undertaken with reference to preventing death in animals deprived of their suprarenal capsules by means of portions of suprarenal gland transplanted to other localities, had not succeeded. These investigators sewed both organs in their entirety to the abdominal parietes, sometimes placed them free in the peritoneal cavity, in both cases without success. The same result attended the transplantation of slices of the adrenals. The author states that he has operated with various modifications upon dogs, and transplanted the adrenals as quickly as possible after extirpation. In no case was the entire gland removed, but always slices as large as one-fourth of the organ were transplanted. While small portions placed in the kidney became united to this organ without delay, and were found after six months unchanged both in their macroscopic and microscopic appearance, the author found that in the case of larger portions, particularly when placed in the peritoneal cavity, there resulted a central necrosis, although the peripheral zone remained alive. These results corresponded in every way with those obtained by von Eiselberg and Enderlen in the transplantation of pieces of the thyroid gland. The fact that certain transplanted portions of the adrenals failed to unite with the surrounding tissues, the author attributes largely to faulty technique. He proposes to repeat these experiments and also to try to graft portions of suprarenal gland from one animal to another, which he has not yet succeeded in doing.—*Archiv für die gesammte Physiologie*, 1902, vol. ix. p. 113.

The History of Uric Acid Introduced into the Organism.—DRS. F. SOETBEER and J. IBRAHIM experimented to determine whether circulating

uric acid is eliminated as such or is transformed into urea. Of eminent value in all future studies on the pathogenesis of the uric-acid diathesis and gout is the determination of the effect of the administration of uric acid either by mouth or subcutaneously. It has been generally accepted by physiological chemists that this substance, when artificially administered, disappears as such in the system and reappears in the urine under the form of urea. Some observers have found an increased output of uric acid following its introduction into the alimentary canal, attributing this either to the direct elimination of the unchanged acid, or at least to an indirect increase caused by the leucocytosis following the administration of this agent. In the case of uric acid introduced by the mouth, the experimenters found that the greater part of it is not absorbed in the alimentary canal; that its presence here causes no changes in metabolism, neither an increased nitrogen elimination nor an augmented production of uric acid. They reached the conclusion that the history of uric acid in the organism cannot be studied by watching the effects of its ingestion by the mouth, but that it is necessary to study the effects wrought by the subcutaneous administration of this agent. One of the authors was the subject of the research. After twenty-one days of careful feeding, so as to bring him into nitrogenous equilibrium, a solution containing a mixture of piperazin and uric acid was injected into the cellular tissue of the abdomen. Analysis of the urine showed on the day of the experiment a considerable increase of uric acid, the excess representing 80 per cent. of the uric acid administered. On the following day, when no uric acid was administered, the surplus of this substance in the urine continued, there being eliminated a little over 18 per cent. of the drug previously administered. The excess of uric acid on these two days represented practically all of this substance that had been injected. This was, however, not the only result, for on the three succeeding days there was a continuance of the surplus of uric acid in the urine. This latter fact showed that pathological changes occurred in the organism, which manifested themselves in causing a nitrogenous elimination amounting to 45 grains above the normal. Fever did not accompany this manifestation. The authors draw the following conclusions from their observations: (1) Circulating uric acid is eliminated as such, and not as urea; (2) it seems to act as a poison to the tissues, causing an increased production and consequent elimination of uric acid. Whether or not increased leucocytosis occurs in the course of these changes, the authors have not determined. They conclude that their researches afford a new perspective of those diseases accompanied by an increased uric-acid content of the blood, this increase causing by its toxic effects on the tissues a still greater production of uric acid, a "*circulus vitiosus*" being created. The original increase of this substance may be due to resistance to its elimination, as in nephritis or certain other unknown factors may come into play, as in gout.—*Zeitschrift für physiologische Chemie*, 1902, vol. xxxv. p. 1.

Bufonin and Bufotalin.—Dr. E. S. Faust has thoroughly studied the pharmacological action of the active ingredients of the secretion from the skin of lizards—bufonin and bufotalin. The latter closely resembles the drugs of the digitalin group, in that it increases the blood pressure, owing to

a rise of the pulse-volume and more forcible systolic contraction of the heart. The nervous apparatus of the heart is not influenced by it. After large doses cardiac paralysis with intact sensorium takes place. There is no direct action on the skeletal muscles and no local reaction on injection, as it is rapidly absorbed. Gastric disturbances are very common after both oral and hypodermic administration. The lethal dose is ½ milligramme per kilogramme. Bufonin, in the main, has the same action, but is much weaker, as less soluble; if, however, it be dissolved in dilute alcohol and injected, it may produce systolic arrest of the heart. Chemically, bufotalin differs from the drugs of the digitalis group, in that it is a weak acid.—*Archiv für experimentelle Pathologie und Pharmakologie*, 1902, vol. xlvii.

Action of Demulcents.—Dr. H. J. Tappeiner conducted a large number of experiments on animals and human beings to determine whether the group of drugs known as demulcents really possess the property of allaying irritation. A distinct diminished irritability of motor nerves by chemical salts was found in the presence of mucilaginous substances. The same can also be said of sensory nerves, since pain appeared later and was less intense than in control experiments. The mucous membranes of the eyes and of the intestines gave less evidence of inflammation when demulcents were added. On the other hand, the cathartic action of drugs is enhanced since their irritation is prolonged, owing to slowed absorption. It was also found that this absorption is less active in the stomach and the upper part of the intestines, and that this holds true for water alone. All these experiments prove that the time-honored custom of using the demulcent to allay inflammation and irritation is based upon scientific facts.—*Archives Internationales de Pharmacodynamique et de Therapie*, 1902, vol. x. p. 67.

The Bile and Saponification.—Dr. E. Pflüger discusses the conditions under which saponification occurs and the determination of the relative quantities of fatty acids and of soaps found in biliary mixtures. As ordinarily stated in the text-books, the formation of soaps in the small intestine is brought about by the union of the alkalies of the bile with the fatty acids produced by the splitting up of the fats. In a series of experiments the author has shown that bile in the presence of sodium carbonate and at the body temperature is able to bring about the solution of a considerable quantity of fatty acids. This solution cannot be accomplished without the presence of bile. His researches seemed to indicate that the solutions contained, beside soaps, considerable quantities of fatty acids in a free form. A general review of his last researches indicated that of the fatty acids dissolved in bile mixtures, only the smaller portion, at most 45 per cent., is dissolved through saponification. The author claims to have established the following conclusion, namely, that, strictly speaking, no freely dissolved fatty acids occur in bile mixtures, but that the former are present in a loosely combined state. It is remarkable, from both the physiological and the chemical standpoint, that the fatty acids form soluble acid salts, although there is present in the bile enough alkali to form neutral salts. The reason for this is the fact that the carbon dioxide contained in the sodium carbonate of the bile has a greater affinity for the sodium than have the fatty acids,

the neutral salts of which bind more readily a second molecule of fatty acid, although in a loose form. These significant facts make one understand why the transformation of the fatty acids into a soluble form requires one-half as much alkali as has been deemed necessary. The newer researches of the author show that the quantity of saponified fatty acids surpasses that of the freely dissolved fatty acids. Accordingly the provision has been made for the complete binding of all fatty acids by means of the neutral soaps, which are thus transformed into acid salts. The secret of the physiological significance of the bile in promoting the absorption of fats is to be found in the fact that the cholates dissolve the fatty acids, holding them in loose combination, and thus enable them to react with the sodium carbonate and the already formed neutral soaps. The cholates themselves undergoing no decomposition, a small portion of them have the power to bring about the transportation of a large quantity of fatty acids into neutral and acid salts. He showed by his investigations that the greatest quantity of fats that can at any time be absorbed can by means of the bile be made soluble in water. Since the action of the bile consists in the formation of neutral and acid soaps, the soluble form of the fats is the first to be taken into account from the standpoint of absorption. The latter can be accomplished without the intervention of bile; but, since the bile increases to a greater degree, the solubility of soaps, its presence in the jejunum and ileum augments the absorption of the soaps that occur there. It is probably in the epithelial cells that the soaps are retransformed into fatty acids and alkali, the former becoming neutral fat and the latter being taken up by the bloodvessels as sodium carbonate. Thus to the blood is restored the alkali that it has delivered into the intestine for the purposes of saponification. The discovery by Pawlow that the stimulation of the intestinal mucous membrane with acids causes an abundant flow of alkaline pancreatic juice furnishes a wonderful example of the self-regulating mechanism serving the needs of saponification. Moreover, fat itself is a powerful stimulus of the intestinal mucosa, whereby larger quantities of pancreatic juice, rich in steapsin, are secreted; and it is the opinion of Pawlow that fat exercises this power even in a neutral medium. This same investigator seeks the significance of this intimate relationship between acid stimulation and the pancreatic flow, in the fact that the alkali of the pancreatic juice inhibits the action of pepsin, favors the splitting action of the pancreatic enzymes, and restores the normal alkalescence of the blood. According to Pflüger, the excess of acids in the intestine produces a deficiency in the alkalies and consequently inhibits saponification, which, according to the author's law of self-regulation, excites the flow of richly alkaline pancreatic juice.—*Pflüger's Archiv für die gesammte Physiologie*, 1902, vol. xc. p. 1.

Respiratory Action of Some Drugs.—Drs. H. Hayashi and K. Muto have been studying some drugs which are known to affect the respiratory apparatus. They found that with curarine the conductivity of the peripheral ends of the motor nerves are diminished. Irritation of the nerve trunks by the secondary coil will still reach the muscle at first, but later, when the cerebral impulse is no longer active, all electricity is ineffective. With fungus poison arrest of respiration takes place owing to paralysis of

the phrenic; in large amounts an action similar to that of curarine occurs. Lastly, andromedotoxin was found to affect the motor nerves in such a way that, although they react normally to the electrical and the will impulse, they quickly are paralyzed after a short, strong irritation, but this paralysis disappears after a short rest. Respiratory disturbances are, however, due to centric causes in non-fatal doses; with fatal ones there is exhaustion of the respiratory centre.—*Archiv für experimentelle Pathologie und Pharmakologie*, 1902, vol. xlvii. p. 209.

Treatment of Sciatica.—Dr. Thiellement presents a parallel series of observations on the value of extradural injections of physiological salt solution and of cocaine in the treatment of sciatica, to the former of which the preference is given. In the injections of cocaine, anæsthesia is not produced in every case; pain usually disappears for from two to three days. The action of salt solution has given apparently similar results which were more lasting.—*Thèse de Paris*, 1001, No. 633.

GYNECOLOGY.

UNDER THE CHARGE OF

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Retroperitoneal Hæmatoma.—Waldstein (*Centralblatt für Gynäkologie*, No. 24, 1902) reports the case of a nullipara, aged twenty-seven years, who had menstruated normally since the age of fifteen. Two years before she had a blow in the abdomen, followed by faintness and anæmia, and the appearance of a tumor the size of an orange. Frequent attacks of peritonitis followed, with a gradual increase in the swelling. On admission to the hospital she presented a fluctuating tumor as large as a man's head, occupying the left side of the abdomen and filling the pelvic inlet. Tympanitic resonance was noted over the tumor. The diagnosis of ovarian cyst with twisted pedicle was made, but on opening the abdomen the enlargement was found to be retroperitoneal and to have no connection with the pelvic organs, but was recognized as an hæmatocele of perirenal origin. Drainage was established after removal of the mass and the patient made a good recovery.

Arterio-Sclerosis as a Cause of Metrorrhagia.—Grube (*Centralblatt für Gynäkologie*, No. 25, 1902) describes the microscopic appearances of two uteri removed for obstinate hemorrhage. He found an excessive development of the connective tissue in the walls of the uterus, as well as in their

immediate neighborhood, and infers that the blood escaped per rhexin. He was unable to find any evidence of rupture of capillary walls, although old and recent collections of blood were often found throughout the uterine tissue. The diagnosis of this condition can be made only by exclusion. The material removed by curettement gives no clew to it. The writer holds that vaginal hysterectomy is clearly indicated in cases which resist all milder methods of treatment, atmokausis being uncertain in its results.

Abdominal Hysterectomy for Cancer.—Döderlein (*Centralblatt für Gynäkologie*, No. 26, 1902) begins a clinical lecture on the radical operation with the statement that five years should be allowed to elapse before a case is reported as cured. He cites the statistics of the Tübingen clinic for five years, in which 141 cases of total extirpation are recorded, with a mortality of 16 per cent.; 38 per cent. remained free from recurrence, 15 per cent. after the lapse of three years.

The writer speaks highly of Wertheimer's method of radical abdominal extirpation, and reports twenty-six cases operated upon by him since January of the present year, twenty patients surviving. He regards necrosis of the ureters as a real danger when they are denuded to a considerable extent. As regards the removal of glands, he notes that this was done in eighteen cases, cancerous infiltration being certainly observed in seven. Hardness of a gland, he believes, aside from increase in size, is a reliable criterion of infection. One must always fear that impalpable foci of disease in the lymph vessels and node have been overlooked. Probably in only one-third of the cases can infected glands be recognized and removed, which are always so situated that they could not be reached per vaginam. The writer concludes that this difficult and dangerous operation offers too little prospect of a radical cure to justify resort to it simply to prolong life.

Oil Enemata.—Pusinelli (*Medizinische Wochen.*, No. 45, 1901) uses a quart of sweet oil in a three-necked flask, with one neck of which a vessel of water is connected, the pressure of which forces out the oil. The following indications for this treatment are recognized: Chronic constipation, especially when occurring in connection with membranous enteritis. In cases of neoplasm of the large intestine, especially cancer, accompanied by colicky pains and the passage of blood and mucus, oil injections give great relief where the question of operative intervention cannot be entertained. In recurrent appendicitis the writer finds this treatment excellent; also in the first stage in acute cases to relieve painful peristalsis and to clear the intestines of fecal masses. Obstinate constipation in women, accompanying enteroptosis, yields better to oil injections than to laxatives.

Treatment of Congenital Anteflexion.—Alexandroff (*Frauenarzt*, Heft 193) describes the following operation for the relief of dysmenorrhœa due to congenital anteflexion: The os externum is drawn apart with two pairs of bullet-forceps, while an incision is carried downward along the anterior vaginal wall, beginning at the portio. The cervix is dissected off as in vaginal hysterectomy as high as the os internum, is then split, and each half is sutured to the edge of the vaginal wound on either side, in such a

way that the cervical endometrium is united to the submucous muscular layer of the vagina. The flaps of mucous membrane are next allowed to slide over the sutured edges, to which they are also sewn, thus covering all raw surfaces. A strip of iodoform gauze is introduced into the canal and the vagina is tamponed. The stitches are removed on the tenth day and the patient may leave her bed two days later.

Transplantation of Ovaries.—Roxas and Lukasiewicz (*Frauenarzt*, Heft 194) found experimentally that ovaries can be transplanted from one animal to another, not only of the same, but of different species, and thus the after-effects of castration (non-oxidation of fats and hydrocarbons) can be prevented. The transplanted ovaries usually grow and retain their functions, though in some cases they atrophy within the first three months after operation, from insufficient vascular supply. The usual climacteric atrophy of the genitals and increase in adipose do not appear until later. The writer adds certain cautions with regard to technique. Strict asepsis must be maintained. The transplanted ovary must be carefully sutured to the mesovarium, as nearly as possible in its normal position, its lower half being covered with peritoneum. No stitches should be passed through ovarian tissue. Care must be taken that no pressure is made upon the ovary by neighboring organs.

Etiology of Hydrosalpinx.—Meedernoort (*Revue de Gyn. et de Chir. Abdom.*, No. 4, 1901) discusses the question whether hydrosalpinx can develop without a previous catarrhal inflammation of the tube. Since the tube normally contains a small quantity of serous fluid, which is increased during menstruation, it follows that the hyperæmia of the tubal mucosa accompanying any abnormal condition of the uterus, especially fibromata, would naturally result in profuse secretion. This may also occur at the time of the climacteric.

Besides the accumulation of serous fluid in the tube, its distal end must be occluded. This may readily follow any mild degree of inflammation in the neighborhood, or even loss of the epithelial layer in consequence of extreme hyperæmia. A case is reported which developed at the menopause; careful microscopic investigation showed no evidence of inflammatory changes.

The Glands in Cancer of the Breast.—Ozenne (*Révue prat. d'Obstétrique et de Gynécologie*, 1901, No. 11) was able to keep twenty-three cases of cancer of the breast under observation from two to five years. In eleven cases the breast alone was removed, as the glands showed no evidence of being involved. In one instance, where the patient lived for ten years after operation, an enormous enlargement of one of the retropectoral glands was not disturbed, as it was regarded as purely inflammatory—in fact, it disappeared spontaneously.

Twelve patients from whom the axillary glands were removed at the same time with the breast had a recurrence within a year after operation. The writer refrained from removing the axillary glands in nine subsequent cases, with the result that two patients are now alive four years after operation, and five lived from two to three and a half years. The writer infers that

the results after these partial operations are quite as satisfactory as after the radical ones. While the principle of complete extirpation is theoretically ideal, he does not think that the results have shown that the hopes of a permanent cure have been realized. He is even inclined to believe that the extensive removal of glands may favor the spread of the disease to distant parts of the body.

OBSTETRICS.

UNDER THE CHARGE OF

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The Treatment of Puerperal Insanity.—JONES (*British Medical Journal*, 1902, Nos. 2149 and 2150) contributes a paper upon this subject, giving the results of his experiments in the London County Asylum.

Regarding the pathology of the condition, he calls attention to the changes of a toxæmic character occurring in the maternal blood. He believes the relation of general paralysis to this form of insanity to be accidental, for the paralysis had been in existence some time when pregnancy supervened. Insanity occurring after confinement must be referred, at least to some extent, to the absorption of waste material which should otherwise be discharged through the lochia. It is uncertain and improbable that all forms of puerperal insanity are due to the presence of bacterial poison. Some of the cases had no fever, the temperature remaining normal. Where septic infection cannot be diagnosed the cause must be considered as uræmic or due to some condition of the blood.

The pathology of lactation in insanity is practically that of insanity from exhaustion. The continued loss of albumin brings about a condition in which pneumonia with gangrene of the lung or phthisis may often supervene.

In selecting treatment it must be considered whether the case is that of pregnancy, childbirth, or the puerperal state. Out of fifty-six cases in which insanity occurred during pregnancy forty-seven went to full term. One died before confinement, the cause of death being given as vomiting, and autopsy revealing the lesions of general paralysis. Jones does not advise the induction of labor for insanity occurring during pregnancy, unless acute toxæmia or persistent nausea complicates the case. Patients usually recover from this condition, and the difficulties of maintaining asepsis make the induction of labor a dangerous thing. The violent outbreaks with fits of depression and fear, culminating in suicidal attempts, require the most constant vigilance on the part of attendants. Unless the patient can surround her-

self with the essential features of hospital care in her own home she should go to a hospital or an asylum. The general treatment includes a light dietary, gentle exercise, bright surroundings, the regulation of the bowels by saline aperients, and mild hypnotics to obtain sleep.

During the puerperal period insanity occurs in its most recoverable form, and well-to-do patients in the first attack should not be sent away from home within the first six weeks of the case. A strict watch must be kept upon the patient, and constant care is required to control the emotional disturbances and the tendency to infanticide and suicide.

In cases becoming chronic and stuporous good results have been seen from the use of the electric bath. The patient must be persistently fed often with the nasal tube during every quiet interval, as the exhaustion of active delirious mania in these cases is intense. Alcoholic stimulants are absolutely necessary. In 259 cases under review there was no proof that the cause of the affection was septic or of bacterial origin.

For feeding these cases eggs, beef-tea, milk, malt liquor, malt extract, and cod-liver oil were used, and, if required, free doses of calomel, podophyllin, jalap, or croton oil. In procuring sleep, opium and morphine should be avoided, and sulphonal, paraldehyde, and chloral and bromide should be selected. During the later stages of involution, iron, strychnine, and digitalis may be required. As anæmia disappears menstruation should return, which must be considered a most favorable sign.

Before recovery is complete, relapses with a return of mental confusion are sometimes seen after apparent convalescence. Sometimes a dull, listless condition is developed, which requires a special effort to overcome. In these cases a change should be made from a hospital to the patient's home, if possible. Vaginal douches of antiseptics hasten convalescence in some cases. Occasionally dilating and curetting the uterus are necessary, while hemorrhage is an uncommon complication. In two cases antistreptococcic serum was employed without result, and thyroid extract produced in some cases physical reaction, but no influence upon the mind. The breasts require special attention to prevent the formation of abscess. The excessive use of stimulants is not to be recommended during the puerperal state, and cases are sometimes seen which apparently owe their origin to this cause.

It must be remembered that the marriage of hysterical and neurotic persons should be strongly discouraged in the avoidance of insanity. The writer concludes by expressing his firm belief that insanity is the product of two factors—stress and heredity. The strain of pregnancy in a patient disposed to mental disease gives abundant opportunity for its development.

[The writer does not call attention to one danger which the reviewer has experienced in dealing with these cases. When the necessity arises for operation upon the parturient and insane patient the uterus reacts to all forms of interference very differently from that seen in normal patients. The induction of labor is most difficult, because the womb fails to contract under stimuli usually successful. During labor insane patients often become actively maniacal, and are controlled with the greatest difficulty. They may do great and even fatal injury to the child or to themselves at this time. The strange determination to destroy the child which is seen

in many cases renders the care of these patients difficult and makes constant vigilance imperative.]

Pelvic Changes in Symphysiotomy.—In the *Journal of Obstetrics and Gynecology of the British Empire*, March, 1902, SANDSTEIN contributes a paper upon this subject. He finds that after symphysiotomy three sorts of motions occur in the pelvis. The first is the movement of the pubes outward by rotation of the innominate bones on vertical axes passed through their respective iliac joints. This he considers of little importance. The second movement consists in rotation of the innominate bones on a horizontal transverse axis passing through the sacrum, and carries the pubes downward.

Besides these two movements a third and hitherto undescribed movement occurs. This consists in rotation of the innominate bone on its own axis so as to cause the ilium to become more erect or vertical. This movement of itself would cause shortening of the interspinous and intercristal diameters were it not more than compensated by the outward movement of the bones after pubic section.

The writer considers that Walcher is correct in maintaining that the pubes move downward to a considerable extent.

Regarding the increase in the various diameters of the pelvis, the conjugata vera was increased 1.67 millimetres per cm. of pubic separation. Roughly speaking, 6 cm. of pubic separation give 1 cm. of increase in the conjugata vera. The diagonal conjugate increased nearly two millimetres and the intertrochanteric over 6 millimetres, the intercristal 2.4 millimetres, and the interspinous 5.61 millimetres per centimetre of pubic separation. The transverse diameter of the brim increases 4 millimetres and the right and left oblique diameters of the brim 3.84 and 3.9 millimetres, respectively.

By comparing the gain in various diameters it is seen that the true significance of symphysiotomy during labor lies mainly in the fact that it permits increased descent of the pubic bones. Symphysiotomy is a means of obtaining greater effects than we can by Walcher's position. By Walcher's position the pubes can be depressed not more than 5 millimetres, whereas by symphysiotomy with 6 centimetres of pubic separation the mean depression of the pubes is 8.4 millimetres.

The danger of pubic separation lies in the damage done to the vulva, to the anterior vaginal wall, the urethra, and the bladder. Pubic separation should then be limited, if possible, to a maximum of 6 centimetres. Symphysiotomy, then, must be limited to cases in which by a gain of 1 centimetre, or two-fifths of an inch, in the true conjugate, the child may safely be delivered. The true conjugate must certainly not be below 7 centimetres, and should be above this measurement. The child must be living, and Walcher's position must be used, with support to the sides of the pelvis. Care must be taken to counteract unequal movements on the two sides of the pelvis. By flexing the thigh of the non-moving side and abducting the bent-up knee that side can be made to move equally with the other side, and the rupture of the ligaments avoided or delayed. The symphysis should be severed with a broad-bladed knife, and division of the

subpubic ligament should not be aimed at. This ligament prevents the extent of the wound down into the vulva. Ossification of the pubes does not occur, and hence the operator can always cut through cartilage. In 13.3 per cent. of cases the joint was in the median line, in 66.3 per cent. on the left side, and in 20 per cent. on the right. The tubercle upon the upper surface of the pubes is the best guide. Rigid asepsis is necessary, and infected cases should not be subjected to the operation.

OTOLOGY.

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Surgical Operations on the Middle Ear having for Their Object the Improvement of Hearing.—(Three articles by G. GRADINIGO, *Arch. f. Ohrenheilkunde*, Bd. liv., lv.). In the first article the author emphasizes three points of the subject to be considered:

1. The character of the middle-ear disease for which the operation is undertaken. All operative interference is contraindicated when the internal ear is also affected, as the reaction following the middle-ear operation causes an increase in the deafness depending on the inner-ear affection. Those cases of progressive deafness which are caused by lesions affecting chiefly the incus and malleus, the inner ear being intact—*i. e.*, ankylosis of or adhesions affecting these ossicles—are best adapted to surgical interference.

2. The method of operation. The conservative operations, such as simple perforation of the drum membrane, or removal of a segment of the same, or tenotomy of the tensor tendon, give only a temporary improvement. Gradinigo advises removal of the membrana tympani, malleus, incus, and, when possible, the stapes. This constitutes the "exenteratio cavi tympani." The removal of the stapes is only in certain cases practicable, as a high situation of the oval window and the delicacy of the arms of the ossicle lead often to fracture of the latter in the extraction, and the foot-plate remains behind. The removal of the incus alone, thus destroying the continuity of the abnormally fixed chain of ossicles, also accomplishes good results.

3. The post-operative treatment is of great importance. The reaction following the extraction of the ossicles, if of a severe type, influences unfavorably the final result for the hearing. Gradinigo has found that those cases of middle-ear adhesions which follow a catarrhal process, when operated are followed by less reaction than those which are consecutive upon a suppuration. The regeneration of the cicatricial membrana tympani should be

watched with great care, and granulations on the promontory which would lead to fixation with the new-formed membrana should be carefully avoided. After the formation of a new membrana its mobility should be ensured by suitable massage.

In the second article, Gradinigo describes the method of operation used by him, as follows: 1. Three small incisions through the drum membrane are made—one through the lower end of the vertical diameter of the membrane and one at either end of the horizontal diameter, all three being at and parallel to the border of the membrane. These three are then united by a circular incision, and the incision carried from either side to within a short distance of the neck of the malleus. The incision is not carried close to the neck of the malleus in order to avoid the vessels situated there. 2. Tenotomy of tensor tympani and division of any synechiæ. 3. Incision through the incudo-stapedial joint. 4. The incision around the border of the membrana, which was arrested a short distance from the hammer-neck in order to avoid an obscuring hemorrhage, is now finished up to the neck of the malleus on either side. The hammer is now extracted with the forceps of Faraci. 5. The incus is then extracted by grasping the long process with the forceps or it is swept down by a Zegroni hook if it is in the epitympanic space. 6. If the stapes is in sight it is either removed by means of pointed forceps after tenotomy of the stapedius, or it is mobilized.

Emphasis is placed on the post-operative treatment. The prevention of suppuration is of the first importance, and as a means to this end a gauze tampon which shall remain in place if possible thirty-six to forty-eight hours is advised. Syringing of the ear is contraindicated. The gauze tampon, after remaining thirty-six to forty-eight hours at first, should be renewed twice every twenty-four hours, but the tamponade should not be used longer than one week. The functional result of the exenteration of the cavum tympani, the author points out, depends on the nature of the disease process which causes the deafness, and he differentiates four classes: 1. Otosclerosis. 2. Chronic catarrhal inflammation. 3. Result of previous suppurative disease with intact membrana where the appearances are the same as in chronic catarrhal inflammation. 4. Results of previous suppurative disease where the membrana has been left perforated or wholly destroyed.

Class 1 (otosclerosis) can be distinguished by the thin, lustrous, movable drum membrane and often history of progressive deafness in the family.

Classes 2 and 3 present objectively the same picture, viz.: a thickened, lustreless, immovable, and often retracted drum membrane, and they can be distinguished from each other only by the history of the case.

Class 4 can be distinguished by simple inspection. As regards the functional examination, the author accepts the common differential signs—*i. e.*, shortened perception of the high tones in the sclerosis class, together with loss of the low tones, whereas in the other classes (2, 3, and 4) the chief defect is in the loss of the lower tones.

In the third and concluding article the author reports at considerable length the examination and results of operation in nine cases of progressive deafness. Two of these belonged to Class 1 (sclerosis). In neither of these was the stapes extracted, but it was mobilized in one. The improvement in hearing was considerable; in one case from inability to hear numerals in

conversation tone before operation above 0.25 m. distance to 1 to 1.5 m. after the lapse of one year after the operation. In Class 2 (chronic catarrhal middle-ear inflammation) three cases are reported. The stapes was not removed in any of these. The results were favorable in two of these cases. In Class 3 (chronic catarrhal, following suppurative, otitis) two cases are reported. In one (a double-sided affection) the stapes was removed from one side, and an attempt to remove it from the other was made, but the foot-plate remained in place. Marked improvement followed the operation. The second case was unsatisfactory, owing to labyrinthine involvement. Separate cases of Class 4 are not reported, but good results are claimed.

The reports of a case of chronic catarrhal otitis where the incus alone was removed, and one where the malleus was reduced from a retracted position to the normal position after tenotomy of the tensor tendon, show considerable improvement in the first case, but none in the second.

The author concludes as follows: The best results of exenteration of the cavum tympani are found in those cases following suppurative otitis where a destruction of the drum membrane has taken place (Class 4). Good results also follow in those cases (Class 3) where the diseased condition has resulted from previous suppurative disease without persistent perforation of the membrane or typical change in the same. In the first two classes (1 and 2—sclerosis and chronic catarrhal middle-ear inflammation) the operation was more successful in the sclerosis cases than in the catarrhal.

PATHOLOGY AND BACTERIOLOGY.

UNDER THE CHARGE OF

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The Intercommunicability of Human and Bovine Tuberculosis.—RAVENEL (*Proceedings of the Pathological Society of Philadelphia*, May, 1902, vol. v., No. 7) states that the probability of the transmission of tuberculosis from diseased cattle to man is a matter of such economic importance that, in lieu of definite proof in the matter, a greater or less attempt at eradication of this menace to public health by careful inspection of cattle has been going on for some years. Most men interested in the subject were somewhat startled by the emphatic propositions enunciated by Prof. Koch at the British Congress on Tuberculosis, last July, when he stated, first, that human tuberculosis differs from bovine, and cannot be transmitted to cattle; second, that the susceptibility of man to bovine tuberculosis is of

such rare occurrence, if it exists at all, that its import may be disregarded, and it is not advisable to take measures against it.

The first proposition is subject to direct experimental proof. Koch's statement was based on results obtained from nineteen attempts to infect healthy cattle by injecting tuberculous sputum into the jugular vein, peritoneal cavity, or subcutaneous tissues. On killing the animals after from six to eight months no traces of the disease were found in the internal organs. Controls with bovine tubercle bacilli were uniformly fatal.

After a carefully detailed review of successful experiments in producing tuberculosis in animals from human sputum conducted by Chauveau, Bollinger, Klebs, Crookshank, Martin, and others, Ravenel describes his own experiments along this line, conducted at the State Live-stock Sanitary Board during the last four years. With cultures of tubercle bacilli isolated both from human sputum and from the glands of generalized tuberculosis the author has been able to produce typical generalized tuberculosis in calves. He has further shown that successive passages through calves will increase markedly the virulence of such human cultures. He concludes from his own results and from those of others that Koch's first proposition is erroneous and untenable.

In judging the second and more important proposition we are naturally deprived of the conclusiveness of experimental data. The histological differences of human and bovine tuberculosis are more apparent than real, and the latest results show us that they are in no way essential to the problem. The morphological and cultural differences of human and bovine tubercle bacilli have been carefully studied by Theobald Smith and Ravenel. Morphologically, the bovine form is shorter and more uniform in size, and culturally it grows less readily; it is decidedly more pathogenic for laboratory animals than is the human form. Whether this criterion of pathogenicity holds for man must rest on a supposition in default of more direct evidence. The publication of Koch's paper has brought out many additional cases of transmission of tuberculosis from cattle to man. In addition to cases of generalized tuberculosis on rather definite evidence, many cases of localized occurrence of tuberculous lesions, principally verrucose tuberculosis of the skin, are reported. Koch bases his theory of the non-transmissibility of bovine tuberculosis chiefly on the alleged rarity of primary intestinal tuberculosis. The clinical observations on tuberculosis in children fed with tuberculous milk are not many, and are all open to criticism. From post-mortem examination it is difficult to prove that the point of entrance is through the intestine, and, on the other hand, we are far from justified in supposing that tuberculous lesions at points distant from the intestine may not owe their origin to this portal. Statistics as to the origin of the disease vary greatly in different countries both from actual differences and from the varying point of view of the observers. On the whole, the author feels assured that the greater part of the children who die of tuberculosis are infected through their food.

The number of cattle infected varies greatly in different regions, and many animals apparently free from disease have tuberculosis, and can give tuberculous milk from an udder that is in itself normal.

Strangely enough, Koch has not considered one very important means of

infection, namely, through the tonsils, many cases of which have been observed, and experimental reproduction of which in animals has been achieved.

In conclusion, we may assume from the evidence at hand "that human and bovine tuberculosis are but slightly different manifestations of the same disease, and that they are intercommunicable. Bovine tuberculosis is, therefore, a menace to public health.

"The eradication of bovine tuberculosis is amply justifiable from a purely economical standpoint; viewed in its bearing on human health it becomes a public duty."—F. P. G.

HYGIENE AND PUBLIC HEALTH.

UNDER THE CHARGE OF

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Insects and Human Diseases.—C. von Holub (*Centralblatt für Bakteriologie*, etc., Band xxx., p. 284) makes the interesting communication that he has succeeded in infecting different species of insects with the streptobacillus of Ducrey, the cause of ulcus molle, in more than one thousand cases. Within several days after inoculation each insect became literally a package of pure culture of the organism. Every part of the organism—head, thorax, abdomen—was filled with the bacteria, and, although in the beginning there was in the pus of the ulcer a mixture of bacilli and cocci, in the insects there was nothing but pure cultures of the streptobacillus. Among the inoculated insects, those which were fed lived not longer than twenty-one days; those that were not fed lived only two weeks. Twelve hours after infection the development of the micro-organisms could already be observed.

The following proved to be susceptible to infection: Orthoptera, rhynchota, hemiptera, coleoptera, lepidoptera, diptera, and hymenoptera. Inoculation was performed by means of a very slender and sharp sterilized needle. The infected males conveyed the disease to members of the other sex, and in cages where numbers of insects were kept with only one that was inoculated all the rest became infected. Feeding with pus also caused infection.

The Significance of the Colon Bacillus in Drinking-water.—W. G. Savage (*Journal of Hygiene*, July, 1902, p. 320), in an interesting article on the significance of the colon bacillus in drinking-water, quotes Jordan as objecting to that organism as a true index of sewage contamination, since it may be found in spring-water beyond any suspicion of contamination. Savage believes that it is not so much the presence of B. coli which is of positive value as the number present; that the kind of water in which this organism is found is of great importance; that a number of bacilli per litre of water from one source may be passed as safe, or at least as not evidence of danger of contamination, while the same number would be sufficient to

condemn water from another source; and that the exact point of the water-supply from which the sample is collected is of great importance. Frequently results differing considerably are obtained with samples taken from source and tap, respectively, and with arbitrary standards the one would be condemned and the other passed. His conclusions are as follows:

1. In estimating the significance of B. coli in a sample of water, the particular kind of water must be carefully considered; also the exact part of the system from which the sample was taken.

2. The number of B. coli present is an essential factor, but arbitrary standards of the number of this organism allowable per litre are of but little value, and are fraught with considerable possibilities of error unless the particular kind of water and the local conditions are considered in every case.

3. Waters which show no B. coli in 50 c.c. are of a high degree of purity, and, therefore, the proved absence of this organism in this amount, and, still better, in larger quantities, is of great value.

4. B. coli should be absent from at least 50 c.c. of spring-water; possibly from greater amounts.

5. In upland surface waters the presence of B. coli in 40, 10, or even 2 or 1 c.c. means contamination, but not necessarily a contamination which it is essential to prevent. It may be from contamination with the excreta of animals grazing on the gathering areas, and is by no means necessarily from sewage or other material containing specific organisms of infection. Further, there is no evidence that an amount of such animal contamination sufficient to cause a considerable number of B. coli per litre to be present in the water is harmful.

If B. coli are present in numbers greater than say 500 per litre (or even in that amount) such a water is suspicious, as it is rare to get so many B. coli in a water purely from the kind of animal contamination indicated, and further investigation is desirable. In filtered samples the number of B. coli is, as a rule, considerably reduced.

6. Chemical analysis cannot be considered a delicate method of detecting organic contamination, because it may fail with many waters in which pollution is undoubtedly taking place.

7. In surface wells, B. coli in large numbers indicate a surface or other contamination, generally very undesirable, if not actually dangerous. A knowledge of the position and the possibilities of contamination is very desirable in giving an opinion as to the purity of the water.

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ON SPLENIC ANÆMIA.[1]

[SECOND PAPER.]

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The question of the existence of a separate malady—anæmia splenica—is still in what may be called the tentative or inquisitive stage. The proposition which I offer for discussion is that a special malady does exist, of unknown etiology, characterized by a chronic course, enlargement of the spleen, anæmia of a secondary type, a marked tendency to hemorrhage from the stomach, and a liability in the late stages to be associated with jaundice, cirrhosis of the liver, and ascites. The conditions described as primitive splenomegaly and Banti's disease are initial and terminal stages, respectively, of this malady. The history of the question I need not discuss, as it is very fully given in the papers of Sippy[2] and of Wentworth;[3] nor it is necessary to discuss the possible connection of the malady with Hodgkin's disease or pseudo-leukæmia, with which a majority of observers rightly consider it has nothing whatever to do. In January, 1900, I reported a series of cases.[4] In the present paper I shall give (1) a few additional cases and the subsequent history of several of those previously reported; (2) an analysis of a series of cases of anæmia with enlarged spleen, furnished by members of the Association; and (3) a summary of the clinical features of the disease.

[1] Read at the meeting of the Association of American Physicians, May, 1902.
[2] The American Journal of the Medical Sciences, November, 1899.
[3] Boston Medical and Surgical Journal, 1901.
[4] The American Journal of the Medical Sciences, 1900, vol. cxix.

I.

The subsequent history of some of the cases in my previous paper may first be given:

Case X.—A man, aged thirty-nine years, was first seen June 15, 1898, with moderate enlargement of the spleen, moderate corpuscular anæmia, low hæmoglobin, and marked pigmentation. He did not know exactly how long he had had the anæmia or the enlarged spleen. I heard from him March 27, 1902. He had been in fairly good health, except that in March, 1901, he had three hemorrhages from the stomach, which, he says, nearly killed him. He was unconscious and in a state of torpor for two weeks. Following this he had ascites, and had to be tapped. At the date of writing he said he had recovered sufficiently to be able to do his work.

Case XIV.—A man, aged thirty-five years; a very typical instance, with a greatly enlarged spleen, characteristic blood condition, slight pigmentation of the skin, attacks of hæmaturia, with slight jaundice. He was last seen on April 16, 1900. The spleen was enlarged; he had been jaundiced for two weeks; edge of liver could be felt 6 cm. from the ensiform cartilage; the right lobe only felt on deep inspiration. He has been under Dr. Thayer's care, who reports this spring that he is still anæmic, but able to be at work.

Case XIII.—Mrs. C. was of exceptional interest, as there was a doubt as to whether the case was not one of pernicious anæmia, with greatly enlarged spleen. She did well in the hospital; the spleen reduced in size in a remarkable way. She left the hospital November 20, 1899. She remained well during 1900. The spleen was not below the costal border. She was readmitted in April, 1901, in a condition of the most profound and progressive anæmia, in which she died on the 26th. The blood had all the features of a pernicious anæmia. The spleen weighed only 400 grammes, and the pulp was soft and flabby. There was fatty degeneration of the heart. The liver weighed 1500 grammes. The bone-marrow was of a deep gray-red color. The blood condition on her first admission (see first paper), the remarkable improvement with rest and arsenic, the complete disappearance of the symptoms, and the enlargement of the spleen, the relapse, with profound and fatal anæmia, leave no doubt, I think, that this belongs to a group of cases of pernicious anæmia with enlarged spleen, and does not come in the category of chronic cases here considered.

Case V.—Male, aged thirty-eight years; seen first November 10, 1898. For nearly twelve years he had had recurring hemorrhages. He returned to the hospital in January, 1900. Dr. Cushing removed the spleen. He did well for ten days, and then had a severe, uncontrollable hemorrhage from the stomach, which proved fatal. On post-mortem there were found (1) a practically normal condition of the viscera, (2) moderate cirrhosis of the liver, and (3) œsophageal varices, from one of which the last bleeding had occurred. The spleen showed a condition of chronic hyperplasia. In this extraordinary case the enlarged spleen had existed for fourteen years, and he had had throughout the period recurrent hemorrhages.

NEW CASES.

CASE XVI. *Clinical summary: Enlarged spleen and marked pallor for nine years; four severe attacks of hæmatemesis; removal of spleen; uncontrollable hemorrhage; death.*[1]—Frederick G., aged thirty years; referred to me by Dr. W. W. Johnston, January 14, 1901. The patient had lived in Washington all his life. When a boy at school he had chills and fever. He has had no attacks within ten years. For years he has been pale. He has, however, been able to attend to his work, and has been active and energetic. He is married. In 1892 it was first noticed that he had an enlargement in the abdomen. This was recognized by Dr. Johnston and others to be the spleen. It had caused him no inconvenience except for an occasional attack of pain in the side. He has had four severe attacks of hemorrhage from the stomach—the first in November, 1896, the second in November, 1897, the third in August, 1900, and the fourth on December 17, 1901, from which he is just recovering. Dark and bloody stools were often noticed after the attacks. They were of great severity. In the one in November, 1897, he had repeated hemorrhages, and very nearly died. He did not recover for nearly five months. Apart from the hemorrhages, his health, on the whole, has been good. The appetite and digestion had been normal and the bowels regular. He has never had a high color, but has had a curious gray pallor, with slight, diffuse pigmentation, which has increased of late. His average weight has been 133 pounds. The spleen was enormous, almost filling the left half of the abdomen. The liver was not enlarged.

He was urged by Dr. W. W. Johnston to have the spleen removed, in which opinion I concurred, and he was admitted to the hospital for preparatory treatment. The blood showed red corpuscles, 3,300,000; white blood corpuscles, 2400; hæmoglobin, 30 per cent.; moderate poikilocytosis; no nucleated reds. Between February 14th and April 14th he gained thirty pounds in weight! The blood improved, rising gradually, until on April 5th the red blood corpuscles were 5,200,000 and the hæmoglobin 75 per cent. On April 15th Dr. Halsted operated. After ligature of the splenic vessels great difficulty was met with in controlling the hemorrhage from the large veins passing to the stomach—vasa brevia—some of which were as large as the little finger. He lost so much blood that death took place a few hours after the operation. There was no autopsy. The liver, seen at the time of the operation, was smooth, and did not look cirrhotic.

CASE XVII. *Clinical summary: History of malarial fever eighteen years ago; tumor of left side of eleven years' duration; in* 1898 *an attack of severe anæmia, with ascites; recovery; in* 1900 *a second attack, with jaundice, anæmia, and ascites; gradual recovery; in* 1901 *a third attack, with jaundice, ascites, profound anæmia; recovery.*—Minnie W., aged forty years, was first seen in 1898, when she was admitted to Ward O on August 3d (Med. No. 8864), with great swelling of the abdomen and anæmia. She had been a healthy woman, married, three children—the youngest eighteen years old. She has always lived in Baltimore. In 1890 she had chills and fever through the summer, and they recurred

[1] The surgical and pathological aspects of Cases IV., V., and XVI. will be considered in a separate paper by Drs. Cushing and Macallum.

for several years. She has noticed a hard mass in the left side of the abdomen since 1890. On the first admission, August 3d, there was no jaundice. She had a greatly distended abdomen, œdema of the ankles, and an extreme anæmia. The red blood corpuscles were 2,500,000; hæmoglobin, 47 per cent.; white blood corpuscles, 1500. There were no malarial parasites; no pigment in the blood. The dropsy subsided rapidly, and it was then found that the spleen reached 18 cm. from the costal margin. A differential count of 525 leucocytes gave small mononuclears 21, large mononuclears 5, polymorphonuclears 67, eosinophiles 2.6, transitionals 1.9. Two nucleated reds were seen. With iron, good food, and open-air treatment (eight to ten hours daily) she improved rapidly, and on September 30th she left the hospital, with the condition of the spleen unchanged, but with the red blood corpuscles at 3,500,000; white blood corpuscles, 2400; hæmoglobin, 53 per cent. The edge of the liver could be felt 3.5 cm. below the costal border, "soft and slightly tender."

Second admission August 10, 1900, with jaundice, anæmia, and ascites. The jaundice had come on about three weeks previously. She has been pretty well for two years, and had been at work. The abdomen measured 92 cm. She was anæmic. Red blood corpuscles, 3,800,000; white blood corpuscles, 2000; hæmoglobin, 65 per cent. The ascites quickly disappeared and the jaundice lessened. She had two transient attacks of fever. There were no parasites in the blood, and no pigment. She left the hospital November 10, with red blood corpuscles at 4,600,000; white blood corpuscles, 7000; hæmoglobin, 70 per cent. The liver reached 3 cm. below the costal margin in the nipple line, and was very tender.

Third admission September 30, 1901, with jaundice, moderate ascites, and anæmia. She had kept pretty well since last note. Two weeks before admission she had nausea and vomiting and a chill. With the exception of the deeper jaundice her condition was a good deal better than at the last admission. The abdomen was large and contained a good deal of fluid. The spleen reached 5 cm. below the navel, and the edge was 18 cm. from the costal border. Red blood corpuscles, 3,800,000; white blood corpuscles, 4200; hæmoglobin, 58 per cent. As the fluid reduced the liver could be felt just below the costal border in the nipple line, and I noted on October 4th the "edge can be distinctly felt; it is very hard and feels cirrhotic." The jaundice was marked, and there were dilated venules on the face. She again improved, and on October 26th the red blood corpuscles were 4,700,000; white blood corpuscles, 3000; hæmoglobin, 62 per cent. The spleen was unchanged. On October 5th a differential count of 500 leucocytes gave polymorphonuclears 80.6, small mononuclears 9, large mononuclears 5.8, transitionals 3.4, eosinophiles 1.2.

Case XVIII. *Clinical summary: Enlarged spleen first noticed fifteen years ago; attacks of abdominal pains; marked pigmentation; slight enlargement of the liver; jaundice and secondary anæmia; slight fever; marked improvement.*—A. L. W., aged thirty-three years; admitted December 27, 1901 (Med. No. 13,848), with jaundice and slight fever. Inflammatory rheumatism fifteen years ago; ulcers on the right leg afterward. Sixteen or seventeen years ago had chills and fever. He went to Mexico, and while there was jaundiced and sickly for eight or nine months. He returned from Mexico fifteen years ago, and the

doctors told him he had an enlarged spleen, which has persisted ever since. He has had gonorrhœa, but has not had syphilis. He has been a moderate drinker. He does not think the spleen has increased much in size since it was first noticed. He has been pale for years; he has had occasional attacks of pain, and often a sense of discomfort after eating. For some time he has been losing in weight and feeling badly. His normal weight is 145 pounds; on admission it was 127 pounds. He has lately had cough, with fever and sweats.

On admission Dr. McCrae made the following note:

"His color is striking; he is exceedingly sallow. There are numerous areas of pigmentation over the face and forehead; there is definite jaundice. The patient is sweating profusely; tongue slightly coated; gums and mucous membranes rather pale.

"*Thorax.* Well formed, rather rounded. Expansion good; seems equal. Percussion note clear throughout; everywhere hyperresonant. Breath sounds seem clear throughout.

"*Heart.* There is rather a diffuse impulse. Point of maximum impulse, fifth left interspace, 155 cm. from mid-sternal line. Cardiac dulness begins at third right, opposite fourth interspace; extends 3 cm. to right and 11 cm. to left of mid-sternal line. Impulse well felt; no thrill. At apex the first sound completely replaced by soft murmur, carried to axilla. In fourth interspace there is a suggestion of a sound. On passing upward the systolic bruit increases in intensity, reaching a maximum in aortic and pulmonary areas. It can be heard on both sides out to about the nipple line; is loudly heard over the vessels of the neck. In the third left interspace close to the sternum the systolic murmur has a very rough quality. The second sound everywhere is soft. No definite diastolic murmur is made out. In aortic area has a murmurish quality. Pulse 24 to quarter, of fair tension, regular, of suggestive collapsing quality; there is a quick rise. Pulse is not that of aortic stenosis.

"*Abdomen.* Slightly full; no special visible prominence; no rose spots; walls fairly soft. Spleen very readily palpable; extends 12 cm. from the left costal margin, and comes to within 4 cm. of the navel and 5 cm. of the left anterior superior spine. It is hard, slightly tender, and slightly movable. Liver apparently also enlarged; in median line the edge being 5 cm. above the navel, and in the right nipple line 4 cm. below the costal margin. In the right nipple line dulness begins at the fifth right and extends 12 cm.; in the mid-axillary line dulness begins at the fifth interspace. The patient's body not specially pigmented, though dark; no special pigmentation about the nipples.

"Hæmoglobin, 53 per cent.; red blood corpuscles, 3,026,000; white blood corpuscles, 6875. Differential count; Jenner stain. Red cells show marked poverty in hæmoglobin, marked variation in size, there being many microcytes, no macrocytes, some poikilocytosis. In counting 536 cells no nucleated reds seen. Count in general shows relative increase in mononuclear elements; polymorphonuclears, 55.96; large mononuclears, 29.85; small mononuclears, 11.19; transitionals, 2.23; eosinophiles, 0.37; mastzellen, 0.37."

For five days his temperature ranged between 100° and 101° F., and he had a soft friction murmur in the left axilla. He had a small quantity of sputum, which was repeatedly examined for tubercle bacilli, with negative results. He gradually improved, the jaundice lessened,

but there seemed to be an increase in the general pigmentaton of the skin. By February 1st the patient was very much better. On the 2d, red blood corpuscles, 3,600,000; hæmoglobin, 65 per cent.

He was discharged February 7th, still looking rather pigmented, but free from fever, and having gained six pounds in weight. The urine contained bile at first, but was otherwise normal. The spleen was unchanged.

II. Incidence of Enlarged Spleen with Anæmia.

While the combination seems to be not infrequent, yet cases reported in the literature as splenic anæmia are rare. Rolleston, in his recent paper,[1] states that he has been able to collect only thirty-seven cases. In February last I sent a circular letter to members of the Association asking for information on the subject, and for notes of unpublished cases. I am indebted to twenty-four physicians for notes of forty-five cases, which I have grouped as best I could. It was not always possible to classify the cases properly, as in some no information was given as to the duration of the disease.

1. *Acute Anæmia, Under One Year's Duration, with Enlarged Spleen*, 12 cases.

In none of the cases was there a history of malaria; the duration of the illness ranging from eleven weeks to twelve months. The size of the spleen was not always stated. In the case of A. O. J. Kelly and J. C. Wilson it was only two fingers' breadth below the costal border, but in the cases of Cary, Edwards, Blackader and Martin, and Rotch the organ was greatly enlarged. In eight of the cases the red blood corpuscles were below 2,500,000 per cubic millimetre. In the cases of Musser and Blackader the count sank below 1,000,000 per cubic millimetre. The hæmoglobin was relatively low in six cases, of normal proportion in two, plus in two, and not given in two cases.

The leucocytes were under 6000 per cubic millimetre in eight cases; in three of these, below 2500. In two they were about normal, and in only two above normal, in one 7000 per cubic millimetre, and in one 20,000 per cubic millimetre.

In some of these cases the history, course, and blood condition suggest progressive pernicious anæmia. Case XIII., reported in my first paper, had, as I then remarked, many of the features of this disease. She returned (as noted in the early part of this article), and died with all the features of a pernicious anæmia plus great enlargement of the spleen. This group is of unusual interest, and brings up the question of the frequency of enlarged spleen in pernicious anæmia. Hunter[2] says "in a certain number of instances the spleen has been found enlarged, this condition being even recognizable during life." He mentions a number of cases reported by different observers; the largest mentioned "was in a case reported by Wilks (500 grammes). In 4 cases of his own the

[1] Clinical Journal, 1902.

[2] Pernicious Anæmia (monograph), 1901.

spleen weights were 19 ounces, 11 ounces, 10 ounces, and 13 ounces." In a great majority of the cases the spleen is either described as normal or no mention is made of the condition at all. Cabot[1] notes enlargement in 13 of 110 cases; Billings[2] in 5 of 20 cases. Among 40 cases from my wards, reported by McCrae,[3] "'the spleen was felt in only 6 cases, and in none of them was the enlargement at all marked, it being noted that 'the spleen was just felt.'"

2. *Chronic Anæmia, with Enlarged Spleen*, 26 cases.

Eighteen of these were in males. The duration of the disease is most interesting: eleven years, 1 case; nine, 1; eight, 1; seven, 3; six, 2; five, 1; three, 2; four, 1; two, 3; between one and two years, 3; in 1 doubtful—"many years." In 9 of the cases the disease had lasted for more than five years; in 7 the duration was unknown. Hæmatemesis occurred in 9 cases, jaundice in 4 cases, ascites in 5, and in 7 cases the liver was enlarged. Several of the cases had been regarded as Banti's disease, or the terminal stage of anæmia splenica.

In only 7 of the cases were the red blood corpuscles below 2,500,000 per cubic millimetre. In 22 cases the hæmoglobin percentage was relatively low, in 3 it was normal, and in 1 it was not given. In 13 cases the leucocytes were below 5000 per cubic millimetre. In a case of Vickery's they were only 650 to 700 per cubic millimetre, and in Peabody's case they were only 800 per cubic millimetre, and the highest of several counts in this case was 1400. In 3 cases they were above 7000 per cubic millimetre, and in 9 cases they ranged from 5000 to 7000 per cubic millimetre.

3. *Simple Splenomegaly*, 2 cases.

Two cases were returned as simple or primitive splenomegaly. In Dr. Herrick's case the normal red count and the relatively low hæmoglobin, with a history of ill-defined symptoms for five years, suggest the early period of splenic anæmia. In Dr. Martin's case the enlarged spleen was found after an accident in which the man was knocked breathless. He vomited dark material. The spleen has gradually increased in size. There is practically no anæmia.

There were three cases difficult to classify, and in two cases other diseases were presented—cirrhosis of the liver and sarcoma of the spleen. The cases are given in an appendix in the *Transactions of the Association of American Physicians* for this year.

III. Anæmia Splenica Chronica.

Definition. *A chronic affection, probably an intoxication of unknown origin, characterized by a progressive enlargement of the spleen which can-*

[1] The American Journal of the Medical Sciences, 1900, p. 1. [2] Ibid.
[3] Journal of the American Medical Association, 1902.

not be correlated with any known cause, as malaria, leukæmia, syphilis, cirrhosis of the liver, etc. (primary splenomegaly); anæmia of a secondary or chlorotic type (leucopenia); a marked tendency to hemorrhage, particularly from the stomach; and in many cases a terminal stage, with cirrhosis of the liver, jaundice, and ascites (Banti's disease). It seems probable that the conditions separately described in the literature as primitive splenomegaly, splenic anæmia, splenomegalic cirrhosis of the liver, or Banti's disease are stages of one and the same malady. Let me first give a brief analysis of the cases which have been under my care which conform to the above definition. I have cut out Cases I. and II. of my first series, as they were seen long ago (1879), though both patients had enlarged spleen and hæmatemesis; but I am uncertain about the duration and etiology. Case XIII. I have also discarded as probably progressive pernicious anæmia with greatly enlarged spleen. This leaves a group of fifteen cases seen within the past ten years; all have been carefully studied, and the full report of the blood condition will be found in the *Edinburgh Medical Journal*, May, 1899, and in THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, January, 1900, and in the present paper.

ABSTRACT OF FIFTEEN CASES.

CASE III.—Male, aged thirty-five years; duration twelve years. Enormous spleen; recurring attacks of hæmatemesis and melæna; pigmentation of the skin; death after an attack; no cirrhosis of the liver. Blood count lost.

CASE IV.—Male, aged thirty-three years; duration ten years. Recurring attacks of hæmatemesis and melæna; enormous spleen; pigmentation of the skin; removal of the spleen; liver not cirrhotic; recovery. Red blood corpuscles, 3,000,000; hæmoglobin, 25 per cent.; leucocytes, 2800.

CASE V.—Male, aged forty years; duration thirteen years. Recurring attacks of hæmatemesis; occasional melæna; enormous spleen; grayish-brown pigmentation of the skin; slight ascites; removal of the spleen; liver moderately cirrhotic; death from rupture of œsophageal varix. Red blood corpuscles, 4,000,000; hæmoglobin, 30 per cent.; leucocytes, 6500.

CASE VI.—Male, aged twenty years; duration eleven years. Onset with hæmatemesis; pigmentation of the skin; spleen very large. Red blood corpuscles, 2,187,000; leucocytes, 12,497.

CASE VII.—Male, aged forty years; duration two years. Enormous spleen; recurring cutaneous hemorrhages; remarkable pigmentation of the skin. Red blood corpuscles, 4,816,000; hæmoglobin, 55 per cent.; leucocytes, 5000.

CASE VIII.—Female, aged fifty-six years; duration three years. Spleen very large; no hemorrhages; no pigmentation. Red blood corpuscles, 3,600,000; hæmoglobin, 60 per cent.; leucocytes, 3000.

CASE IX.—Male, aged fifty-eight years; duration six years. Spleen very large; recurring ascites; no hemorrhage; no pigmentation;

enormous ascites; no cirrhosis of liver; death. Red blood corpuscles, 4,788,000; hæmoglobin, 60 per cent.; leucocytes, 5200.

Case X.—Male, aged thirty-nine years; duration doubtful—more than three years; hæmatemesis, melanoderma, and leukoderma; spleen greatly enlarged. Red blood corpuscles, 4,128,000; hæmoglobin, 45 per cent.; leucocytes, 2800.

Case XI.—Male, aged fifty-seven years; duration two years. Spleen greatly enlarged; no hemorrhages. Red blood corpuscles, 2,500,000; hæmoglobin, 37 per cent.; leucocytes, 3000.

Case XII.—Male, aged forty years; duration (now) four years. Greatly enlarged spleen; recurring hæmatemesis; ascites; recovery. Red blood corpuscles, 4,208,000; hæmoglobin, 45 per cent.; leucocytes, 4000.

Case XIV.—Male, aged thirty-five years; duration (now) four years. Hemorrhage from kidneys; no malaria; greatly enlargd spleen; marked pigmentation of the skin. Red blood corpuscles, 3,856,000; hæmoglobin, 55 per cent.; leucocytes, 4500.

Case XV.—Male, aged forty-three years; duration eight years. Very large spleen; recurring hæmatemesis. Red blood corpuscles, 4,270,000; hæmoglobin, 45 per cent.; leucocytes, 2500.

Case XVI.—Male, aged thirty years; duration ten years. Recurring hæmatemesis; grayish-brown pigmentation of the skin; removal of spleen; no cirrhosis of liver; death. Red blood corpuscles, 3,300,000; hæmoglobin, 30 per cent.; leucocytes, 2400.

Case XVII.—Female, aged forty years; duration ten years. Recurring attacks of acute anæmia, with jaundice and ascites; enormous spleen; no hemorrhages. Red blood corpuscles, 3,500,000; hæmoglobin, 53 per cent.; leucocytes, 2400.

Case XVIII.—Male, aged thirty-three years. Duration of enlarged spleen fifteen years, organ greatly enlarged; liver also enlarged; slight jaundice; marked pigmentation of the skin; no hemorrhages. Red blood corpuscles, 3,326,000; hæmoglobin, 53 per cent.; leucocytes, 6875.

As in the cases collected by Rolleston, the *sex* in my series shows a great prevalence among males—thirteen to two. All of the cases were in adults, chiefly in young adults; in only one (Case VI.) had the disease begun in childhood.

There is nothing in the *etiology* of the cases to throw any light on the causation. The question of *malaria* naturally arises, considering the locality in which I practice. There was history of malaria in five cases. In three of these (aged forty, fifty-six, and thirty years) the infection was in childhood. In only two (Cases XVII. and XVIII.) had the infection occurred in adult life—one twelve years before onset of illness, the other eighteen years before. The locality has nothing to do with the number of cases observed; only five cases came from Maryland, four of which were from the city of Baltimore. The others came from New York, Pennsylvania, Illinois, Massachusetts, West Virginia, North Carolina, South Carolina, Canada, and Jamaica.

Heredity has played no part in my cases, but Brill[1] has reported three cases in one family. One girl died, aged nine years, with enlargement

[1] The American Journal of the Medical Sciences, April, 1901.

of the spleen. The description of the other two cases leaves no doubt, I think, that they belong to the disease under discussion. Case III., with the peculiar pigmentation, the tendency to hemorrhages, and the type of anæmia present, corresponds exactly with chronic splenic anæmia. Bovaird[1] has described a similar condition in two sisters; a sister of Collier's[2] patient died with enlarged spleen, while C. Wilson[3] has reported a family in which in three generations six members had enlarged spleen. It is quite possible that all of these cases belong in the category of chronic splenic anæmia.

Symptomatology. 1. *The Remarkable Duration of the Disease.* Among disorders of the blood or blood-making organs anæmia splenica is characterized by an extraordinary chronicity. In some of the cases in my series the disease had lasted more than twelve years. Rolleston reports a case of twelve years' duration, beginning in the eleventh year, the condition remaining throughout very much the same, except that during the last three years of life there was recurring hæmatemesis. Senator and others have noted this peculiarity. An extraordinary illustration I saw last winter in New York with Dr. Walter James, who will report the case in full. The patient had had an enlarged spleen, with anæmia of varying intensity, for at least twenty-five years. He died at last in a profound anæmia, with ascites. Gaucher's case of splenic enlargement existed for twenty-five years. In my series of fifteen cases, in seven the duration of the disease was more than ten years, and in eleven more than four years.

In ten of the twenty-six cases of chronic splenic enlargement, with anæmia, under the care of my colleagues in the Association, the disease had lasted more than five years. It is strange how slight may be the inconvenience, even with a spleen extending below the navel. A majority of my patients were active business men, and, as in Cases III. and XVI., the chief trouble was the recurring hæmatemesis and the protracted up-hill convalescence after the attacks.

2. *The Splenomegaly.* There are many conditions in which the spleen may be enlarged for months or years, sometimes without any apparent injury to health. I have had a group of cases of moderate enlargement of the spleen in women, without obvious cause and without marked anæmia, in which the discomfort of the movable organ was the chief complaint. Two of these cases have remained well for years, having had the organ "packed" into position. Among the dark-skinned emigrants from southern and eastern Europe and from Armenia moderate enlargement of the spleen is not uncommon—a point noted by Cabot in the discussion of this paper. It may be a manifestation of latent paludism.

[1] The American Journal of the Medical Sciences, October, 1900.
[2] Pathological Society Trans., vol. xlvi.
[3] Clinical Society Trans., vol. xxiii.

In the very large group of cases of splenomegaly, with secondary anæmia:

(*a*) The cause is usually apparent—malaria, tuberculosis, rickets, or syphilis—particularly in children, in whom any state of malnutrition, if protracted, may be associated with enlargement of the spleen.

(*b*) The anæmia and splenomegaly usually yield to appropriate treatment; at all events there is not the remarkable chronicity.

(*c*) The spleen in this group rarely reaches the colossal size seen in chronic splenic anæmia.

(*d*) The sequences so characteristic of splenic anæmia are not seen.

(*e*) While the blood shows the features of a secondary anæmia there is rarely the exaggerated chlorotic type, and leucocytosis is more common than leucopenia.

There are many gaps in our knowledge, and it is difficult to assign to individual cases their proper places. It may not always be possible to speak definitely. For example, in the case of James P., aged four years, sent by Dr. Rotch (No. 12, acute cases), with a large spleen and a marked anæmia, with leucopenia of two months' duration, where shall we classify it? or a case, sent by Cabot, of a child aged seven months, duration of illness not stated, with red blood corpuscles 3,200,000; hæmoglobin, 25 per cent.; leucocytes, 36,800, and nucleated red blood corpuscles 6190 per cubic millimetre? The anæmia is more or less acute, the splenomegaly moderate, and the blood condition may be very variable. On the other hand, many of the cases in children conform to the definition above given of chronic splenic anæmia. Another case of Rotch's (No. 18 in chronic series): At the age of three years the spleen and liver were large, the anæmia was marked; nine years later the spleen was enormous, the liver still enlarged, the anæmia pronounced, and the skin was pigmented.

The special feature of the enlarged spleen in chronic splenic anæmia is the size, which is unequalled in any other disease, except, perhaps, leukæmia. The abdomen may be enormously distended, and the organ may not only occupy the left side, but may curve upon itself and pass across to the right iliac fossa and the right flank. The notches may be directed upward, as in one of Collier's cases which I saw with him at the Radcliffe Infirmary, Oxford, in which the border of the spleen and the notches were between the navel and the ensiform cartilage. The average weight in twelve cases collected by Rolleston was sixty-one ounces. In Bovaird's case the organ weighed twelve and one-half pounds. The mechanical discomfort may be considerable, though as a rule there is very little pain unless perisplenitis be present, in which case a friction may be felt or heard. In Rolleston's case a *bruit de diable* was heard over the organ.

Many of the cases reported in the literature as primary or primitive

splenomegaly come under the definition of the disease as given above. In the chronicity (eleven and fifteen years and thirteen years) and in the general features the cases of Brill and of Bovaird conform to chronic splenic anæmia.

3. *Hæmatemesis* is a remarkable feature of the disease. Eight of my patients had attacks of vomiting of blood. In Cases I. and II. (which I have discarded from my series as seen in 1879 as deficient in certain details) the hemorrhages were most profuse. I have never seen such enormous losses of blood as in Case II. In the nineteen cases communicated by members of the Association, hæmatemesis occurred in seven. In a large proportion of the cases the hemorrhage is due to conditions associated with the enlarged spleen, not to accompanying cirrhosis of the liver. In Cases IV. and XVI. of my series the spleen was removed, and at the operation the liver was seen to be normal. In Case III. it was not cirrhotic post-mortem. It is easy to understand this splenic origin, as 40 per cent. of the blood from the stomach passes by the vasa brevia to the splenic veins. (Mall and Krauss.) Watson gave a mechanical explanation (which I have quoted in my first paper) of the bleeding. The source of the blood may be (*a*) a general diapedesis from the gastric mucosa. This is doubted by some writers, but on several occasions I have not been able to find, after a most careful search, either minute erosions of the mucosa or ruptured veins in the œsophagus, and there seems to be no other explanation; (*b*) small erosions of the gastric mucosa; (*c*) rupture of a varicose vein of the œsophageal plexus, which was the cause of death in Case V. after removal of the spleen. The recurring profuse bleedings may very often be from this source, considering the intimate relation between the veins of the fundus of the stomach supplying the *vasa brevia* and those of the cardiac orifice and the œsophagus; (*d*) Rolleston suggests that the large wandering spleen may pull on the gastrosplenic omentum and give rise to torsion of the veins, or cause a kink in the splenic vein, and so induce intense venous engorgement of the stomach.

With the exception of the chronic hemorrhagic form of the peptic ulcer there is no known condition in which hæmatemesis may occur for so many years. In Preble's[1] study of gastro-intestinal hemorrhages in cirrhosis of the liver, in five of the thirty-five cases in which œsophageal varices were found the hemorrhages had occurred at intervals varying from a few months to five years.

Hemorrhage from other sources is less frequent. Epistaxis may recur at intervals; retinal hemorrhages, bleeding gums, menorrhagia, and hæmaturia have been recorded. Purpuric attacks, as in Case VII. of my series, may occur.

[1] The American Journal of the Medical Sciences, January, 1901.

4. *Anæmia.* Even in well-defined cases the anæmia may be slight. As in locomotor ataxia there may be no ataxia, so in anæmia splenica there may be no corpuscular anæmia—a point which may be urged against the use of these names. Take, for example, Case XVI., here reported. Prior to the operation there was no anæmia of corpuscles, which were 5,200,000 per cubic millimetre, but he was still pallid and had only 75 per cent. of hæmoglobin, and there was not the slightest change in the spleen; yet he presented a most typical picture, and anyone who had seen Cases III., IV., and V. could have recognized at a glance that the case belonged, with them, to a separate clinical group, quite as definite as leukæmia or Addison's disease. Very few of the patients will be found to have a normal amount of hæmoglobin; they are constantly "off color."

There is nothing peculiar or distinctive in the anæmia, which is of the secondary or chlorotic type.

(*a*) *The corpuscular anæmia* is of a moderate grade. Of the forty-one cases of my series the average was 3,425,000 per cubic millimetre. The lowest blood count was 2,187,000; the highest count was 5,200,000, in the patient just referred to.

(*b*) *The low hæmoglobin* is an interesting feature, and rather more striking than in other secondary anæmias. It is certainly rare, except in chlorosis, to find a patient with obvious anæmia and a blood count (corpuscles) normal or even, as in Case XVI., above normal. The average of thirteen hæmoglobin counts was 47 per cent.

(*c*) *Leucocytes.* Immediately after a profuse hemorrhage, or in a terminal affair, there may be a leucocytosis, but, as a rule, there is a leucopenia. Of fourteen cases the average leucocyte count was 4520 per cubic millimetre. If we leave out Case VI., admitted shortly after a severe bleeding, with a leucocytosis of 12,500, the average of thirteen cases—in one of the series (III.) the blood count was mislaid—was 3850 per cubic millimetre.

In the extreme anæmia which may come on at the close there may be marked poikilocytosis, with nucleated red corpuscles, etc. There has been nothing characteristic in the differential count of the leucocytes.

5. *Pigmentation of the skin* is a common event in the very chronic forms, having been present in eight of my cases. A majority of these presented the usual bronzing of the skin, diffuse in character, and resembling that seen in Addison's disease, though rarely so intense. In some it was a curious steel-gray staining of the skin, of a very peculiar character, suggesting rather argyria than the usual form of melanoderma. In some cases it was patchy and associated with areas of leucoderma.

Pigmentation of the skin seems to be a common feature in the long-standing cases, and has been commented upon by Brill, Bovaird,

Frederick Taylor, and others. It is of special interest in connection with the melanoderma of hæmochromatosis (bronzed diabetes) and of Hanot's cirrhosis. In Case XIV. of the series a portion of the skin did not show the ochre-brown pigment such as is present in hæmochromatosis. It is to be borne in mind that arsenic is used largely in these cases, and it is quite possible that to it in part may have been due the dark color of the skin. In no case were there keratoses.

6. *Hepatic Features.* The mutual relations of diseases of the spleen and liver are well illustrated in splenic anæmia. While a majority of the cases present no symptoms of disturbed action of the liver, and in a few the occurrence of ascites, even when the liver is normal, suggests cirrhosis, there is a third group in which the hepatic features so predominate that cirrhosis of the liver is at once suspected. Hæmatemesis is a splenic, not an hepatic, feature of the disease. Cases IV. and XVI., in which the hemorrhages had occurred for many years, presented at the time of operation a normal liver. Case IV. was alive and well (having had no recurrence of the hemorrhage) nearly three years subsequently. While hemorrhage from the stomach may be a very early, indeed, the very first, symptom of cirrhosis of the liver, it is most unusual to have recurrences over long periods, as in the cases recorded in this series. Even in the more chronic type of cirrhosis—Hanot's variety—hæmatemesis is not so special a feature as in splenic anæmia. In the later stages of the disease the cirrhosis of the liver, if present, as in Case V., may aggravate the conditions favoring hemorrhage. In my series hepatic features have not been very marked.

Ascites occurred in four cases. In Case V. it was slight and associated with œdema of the ankles. The patient had had shortly before readmission a series of bleedings. At the operation, and ten days subsequently at autopsy, slight cirrhosis of the liver was found. In Case XVII. ascites was present at the time of the admissions, August 3, 1898, August 10, 1900, and September, 1901. In each instance it disappeared with the general improvement. In the second and third admissions there was jaundice. The liver was slightly enlarged and felt cirrhotic. In Case XII. there was no dropsy when I saw him; six weeks before six quarts were drawn off. Dr. Vickery writes that he had been tapped again. The liver was not enlarged. In Case IX. there was ascites in 1895, again in 1897, and a third time in his final illness, in the spring of 1898. The liver could be felt a little below the costal border, but at the post-mortem there was no cirrhosis

In the series of cases of anæmia, with enlargement of the spleen, sent by my colleagues, ascites was present in the cases of McPhedran, Edes, Atkinson, Sears, and Cabot; in two of the cases in association with jaundice.

Jaundice was present in only two cases in my series and in four in the association series.

State of the Liver. In eight cases the liver was of normal size. In Cases IV. and XVI. the organ was seen to be smooth and natural looking at the time of operation. In Cases III. and IX. it was normal post-mortem. In six cases it was slightly enlarged; in no case was the organ large and hard, as in forms of hypertrophic cirrhosis. In one case it was reduced in size; in only one (Case V.) was cirrhosis of moderate grade found post-mortem. In seven of the cases in the association series the liver was enlarged.

Relation of the Cirrhosis of the Liver to the Enlarged Spleen. Splenomegaly and cirrhosis of the liver are associated in the following conditions:

1. *Atrophic Cirrhosis of the Liver.* So constant is moderate enlargement of the spleen that in doubtful cases it is an important help in diagnosis. The organ is not often very large, rarely reaching to the navel. That it is due to the chronic passive congestion is shown by the remarkable reduction in size which may follow an attack of hæmatemesis. There is a moderate hyperplasia and often a perisplenitis. Parkes Weber suggests that the enlarged spleen may be due in part to a toxæmia.

2. *Syphilis of the Liver.* Both liver and spleen may be involved in amyloid degeneration, but the cases in question are gummata of the liver, with consecutive contraction. The spleen may reach a very large size. A remarkable congenital case, in a girl twenty-one years of age, occurred some years ago in my wards,[1] in which, in addition to the big spleen and syphilitic liver, there was a high degree of leucocytosis.

In my previous paper on splenic anæmia I have reported two other cases, and have called attention to the liability of error. In one of the histories sent by Dr. Musser the patient, aged forty-five years, had had syphilis of the brain. In 1898 and 1899 he had jaundice, with great enlargement of the spleen and liver, hemorrhages from the stomach and bowels, and moderate anæmia. In Coupland's case[2] an enlarged spleen was removed, and two years later the patient died with hæmatemesis and ascites; the liver was found to be syphilitic. When we recognize more fully the great frequency of syphilis of the liver[3] and learn the extraordinary diversity of its clinical features we shall find, I think, a very interesting group of cases characterized by irregularly contracted liver, big spleen, and anæmia.

[1] Johns Hopkins Hospital Bulletin, vol. ii. [2] British Medical Journal, 1896, vol. i.
[3] See recent papers by Einhorn, Medical Record, 1901, and Stockton, Journal of the American Medical Association, 1902, vol. ii.

In both the alcoholic and syphilitic cirrhosis the liver, as a rule, is small, and *the splenomegaly follows and depends, in great part at least, on the condition of the liver.*

3. *Hæmochromatosis.* This remarkable and most obscure affection is characterized by a chronic curve, a gradual deposition of an iron-containing pigment in the organs and in the skin (leading to pigmentation), a progressive enlargement of the spleen, hypertrophic cirrhosis of the liver, sclerosis of the pancreas, and, finally, diabetes—the bronzed diabetes of the French. Anschutz[1] and Opie[2] regard the affection as a chronic toxæmia leading to hæmolysis, with gradual deposition of blood pigment in the organs (leading to sclerosis) and in the skin. There may be a marked tendency to hemorrhage (purpura). In the cases I have seen the spleen has not been enormously large,[3] and the condition is one in which *the splenomegaly and the cirrhosis of the liver go hand-in-hand,* both apparently due to the same cause.

Anæmia, so far as I can learn, has not been a special feature of the cases. It is of interest to note that in the case which was reported by H. A. Hare as Banti's disease, and which had been under the care of Musser and J. C. Wilson, the patient, who had been ill for seven years, had a very large spleen, moderately enlarged liver, anæmia, and diabetes. No mention is made of pigmentation of the skin.

4. *Other Forms of Cirrhosis.* Apart from the alcoholic and syphilitic varieties, there is a large group of cases in which the disease occurs chiefly in the young, usually the hypertrophic form, and in association with great enlargement of the spleen.

(*a*) *Hanot's cirrhosis,* the best known of these varieties, is a very chronic enlargement of the liver occurring in young persons, sometimes as a family form, not associated with the abuse of alcohol or with malarial or syphilitic infection. The spleen is enlarged, but not of very great size in proportion to the liver. There is a chronic jaundice of varying intensity, a marked tendency to hemorrhage, but not specially to hæmatemesis, and very often a terminal *icterus gravis.* Rarer features are bronzing of the skin, a marked leucocytosis, and fever. Ascites does not occur (?). The relation in time of the hepatic enlargement and the predominance of the biliary symptoms from the outset are characteristic features. The lesions are those of a biliary cirrhosis.

(*b*) There is a *simple cirrhosis* of the liver in children, without great enlargement of the liver, moderate splenomegaly, and a clinical picture almost identical with that of the disease in adults. Ascites is a prominent feature. Some of the cases have been of alcoholic origin, but in

[1] Deutsches Archiv für klin. Med., 1899, Band lxii.
[2] Opie. Journal of Experimental Medicine, vol. v.
[3] British Medical Journal, 1899, vol. ii.

a majority I think the starting point has been in the changes which have followed one of the fevers of childhood. The condition is certainly very different from Hanot's cirrhosis, and very different, too, from the third type, (*c*) *splenomegalic cirrhosis*, the form which specially concerns us here on account of its relations with splenic anæmia, and must be discussed as a separate section.

5. *Splenomegalic Cirrhosis of the Liver.* After lasting for some time, splenic anæmia may be followed by cirrhosis of the liver. It was the merit of Banti to call attention to this sequence. The splenomegaly may exist for a long period of years without leading to cirrhosis of the liver, as illustrated in Cases III. and IV. of my series. In Case V., after a period of between thirteen and fourteen years, the organ was only moderately cirrhotic. The enlargement, in adults at least, is not very great, and the splenic features dominate the case throughout, and the ascites and hæmatemesis, as I have insisted, do not necessarily indicate that the liver is involved.

Can we bring into this category the remarkable group of cases in children, particularly the family form of splenomegaly, which corresponds in so many features with chronic splenic anæmia? Take, for example, the case reported by Frederick Taylor.[1] The lad, aged thirteen years, had for six years an enlarged spleen, with jaundice and enlarged liver. There were anæmia, melanoderma, hemorrhages, and clubbed fingers. Post-mortem the spleen weighed eighty-seven and a half ounces, and the liver, only forty ounces in weight, was rough and nodular. The case is reported as one of splenomegalic cirrhosis. Bovaird's case, already referred to, was one of two sisters affected. At the age of sixteen years, thirteen years after the onset, there was marked anæmia, no jaundice, enormous spleen, moderate enlargement of the liver, and melanoderma. The spleen weighed twelve and a half pounds; the liver, sixty-eight ounces, was cirrhotic. In Rotch's case the lad, aged twelve years, had had a big spleen for nine years. When three years old the spleen and liver were enlarged, and there was anæmia. Nine years later the spleen was enormous, reaching to the pelvis; there was pigmentation of the skin and extreme anæmia, without leucocytosis. In the cases of Edes (No. 8) and Vickery (No. 12), also of long duration in children with enormous spleens—ascites in the one case and hæmatemesis in the other—the liver was not enlarged.

Some of these are undoubtedly cases of splenic anæmia in childhood. The truth is, we need a very careful study of this group of cases before we can speak of them with any certainty. The cases are singularly chronic, and pass from one physician to another. The relation in time

[1] Guy's Hospital Reports, vol. liv.

of the hepatic and splenic lesions, the forms of hypertrophic cirrhosis of the liver in children, the relation of the family variety to the others, the state of the liver in the cases of primary splenomegaly, the condition of the blood, the relation of the cases to hæmochromatosis and to Hanot's cirrhosis—these are some of the questions awaiting solution. I have purposely refrained from using the terms introduced of late years by our French colleagues, whose studies in cirrhosis of the liver have been so important. The long-sounding names simply express the plain fact that the cirrhosis of the liver may precede (as in portal cirrhosis), accompany (as in hæmochromatosis), or follow (as in splenic anæmia) the splenomegaly. For the last group the term splenomegalic cirrhosis is allowable; but, as Dr. Frederick Taylor says, it is devoutly to be hoped that "we may be delivered from the cumbrous and unwieldly nomenclature which has been suggested for temporary use by our foreign *confrères*."

Pathology. The morbid anatomy throws very little light on the origin of this remarkable disease. Two conditions have been described in the spleen: 1. A fibrosis and hyperplasia, with atrophy of the pulp and a hyaline degeneration of the Malpighian bodies;[1] and with this description Dr. W. G. McCallum tells me our cases (IV., V., and XVI.) correspond, with certain minor differences. 2. On the other hand, a very remarkable change has been found in certain cases of splenomegaly; cases which, as I have said, agree in every clinical particular with the definition of the disease above given. The normal texture is largely replaced by fibrous tissue and large endothelial cells with clear protoplasm containing two or more nuclei, and among them giant cells. The condition is beautifully shown in the illustration in Bovaird's article. No wonder that Gaucher described it as primary endothelioma, although the spleen had been enlarged twenty-five years. The same structure has been described by Picou and Ramond, Collier, Harris and Herzog, and Rolleston. "It has been suggested by Bovaird that the proliferated endothelial cells eventually form fibrous tissue, and, though Harris and Herzog do not support this, the microscopic appearances certainly are compatible with this view. It is perhaps more probable that the fibrous hyperplasia goes on at the same time as the endothelial proliferation, and is due to the same cause, viz.: a chronic intoxication. The fibrous tissue of the organ contains pigment granules of hæmosiderin and hæmatoidin. . . . In some recorded cases fibrosis and atrophy of the pulp and Malpighian bodies have been the only changes described. It is perhaps possible that in such cases the change has progressed, as it may do, in lymphadenoma to fibrosis and disappearance of the endothelial proliferation" (Rolleston). A point to be emphasized

[1] Banti. Zeigler's Beiträge, Band xxiv.

in favor of the view that these two changes of endothelial proliferation and fibrous hyperplasia are part of the same process is the identity of the clinical course in cases in which one or other of the changes has predominated. In Bovaird's patient the splenomegaly had lasted thirteen years; there was marked pigmentation, a secondary anæmia, and moderate sclerosis of the liver. In Rolleston's case the enlarged spleen had existed twelve years, and, as already stated, in Gaucher's patient twenty-five years.

The true nature of the disease is unknown. It is probably a chronic toxic rather than an infective process, but of the character and the source of the poison we are ignorant. Naturally, with the prevalence of theories of autointoxication, the origin has been sought in the intestinal tract—among the *fermenta imaginaria*, of which Glisson speaks in the section *de Flatu* of his celebrated *Tractatus de Ventriculo et Intestinis*. Harris and Herzog suggest that a chronic hæmolysis is caused by an enzyme manufactured by the endothelial cells of the spleen, but this does not explain the cause of the splenic changes. That the spleen is a most important factor in the disease is shown by the cure which has followed its removal, as though the organ was the seat of the manufacture of some poison; but all this is theory.

Nomenclature "What's in a name?" may well be asked of the disorder under discussion, to which an unusual number of labels have been attached. The all-important matter is to define as accurately as possible the condition named, according to the good rule laid down by Socrates: "Now, I have no objection to your giving names any significance that you please if you will only tell me what you mean by them."[1] If our knowledge does not permit to give a name according with the etiology of the disease, the rule should be to pick the one which seems least objectionable, taking priority and usage into account. To me splenic anæmia seems a less objectionable term than *splenic pseudo-leukæmia, splenic lymphadenoma, splenic cachexia, primitive splenomegaly,* or *Banti's disease.* So far as we know, the primary involvement is of the spleen, though the anæmia and the enlargement of the organ may both depend on a common, unknown factor. The name certainly expresses the two most constant features of the affection, though the anæmia is not necessarily present throughout. A serious objection is that the term has been used in a generic sense, as under anæmia splenica several diseases have doubtless been described; but the condition here described has features so remarkable and definite that to restrict the term to it seems advisable, with the qualifying addition of the word *chronic.* The protracted course of the disease is one of its most extraordinary peculiarities, and serves to separate this group from the acute

[1] Plato's Charmides (Jowett's Plato, vol. i. p. 21).

anæmias with enlargement of the spleen. Usage, too, should count, and it is something that the name should have been introduced by a great clinical physician, Griesinger, and has been adopted by such men as Strümpell, Senator, Coupland, Rolleston, and others.

The name *primary* or *primitive splenomegaly* has the advantage of neutrality or indifference in not suggesting any theory of origin, and there is no objection to its use in designating cases—such as those reported by Herrick, Martin, and others—in which the enlarged spleen constitutes the only manifestation. *Banti's disease* is simply chronic splenic anæmia plus features of cirrhosis of the liver, which represent a terminal stage in the disease. Banti's merit consists in calling attention to this important aspect; but, after all, these secondary changes in the liver are somewhat rare, and, as my records show, the hemorrhages, ascites, and even the jaundice may be present without existing cirrhosis.

Treatment. Since my first paper there has been a notable contribution made to the treatment of splenic anæmia in the study, by Harris and Herzog,[1] of the results of splenectomy. Of nineteeen cases, in fourteen recovery followed; in one the result was not given. In three of my patients, as already stated, the spleen was removed. In Case IV. (operated on by Dr. Cushing) the man, when heard from last, three years after the operation, remained well. This man had had at intervals of a year, for ten years, attacks of hæmatemesis. In Case V. (operated on by Dr. Cushing), in which the hemorrhages had recurred for more than fourteen years, death occurred on the tenth day from rupture of an œsophageal varix. In Case XVI. (operated on by Professor Halsted) the patient died of uncontrollable hemorrhage from the large veins passing between the stomach and the spleen. Recurring hæmatemesis, the most serious event in the disease, and, as I have insisted, usually of splenic origin, is the most important indication for operation

Conclusion. A growing clinical experience should give a sort of miniature picture of the general clinical experience of the profession. Few of us see all the aspects of any disease; few of us recognize all the aspects of the diseases we see; but all of us can try to correlate our own observations with the facts presented by our colleagues, and this is what I have attempted in these papers on splenic anæmia. The conclusion to which I have been led by the study of a remarkable group of cases is that—

From among the conditions with which anæmia and enlarged spleen are associated a well-defined disease may be separated conforming to the definition above given, and which may be called chronic splenic anæmia.

[1] Annals of Surgery, July, 1901.

THE ROLE OF THE TOXINS IN INFLAMMATIONS OF THE EYE:

BEING AN ESSAY TO WHICH WAS AWARDED THE BOYLSTON PRIZE.

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The investigations of Sattler, von Michel, Fick, Weeks, and others have shown that bacteria are constantly present in the normal conjunctival sac, and that these bacteria are not always harmless. It is no uncommon thing to find either the micrococcus lanceolatus or the staphylococcus aureus in a conjunctiva which is, clinically speaking, normal, while Randolph's[1] investigations prove that the micrococcus epidermidis albus (Welch) is an almost constant inhabitant of the normal conjunctival sac.

The researches of Uhthoff and Axenfeld[2] show that the pneumococcus is the most important etiological factor in serpent ulcer of the cornea, and this affection is commonly spoken of nowadays as "pneumococcus ulcer." Such an ulcer usually presupposes two conditions—first, a break in the corneal epithelium; and, second, the presence of the pneumococcus, which, as I have said, is often found in the conjunctival sac.

And when I speak of the staphylococcus aureus I am reminded of the records of many unsuccessful cataract operations where failure was traced to the presence of this organism, which there were strong reasons for believing was not introduced into the conjunctiva through blunders in modern operative technique.

The micrococcus epidermidis albus has but slight pathogenic properties, and to this we owe it in large measure that so many eyes survive serious wounds, for this organism has been demonstrated as being generally present in the normal conjunctival sac. Abundance of evidence, then, is at hand to show that the healthy conjunctiva, like the healthy vagina and the healthy intestine, probably contains bacteria at all times.

On the other hand, we know that most inflammations of the conjunctiva are caused by the growth and multiplication, either in the conjunctiva or on its surface, of special bacteria. Trachoma, vernal catarrh, and phlyctenular conjunctivitis have all been thought to originate in special bacteria, and efforts to solve these problems have brought forth much that is valuable, but nothing definite. Personally, I feel quite certain of the parasitic origin of trachoma, but I doubt whether it can be shown that either of the other diseases has its own bacterium. But when we speak of serpent ulcer, acute contagious conjunctivitis or "pink eye," gonorrhœal ophthalmia, and subacute or

chronic conjunctivitis we no longer walk on debatable ground, but are in territory whose landmarks are well established, and at once we remember that serpent ulcer is caused by Fraenkel's pneumococcus, "pink eye" by the Koch-Weeks bacillus, gonorrhœal ophthalmia by the gonococcus of Neisser, and subacute or chronic conjunctivitis by the diplobacillus of Morax-Axenfeld.

These are only a few examples which show the relationship which bacteria bear to inflammations of the eye, and as ophthalmic literature of the past ten years is full of proof of this fact, it is unnecessary for me to multiply evidence of this character.

How do these, or in fact any organisms, produce inflammation of the conjunctiva? Either by acting as a foreign body—in other words, by irritating the conjunctiva—or by producing soluble substances, which in their turn act upon the cellular elements of the tissues. It is easy to see that there are decided objections to accepting the view that when organisms produce inflammation of the conjunctiva they do so by acting as foreign bodies, for in that case all organisms would be on pretty much the same footing when present in the conjunctiva, and they would always produce more or less irritation. Then, again, it would be difficult to explain how certain organisms produce more intense reaction than others, for, so far at least as size is concerned, there is no significant difference in the bacteria which we usually find in the conjunctival sac; and we know, too, that in the case of the very organisms which I have mentioned (as causing specific inflammation of the eye) they must have been a certain length of time in contact with the surface of the conjunctiva before the clinical symptoms of inflammation are visible. The mechanical hypothesis, then, if I may so term it, can easily be shaken; while the other hypothesis—the gist of which is that the inflammation results from the action of the poisonous products of the organisms upon the cells of the eye—rests upon a much firmer foundation.

It is evident, however, that we are beset with many difficulties when we attempt to prove this experimentally, for we know that the Koch-Weeks bacillus, the gonococcus, and the diphtheria bacillus are peculiar to man, and that these bacteria will produce little or no reaction in the conjunctiva of animals, because the medium is not the proper one for their growth. Heller[3] inoculated the conjunctiva of the newborn rabbit with a gonococcus culture, and claims to have found the organism living in the purulent secretion of the conjunctival sac twenty-four hours after the inoculation. I have repeatedly tried to get a reaction by introducing this organism into the conjunctival sac of the rabbit, but the result of the experiment was always negative, and even when a slight wound of the conjunctiva was made the reaction was very doubtful.

Morax and Elmassian[4] have repeated Heller's experiments, and have occasionally succeeded in getting his results. In order to get the desired reaction one must secure a very virulent race of gonococci—that is to say, the organism must have figured in a very severe case of gonorrhœa. One must introduce as much as possible of the culture (of twenty-four hours' growth) into the conjunctiva. The lids must then be either occluded with collodion or a thread passed through them, and this condition maintained until the next day. But even with conditions so favorable Morax and Elmassian failed to produce an inflammation which was comparable to the gonorrhœal ophthalmia of the human being; and as regards the organism itself, cover-slips gave most unsatisfactory information, while nothing grew from cultures made from the inoculated conjunctival sac.

From all this it would seem clear that it is impossible to produce with the gonococcus in the rabbit's conjunctiva a reaction similar to genuine gonorrhœal ophthalmia, and the same observation holds good for the diphtheria bacillus, the Morax-Axenfeld diplobacillus, and the Koch-Weeks bacillus.

Infectious bacteria produce inflammation in the conjunctiva not only by growing and multiplying in this region, but, in addition, by producing substances called toxins. Toxins, according to Armand Gautier,[5] are chemical substances susceptible of filtration, precipitation, and resolution. They are usually complex, and made up of an alkaloidal material and a nitrogenous substance, which is very active. It must, however, be said, that we have no precise information as to the chemical nature of bacterial toxins. They are chemically undefined substances which at present can be recognized only by biological tests; these relating especially to their specific effects upon living organisms, including the capacity to lead to the production within the animal body of specific antitoxins.

Inasmuch as we have no multiplication of bacteria, and consequently no formation of toxins, we have an explanation for the absence of inflammation when the bacteria just mentioned are introduced into the conjunctival sac of the rabbit. But when we do get inflammation—as, for instance, when these same bacteria under certain conditions find their way into the human conjunctival sac—what part do the toxins play in causing this inflammation? This is the problem under consideration.

The question as to the part played by the toxins in inflammations of the eye is one which has not led to much discussion, still less to original research. The only experimental studies which have been made on the subject are by Bardelli,[6] Druault and Petit,[7] Henri Coppez,[8] and Morax and Elmassian.[4] The first two communications are very brief, and while suggestive, they cover too little ground to rank with the work either of Coppez or of Morax and Elmassian.

The contribution of Coppez contains an account of experiments made with a view of ascertaining more particularly the manner in which the toxins secreted in the conjunctival sac act upon the cornea. One can take as a typical disease diphtheria of the conjunctiva. He finds that the diphtheritic toxin acts upon the anterior surface of the cornea. The epithelium offers a certain resistance to the action of the toxin, but when the former breaks down the cornea undergoes rapid changes. Anything now which produces a lesion of the anterior surface of the cornea would aggravate the trouble. For example, the epithelium can be injured by the very act of making applications to the eye in the course of the treatment; the constant brushing of the cornea by the false membrane on the upper lid can easily produce a disturbance in the corneal epithelium; and, finally, the action of the toxin itself upon the epithelium, which is often macerated after about forty-eight hours.

Contrary to the results of Gosetti and Iona,[9] the experiments of Coppez demonstrate that the tears have no antiseptic influence upon the diphtheria bacillus. The toxin of diphtheria has a real action upon the cornea.

The streptococcus toxin has very little action upon the cornea, and Coppez has shown that many of the phenomena observed by Bardelli in his experiments were due not to the toxins, but either to the bouillon or to the dead bodies of the microbes, or possibly to the substances which were added to the bouillon in order to kill the microbes. The pneumococcus toxin has also very little effect upon the cornea; and this is due not only, as Druault and Petit believe, to the peculiar or special resistance which the corneal epithelium offers to this toxin, but, above all, to the feebleness of the latter.

The toxins of the staphylococci, the effects of which have also been studied by Soloview and Molodorosky,[10] reproduce on a small scale pretty much the same lesions as the staphylococci themselves.

The most valuable study, however, up to 1899, was made by Morax and Elmassian,[4] and the results of their experiments were embodied in a communication made to the Ninth International Ophthalmological Congress at Utrecht, in August, 1899. These observers instilled into the rabbit's conjunctival sac the toxins of the gonococcus, of the Koch-Weeks bacillus, of the Morax-Axenfeld diplobacillus, and of the staphylococcus. Their work is far more comprehensive than any previous communication upon the subject. They were able to produce in rabbits a conjunctivitis by instilling into the conjunctival sac either a suspension of the dead organisms or the filtrate of these cultures. Of course, these organisms do not multiply in the conjunctival sac of the rabbit; and it is for this reason, as has been stated, that we only get negative results when we try to produce a conjunctivitis in this animal

by inoculating with exudates or infectious material taken from the human conjunctiva.

As regards the toxins of the organisms just mentioned, the experiments of Morax and Elmassian show that the ocular mucous membrane of the rabbit reacts under the influence of these toxins very much as does the human conjunctiva. These toxins do not seem to have much penetrating power, as prolonged contact is necessary in order to get the characteristic reaction. The reaction is not immediate, for there is always an interval of two or three hours between the commencement of the instillation and the moment of the appearance of the reactional symptoms. The different toxins do not seem to be characterized by the same kind of reactional symptoms. The reaction following the instillation of the gonococcus toxin was a little more persistent than that of either the Koch-Weeks bacillus or of the diplobacillus, while the toxins of none of these organisms produced so intense a reaction as the diphtheria toxin. These observers made thirty-eight experiments.

In October, 1899, a few weeks before I had seen either the work of Coppez or of Morax and Elmassian, I had commenced an experimental study along these lines. In a work of this character one would naturally select the toxins of those organisms which were known to be concerned in the production of certain ocular inflammations, as, for instance, the gonococcus, the diphtheria bacillus, and the pneumococcus. In addition to these organisms I experimented with the toxins of the staphylococcus aureus, micrococcus epidermidis albus, streptococcus pyogenes, bacillus coli communis, and bacillus xerosis, each of which, with the exception of the micrococcus epidermidis albus, has been placed on record at various times as being more or less concerned in producing inflammation of the eye in some form or other. For example, the staphylococcus aureus is related to a number of inflammatory conditions of the cornea and conjunctiva, being found on the margins of the lids in blepharitis and phlyctenular conjunctivitis. This organism is often found in blennorrhœa of the lacrymal sac, and in mixed infections in most corneal ulcers except in the so-called "pneumococcus ulcer" (serpent ulcer).

The micrococcus epidermidis albus is a less pathogenic organism than the preceding one; and while I can find no record which would indicate that it was the principal agent in an inflammation of the eye, I am of the opinion that under suitable conditions it is pathogenic, and that in many of our more common conjunctival and corneal troubles, to say nothing of post-operative inflammations, this organism plays a part.

The streptococcus pyogenes is sometimes the cause of corneal ulcer, and it is also concerned in various suppurative processes in the eye. This organism is not infrequently present in purulent dacryocystitis,

either alone or mixed with other bacteria, and there is a form of membranous conjunctivitis generally seen in children, and which is caused by the streptococcus, and known as streptococcus diphtheria of the conjunctiva.

The bacillus coli communis is on record as having caused panophthalmitis.[11] Groenouw[12] has observed this organism in catarrhal conjunctivitis of the newborn.

The xerosis bacillus, like the micrococcus epidermidis albus, is often found in the normal conjunctival sac, and, like the latter organism, probably plays a part in many of the inflammations in this locality.

The toxins were obtained by filtration, though sometimes the dead cultures were used.

I have divided this work into four parts: Part I. The effect produced by toxins when they are instilled into the conjunctival sac. Part II. The effect produced by toxins when they are injected into the conjunctiva. Part III. The effect produced by toxins when they are injected into the anterior chamber. Part IV. The bacteriology of the normal conjunctiva of the rabbit, based upon an examination of forty-seven cases.

Part I. The Effect Produced by Toxins when they are Instilled into the Conjunctival Sac.

Technique. The filtrate was obtained as follows: An inoculation was made from a pure culture of the organism into an Erlenmeyer flask which contained bouillon free of sugar. It is necessary for the bouillon to be free of sugar, as the presence of the latter has been shown to inhibit more or less the production of toxins. The inoculated bouillon is placed in the incubator and allowed to remain there for at least two weeks.

It is well that this amount of time be allowed for the growth of the organisms, for in this way we obtain a filtrate which is much richer in the so-called products of these organisms.

Cultures and cover-slips are then made from this mixture to see whether the original organism is present in pure culture. If these two tests result satisfactorily the fluid is passed through a Pasteur filter into a sterile Erlenmeyer flask. Inoculations are made from this filtrate on "slant agar," and both the tube and the filtrate are placed in the incubator. If at the end of three days there is no growth in the agar, and the filtrate has remained perfectly clear, the evidence is sufficiently conclusive that the filtrate contains no bacteria.

The animal is wrapped up tightly in a towel, which is carried up well around the neck, and in this position the rabbit can be kept absolutely quiet.

When the experiment lasted longer than two hours the animal was allowed to move about on a large table which was free of obstructions, and here the chances of infection were slight as compared to the chances of infection when in either a large cage or in the enclosure with the other animals.

A long sterilized dropper was used to instil the filtrate into the conjunctival sac, and when it was not being used it was kept in a vessel of sterile water.

In those experiments which lasted for two hours and less the conjunctival sac was kept full of the filtrate all the time. When the animal was allowed to run around on the table the instillations were made every few minutes, and in this way the experiment could be started at 8.30 in the morning, and, with the exception of the hour between 12 o'clock and 1 P.M., kept up until 5.30 in the afternoon. None of the experiments lasted longer than eight hours, and the shortest time was fifteen minutes. The animal was kept under the closest observation for two days after the experiment, and anything approaching a reaction was noted. Such, then, was the technique of the experiments performed in this division of the work.

Gonococcus Toxin. According to Christmas,[13] the gonococcus toxin is found partly in the body of the organism and partly dissolved in the culture medium. It is albuminoid in character, soluble in glycerin, precipitated by strong alcohol, and is destroyed by any considerable exposure to a high temperature. It is possible to produce immunity in animals by inoculating with increasing doses. Wassermann[14] is of the opinion that the toxin is confined to the body of the organism, and that no toxic products are found in the culture medium. He thinks that feeble traces of a toxin in the medium indicate that this toxin has diffused from the dead bodies of the bacteria. He was unable to produce immunity in animals.

Nicolaysen[15] found that the body of the gonococcus contained a toxin which in small doses would kill a mouse, but his filtered cultures appeared to be inert.

Laitinen[16] found only slight evidence of a toxin in the body of the organism. He holds that the filtered culture contains no toxic substance; at any rate, it is so feeble as not to be distinguishable in its effects from those of the culture medium.

Schaeffer[17] seems to be the only one besides Christmas who obtained toxic cultures. He found that the injection of cultures freed of the organisms into the human urethra produced an acute inflammation accompanied with a purulent discharge. He does not seem to have studied the effect of this toxin upon animals. I may add that the inflammatory reaction following the injection of the dead organisms into the urethra has been studied by Panichi[18] and by Scholtz.[19]

It will be seen from this that several investigators failed to get cultures which contained a soluble toxin. Christmas says that this is due to the fact that defective media were employed, and he has shown that slight differences in the composition of the medium and slight deviations in temperature are sufficient to render a culture atoxic.

The observations of Christmas are fully borne out by my experiments, and I am convinced of the existence of a toxin in the filtrate from a gonococcus culture. This fact is brought out very forcibly in the experiments where the filtrate was injected into the conjunctiva. (Part II.)

I stated that the dead cultures of the organisms were used in only a few instances, and in such cases the growth was always on "slant agar" (two parts plain sugar and one part hydrocele fluid). When the growth was eight days old its surface was covered with about an inch of chloroform, which was not poured off for twelve hours. Six hours later, when every trace of the chloroform in the tube had evaporated, the growth was scraped off and mixed up in a test-tube with sterile water or with sterile bouillon. When the filtrate was used the culture medium consisted of one part bouillon and two parts hydrocele fluid.

Case I.—White rabbit. Instillations of dead cultures mixed with sterile bouillon into the conjunctival sac of both eyes. This was kept up for fifteen minutes, during all of which time the conjunctival sacs were more or less full of the bouillon. *No reaction.*

Case II.—White and gray rabbit. Both eyes. Instillations lasted for one hour. *No reaction.*

Case III.—White and black rabbit. Instillations lasted for one and a half hours. *No reaction.*

Case IV.—White rabbit. Instilled filtrate of gonococcus culture into right eye continuously for two hours. *No reaction.*

Case V.—Same rabbit. Instilled filtrate into left eye for three hours. *No reaction.*

Case VI.—Gray rabbit. Here the instillations lasted for five hours, at the end of which time there was decided ocular and palpebral congestion. The instillations in this case were kept up for seven hours, and at the end of this time there was conjunctivitis and slight mucopurulent discharge. A repetition of this experiment in the other eye gave *a negative result.*

Case VII.—Gray rabbit. Instilled dead organisms suspended in sterile bouillon into right eye for eight hours. *No reaction.*

At first sight it would appear to be possible to cause a reaction with the gonococcus toxin if the instillations were sufficiently prolonged; but I was unable to repeat this result, and I am led to think that other causes must have co-operated to produce the conjunctivitis. Very probably a tear was made in the conjunctiva during the instillations. It will be observed in the experiments immediately following this one

that the instillations were kept up for the same length of time, but with negative results. (See last half of Case VII. and also Case VIII.)

Staphylococcus Aureus Toxin. It will be remembered that the statement was made that in inflammations of the eye this organism was generally found associated with other organisms, and that it occurred in such affections as phlyctenular conjunctivitis, blennorrhœa of the lacrymal sac, and in mixed infections of the cornea. I have never met with a conjunctivitis where there was reason to believe that this organism by itself caused the inflammation.

It has been shown by van de Velde,[20] Kraus,[21] von Lingelsheim,[22] and Neisser and Wechsberg[23] that a soluble toxin—the so-called staphylotoxin—is secreted by the pyogenic staphylococci, the most interesting property of this toxin being its power to dissolve red and white blood corpuscles.

Case I.—Gray rabbit. Instillations into the right eye for fifteen minutes, during which time the toxin was constantly in contact with the conjunctiva. *No reaction.*

Case II.—Black and white rabbit. Right eye. Instillations lasted for one hour, and during this time the filtrate was continuously in contact with the conjunctiva. *No reaction.*

Case III.—White and gray rabbit. Right eye. Here the instillations were kept up for two hours, and with absolutely *no reactional symptoms.*

Case IV.—Same rabbit. Left eye. Instillations kept up for five hours. *No reaction.*

Case V.—Black and white rabbit. Left eye. Instillations continued for eight hours. *No reaction.*

Case VI.—Gray rabbit. Dead organisms suspended in sterile bouillon. Instillations kept up for eight hours. *No reaction.*

It will be seen, then, from this series of experiments that the instillation of the staphylococcus filtrate into the conjunctival sac, even when the instillations are kept up for eight hours, is followed by no reaction.

Diphtheria Toxin. I need not recall the fact that the etiology of probably the gravest of conjunctival affections (diphtheritic conjunctivitis) is bound up in the Klebs-Löffler bacillus. The sugar-free bouillon, in which medium all of my bacteria were cultivated, is, according to Spronck and Theobald Smith, a particularly suitable medium for the production of the diphtheria toxin.

Case I.—White rabbit. Right eye. The conjunctival sac was practically full of the filtrate for fifteen minutes. *No reaction.*

Case II.—Left eye of the same rabbit. The instillations were kept up for one hour, with *no reaction.*

Case III.—White and gray rabbit. Right eye. Instillations were kept up for two hours. *No reaction.*

Case IV.—Black rabbit. Right eye. The instillations were kept up for five hours. *No reaction.*

Case V.—Same rabbit. Left eye. Instillations continued for eight hours, with *no reaction.*

Case VI.—Gray rabbit. Right eye. Instillations of dead organisms suspended in sterile bouillon for eight hours. *No reaction.*

Streptococcus Toxin. Case I.—Instillations for half an hour into the right eye of a white and black rabbit. During all this time the filtrate was in contact with the conjunctiva. *No reaction.*

Case II.—Same rabbit. Instillations for two hours into the left eye. *No reaction.*

Case III.—White rabbit. Right eye. Instillations for three hours, with absolutely *no reaction.*

Case IV.—Same rabbit. Instillations for four hours into the left eye, with *no reaction.*

Case V.—Gray rabbit. Right eye. Instillations for five hours. *No reaction.*

I cannot say that I was surprised at the results of the experiments in this series, for we know that subcutaneous injections of the organisms into rabbits and mice are, as a rule, without either local or general manifestations of importance. The organism is not particularly pathogenic for animals.

Bacillus Coli Communis Toxin. This is another organism which is not supposed to possess a soluble toxin, and which in this respect resembles the gonococcus and the pyogenic cocci. It may be interesting to recall a very recent communication by Victor C. Vaughan,[24] of Ann Arbor. This observer in his study of the bacterial toxins devoted a good deal of time to the bacillus coli communis. He finds that the toxin is contained within the cell, from which it does not, at least under ordinary circumstances, diffuse into the culture medium, and that it is not extracted from the cell by alcohol, by ether, or by dilute alkalies. The unbroken germs may be heated to a high temperature with water without destruction of the toxin, and the same result follows boiling with a 0.2 per cent. aqueous solution of hydrochloric acid; but when the acid is increased from 1 to 5 per cent. the cell wall is broken up and the toxicity lessened, but not destroyed.

The toxin separated from the cell wall by digestion of the latter with hydrochloric acid and pepsin is markedly active.

It will be remembered that this organism has been discovered in pure culture in a case of panophthalmitis, and that several observers report its occurrence in unusual forms of conjunctivitis.

Case I.—Gray rabbit. Right eye. Instillations lasted for fifteen minutes, and the contact was constant. *No reaction.*

Case II.—Same rabbit. Left eye. Instillations for one hour. *No reaction.*

Case III.—Black and white rabbit. Instillations for two hours into the right eye, and during this time the contact of the filtrate with the conjunctiva was constant. *No reaction.*

CASE IV.—Same rabbit. Left eye. Instillations kept up five hours. *No reaction.*

CASE V.—Left eye of rabbit used in Case I. Instillations kept up for eight hours. *No reaction.*

A negative result, then, was obtained in every case in this series. Even when the instillations are kept up practically all day the conjunctiva gives no evidence of inflammation.

Pneumococcus Toxin. CASE I.—White rabbit. Right eye. Instillations kept up for fifteen minutes. *No reaction.*

CASE II.—Same rabbit. Left eye. Instillations for one hour, with *no reaction.*

CASE III.—Black rabbit. Right eye. Instillations for three hours. Absolutely *no sign of reaction.*

CASE IV.—Same rabbit. Left eye. Instillations kept up for five hours, with the *same result as in Case III.*

Micrococcus Epidermidis Albus Toxin. This organism has been found by a number of observers in the normal conjunctiva, and by Randolph[1] eighty-eight times out of a hundred individuals whose conjunctivæ were examined.

CASE I.—White rabbit. Right eye. Instillations for one hour, during which time the contact was constant. *No reaction.*

CASE II.—Same rabbit. Left eye. Instillations for two hours. *No reaction.*

CASE III.—Black and white rabbit. Instillations into both eyes for three hours. *No reaction.*

CASE IV.—Same rabbit. Instillations into right eye for seven hours. *No reaction.*

As might have been expected from the results obtained in the preceding series, I was unable to get a conjunctivitis by prolonged instillations with the filtrate of this organism.

Xerosis Bacillus Toxin. This organism, which morphologically is so much like the diphtheria bacillus, is frequently found in the normal conjunctiva, and, like the white skin coccus, is no doubt concerned in many of the more common external eye inflammations.

CASE I.—Right eye. Instillations for one hour, during which time the filtrate was in constant contact with the conjunctiva. *No reaction.*

CASE II.—Same rabbit. Left eye. Instillations for two hours. *No reaction.*

CASE III.—White and gray rabbit. Instillations for four hours into right eye. *No reaction.*

CASE IV.—Same rabbit. Left eye. Instillations for five hours. *No reaction.*

It will be seen that forty experiments were performed in this part of the work. In many instances the filtrate was kept in constant contact with the conjunctiva for hours, and only once did I succeed in exciting

a conjunctivitis (Case I., p. 783); and I think the interpretation which I gave of this case is probably the proper one—an interpretation which is strengthened by the uniformly negative results obtained in the other thirty-nine cases.

With the exception, then, of this case, the results of the instillations of the filtrates into the conjunctival sac are directly opposed to the results which were obtained by Morax and Elmassian.

Part II. The Effect Produced by Toxins when they are Injected into the Conjunctiva.

There is probably no part of the body which is as able to fight with infectious bacteria as the eye. When we consider how frequently the eyeball is wounded not only by accidents, but also by operative measures, and how comparatively seldom pathogenic infection results, we are forced to the conclusion that the eye must enjoy immunity to a high degree. This immunity or resistance to disease is partly accounted for, no doubt, by the exceptional activity of the leucocytes of the eye. This activity is remarkable in the case of the rabbit's eye, in which animal a considerable wound of the cornea will in twenty-four or forty-eight hours have vanished and left hardly a trace.

In our daily practice we often see the same thing to a less marked degree, and it suggests that the strength of the eye lies not only in the peculiar activity of its leucocytes, but also in the properties of its fluids, which are probably to some extent antibacterial. I need not bring forward evidence to show how much happier have been the issues from operations upon the eye since the advent of Listerism and of all that this word means. That goes without saying, but I think I am quite safe in saying that Listerism found no part of the body so well equipped to take care of its bacteria as the eye. While the mortality (if I may use the word) is less nowadays, the difference in this respect is much less startling than it is in the other fields of surgery.

It is perfectly clear from a study of the foregoing experiments that the rabbit's eye is quite able to withstand the harmful effects of the instillation of toxins upon its surface, no matter if these instillations are kept up practically all day. The question is, can this immunity of the eye nullify the effects of these toxins when they are injected into or have gained a foothold in the tissues?

Technique. The syringe and fixation forceps were boiled five minutes. The eye of the rabbit was anæsthetized with holocaine. The animal was always wrapped in a towel, as in the first series of experiments, in order to keep it immovable. The operation was apparently painless.

In the first place, the conjunctivæ of five eyes were injected with sterile bouillon, to see whether any reaction could be produced by the

medium. Varying quantities were injected, up to as much as a syringeful.

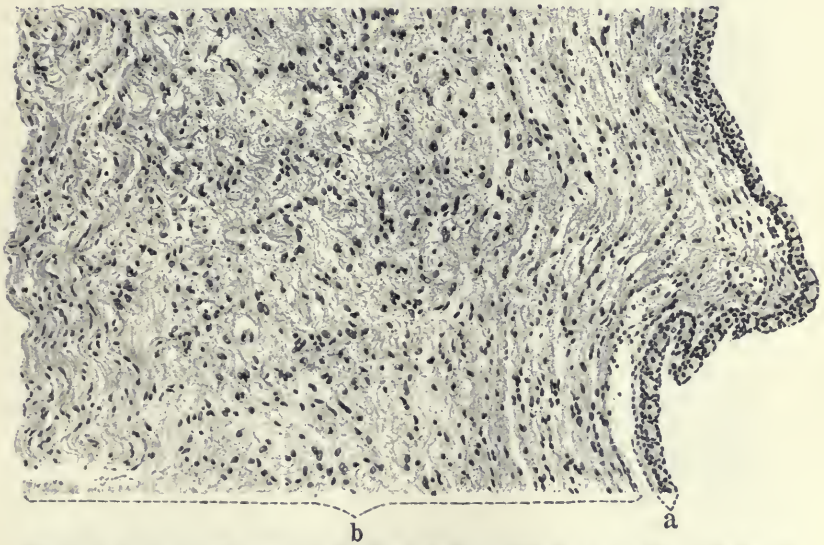
With the exception of one case in which there was some difficulty in penetrating the conjunctiva, and where there was, in consequence, bruising of the latter, there was no reaction. In the case mentioned it was noticed that the syringe leaked. It was withdrawn, and on inserting it again the conjunctiva was torn.

I always endeavored to make the injection at one point in the conjunctiva, which at this location at once puffed up and looked like a big blister.

The operations were performed in the afternoon, and the eyes were examined the next day at the same time.

There was no particular point selected for the injection, though usually it was made above the cornea, at about half an inch from the margin of the latter.

FIG. 1.



Section from the normal conjunctiva of the rabbit. (Zeiss, oc. 4; obj. a a. Enlarged 90 times.) *a*. Epithelial layer. *b*. Connective-tissue layer.

Gonococcus Toxin. CASE I.—Gray rabbit. Injected ten drops of filtrate into the conjunctiva of the right eye, and into the conjunctiva of the left eye the same quantity of sterile bouillon. The next day there was intense reaction in the right eye and no reaction in the other eye.

CASE II.—Gray rabbit. Right eye. Injected eight drops into the conjunctiva. The next day there was marked congestion of the upper half of the eyeball, much more intense at the point of penetration.

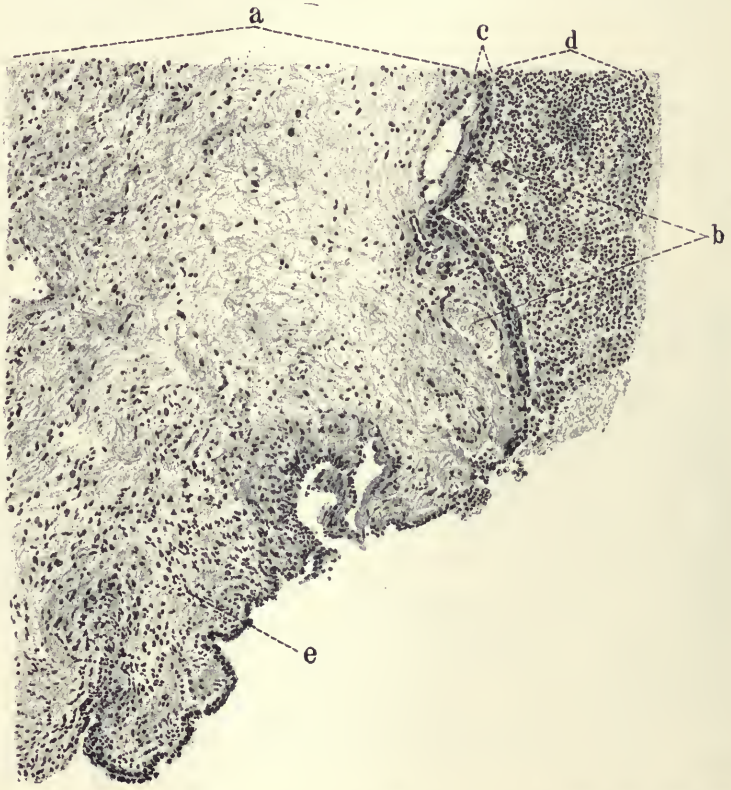
CASE III.—White and black rabbit. Right eye. Injected five drops

of the filtrate. Conjunctivitis possibly not so marked as in either of the last cases.

Case IV.—Same rabbit. Injected three drops of the filtrate. The next day a slight redness near point of injection, covering about a fourth of the globe.

Diphtheria Toxin. Case I.—White rabbit. Injected ten drops of filtrate into the conjunctiva of the right eye and ten drops of sterile bouillon into the left. At the end of twenty-four hours there was

Fig. 2.



Conjunctivitis. Gonococcus toxin. Case I. (Zeiss, oc. 4; obj. aa. Enlarged 90 times.) *a.* Connective-tissue layer. *b.* Distended bloodvessels. *c.* Epithelial layer. *d.* Large exudate resting upon the epithelial layer. *e.* Area in connective-tissue layer crammed with leucocytes and round cells.

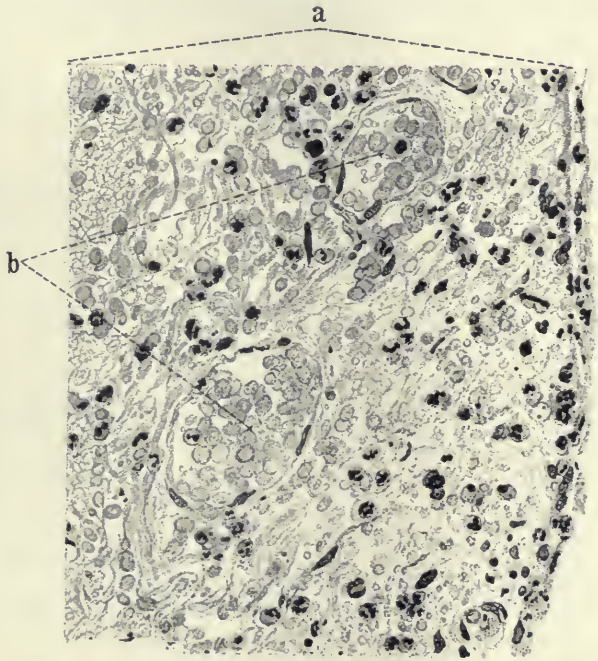
intense reaction in the right eye. There was an almost typical picture of diphtheritic conjunctivitis. The swelling of the lids was so great that the animal could not open its eye. When the lids were forcibly opened there was a welling up of a purulent discharge, and there was a strong suggestion of a membrane on the upper lid. The cornea was rather dull. The left eye, into which ten drops of sterile bouillon had been injected, showed no reaction. This was the only case in which I obtained a reaction which resembled the picture seen in the human being.

The same filtrate was used for an instillation experiment and the instillations kept up nearly all day, but with negative result.

Welch and Flexner have shown that the poison producing the false membrane is an intracellular one, and not the soluble toxin, so that a definite pseudomembrane is not to be expected after injecting the latter alone.

Case II.—White rabbit. Right eye. Injected eight drops of the filtrate. The next day there was marked conjunctivitis, with possibly a little excess of secretion.

Fig. 3.



Conjunctivitis. Intense hemorrhagic inflammation. Diphtheria toxin. Case I. (Zeiss, obj. D D; oc. 4; enlarged 420 times.) *a*. Connective-tissue layer which is very œdematous. Red blood corpuscles and polynuclear leucocytes may be seen everywhere throughout this section. *b*. Engorged bloodvessels.

Case III.—Same rabbit. One week later. Injected into left eye six drops of filtrate. Twenty-four hours later there was conjunctivitis which did not differ materially from the condition which was seen in Case II.

Case IV.—White and black rabbit. Left eye. Injected three drops of filtrate. The next day there was conjunctivitis which consisted in simple congestion of the upper half of the eyeball, with no discharge.

Pneumococcus Toxin. Case I.—White rabbit. Injected fifteen drops of filtrate into the conjunctiva of the right eye and the same quantity of sterile bouillon into the conjunctiva of the left eye. The next day the

right eye showed marked conjunctivitis which extended over the entire eyeball, while the result of the injection in the left eye was negative.

Case II.—Injected left eye of the same rabbit. Eight drops of filtrate were used. Twenty-four hours later conjunctivitis, with no increased secretion.

Case III.—White and black rabbit. Injected six drops of filtrate into the conjunctiva. The next day there was conjunctivitis which did not differ materially from the condition in the preceding case.

Case IV.—Same rabbit. Left eye. Injected three drops of filtrate. The next day there was redness of the conjunctiva near the point of the injection, but the inflammation in this case was very localized.

Streptococcus Toxin. Case I.—Injected fifteen drops of filtrate into the conjunctiva of the right eye and the same quantity of sterile bouillon into the conjunctiva of the left eye. Next day pronounced conjunctivitis, which was uniformly distributed. The left eye showed no change.

Case II.—Same rabbit. Few days later. Injected ten drops of filtrate into left eye. Conjunctivitis the next day. Possibly somewhat less marked than in the preceding case.

Case III.—White rabbit. Injected ten drops of filtrate into right eye. The next day conjunctivitis, which was pretty uniformly distributed.

Case IV.—Same rabbit. Left eye. Injected eight drops of filtrate. Next day there was conjunctivitis which differed very little from the reaction seen in Case III.

Case V.—White and black rabbit. Right eye. Injected five drops of filtrate. Next day there was slight conjunctivitis.

Staphylococcus Aureus Toxin. Case I.—White rabbit. Injected into the right eye fifteen drops of filtrate. The next day there was marked conjunctivitis which differed in no respect from the conjunctivitis which was seen in Case I. in the preceding series. The other eye, into which the same quantity of sterile bouillon was injected, showed no reaction.

Case II.—White and gray rabbit. Injected ten drops of filtrate into right eye and the same quantity of sterile bouillon into the left eye. The next day the right eye showed conjunctivitis. There was also some congestion of the left eye, but I am disposed to attribute the reaction in this eye either to bruising of the tissues or to some accidental infection which occurred after the experiment.

Case III.—Same rabbit. One week later. Injected eight drops of filtrate into left eye. The next day there was conjunctivitis, but not nearly so marked as in Case I.

Case IV.—White and black rabbit. Right eye. Injected five drops into the conjunctiva of this eye and five drops of sterile bouillon into the conjunctiva of the left eye. Slight conjunctivitis in the right eye and no reaction in the left eye.

Bacillus Coli Communis Toxin. Case I.—Black rabbit. Injected fifteen drops of filtrate into the right eye and the same quantity of sterile bouillon in the left. The next day there was almost as intense a reaction in the right eye as was seen when ten drops of the gonococcus and diphtheria toxins were used. The left eye showed no reaction.

Case II.—Same rabbit. Left eye. Injected ten drops into the conjunctiva. The next day there was quite a marked conjunctivitis.

Case III.—White and black rabbit. Right eye. Injected eight drops of filtrate. The next day there was conjunctivitis not differing materially from what was seen in the preceding case.

Case IV.—White rabbit. Injected three drops into the conjunctiva of left eye. The next day there was slight congestion in the upper half of the eyeball, more marked near the point of the injection.

Xerosis Bacillus Toxin. Case I.—White rabbit. Injected fifteen drops of filtrate into the right eye and fifteen drops of sterile bouillon into the left. The next day there was marked conjunctivitis in the right eye and no reaction in the left eye.

Case II.—Same rabbit. Left eye, a few days later. Ten drops of filtrate injected. Conjunctivitis, but less marked than in the preceding case.

Case III.—White rabbit. Injected into the right eye five drops of filtrate. Next day there was conjunctivitis not differing materially from Case II.

Micrococcus Epidermidis Albus Toxin. Three experiments were performed in this series, and they resulted practically as did those in which the xerosis bacillus was employed.

It will be seen that thirty-one experiments were performed in this series, with a positive result in every case—a marked contrast to the results which were obtained in Part I.

I have more than once recalled the fact that several of the organisms with which I have experimented are not supposed to produce soluble toxins. The uniformly positive results which were obtained in Part II. suggested that possibly the effect produced was due to the presence in the filtrate of some of the so-called bacterio-proteins described by Buchner, and which are distinctly irritating. These products are incorporated in the substance of the bacterial cells, and are set free especially from degenerated or dead bacteria. The older a culture the greater the number of dead or degenerated bacteria which it contains. It is evident, then, that these bacterio-proteins are more abundant in a culture say of two weeks' growth than in one which is only twenty-four hours old. It will be remembered that my cultures were usually allowed to remain undisturbed for two weeks, as in this time I obtained a more concentrated culture, and consequently a more satisfactory filtrate.

To eliminate to a considerable extent the agency of these bacterio-proteins the cultures were filtered when they were only twenty-four hours old. Five experiments were made with a filtrate of this character.

Case I.—White rabbit. Ten drops of filtrate were injected into the conjunctiva of the right eye. Same quantity of sterile bouillon was injected into the conjunctiva of the left eye. The next day there was a well-marked redness of the right eyeball, while the left eye showed no change. The toxin in this case was of *staphylococcus pyogenes aureus.*

Case II.—*Same Toxin.* Same rabbit. Left eye. Ten drops of filtrate were injected. The result was the same as in Case I.

Bacillus Coli Communis. Case I.—White and gray rabbit. Right eye. Injected ten drops of filtrate into the conjunctiva. A decided conjunctivitis followed.

Case II.—Same rabbit. Left eye. Ten drops of filtrate were injected into the conjunctiva. Next day there was a slight conjunctivitis.

Diphtheria Toxin. Case I.—Black rabbit. Right eye. Injected ten drops of filtrate into the conjunctiva and the same quantity of sterile bouillon into the conjunctiva of the other eye. There was a conjunctivitis in the right eye the next day and slight redness of the fellow eye, which latter condition I interpreted as being due, in all probability, to some mechanical injury of the conjunctiva at the injection.

It will be seen from this that the elimination to a large extent from the filtrate of the bacterio-proteins had scarcely more than an appreciable effect upon the character of the reaction. In these last five cases the congestion of the conjunctiva was possibly a little more localized around the point of the injection than was the case in the other experiments of this division of the work, and this we might interpret as being due in part to the feebler concentration of the culture as well as to the smaller quantity of bacterio-proteins.

Part III. The Effect of the Toxins when they are Injected into the Anterior Chamber.

The following was made as a control experiment: A Graefe cataract knife was passed into the cornea at its upper scleral border. Through this incision ten drops of sterile bouillon were injected into the anterior chamber. The next day, with the exception of a very small hernia of the iris and three or four vessels grouped at the point of the wound, the eye was normal. On the second day the congestion had entirely disappeared, but the slight irregularity in the pupil persisted, and this is due to the incarceration of the iris in the lips of the incision, and it will never disappear. There was, however, not the slightest sign of an iritis.

The following experiments were then made:

Gonococcus Toxin. Case I.—White rabbit. Right eye. Anterior chamber was opened as in the preceding case and five drops of the filtrate injected from a hypodermic syringe. The next day there was pericorneal congestion, which was more marked at the point of the incision. The aqueous was slightly cloudy. Iritis. In seven days the symptoms had entirely disappeared.

Diphtheria Toxin. Case II.—Same rabbit, ten days later. Left eye was utilized. An incision was made in the usual manner above, just as we do in a cataract incision, except that the incision in the experiment is, of course, much smaller. Ten drops of the filtrate were injected through this incision into the anterior chamber. The next day there was a very intense iritis, showing itself in practically the same symptoms as in Case I. The eye had cleared up in a week.

Bacillus Coli Communis Toxin. CASE III.—Gray rabbit. Injected ten drops of filtrate into the anterior chamber above. Next day there was iritis, with the usual symptoms.

Pneumococcus Toxin. CASE IV.—Gray rabbit. Left eye. Injected into the anterior chamber ten drops of the filtrate. In twenty-four hours there was iritis, which did not differ materially from what was seen in Case II.

Staphylococcus Aureus Toxin. CASE V.—White and black rabbit. Right eye. Ten drops of filtrate were injected into the anterior chamber. Result was the same as in the last two cases.

Micrococcus Epidermidis Albus Toxin. CASE VI.—Ten days later fifteen drops of the filtrate were injected into the anterior chamber of the left eye. I saw no material difference in the reaction from that in the preceding case.

At first sight one would suppose that the reaction in experiments of this character would be more intense, more destructive than when the injection was made into the conjunctiva. The absence of panophthalmitis and closed pupil is explained by the fact that some at least of the filtrate oozed out of the anterior chamber. As long as the wound was open, and no doubt it remained so for several hours, there was more or less oozing. The filtrate which remained was certainly considerably diluted by the rapidly regenerating aqueous, so the toxin in its original condition remained for a very brief space of time in the anterior chamber, but quite long enough to light up inflammation; and no doubt is left in my mind that had I injected the toxin through a needle-hole opening right into the anterior chamber serious results would have followed, for in this case the tension of the eye would have been markedly increased, and the toxin would have been retained.

In the conjunctival injections the needle-hole closed on withdrawing the needle, and there was apparently no oozing, the bleb remaining for some little time after the experiment.

We have evidence enough to show, then, that the filtrate from the cultures of the organisms which were used in these experiments is sufficiently irritating to set up inflammation in the conjunctiva and in the iris. That the bacteria in the rabbit's conjunctiva play a part in this inflammation is almost certain. The effect of the toxin is simply to irritate, and in this way to lessen local resistance. We know that the normal human conjunctiva is rarely if ever free of bacteria, several of which have very slight pathogenic properties, but that when an irritant is applied to the eyeball the conditions are at once produced under which these very organisms become pathogenic and do harm

Mention has been made of several works upon the bacteriology of the normal human conjunctiva; but, so far as I know, no work has been done upon the bacteriology of the rabbit's conjunctiva—an important omission when we consider that practically all of the experimental work of the ophthalmologist is done upon the rabbit's eye.

It has occurred to me, in this connection, to make an examination of the normal conjunctiva of the rabbit, to see whether its bacteriology resembles that of the human conjunctiva, and this brings me to Part IV.

Part IV. The Bacteriology of the Normal Conjunctiva of the Rabbit Based upon an Examination of Forty-seven Cases.

The technique consisted in rubbing a rather large, sterile platinum loop over the conjunctiva of the eyeball, and carrying it well into the conjunctival sac, from which points inoculations were made into the fluid agar. Plate cultures were always made.

1. Two whitish, well-defined colonies; both micrococci.
2. Two colonies; one evidently an impurity, the other a micrococcus.
3. One colony; micrococcus, which was like the coccus found in 1 and 2.
4. One colony; similar to 3.
5. Several small colonies; whitish; all proved to be micrococci.
6. Coccus similar to preceding; a large bacillus.
7. Plate was covered with small colonies; micrococcus like 1 and 2.
8. Several colonies. The large colored ones proved to be a big bacillus. There was a streptococcus colony; also a micrococcus similar to 1 and 2.
9. Four colonies, all of which were micrococci.
10. Two colonies; one proved to be a bacillus, the other a micrococcus.
11. Micrococcus, like the preceding; also a large, yellowish colony, proving to be a big bacillus.
12. A colony which covered a large area, proving to be a big bacillus; also a micrococcus.
13. Several yellowish colonies; bacilli of different sizes.
14. Several yellowish colonies, which proved to be a short bacillus; also a number of whitish colonies, which were micrococci like 1 and 2.
15. A number of colonies; all micrococci like those seen in 14.
16. Abundant growth; micrococci like the preceding.
17. Abundant growth; micrococci like the preceding.
18. Several colonies; micrococci like the preceding.
19. Two colonies, one of which was a large bacillus and the other a large coccus.
20. One large colony, which proved to be a large coccus, and several smaller colonies, which proved to be micrococci like those frequently seen in preceding cases.
21. Several colonies; micrococcus.
22. Several colonies; micrococcus.

23. One colony; micrococcus.

24. One large colony, which proved to be a big, short bacillus.

25. Several colonies; micrococci like those in 1 and 2.

26. Several colonies; micrococci like preceding. There was a yellowish colony in this plate, but an examination of the organism showed it to be a micrococcus not differing morphologically from the other coccus.

27. Two colonies, one whitish and the other yellowish-white; micrococci which did not differ morphologically.

28. Nothing grew in this plate.

29. One large colony, covering half the plate, which proved to be the bacillus subtilis. There were other small colonies in this plate, some of which were micrococci like 1 and 2, and others were very small bacilli.

30. Three colonies, which proved to be very fine bacilli.

31. Several colonies. One was a large coccus and the others were short bacilli.

32. A number of colonies which were sharply round and white, some consisting of a large coccus, and others were micrococci.

33. Several colonies, consisting, for the most part, of diplococci and large cocci.

34. Two colonies; both diplococci.

35. Several colonies; micrococcus like that in 1 and 2; fine streptococcus.

36. Micrococcus similar to 1 and 2.

37. A number of colonies, consisting for the most part of micrococci like those in 1 and 2; also a fine streptococcus.

38. A number of colonies; micrococci like 1 and 2.

39. Rather large coccus. A number of other colonies, which were micrococci like 1 and 2.

40. Two colonies. One was a large coccus, while the other was a micrococcus like 1 and 2.

41. A number of colonies, most of which were micrococci like 1 and 2. There was also a growth which proved to be a fine streptococcus.

42. Large number of colonies which proved to be a big coccus, and one colony which was a fine streptococcus.

43. One colony; micrococcus like 1 and 2.

44. Several colonies; large coccus; micrococcus like 1 and 2.

45. Number of colonies; same micrococcus as in 1 and 2.

46. Number of colonies; same micrococcus as in 1 and 2.

47. Number of colonies; same micrococcus as in 1 and 2.

From a study of these cases it appears that the normal conjunctiva of the rabbit contains quite a variety of bacteria. There was more often found, however, a micrococcus which proved to be the staphylococcus

albus. This organism occurred in thirty-six out of the forty-seven cases (1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 14, 15, 16, 17, 18, 20, 21, 22, 23, 25, 26, 27, 29, 32, 35, 36, 37, 38, 39, 40, 41, 43, 44, 45, 46, 47).

The staphylococcus albus, as we know, is feebly pathogenic; but given sufficient irritation it can and often does produce inflammation, and it is reasonable to presume that this organism was frequently concerned in causing the conjunctivitis and iritis recorded in Parts II. and III.

At any rate, the normal conjunctiva of the rabbit, like the normal human conjunctiva, is probably never sterile. In only one case (Case XXVIII.) was there a sterile plate.

Epicritical Observations. The foregoing experiments are of interest in several respects. The forty experiments recorded in Part I. indicate that simple contact of bacterial toxins with the normal conjunctiva produces no local inflammation or other injury to the animal. This is in accordance with what is already known concerning the behavior of this class of poisons when applied to other intact mucous surfaces. Unlike alkaloidal and many other kinds of poisons, the chemically undefined toxins produced by bacterial cells, as well as similar toxins produced by certain cells of higher plants (ricin, abrin) and of animals (snake venom), are in general incapable of absorption from intact mucous surfaces, although before the present series of experiments this had not been satisfactorily demonstrated in the case of the conjunctival mucous membrane.

Not only are the toxins not absorbed under these circumstances, but they do no damage to the intact epithelium. In fact, it is probably this absence of local injury induced by the bacterial toxins which explains the lack of absorption of the toxins. That there are special epithelio-toxins capable of damaging epithelial cells has been demonstrated by von Dungern[25] and others, but such specific toxins for epithelium have not been discovered in filtrates of bacterial cultures. We know, however, that certain bacterial toxins, notably the diphtheria toxin, may act injuriously upon previously altered epithelial cells, and further investigations may show the existence of bacterial toxins capable of directly injuring intact epithelium.

The experiments recorded in this paper, therefore, indicate the great importance of integrity of the epithelial surfaces in protecting against local and general injuries from toxins secreted by bacteria. We were already familiar with this protective influence in guarding against local and general infections by the bacteria themselves, although there are bacteria which can attack the normal epithelium. Inasmuch as bacteria in general are more virulent when they are accompanied by their toxins at the time of their invading the animal body, it seemed important to determine, as has been done in this paper, the action of

the toxins separated from the bacteria upon the intact conjunctival membrane.

To what extent the protection afforded by intact epithelium against bacterial toxins is purely mechanical, or is due to incapacity of the toxin to enter into a chemical union with the epithelial cell in the sense of Ehrlich's "side-chain" theory or to other causes, I have not attempted to determine. When, however, the toxin has gained access to the subepithelial tissues we find the conditions entirely different.

The numerous experiments recorded in Part II. demonstrate that filtrates from both young and old cultures of all the various bacterial species used contain some irritative poison capable of setting up local inflammation when these filtrates are injected into the substance of the conjunctival mucous membrane. Certain of the bacterial species employed produced more powerful irritative poisons than others, the strongest of these toxins being found, in the present experiments, in cultures of the gonococcus, the diphtheria bacillus, and the colon bacillus, but notable effects were obtained with cultures of the pyogenic micrococci.

That the substances concerned in producing these local inflammations are specific products of the bacteria, and are not attributable to ingredients of the original culture media, was abundantly demonstrated by the fact that control injections of the uninoculated culture media even in much larger doses were entirely without any injurious effect.

It is possible that bacteria normally present in the rabbit's conjunctival sac may have participated in causing the inflammations which regularly followed the injections of the toxins into the conjunctival membrane. In Part IV., I have shown that the normal conjunctival sac of the rabbit contains a variety of bacteria, and that among these a white staphylococcus resembling if not identical with the staphylococcus albus (staphylococcus epidermidis albus) is common. But the primary and essential damage is that which is inflicted by the toxin, as the control experiments show; and if bacteria were secondarily active it is because the soil was prepared for them by the damage done to the cells and tissues by the toxins.

I can readily understand that such ordinarily harmless bacteria as the white staphylococcus or other common bacterial inhabitants of the conjunctival sac may gain a foothold and multiply in tissues whose vital resistance has been impaired by the previous action of toxins.

After it had been determined that bacterial toxins introduced into the connective tissue of the conjunctiva cause inflammation it was not surprising to find that a similar result followed the injection of the same toxins into the anterior chamber of the eye, as is demonstrated by the experiments recorded in Part III.

There is another aspect of the experiments which is of considerable interest. Filtrates were used from cultures not only of bacteria known to produce powerful soluble toxins, but also of those not before positively known to secrete soluble toxins. Inasmuch as we have at present no means of determining whether a given bacterium secretes a toxin or not, except by the biological test, it has been generally assumed that when this test fails there is no evidence of the existence of such a toxin. But it may be asked whether in all instances sufficiently delicate tests have been made?

The need of caution in drawing conclusions in this matter is made evident by the interesting experiments of Kraus,[26] who has shown that specific soluble bacterial products previously unsuspected are present in the fluid cultures of the typhoid bacillus, the cholera bacillus, and other bacteria, and can be revealed by the action of the homologous antiserum. That toxins may have peculiar specific effects upon certain cells, and that these effects may be of such a nature that they are readily overlooked until careful search is made for them, has been shown by the discovery in recent years of the various cytolysins produced by the pyogenic staphylococci and the tetanus bacillus.

It is from this point of view of interest that all of the bacteria which I employed were demonstrated to produce toxins capable of causing injury and inflammation of the tissues of the conjunctiva. Injection into the eye, particularly into the substance of the conjunctiva, would seem, therefore, to make a more delicate biological test for the recognition of certain toxins than the tests which have usually been employed to determine this point. That the toxins concerned were not simply the so-called bacterio-proteins of Buchner, derived from degenerated and macerated bacterial cells, was proven by the determination of the toxicity of young cultures.

The experiments recorded in this paper are in harmony with clinical experience, and they shed some light upon questions of clinical interest. We know that in a large proportion of cases of infectious inflammations of the eye a lesion of continuity is demonstrable or can reasonably be inferred. This lesion is now shown to be important not only in opening a path for the invasion of bacteria and in weakening the local vital resistance to bacteria, but also in permitting the entrance of toxins which constitute the weapons by which the bacterial cells do injury. Without this opportunity for the penetration and action of toxins even highly virulent bacteria may be harmless, as has been shown in the case of the tetanus bacillus, and with this opportunity bacteria of even very weak virulence, such as the common white staphylococcus, may be pathogenic. In support of these views I need not dwell upon conditions where the injury is manifest, as in postoperative inflammations, penetrating wounds of the eyeball, serpent ulcer, etc. I am of the

opinion that many cases of gonorrhœal ophthalmia and of "pink eye" are produced not by the simple introduction of the specific bacterium into the healthy conjunctival sac, but by the bacterium acting upon a conjunctiva slightly injured, even if the injury be no more than the slight abrasion of the conjunctival epithelium which may result from rubbing the eyes with the fingers. I have seen in the last two years two cases of gonorrhœal ophthalmia resulting from the spurting of fluid from a pyosalpinx into the eye of the operator, and in each instance this accident was followed by violent rubbing of the eye, which would produce a lesion of the conjunctival epithelium.

How often we meet with gonorrhœal ophthalmia as a monolateral affection!—in fact, in the majority of cases. What a very common disease is gonorrhœa, and how comparatively infrequent is gonorrhœal ophthalmia!

It can hardly be otherwise than that the gonorrhœal virus often gains access to the conjunctival sac without setting up inflammation.

It must often happen in cases of highly infectious inflammations of one eye that the infectious germs are conveyed to the other eye without resulting injury. While every precaution should be taken to guard against such a contingency, it is probable that our protective measures are effective in many instances as much by preventing slight local abrasions as by the exclusion of the infectious bacteria.

We know that it is scarcely within the power of the surgeon to exclude absolutely all bacteria from wounds, and that in so-called aseptic wounds bacteria, sometimes even pathogenic forms, are present. Nothing is easier than the entrance of bacteria into the conjunctival sac, nor can we rid the sac entirely of micro-organisms. Whether or not bacteria there present do harm depends upon a number of circumstances, and among the most important of these circumstances is the condition as regards integrity of the conjunctival surface.

My experiments have demonstrated, I think, the importance of this factor in relation to toxins; and also that pathogenic bacteria, even those for which toxins had not previously been satisfactorily demonstrated, do harm through the action of specific soluble poisons.

What, then, is the conclusion of the whole matter?

1. Bacterial toxins, so far as tested, when instilled even for many hours into the healthy conjunctival sac were found incapable of producing inflammation or causing other injury.

2. The same toxins when injected into the tissue of the conjunctiva or into the anterior chamber invariably set up local inflammation, the extent and intensity of the inflammation varying to some degree, according to the species of bacterium yielding the toxin.

3. Bacteria which had not previously been proven to produce soluble toxins were found to produce them even in young cultures, and it is

suggested that injections of bacterial filtrates into the eye, particularly into the conjunctival tissue, constitute a more delicate biological test for the detection of certain toxins than the tests usually employed for this purpose.

4. The experiments recorded in this paper furnish additional examples, in a comparatively new field, of the importance of toxins in explaining the pathogenic action of bacteria, and likewise emphasize the etiological significance of injuries of the covering membrane of the eye in favoring the action of toxins and of bacteria.

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OSTEITIS DEFORMANS AND HYPEROSTOSIS CRANII. A CONTRIBUTION TO THEIR PATHOLOGY, WITH A REPORT OF CASES.

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of Boston.

The symptomatology and general features of osteitis deformans have been so exhaustively discussed in this country within a recent period in the monographs of Elting, Wilson, and Packard, Steele and Kirkbride, that I shall limit myself in this communication to a brief

description of two cases and to the question of its pathology. The last-named writers have not only contributed a valuable addition to our knowledge of the anatomical lesions, but also an important summary of the data furnished by sixty-six cases collected from the literature.

CASE I.—Mrs. M., aged forty-four years, was referred on November 1, 1901, to my clinic at the Boston City Hospital from the Eye Department, to which she had applied for impairment of vision, but the

FIG. 1.

CASE I. Osteitis deformans, aged 44 years, showing deformity of jaw, right forearm, kyphosis and temporal artery.

FIG. 2.

CASE I. Osteitis deformans, showing enlargement of parieto-occipital region, arterio-sclerosis, and deformity of radius, right arm.

ophthalmic records note only errors of refraction. She was referred to me for certain neuralgic pains in her head. The peculiar enlargement and deformity of the cranium and jaw were noticeable and led to a careful examination of the osseous system.

As to her previous history and the family history, they were practically negative. There were no evidences of syphilis. She had not had a pain or an ache referable to her present condition until April, 1901, when she had some dizziness (heart?), and a month later she

experienced some pain in her head. From May to October she was free from pain and all other symptoms excepting the impaired eyesight, for which she was fitted with glasses. On November 1st her symptoms were mild, and, such as they were, consisted of neuralgic

FIG. 3.

CASE I. Osteitis deformans; right radius, showing curvature.

pains in the head, tinnitus aurium and cardiac fluttering. Until two years ago she had never noticed any deformity of the bones—not until the curvature and enlargement of the right forearm were pointed out to her by a friend—and when first examined she was entirely uncon-

scious of the extreme deformity of the skull that exists and of the obtrusive bending and thickening of the bones of the legs.

On first inspection, aside from the asymmetry of the skull and jaw, the most noticeable peculiarity about her is the general degeneration of her physique. She looks much older than she is; she is short of

FIG. 4.

CASE I. Right femur. (The curvature and hypertrophy would be more apparent if the whole length of the bone were reproduced in the cut.)

stature, bent over, and has generally small, poorly developed muscles. There is a lack of color and vascularity of the skin, which has a dried and slightly yellow appearance. Physical degeneration is stamped upon her. She looks shrunken in height and development. On her temples enlarged and tortuous atheromatous arteries stand out and strike the eye. The heart is enlarged, the apex being one inch outside

the mammillary line, but in the fifth space, and its action is heaving. A systolic murmur is heard over the aortic valves and at the apex whither it is probably transmitted. The eyes are unusually prominent. (Figs. 1 and 2.)

Osseous System. The condition of the bones resembles in general that which has been frequently described in cases of osteitis deformans. The cranium is irregular and enlarged, although the hyperostosis is most obtrusive in the left parietal bone. The circumference of the fronto-occipital region is 61½ cm. The ramus of the jaw on the right is thickened and prominent to the eye; the spine is very slightly flexible, and has a marked kyphosis in the upper dorsal region. There is some deformity of the sternum from thickening; both clavicles are enlarged, the ribs thickened. The bones of the upper arms appear to be normal; but both radii, the right being the most affected, are thickened and curved, the bowing being outward. The last phalanges of the first and second fingers of both hands exhibit nodular thickenings and are distorted, being everted at an angle outward, giving the *impression of an osteo-arthritis.*

Coming to the lower half of the body, both femora are curved and greatly thickened, as are the tibiæ. As in the forearm, the right side is more largely affected than the left; the bones of the pelvis are also involved in the process. The photographs and skiagraphs show fairly well the conditions present. Examination of the blood failed to throw any light on the morbid process, showing simply a mild secondary anæmia.[1] Examination of the nervous system at this time was negative.

Since my last examination of this patient she entered the Massachusetts General Hospital, where she came under the observation of Dr. Fitz, who also has made a careful study of her condition. While in this hospital she developed delusions and other mental symptoms, and was removed to the Boston Insane Hospital, where she now is under the charge of Dr. Lane, who has kindly furnished me with notes of her present condition, which is that of a rather mild stupor, with some depressions and delusions.

The most interesting problems connected with this most interesting disease are its pathology and its relation to allied affections. The symptomatology has been adequately and exhaustively discussed within the limits of our present knowledge in the paper presented to this Association by Drs. Packard and Steele at the last meeting. It will be remembered that the basic and anatomical process in osteitis deformans as shown by the microscopic changes was summed up (but as I shall show incompletely) by these authors as follows:

"*a.* Absorption of the compact substance, causing enlargement and confluence of the Haversian canals.

"*b.* Formation of new bone, which runs diffusely through the affected and the adjacent healthy portions. This new bone remains uncalcified, and is in turn reabsorbed.

[1] White count, 3800; red count, 3,768,000; hæmoglobin, 65 per cent. Differential count: polymorphonuclear neutrophiles, 66 per cent.; small lymphocytes, 26 per cent; large lymphocytes, 6 per cent.; eosinophiles, 2 per cent.

"*c.* The conversion of the medullary substance into a vascular connective tissue containing fat cells, giant cells, and leucocytes.

"*d.* As a consequence of these three processes the ordinary relations of the compact substance and medulla are destroyed. The bones become exceedingly thickened and asymmetrical, but since the new bone tissue remains uncalcified its elasticity permits of great deformity of the long bones from the weight of the body, and fractures do not occur."

This summary is incomplete in that it neglects to take into account the important fact that often *calcification does take place in the new bone*, and then a different picture is presented.

Clinically considered, the disease resembles in the peculiar enlargement and deformity of the skull what has been noted and described in hyperostosis cranii, or leontiasis ossia, and although the two diseases are regarded as distinct, it is interesting to reconsider whether, after all, hyperostosis cranii may not be an incomplete development of the same process, and, therefore, the same disease. Putnam,[1] in his exhaustive and critical paper, in 1896, has already recorded one case of my own of hyperostosis cranii. I have now to report another interesting case, which in general appearance and certain other respects bears a most striking resemblance to the case of osteitis deformans I have just reported.

Case II.—The patient, Miss A., is sixty-three years of age, and looks about ten years older. Her general physical appearance is that of degeneration. She is short and considerably shrunken from her former height, due to the marked kyphosis in the cervico-dorsal region. The anterior borders of the ribs correspondingly approximate the pelvis. There is very marked arterio-sclerosis, which is particularly obtrusive in the temporal arteries, which stand out prominently tortuous and rigid, as in Case I. The eyes are rather prominent and the face thin. All the muscles of the body are extremely small, simulating a dystrophy. The arms, for example, would be small for a child. There are certain nervous symptoms of an atypical character. There is no paralysis, but a decided myasthenia. The gait is shuffling and unsteady, as if rather from a lack of confidence than from any real ataxia; deep reflexes are normal. There are no sensory disturbances. Her ideation is not normal, and yet it is not easy to give it a definite characterization. There is a tendency to fads, eccentricities, and fixed ideas. For example, she will not shake hands with anybody, on the theory that germs of disease are conveyed in that way. She is extremely difficult to influence, owing to her ideas, and she lives a life of exclusiveness; in other words, she presents what one meets with in arterio-sclerosis at times. The cranium is conspicuously enlarged, the hypertrophy of the bone being the most marked on either side in the parieto-occipital region. The frontal bone is also prominent. The head gives the impression of being too large for the face. The patient is not aware of this enlarge-

[1] The American Journal of the Medical Sciences, 1896.

ment of her head, but I am told that it has existed for some twenty years (?). The cervico-dorsal spine is rigid, as if ankylosed. The long bones are small, as if atrophic, like the muscles, but not bent abnormally. She is free from pain and other symptoms, excepting that she is slightly deaf. The eyes were not examined. It was difficult to obtain a complete examination, which was, therefore, somewhat limited, and not as thorough as could be wished.

Whether such a case as this should be classified with hyperostosis' and not as an incomplete case of osteitis deformans, is difficult to answer in the absence of any fundamental criterion. The hypertrophy of the cranium without involvement of the long bones gives a striking resemblance to hyperostosis cranii, while the kyphosis and apparent ankylosis of the spine, giving the effect of a spondylitis deformans, the generally impaired nutrition, and the arterio-sclerosis, are suggestive at least of osteitis deformans.

Putnam, in his excellent monograph on hyperostosis cranii, somewhat summarily dismisses the question of the possible identity of this disease with Paget's, as do almost all writers on Paget's disease, on the ground that the latter affects the long bones and is a disease of advanced age. It seems to me that each succeeding writer passes over this question somewhat cursorily, without due consideration, as if the idea of non-identity were handed down as a transmittendum from the earlier writers.

In addition to Putnam's collection of fourteen cases of hyperostosis cranii, I have been able to find six others reported to date by Horsley,[1] Ellis,[2] Priestly,[3] Sattler,[4] Parker,[5] and Roberts,[6] respectively. These, with the above case of my own, make twenty-one.[7]

Of these twenty-one cases ten apparently began after thirty years of age, and four after forty; and, conversely, of Packard, Steele and Kirkbride's collection of sixty-six cases of osteitis deformans, in eleven the disease began before the age of forty. Moizard and Bourges report a case in which the onset occurred at twenty-one years, and Blanc reports one beginning at seventeen years, but in this last the accuracy

[1] Practitioner, London, 1895, iv. 12–25.

[2] Archives of Ophthalmology, 1899, xxviii. 4.

[3] Quarterly Medical Journal, Sheffield, 1898, vii. 154.

[4] Cincinnati Lancet-Clinic, 1897, and Transactions of the American Ophthalmological Society, 1900. In the second paper the autopsy is reported.

[5] Annals of Surgery, 1894.

[6] Ibid., 1896.

[7] Ten other cases described under this title are to be found in the literature, but with insufficient evidence of the nature of the disease. Under a hyperostosis cranii a variety of diseases has been included from mere local tumors to a diffused condition, which later observation has shown to be osteitis deformans or some other process. In the absence of any definite criterion, I have been perhaps somewhat arbitrary in the exclusion of questionable cases. Perhaps future investigations may show that some of these may be varieties of the disease in question, but at present it would seem to be wiser to limit our study to typical cases. I, therefore, only include those cases in which the bones of the head have been more or less diffusely affected.

of the diagnosis is not above suspicion. At any rate, considering the small number of cases of hyperostosis cranii on record, the age limit seems to be hardly a sufficient criterion.

As to the non-involvement of the *long bones*, Bowlby and Edmunds have each reported a case claiming to be osteitis deformans in which only one long bone was affected, and Hutchinson a case in which only two long bones were affected. In Bowlby's case the histological examination showed changes resembling those described by Paget, so that if the disease may be limited to one bone it is logically possible that it may be limited to the cranium, which is so often and early affected.

It has been argued that a distinction between the two diseases is to be found in the hypertrophy of the malar bones in hyperostosis cranii giving the leonine appearance (leontiasis ossia), but this is not always found in this disease, and, conversely, I find that a careful examination of recorded cases shows that the bones of the upper face are not always unaffected in Paget's disease. For example, besides minor hypertrophic changes, like hypertrophy of the superior alveolar border found by Joncheray[1] and Meunier,[2] and of the inferior orbital arches in two cases recorded by Lunn,[3] Meunier found hypertrophy of the malar bones giving the appearance of leontiasis ossia in a typical case of osteitis deformans. Likewise, Gilles de la Tourette and Magdalaine[4] report a similar hypertrophy of the malar bones, as does Pic;[5] so that the presence or absence of this particular hypertrophy would not seem to have the importance ascribed to it.

From the point of view of pathological anatomy the differentiation of the two affections is equally difficult. In hyperostosis cranii the anatomical findings have consisted of new bone tissue in which calcification has taken place both in the surface layers and in the diploë, so that the latter is converted in some cases into a coral-like tissue; in others into a hard tissue like ivory, as was found in a case of my own. Actual softening does not seem to have been observed excepting in a case reported by Stack,[6] but I know of no case in which a histological examination was made, and, therefore, we can only surmise that, as in osteitis deformans, an absorptive process may have produced the sponge-like spaces in the hypertrophied diploë.[7]

Stack's case, which I have not included because it is not clear that

[1] Paris Thesis, 1893.
[2] Nouvelle Iconographie de la Salpêtrière, 1894, t. vii. 17.
[3] Trans. Clin. Soc., London, xviii. 273.
[4] Nouvelle Iconographie de la Salpêtrière, 1894, t. vii. 1.
[5] Rev. d'Orthopedie, May 1, 1897, viii. 164.
[6] Bristol M. C. J., 1900, xviii. 316–320.
[7] Four cases of Horsley's (Practitioner, 1895) reported under the title of leontiasis ossium ought not to be overlooked entirely. The hyperostosis was of the nature of a bone tumor, and was removed by operation. Histological examination of the removed bone in two showed the presence of a process which was both absorptive and osteoplastic.

it is not a complication of hyperostosis with osteomalacia, should be studied in this connection, for if softening of the long bones is not a complication the case is a transition between the two types we are considering. At the autopsy the skull was found to be enormously and almost uniformly thickened. All the cranial bones were affected, including those of the face. The cerebellar portion of the skull was very protuberant, dipping down toward the neck, and measured here in thickness almost three inches. The bones of the skull, on section, were for the most part softer than natural, but the appearance was not quite homogeneous. In parts there were masses of more compact tissue, and in others the rarefaction had proceeded to such an extent as to leave spaces of an eighth of an inch in diameter. The half skull without the lower jaw weighed seven pounds and a half. The lower jaw weighed one pound. The pelvis was very light, very soft, and much distorted; it was markedly generally contracted, scoliotic, funnel-shaped, and beaked. The femora were both bent and a little softer than natural. The tibiæ were also bent, and in some places the external compact layer was replaced by softened bone developed from the periosteum. There was no overgrowth in any bone apart from the head. It will be noticed that the rarefying process resembles in the description that of osteitis deformans.

Now, although in numerous histological examinations of the bones in osteitis deformans the findings have been similar to those described by Packard, Steele and Kirkbride, this would seem not to be the whole story, for more or less calcification may take place in the new bone tissue, so that patches of greater or less extent of ivory-like density occur.[1]

Not a few autopsy findings in which the formation of new bone with calcification is the chief process might be easily cited. The fact is,

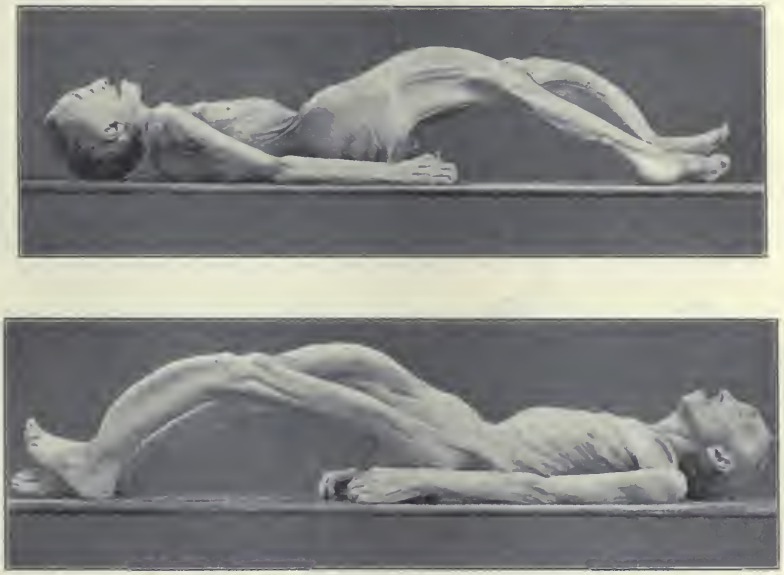
[1] Paget, in describing the findings in his first case, states that "the compact substance of the bones was in every part increased in thickness." "In the greater part of the walls the whole construction of the bone was altered into a hard, porous, or finely reticulated substance, like very fine coral. In some places, especially in the walls of the femur, there were small, ill-defined patches of pale, dense, and hard bone looking as solid as brick. In the compact covering of the articular ends of the long bones . . . the increase of thickness was due to encroachment on the cancellated texture, as if by filling its spaces with compact porous new-formed bone." Microscopic examination confirmed the macroscopic findings of new bone formation, with calcification. Bowlby describes similar changes in a femur, the only bone affected, remarking upon the formation of "new bone, sometimes of a hard, porcellanous appearance, and again of a more cancellous nature." Bowlby's case may be questioned as a true example, owing to only a single bone being affected, and yet the similarity of the changes to those found by Paget should be noted. Silcock, in an important observation, states that in a femur the superadded bone was everywhere compact and ivory-like excepting at one spot.

Lunn, again, while describing changes identical with those found by Packard, Steele and Kirkbride, also notes in addition the formation of calcified bone, which, as parallel lamellæ, reduced the size of the Haversian canals to the smallest calibre.

Equally important in showing calcification is the chemical analysis, which demonstrates substantially no deviation from the normal amount of lime salts in the bone (Paget) and even an increase (Robin, Gilles de la Tourette, and Magdalaine).

whether absorption predominates or new bone formation without calcification or with calcification, is probably either a matter of stage in the process or dependent on unknown determining factors. At any rate, as a matter of observation, one process may predominate in one bone and the other process in another in the same case. The autopsies, then, thus far made describe a combination of anatomical processes which may be briefly stated to be: (*a*) Absorption of bone; (*b*) new formation of bone tissue without calcification; (*c*) new formation of bone tissue with calcification. Any of these processes may predominate.

Fig. 5.



Sophia D., aged 73. Osteitis deformans. From a photograph kindly sent me by Mr. J. R. Lunn, F.R.C.S.

It is an interesting fact, to which attention has not been called in this connection, that in young, healthy growing bones an allied process takes place. The bone tissue around the Haversian canals may be absorbed, as in osteitis deformans, even to the extent of producing "irregularly bounded cavities of varying size with eroded edges, and lamellæ appearing as though gnawed away at points." Thus are formed the Haversian spaces. Reformation of new bone may then take place and fill up these spaces (Frey's *Histology*). This process is plainly a normal trophic one. This would suggest that it is within the bounds of possibility that the process in osteitis deformans is a modification or perversion of the same process which is provided for by nature in

normal bones. Under such an hypothesis it would be a nutritive or trophic disorder.

In hyperostosis cranii it is possible that the anatomical process may be the same as in osteitis deformans, only that the process of calcification has predominated, and hence the greater density of the bones of those skulls examined in this disease as compared with the bones examined in osteitis deformans. But it must be borne in mind that very few cases of hyperostosis cranii observed during life have come to

FIG. 6. FIG. 7.

FIG. 6.—CASE III. Mrs. W., 1896. From Edes' article.
FIG. 7.—CASE III. Mrs. W., 1902. Osteitis deformans, formerly thought to be hyperostosis cranii. Compare with Fig. 6, which is the same case photographed in 1896.

an autopsy, and of these none have been submitted to microscopic examination, and in none, unless Stack's can be accepted, have any of the long bones been examined either macroscopically or microscopically, so that, after all, we have no positive knowledge that the long bones have not to some degree participated in the process. Then, too, in Paget's disease very few bones in any one case have been histologically examined; but, as the facts stand, of the bones examined in the same case one or the other has shown considerable calcification, while another has shown less. The evidence thus far is too fragmentary

to allow us to form a definite conclusion based on the anatomical findings alone.

Case III.—Since the above was written I had an opportunity, through the kindness of Dr. Edes, to re-examine the case which he reported in 1896[1] under the title of hyperostosis cranii. I find that this case has developed into one of Paget's disease. Since 1896 the

Fig. 8.

Case III. Osteitis deformans; right arm.

hypertrophic process in the head has greatly increased, as may be seen by comparing the photographs. (Figs. 6 and 7.) *Almost all, if not all, the long bones of the body are affected.* The right humerus is particularly deformed in a characteristic way, as is shown in the accompanying skiagram. (Fig. 8.) There is kyphosis in the lower dorsal region and deformity of the sternum. The clavicles have

[1] The American Journal of the Medical Sciences, July, 1896.

escaped. The attitude of the patient is characteristic. What is of particular interest is that some of the phalanges of the fingers show traces of the disease in that they are bent, and the bones of the tarsus of one foot appear to be thickened. Then the nervous system shows certain abnormalities. There is general myasthenia, amounting to a paresis. The gait is paretic and unsteady, so that she requires help to maintain her balance in walking. She has a tendency to fall, not due to paresis, but no true ataxia can be made out, and Romberg's symptom is absent. The tactile and pain senses are normal; the knee-jerks are exaggerated. Plantar reflexes are absent. She has marked difficulty in swallowing, so that, for example, a glass of milk was drunk with great slowness and caution. The tongue protrudes straight; the face moves more to the right than to the left in speaking. The eyes are protruding, and there is a twitching of the right upper eyelid. There is decided deafness. There is no evidence of arterial atheroma, but there is an aortic systolic murmur. It is difficult to ascertain the exact time of development of the disease in the long bones. The patient says that her own attention was not called to these changes until after she had been observed by Dr. Edes, who tells me that he does not remember having made an examination of the limbs. It is possible, therefore, that the long bones may have been affected before 1896.

This case suggests the possibility that some of the other reported cases of hyperostosis cranii either may have developed later into Paget's disease, or that, if they had been more critically examined, the long bones would have been found to have been affected. As a matter of fact, in very few instances is any specific reference to the long bones made in the reports, and it is doubtful if they have been often examined. No reference to the long bones is made in Putnam's observations, and it is probable that they were not examined, as they were not in my own first case.

Osteo-arthritic Changes. The frequency with which osteo-arthritic changes are found in Paget's disease has not received the attention which they invite. These changes are identical in character with those found in certain types of rheumatoid arthritis, or, perhaps more correctly, osteo-arthritis. They are always regarded as evidences of coexisting rheumatoid arthritis rather than as different manifestations of the main pathological process. There are many facts which tend to show the incorrectness of this view.

In the first place, the frequency with which osteo-arthritic changes occur suggests some sort of kinship between this process and that in the body of the bones rather than the coincidence of two separate diseases.

Richard pointed out what he called transition cases between the two diseases. Humphrey calls particular attention to the presence of the two diseases in his specimens of a femur and tibia, as does Bowlby, who, in describing the appearance of the femur already referred to, specifically states that "some parts of the head and neck present changes exactly similar to those noted in an early stage of rheuma-

toid arthritis, the bone being smooth and porcellanous, with growth of nodosteophytes and with the worm-eaten appearance so common in this disease." In one of Stilling's cases von Recklinghausen found arthritis deformans at the autopsy. Goodhardt, in one case, describes deposits of new bone along the bodies of the vertebræ anteriorly, resembling in the description spondylitis deformans. In another case Goodhardt states that "bones of hard new-growth projected slightly from the substance of the bodies and welded the bones together by a tough, tuberculated mass, which looks not unlike the nodular masses found in some extreme cases of osteo-arthritis when that disease attacks the spine." Equally if not more remarkable findings in this particular, however, are those of Lunn, who describes a condition of the vertebræ exactly similar to that characteristic of spondylitis deformans of the type we are considering. "Projecting from the sides of some of the bodies of the vertebræ (chiefly lumbar) were well-marked bosses of new bone with disappearance of the intervertebral disks, and bony ankylosis had taken place at different intervals."[1]

The rigidity and ankylosis of the spine, which clinically is frequently observed in Paget's disease, undoubtedly is often, though not necessarily, due to a condition identical with that found by Goodhardt and Lunn, and described by Goldthwait in his monograph referred to. Clinically, also, ankylosis of the larger joints is not infrequently observed in Paget's disease, a process which is hard to explain by the absorptive and formative processes peculiar to osteitis deformans proper, and is probably due to the osteo-arthritic processes found at autopsies.

In my case nodosities are present in some of the phalangeal articulations, strongly suggestive of osteo-arthritis. In three of Lunn's cases ankylosis of the larger joints was present, and in a fourth there were bony growths about the knee-joints.

When we consider the variations in the anatomical processes found in osteitis deformans, there does not seem to be any good reason for regarding these osteo-arthritic changes as anything more than a predominance of the hypertrophic process which is observed in the bodies of the bones—a view which will receive support when we come to consider the disease as a trophic derangement.

In hyperostosis cranii, as well as in Paget's disease, the vertebræ sometimes take part in the hypertrophic process, or at least this seems to be the case from what can be made out during life. At any rate,

[1] Compare this with the following description of Goldthwait from his article on "Spondylitis Deformans, or the Spinal Form of Osteo-arthritis:" "Pathologically, the disease consists of a nodular enlargement of the edges of the articular cartilages, with the subsequent ossification of these nodes and an extension of the process into the ligaments which have their origin or insertion near by. With this hypertrophy at the edges of the cartilage the centres or areas of pressure usually undergo atrophy." . . . "As the process continues either the two surfaces of bone fuse or remain in apposition."

fixation of the spine (my case) and thickening of the vertebræ can be felt (Starr).

Special Pathology. Baumgarten, Starr, and Putnam have insisted that hyperostosis cranii is a trophic disorder, while several writers have done the same for Paget's disease. The thought suggests itself whether all the bone lesions commonly found associated in osteitis deformans and hyperostosis cranii, including those referred to rheumatoid arthritis, different as these anatomical lesions are, may not represent only perversions of a central trophic arrangement analogous to the so-called trophic lesions observed in spinal and nerve lesions. But when we attempt to point to any particular derangement, whether in the nervous system or elsewhere, we are made conscious of the blindness of our knowledge. And yet there are a number of facts which may have a bearing at least on the solution of the problem. So far as concerns the possibility of a central nervous derangement producing the osseous changes, the lesions in tabes and syringomyelia are instructive. In these diseases as well as some others affecting the central gray matter there is a very remarkable tendency to calcification or ossification of the ligaments and absorption of the cartilages of joints and development of bony masses about them—changes which in themselves have a very close resemblance at least to what occurs in osteoarthritis. Then, again, the process may be one of rarefaction or hypertrophy, and either may predominate. In the latter case the shaft of a long bone may undergo an extraordinary increase in size by the development of new osseous tissue on the surface. Further than this, deformities of the skull occur in syringomyelia, characterized by bossing of the frontal and parietal eminences and prominence of the forehead.

A very remarkable case was published by Hale White,[1] under the title of "Hyperostosis Cranii." Later the case came to autopsy as the result of operation for fits, and was described by Collier. Unexpectedly a condition of syringomyelia[2] was found, which did not give rise to the ordinary sensory symptoms of that disease, although there was a spastic atrophic paralysis of one arm of obscure origin, but thought before death to be cerebral. The skull was very remarkable. The deformity which had been taken for a hyperostosis was a projecting ridge or fold extending from the temporal region on each side backward around the occiput and overhanging the neck. It was as if the

[1] British Medical Journal, 1896, vi. 1377.

[2] Lancet, January 5, 1901. The cavity extended from the left inferior olivary downward in the posterior horn to the sixth dorsal, excepting that it intermitted from 8 c. to D 4; marked old degeneration in the right pyramid (tract?), which could be traced to lumbar region. Nerve cells normal by Nissl method; brain normal. Report too incomplete to allow cause of arm paralysis to be determined.

spine and base had been telescoped into the skull, which overhung the base like a mushroom.

The bones of the skull were for the most part small, and in some places thin, but in other places they were "unduly large" (hypertrophied?). The deformity had begun in childhood, and was supposed to have followed a fall upon the head.

The nature of the bone changes is not clear, but it was apparently one of perverted nutrition, and very likely connected with the syringomyelia as one of the trophic lesions of that disease.

The combined anatomical picture presented by these lesions in nervous diseases is very different, of course, from that seen in Paget's disease, but the individual processes suggest the variety of changes which may be brought about by one and the same nervous derangement. Several writers have suggested that the *fons et origo* of Paget's disease was to be found in the nervous system. Stilling, in 1889, attributed the coexistence of the two diseases to coincidence, and this view has been repeated successively by later writers. The possible dependence of osteitis deformans upon some kind of nervous lesion, it seems to me, has been rather hastily discarded without due consideration of the facts, and perhaps without a critical examination of the original records. Sometimes it has been taken for granted that the autopsy findings have negatived such an hypothesis. One of the later monographs states that "the results of many examinations . . . have shown the cord and bone nerves . . . to be perfectly normal." . . . This seems to be a hardly well-considered statement. I have not been able to find that the spinal cord has been examined at all, excepting in ten cases, and in five of these there was more or less evidence of pathological changes. In three (Gilles de la Tourette and Marinesco two, Levi one) a gross lesion in the form of posterior sclerosis was found under the microscope. In one, that of Pic, the spinal cord, to the naked eye, showed a grayish tint in the two posterior columns and in the right pyramidal tract. In one case (Stilling) some, though not marked, changes were found by von Recklinghausen, viz.: There was a small gliomatous growth in the cervical region and sclerosis of the ependyma. To the naked eye the gray substance throughout the whole length of the cord was white, opaque, and not easily distinguishable. The import of this is not mentioned by the reporter, but the ganglion cells and nerve trunks under the microscope appeared to be normal. It is suggestive that this case exhibited contractures and muscular weakness, if not paralysis, which must have been of spinal origin. In the sixth case, that of Lunn,[1] the spinal cord was found to be "soft in the cervical region, almost pulpy opposite the first and second dorsal and seventh cervical vertebræ."

[1] Transactions of the Clinical Society, vol. xviii.

"A year before the patient died he developed symptoms of bulbar paralysis, with extreme wasting of the tongue, dysphagia, and some loss of taste." *No microscopic examination was made.* It was evident that the cord softening, from its situation, was something in addition to the bulbar disease.

This leaves four cases to be accounted for. In two of these four (Stilling, Noizard, and Bourges) there was no microscopic examination of cord or nerves at all; but in the remaining cases, two, the microscopic examination showed the cord and nerves to be normal. Of ten cases, then, there was more or less good evidence of disease in six, not examined microscopically in two, and normal in two only. It does not appear that in either of the normal cases (Stilling and Goodhardt) any of the finer methods of technique were employed, including the special stains. One was examined as far back as 1878 (Goodhardt). The report of this simply states that "the spinal cord was quite healthy, both to the eye and under the microscope." The nerves were not examined. We must also bear in mind that we do not know what cells or elements in the cord, if any, regulate the nutrition of the bones, so that we do not even know where to look for the lesions which may be responsible for bone and arthritic changes. Therefore, it may well be easy to overlook them, as, indeed, the history of many originally obscure nervous diseases shows. At any rate, from this examination of the reports of autopsies it would appear that the frequency with which changes have been found in the nervous system has been overlooked. More opposed to the nervous origin of the disease is the fact of entire absence of nervous symptoms in the mass of cases; but this objection, it seems to me, is based on a too superficial view of the question. In the first place, as I have said, we know almost nothing of the seat of the trophic functions of the cord beyond the fact that lesions of the anterior cornua lead to muscular atrophy, and we are entirely ignorant of what elements in the cord subserve nutrition of bone or skin and other organs. Even in tabes we are ignorant of the special lesion which causes the trophic changes in the bones, whether seated in the anterior or posterior portions or in the peripheral nerves. *It is not inconceivable that as degeneration of the anterior cornua may cause myopathies without other symptoms, so lesions of other special cell groups may cause osteopathies without other spinal symptoms.* In the second place, it is a curious but interesting fact that in neither of the two cases of Gilles de la Tourette nor in that of Levi, in all of which an extensive sclerosis was found, were there any recognizable nervous symptoms during life, not even absence of knee-jerks, excepting that in Levi's case there was diminution of intelligence, ready weeping, and binocular nystagmus, and at the end only incontinence of urine and feces.

But it is exceedingly improbable that the lesion, if it is to be found

in the nervous system, is that of one of the stock nervous diseases. If such were the case we should expect to find the bone lesions occurring from time to time as manifestations of one or more of these diseases. It is much more probable that the pathological changes may be of a more general and finer type, such as would interfere with nutrition alone. Perhaps the arterial sclerosis which almost always is found, and which sometimes is so extraordinarily obtrusive in the younger cases, may be the primary source of nutritional changes. In the first of Gilles de la Tourette and Marinesco's cases the sclerosis of the posterior columns did not extend below the dorsal cord (the cervical cord was overlooked), and some of the fibres in the lateral columns were diseased. (The nerves were not examined.) In the second case, beside the sclerosis of the posterior columns most developed in the dorsal region, the peripheral nerves were the seat of an interstitial neuritis. The authors do not consider that the disease in the cord was a true posterior sclerosis, but rather an atrophy of nerve fibres. Levi also insists that the extensive sclerotic changes, with disappearance of myeline fibres, that he found in both posterior and lateral columns and other regions were to be regarded as a pseudosystemic sclerosis of vascular origin. The vessels throughout were the seat of a periarteritis and endarteritis. The spinal nerves showed irregular thickening of their connective tissues; the sciatic showed practically the same changes that were found in the cord.

It would seem to be highly possible that as a result, not of a posterior sclerosis or a lateral sclerosis, but of the vascular sclerotic changes that are always or almost always found in osteitis deformans, nutritional impairment might be brought about in the central nervous arrangements which we have to suppose govern the nutrition of the bones, just as the anterior cornua govern the muscles, and that future researches may reveal the nature and seat of these changes. In emphasizing this hypothesis I do not overlook the fact that in old people changes in the nervous system are apt to develop, and that the occurrence of these changes with bone lesions may be a coincidence.

What I have said is mostly speculative, but, considering the absolute blindness of our knowledge of osteitis deformans and the completely negative position in which this subject has been left by all writers on the subject, I have thought it might not be without value to put together the allied facts in our possession, hoping that they might furnish a working hypothesis and point the way for further pathological investigation, by which alone we can understand this most remarkable disease.

By way of summary, then, I would say:

1. We have no sure ground for differentiating hyperostosis cranii from osteitis deformans.

2. Hyperostosis cranii and osteitis deformans are probably trophic disorders.

3. Various clinical and pathological facts seem to indicate that they are at least allied disorders, and perhaps only different manifestations of one and the same disease.

4. The osteo-arthritic changes so commonly found in osteitis deformans are probably manifestations of the disease, and not complications.

5. The results of autopsies thus far made do not at all exclude the nervous system as the seat of the trophic derangement, but the changes that have been found in the spinal cord and peripheral nerves and analogy with other known lesions like those of tabes and syringomyelia suggest a neuropathic origin similar to that of the myopathies.

6. In future cases the nervous system should be exhaustively studied.

[Note.—I wish to express my obligation to Dr. Packard for his great kindness in loaning me his references to the literature and abstracts of reported cases, thus materially aiding this study.]

CERTAIN CHARACTERISTICS OF OSTEITIS DEFORMANS.

By Reginald H. Fitz, M.D.,
of Boston.

The first case reported by Dr. Prince subsequently came under my care at the Massachusetts General Hospital, having been referred to me by Dr. M. A. Morris, of Boston. There are certain points of interest resulting from my study of the patient and the disease concerned which I desire to place on record, even at the risk of duplicating some of the observations which Dr. Prince may have made.

These concern especially the recognition, by means of the Röntgen rays, of the alterations of the bones and the intimacy of the relation between cranial hyperostosis and osteitis deformans.

In this connection I wish to acknowledge my indebtedness to Mr. Walter Dodd, of the hospital, for the photographs and skiagraphs which will illustrate my remarks, and especially for his expert assistance in the interpretation of doubtful points in the latter series of pictures and in establishing the conclusions to be drawn from them. I am indebted also to my assistant, Dr. R. F. Gibson, for his aid in obtaining the completest possible record of the case, which is offered as a supplement to that of Dr. Prince.

The patient was born in Boston, in and near which she has always lived. Entered the Massachusetts General Hospital February 6, 1902. Her father died of phthisis, aged eighty-four years; her mother died

of the same disease at fifty-eight. Has two sisters, of thirty and thirty-eight years, respectively; both well. Has four living, healthy children. One died of unknown cause soon after birth. Has had measles, scarlet fever, and whooping-cough early in life, and seven years ago states that she had typhoid fever. Menopause at thirty-six. Has not used alcohol, but drank much tea until a year ago. Her average weight is 110 pounds.

Two years ago, when in her usual health, it was noticed that the right forearm was curved, and she attributed this condition to wringing clothes in her laundry work. A year ago, while walking, had three or four attacks of vertigo, each lasting a few minutes. These ceased at the end of a fortnight. Ten months ago she began to feel weak and tired, and had occasional periods of drowsiness. At this time there was slight, constant pain at the top of the head and in the occiput. She was able, however, to keep at work.

Five months ago, at the Boston City Hospital, she came under the observation of Dr. M. Prince, who first made her conscious of any peculiarity in her appearance, which, in her own opinion, has not since changed.

In January, 1902, she consulted Dr. M. A. Morris, of Boston, in consequence of severe pains throughout the head of some six weeks' duration, although temporarily replaced for a day or two on one occasion by pains in the left shoulder and hypochondrium. She complained also of digestive disturbances, which had been more or less troublesome for three or four months. At this time she considered her strength unaffected. Dr. Morris recognized her condition as one of osteitis deformans, and referred her to me, with the view that she should receive such opportunity for study and observation as the hospital might afford, and that she might attract the attention of medical students.

At the time of her entrance she complained of pain throughout the head and of sharp, shooting pains in the back, hips, arms, and legs. She was disturbed by gas in the stomach and bowels after meals. Pulse, 100; respiration, 20; temperature, 98° F. Weight, 99 pounds.

The cranium appeared large in all diameters, especially from before backward and from above downward. The occiput bulged and the temporal ridges were extremely prominent. The mastoid portion of the temporal bones was conspicuously large. There was marked enlargement of both malar bones and of the right lower jawbone. The other bones of the face were not enlarged. The hair of the scalp was coarse and dry, and bald spots were numerous.

Many of the teeth were gone from the upper jaw and several from the lower jaw. Caries was frequent in those present. The temporal arteries were markedly tortuous and thickened, and lay upon the surface of the bone.

There was pronounced kyphosis, with inability to straighten the curved portion, although elsewhere there was fair motion of the spine. The patient was pigeon-breasted, and the xiphoid cartilage was thickened and unyielding. The right clavicle was slightly enlarged, and there was enlargement of the acromion process and the spine of the right scapula. The crests of both iliac bones were thickened. There was some thickening of the right humerus and extensive upward and backward curvature, with thickening of both bones of the right forearm, the pronation of which was limited. The distal phalanges of each

hand were somewhat thickened. There was extensive thickening of both thigh bones, with curvature forward and outward. Both tibiæ, especially in the upper third, were decidedly thickened, and were curved forward, a change more marked in the right than in the left leg. The epiphyses were enlarged, the motion of the joints was not impaired, and there has never been any complaint of pain or stiffness in any joint or tenderness in any bone.

The following measurements were made by Dr. Gibson: Height, 57 inches; circumference of head, 24½ inches; distance from zygoma to zygoma over top of head, 13 inches; breadth between temples, 4¼ inches; distance from root of nose to point of chin, 4⅝ inches. Girth of right arm 3 inches above bend of elbow, 7⅝ inches; girth of left arm 3 inches above bend of elbow, 7½ inches; girth of right forearm 3 inches below epicondyle, 7½ inches; girth of left forearm 3 inches below epicondyle, 7 inches; girth of right thigh 6 inches above upper edge of patella, 16 inches; girth of left thigh 6 inches above upper edge of patella, 15⅛ inches; girth of right calf 5½ inches below lower edge of patella, 12½ inches; girth of left calf 5½ inches below lower edge of patella, 12½ inches.

The area of cardiac dulness was somewhat enlarged both to the left and right of the sternum. The apex-beat was diffused and heaving, most marked in the left fifth interspace 3½ inches from the median line. There was a systolic murmur in the aortic area, transmitted into the neck, and a harsh, systolic murmur in the mitral area, replacing the first sound and transmitted toward the axilla. The pulmonic second sound was accentuated. The action of the heart was somewhat irregular in force and rhythm. The radial arteries were thickened and ribbed, and the brachial arteries were thickened and tortuous. The volume and tension of the pulse were good in the right wrist, but diminished and obtained with difficulty in the left wrist.

The examination of the blood showed 80 per cent. of hæmoglobin, 4,450,000 red corpuscles, and from 7000 to 10,000 leucocytes. The differential count of the latter gave 70 per cent. of polynuclear leucocytes, 18 per cent. of small, and 4 per cent. of large lymphocytes.

The examination of the lungs and abdominal organs was negative. The urine was acid, 1020, contained neither albumin nor sugar, and the sediment was not pathological. At one examination, however, the slightest possible tracè of albumin and a rare granular cast were found. The pharyngeal reflex was absent, but the pupillary, patellar, and plantar reflexes were present and normal.

The eyesight had been failing somewhat for the past two years, and glasses have been worn with relief for five months. There is no impairment of hearing. The sense of touch is unaffected; there are no paræsthesiæ, and the appreciation of heat and cold is normal. There is less sweating than formerly, but the skin is soft and smooth. The loss of hair began nine months ago, and persisted for six months; she thinks that nearly one-half is gone. There is no loss of hair except from the scalp. The finger-nails show no alteration.

When the patient entered the hospital there was an evident impairment of mental function; her answers were intelligent and direct, but at the end of three days she left her bed at night and wandered from the ward, expressing fear that her eyes were to be taken out; the latter had been examined ophthalmoscopically a day or two before. She

remained in the hospital nearly four weeks. During this time she gained some four pounds in weight, her pains lessened, but she was more or less restless at night, at times screaming or attempting to leave the ward, or threatening to injure herself in consequence of delusions with regard to her children. She believed them dead, and when visited by them stated that the visitors merely simulated the children, although wearing their clothes. She heard imaginary conversations, and complained that the nurse did not give the right medicine and lied about her. She thought some dreaded operation was to be performed, wept occasionally, and talked constantly about her troubles and ailments. In consequence of the persistence of her delusions and the inability of her family to take care of her she was transferred to the Boston Lunatic Hospital.

To recapitulate: A healthy, hardworking woman at the age of forty-three years became aware of a curvature in the right forearm. A year later there were temporary attacks of vertigo for a short time, which soon were followed by pains in the head, drowsiness, and debility. Five months afterward her cranial deformity was first called to her attention. At present there is hyperostosis of the cranium, malar bones, right inferior maxilla, clavicle, scapula, humerus, radius, ulna, iliac crests, femora, and tibia. There were also kyphosis and pigeon-breast.

The case evidently is one of osteitis deformans, with conspicuous cranial hyperostosis complicated with rheumatoid arthritis, arterial degeneration, chronic valvular disease, and, lastly, with mild melancholia accompanied with delusions.

The alterations of the bones in osteitis deformans, originally described by Paget,[1] are recognized as characteristic by later observers, and nothing essential has been added to his statement of them. The bones usually affected are those of the cranial vault, the spine, and the larger long bones of the extremities; less frequently the clavicles, scapulæ, ribs, sternum, and pelvis are altered, and, rarest of all, is mention made of changes in the bones of the face, hands, and feet. The enlarged bones are abnormally dense or rarefied. The surface is smooth or rough, nodular or protuberant; the cortex thickened or thinned, spongy or eburnated, the cancellated structure sclerosed or coarsely trabeculated, the marrow spaces obliterated or transformed into cavities of various sizes. The central canal of the long bones is narrowed or dilated, even to disappearance, and the deformity of these bones is further increased by various degrees of abnormal curvature. There is no uniformity in the distribution of these alterations, and a single bone may give evidence of the decalcification and absorption, the formation of osteoid tissue and its calcification, which are the processes concerned in the production of the gross changes. Multiplicity of the bones affected is the constant characteristic.

Until within the past few years the closer study of the nature and distribution of these changes has been possible only by the examina-

[1] Med.-Chir. Trans., 1877, lx. 87.

tion of macerated bones and by the microscopic investigation of decalcified portions of certain bones. The information thus obtained is somewhat fragmentary, and necessarily limited to the conditions existing at a particular time, although early and late manifestations of the disease may be present at one and the same time. All writers call attention to the unknown period of latency, during which the existence of the malady is unrecognized, and the long term of years through which it slowly progresses. Any means by which periodical examinations of the alterations in the bones may be made promises to add very materially to our knowledge of the subject, especially with reference to the progress of the affection and to the conditions promoting curvature, and the future study of osteitis deformans and allied diseases in

FIG. 1.

Hyperostosis of first phalanx of thumb, fourth metacarpal and carpal end of radius. Osteoarthritis of terminal phalanges. Calcification of arteries of arm and hand.

which the bones are involved must depend largely upon the use of the Röntgen rays. Watson,[1] Elting,[2] and Wilson[3] already have illustrated their communications on osteitis deformans with skiagraphs. These show the degrees of enlargement and curvature of certain bones, and Watson in particular calls attention to peculiarities of structure. The accompanying skiagraphs, made by Mr. Dodd, still more satisfactorily indicate the value to be anticipated from the use of the Röntgen rays in defining the various stages in the progress of the disease, and they are contrasted with those obtained from normal bones for the purpose

[1] Johns Hopkins Hospital Bulletin, 1898, 133.
[2] Ibid., 1901, 343.
[3] Philadelphia Medical Journal, 1902, ix. 322.

of ready comparison. They are a portion only of the series taken. (See Figs. 1–11.)

Mr. Dodd describes the alterations as follows:

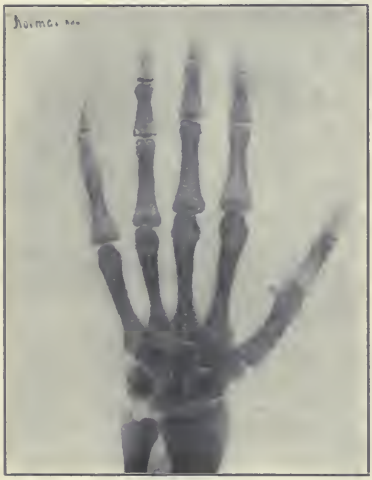
"*Skull* much thickened, lower jaw greatly enlarged, coarse trabeculation and decalcification.

"*Clavicle* hyperostotic, the condition more marked in right than in left collar-bone.

"*Scapula.* Axillary border; acromion and coracoid process of right scapula hyperostotic, with foci of decalcification. A similar condition in the left scapula, but much less in degree.

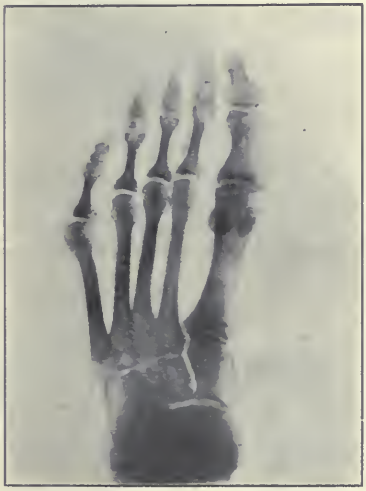
"*Humeri* hyperostotic, with coarse trabeculation and decalcification. The alterations more extensive in the right than in the left humerus.

FIG. 2.



Normal hand.

FIG. 3.



Normal foot.

"*Forearm.* Right radius and ulna hypostatic, with decalcification; marked curvature of radius. Bones of the left forearm apparently normal.

"*Hands.* Terminal phalanges of each hand show the conditions found in osteo-arthritis. The right hand shows hyperostosis of the third metacarpal bone, with area of decalcification; also marked hyperostosis of carpal end of the radius and ulna. In the left hand there are hyperostosis of the first phalanx of the thumb and a spicule of bone (?) at the inner border The head and cortex of the fourth metacarpal bone apparently thickened.

"*Pelvis.* Hyperostosis and coarse trabeculation throughout the right os innominatum.

"*Right Femur.* Hyperostosis and coarse trabeculation throughout the shaft. The neck and head also involved, but to a less extent. Right patella also shows hyperostosis and coarse trabeculation.

"*Lower Leg.* Tibiæ hyperostotic, with coarse trabeculation and large areas of decalcification, more marked in the right than in the left tibia.

FIG. 4.

Right. Left.

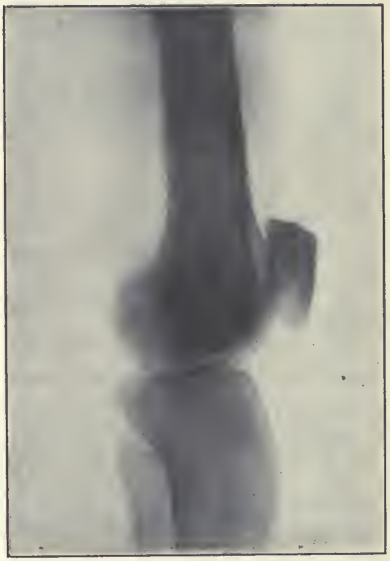
Right. Hyperostosis of all metatarsal bones except the third. Foci of decalcification of first and third. Absence of trabecular structure in second contrasted with its persistence in the fifth metatarsal.

Left. Hyperostosis and decalcification of first phalanx of great toe. Hyperostosis and decalcification of all metatarsal bones except the fifth.

FIG. 5.

Right femur from inner lateral surface. Hyperostosis of femur, extending into epiphysis. Cortical thickening; erosion of anterior surface of femur. Hyperostosis of patella, decalcification and coarse trabeculation.

FIG. 6.



Normal.

Cortical thickening of the right tibia and fibula. Left internal malleolus almost wholly decalcified.

"*Foot* (*Right*). Hyperostosis and decalcification of the astragalus, os calcis, and all the metarsal bones except the third. Decalcification of the first and second metatarsal bones. Trabecular structure well preserved in the fifth, but absent in the first and second bones. The phalanges normal. The left foot shows hyperostosis of the astragalus,

FIG. 7.

Left ankle and lower two-thirds of leg. Hyperostosis and decalcification of the tibia, fibula, astragalus, and os calcis. Coarse trabeculation, lamellar thickening of tibia and fibula.

FIG. 8.

Normal ankle.

os calcis, cuboid, and internal cuneiform bones. Decalcification and coarse trabeculation are especially apparent in the os calcis. Hyperostosis of all the metatarsal bones except the fifth, which is apparently normal. The first phalanx of the great toe shows marked hyperostosis and decalcification. Other phalanges normal."

From the inspection of this series of skiagraphs it is evident that the various changes in the bones described by Paget are to be determined to a considerable degree in the living patient. The nature and extent of the involvement of individual bones is appreciable, likewise the discovery of similar changes in bones which hitherto have attracted but little attention, notably those of the hands and feet. It is obvious that if a series of such pictures could be taken from time to time and preserved a most graphic record of progress would be obtained.

The similarity of the changes of the skull in the affection designated hyperostosis cranii or leontiasis ossea, and in osteitis deformans has

repeatedly been observed, and Paget recognized the importance of discriminating between these affections. In the reported cases of cranial

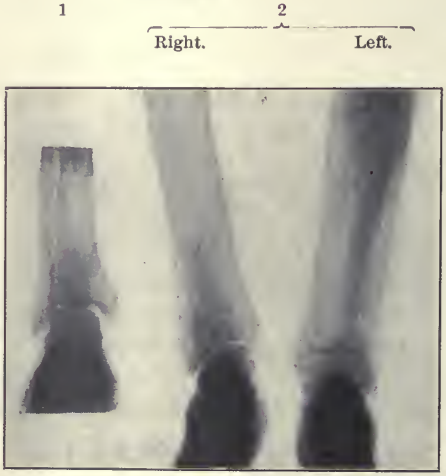
FIG. 9.

Hyperostosis of tibia, astragalus, os calcis, cuboid, and internal cuneiform. Decalcification and coarse trabeculation especially apparent in os calcis.

FIG. 10.

Normal.

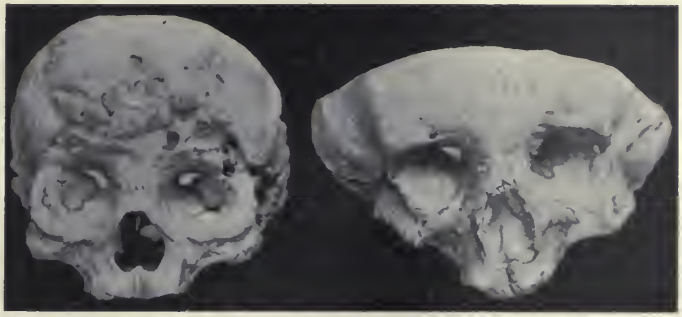
FIG. 11.



1. Normal. 2. Hyperostosis of both external malleoli; extensive decalcification; disappearance of right internal malleolus.

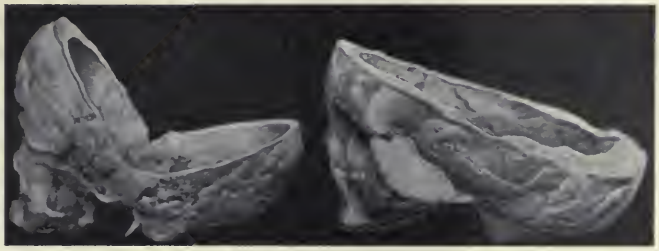
hyperostosis the alterations of the skull have sufficiently been described, but, unfortunately, little mention has been made of the condition of

FIG. 12.



Osteitis syphilitica. Hyperostosis.

FIG. 13.



Osteitis syphilitica. Hyperostosis.

FIG. 14.

Osteitis syphilitica (?). Hyperostosis.

other bones. This omission was due in part to the preservation of the skull alone, in part to the less striking changes in other portions of the

body, perhaps from the early stage of their development, or because attention was not directed to their possible presence.

Within the past ten years renewed attention has been called to cranial hyperostosis, especially through the publications of Drs. M. Allen Starr, Putnam, Prince, and Edes. This disease usually is described as occurring early in life and as almost exclusively concerning the bones of the skull and face. The hyperostosis is frequently combined with sclerosis. The narrowing of foramina, fissures, and cavities and the deepening of canals are emphasized. Affections of sight and hearing, facial paralysis, difficulties in chewing, swallowing, and breathing are to be found among the disturbances, and the cerebral functions generally suffer.

Nevertheless, the difficulty of regarding cranial hyperostosis as an independent disease is repeatedly experienced. Baumgarten, in 1892, discussed the possible relation to Paget's disease, and M. Sternberg[1] admits that some of the cases described as cranial hyperostosis should be regarded as osteitis deformans. Atkinson[2] considers that the former is a manifestation of the latter. Crozer Griffith at the last meeting of the Association of American Physicians also expressed the opinion that a sharp separation between the two diseases is at present impossible. Cranial hyperostosis has appeared at a late period in life, and osteitis deformans is not limited to advanced years.

The failure to recognize bone lesions elsewhere in cranial hyperostosis is not necessarily due to their absence, and the case here reported by Dr. Prince and myself gives evidence that the bones of the face may be diseased in osteitis deformans. The skull brought to this country by Spurzheim, and now preserved in the Warren Museum of the Harvard Medical School, is usually regarded as an example of cranial hyperostosis, but shows the changes described as occurring in Paget's disease, while the skull of the case reported by Putnam as cranial hyperostosis shows extensive sclerosis, little or no rarefaction, and not much enlargement—alterations suggestive rather of syphilis than of Paget's disease. (See Figs. 12–14.) The presence of mental derangement cannot be regarded as of significance in the differential diagnosis, since our patient with Paget's disease eventually so suffered from delusions and loss of self-control as to require treatment in an asylum.

It would seem from the above considerations that hyperostosis is a condition which may affect few or many bones, early or late in life, and with inconstant symptoms; that the evidence in favor of the recognition of an independent disease—diffuse cranial hyperostosis—is insufficient, since the symptoms assigned to this affection are inconstant, and may occur in osteitis deformans.

[1] Nothnagel's Sp. Path. und Therap., 1899, vii. 22.
[2] Maryland Medical Journal, 1901, xliv. 281.

Finally, of the twelve reported cases which, according to M. Sternberg, serve as the basis of the clinical study of this affection, one at least, as shown by Dr. Prince, eventually proved to be an example of osteitis deformans, while the cranium of another, subsequently obtained by Dr. Putnam, showed lesions suggestive rather of syphilis than resembling those present in the hyperostotic skull from the Spurzheim collection, which correspond to those described by Paget as occurring in osteitis deformans.

VARIOUS OPERATIVE PROCEDURES FOR THE RELIEF OF CHRONIC SUPPURATIVE OTITIS MEDIA, AND THEIR COMPARATIVE VALUE.[1]

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A chronic suppurative otitis media may result from several conditions within the middle ear. In its simplest form it presents as a case of acute inflammation of the tympanic cavity in which the products of inflammation have been evacuated either by spontaneous rupture of the drum membrane or by incision of this structure, and in which the discharge simply continues for an indefinite period after the acute symptoms of inflammation, such as pain, etc., have passed away. Cases of this character could not, with propriety, be considered in this paper. Such a condition as that described usually requires no operative procedures upon the middle ear for its relief. This paper has to deal only with those cases in which the suppuration is of long standing and has persisted in spite of the ordinary measures usually undertaken for the relief of a simple aural discharge. By these I mean the enlargement of any opening already present in the drum membrane, the thorough cleansing of the parts, the preservation of asepsis in the canal, the relief of recurrent congestions of the upper air passages by proper surgical measures directed to this portion of the anatomy, and the institution of free drainage through the external canal by the removal of granulation tissue.

A chronic otorrhœa of the type under consideration always depends upon the presence of diseased bone within the tympanic cavity. The intratympanic caries may have resulted from an acute inflammation within the tympanum, the middle-ear condition having been neglected at the time of the acute attack, and bony destruction having occurred

[1] Read before the American Laryngological, Rhinological, and Otological Society, June, 1902, Washington, D. C.

before the evacuation of the inflammatory products of the middle ear by spontaneous rupture of the drum membrane. I think we may lay it down as a general rule, to which there are but few exceptions, that no matter how virulent is the primary infection, if the case is seen early in the acute stage, serious intratympanic caries can be prevented. The only exception that I would make to this statement are the cases in which we have early involvement of the mastoid cells following an acute inflammation within the middle ear; in other words, given an acute purulent otitis media which does not develop acute mastoid symptoms, intratympanic caries can be almost certainly prevented in such a case, provided the patient is seen within the first twenty-four or thirty-six hours of the attack.

In another class of cases, which are fortunately rare, the purulent otitis is due to a tubercular infection of the intratympanic structures. Here treatment in the early stages will probably be of no avail in preventing intratympanic caries, as this caries has generally occurred before the patient has the slightest suspicion that there is anything the matter with the ear and before he applies to his medical attendant for relief.

From what has gone before it is evident, therefore, that intratympanic caries or necrosis is the essential and underlying cause of the symptom, chronic otorrhœa. The surgeon must deal with the dead bone in the tympanic cavity in exactly the same way as he would deal with a similar condition in any other portion of the body. All foci of caries and necrosis must be removed, and free drainage must be established in order to further protect the patient against secondary infection and a later extension of the diseased process within the bone. The operation wound should be made to heal as rapidly as possible, and an attempt should be made to cover the bony surface with epidermis, in order that slight congestions of the upper-air tract may not cause a similar condition within the cavity of the tympanum, which in turn may be followed by a reinfection of the bony structures and an extension of the caries.

Two methods of procedure are open to the operator: The first, and the one which is ordinarily considered the more simple, is to remove all carious bone through the external auditory meatus. Knowing, as we do, that when intratympanic caries exists, in the early stages, it is usually confined to the ossicular chain and to those parts of the tympanum immediately adjacent to the malleus and incus, it seems reasonable to suppose that the removal of the malleus and incus and the thorough curettement of the middle ear through the external auditory canal should constitute an efficient procedure for the relief of a chronic otorrhœa in certain instances. We have abundant proof, both in our own experience and in that of others, that this is a fact.

It is perfectly possible, in performing an operation of this kind, to remove not only the ossicles, but also any carious bone situated low down in the tympanic vault. Where caries is confined to the ossicular chain alone the procedure already mentioned is the ideal one. The operation is not severe, and seldom confines the patient to the house for more than one or two days, and sometimes even for a shorter time. By the thorough use of the curette it is usually possible to destroy the mucous membrane lining the tympanic cavity and to secure a complete dermatization of the walls of the cavity. When this can be done the procedure is certainly an ideal one. In addition to the minimum amount of confinement to which the patient is subjected, it is almost always possible to avoid injury of important structures, either in the tympanum or adjacent to it. This is particularly important when we come to consider that any operation upon the middle ear having for its purpose the removal of certain structures within this cavity must constitute a certain menace to the power of audition. The simpler, then, the character of the procedure the less danger is there of interfering with the function of the organ. Moreover, this must be borne in mind: that injury to adjacent structures, such as the facial nerve, the jugular bulb, the semicircular canals, the cochlea, and the cranial contents, seldom occurs during the course of this simple operation.

In many cases, however, we have to deal with a caries of the middle ear so extensive that it is impossible to remove all diseased tissue through the narrow confines of the external auditory meatus. In these cases it is necessary to freely expose the tympanum and the adjacent pneumatic cells within the mastoid by the extensive removal of the osseous walls. In this way all diseased areas can be brought thoroughly under the eye of the operator, and every vestige of diseased bone can be removed. Such an operation involves the exposure of the bony auditory meatus by reflecting forward the fibrocartilaginous canal. The operative field is still further enlarged by the removal of the upper and posterior wall of the bony external auditory meatus at its inner extremity, thus throwing the tympanic vault and the lower portion of the cavity (that part covered by the tympanic membrane) together. Such a procedure constitutes the operation devised by Stacke,[1] and which has since borne his name.

In the cases where the mastoid cells are also involved it is necessary to make a still more extensive exposure. In these cases a typical mastoid operation is first performed. The mastoid antrum is opened as the first step of the procedure, after which the partition between the external auditory canal and the opening in the mastoid is broken down, thus throwing the tympanic cavity, the tympanic vault, the

[1] Archiv für Ohrenheilkunde, vol. xxxi. p. 201.

mastoid antrum and adjacent cells, and the external auditory meatus into one large cavity. This operation is known as the Stacke-Schwartze operation.

As I have stated many times in previous writings, the choice of operation in each individual case must depend upon the extent to which the bony structures are implicated. In those cases in which there is evidence that the intratympanic caries is limited to the ossicular chain, the simple operation of removal of the ossicles is undoubtedly indicated. Where, however, we have reason to believe that the disease has extended to the tympanic vault, the Stacke operation would seem the procedure of election. In all other cases, where the destruction of bone is extensive, the radical procedure, known as the Stacke-Schwartze operation, would be the procedure of choice. It would seem at first quite possible for the surgeon to make a differential diagnosis in these cases and in every instance to select the procedure advisable in each individual case presenting. I confess in previous years this has been my view, and that I have leaned very strongly to the simple operation of extraction of the ossicles, except in cases where there was abundant evidence of extensive involvement of the adjacent pneumatic structures. Later experience has led me to believe, however, that conservative surgery in this region is a mistake rather than an advantage. While I believe that the simple operation is indicated in a certain proportion of cases, I also believe that the field of this operation will become more and more restricted as the experience of the surgeon becomes wider.

Out of 92 cases operated upon by the author by removal of the ossicles and curettement of the tympanum, 53 were cured, 25 improved, 2 unimproved, and in 12 the result was unknown. The two cases recorded "unimproved" in the preceding statistics were subsequently operated upon by the Stacke method, while two which were reported as "improved" later required the same procedure, and were operated upon subsequently.

Grunert[1] reports the following results from ossiculectomy: of 28 cases, 13 were cured, 13 were not cured, and 2 were still under treatment at the time of the report.

Ludwig,[2] in two articles in which he deals very fully with the subject of middle-ear caries and the relief of the same by the extraction of the malleus and incus, reports[3] 43 cases operated upon in which he found that the suppuration was cured in 22 cases, the discharge continued in 5, 9 were still under treatment at the time of the report, in 5 the result was unknown, and in 2 cases the patients died, although the fatal issue was in no way attributable to the operation.

[1] Archiv für Ohrenheilkunde, vol. xxxiii. p. 222.
[2] Ibid., vol. xxix. p. 241, and vol. xxx. p. 263.
[3] Ibid., vol. xxx. p. 263.

Schroeder[1] reports 130 cases of extraction of the malleus and incus for middle-ear suppuration. Out of this number, 62 were cured, 39 were not cured, in 28 the result was unknown, and 1 was still under treatment at the time of the report. It should be stated that although these cases of Schroeder are reported as cases of extraction of the malleus and incus, in 19 cases the malleus alone was extracted, the operator being unable to find the incus. In 9 others neither the malleus nor incus could be found, presumably having been previously destroyed by caries, while in 3 cases it was necessary to stop the operation on account of profuse hemorrhage.

From the foregoing results it will be seen that out of Grunert's 28 cases, 46 per cent. were cured; in Ludwig's 43 cases, 51 per cent.; in Schroeder's 130 cases, 48 per cent.; while in the author's cases 57 per cent. were cured.

The variations in these statistics are so slight that the difference might easily occur from the class of cases which came under the observation of a certain operator. These statistics simply go to show that in a certain proportion of cases—that is, in at least one-half of the cases of suppurative otitis subjected to this operation—a cure resulted.

A few words may not be out of place in regard to the technique of the operation. From the first I have always insisted upon the absolute necessity of removing the incus in every case. Ludwig, in his masterly article on "Caries of the Ossicula," tells us that in at least 85 per cent. of all cases of intratympanic caries the incus was found diseased. It goes without saying, therefore, that the operator must make a thorough and complete search for the incus in every case. Even a small fragment of this ossicle remaining would be sufficient to cause the suppuration to continue indefinitely. While we have all of us met with cases in which it was impossible to find even a fragment of the incus, the operator should not consider his operation complete unless the incus, or what remains of it, is removed, or unless he has satisfied himself thoroughly that not even the smallest fragment of this ossicle remains. It has been my experience not infrequently to find a small fragment of the incus only after a persistent search, and it has been my invariable rule to prolong my operation almost indefinitely, in order to make certain that no remnant of this ossicle has been left behind. It is, perhaps, for this reason that the result in the cases which I have reported is slightly better than in those of the other operators. I would not be understood as saying that I have always found some portion of the incus in these operations. In quite a number of cases I have failed to find even the slightest trace of the ossicle, but I have only desisted from my search after a prolonged exploration in every portion

[1] Archiv für Ohrenheilkunde, vol. xlix. p. 17.

of the tympanic cavity accessible through the external auditory canal. It is impossible for me to report on my entire 92 cases, as I have not had sufficient time to look over all of my old histories. Moreover, in many of my earlier cases the records are incomplete. Out of the last 33 cases operated upon I find that in 23 cases the malleus and incus were removed, in 4 the incus was not found, and in 6 cases the history of the operation does not state whether one or both ossicles was removed.

Regarding the search for the incus, one point in the technique is to be remembered—that the ossicle lies close to the margin of the tympanic ring. After the malleus has been removed, the incus hook, with the curve looking forward, should be introduced low down into the canal, and should be made to enter the tympanum until its angular extremity disappears behind the posterior margin of the tympanic ring. The hook is then pulled outward until its angular portion engages upon the ring. The instrument is then swept upward toward the tympanic vault and at the same time rotated forward by the fingers, so that the incus, if present and not completely destroyed, will be engaged by this instrument and brought into the field of vision. It is necessary to repeat this manipulation several times in order to be certain that a small fragment of the incus is not lodged in the posterior and upper portion of the tympanic cavity. Too much force should not be used in carrying out this step of the operation, but, at the same time, sufficient force should be employed to break down any adhesions that may be present in the posterior part of the tympanic cavity, and, if the fragment of incus is perfectly encapsulated in dense connective-tissue bands, to break up these adhesions and dislocate the fragment of the ossicle forward and downward into the tympanum. Sometimes we find these bands so dense that the incus hook will not divide them. When this is the case the angular knife should be introduced into the tympanic cavity and swept upward and backward through the posterior and upper segment, so as to divide any connective-tissue bands which may be present in this locality. I have in quite a number of cases found a small fragment of the incus lying in a little pocket just at the junction of the upper and posterior wall of the meatus. In these cases, as we know, the long process of the incus is first destroyed, and the small remaining fragment of the body of the ossicle lies upon the little shelf which is formed by the inner extremity of the superior wall of the bony canal. In cases where the caries is of long standing, after the destruction of the long process of the incus, the body is frequently encapsulated in what appear to be the remnants of the capsular ligament, forming a mass of encapsulated tissue which has been thrown out around the body of the ossicle. This capsule is, as before stated, firmly adherent to the inner extremity of the canal wall, and frequently remnants of the capsule, together with the necrotic incus body, are swept down from

the shelf and extracted at the same time. After the incus hook has been used in the manner already described, and in cases where it is necessary the angular knife as well, if the operator fails to find any vestige of the ossicle it is well to explore the anterior and inferior portions of the tympanic cavity by means of the incus hook, lest the ossicle may have been dislocated downward and forward at the time that the malleus was removed, and have lodged in the antero-inferior portion of the cavity. To effect this the sweep of the incus hook is simply continued forward, through the tympanic vault, down to the tympanic floor, the hook being gradually rotated so that the curve at first looks forward, then backward, and then upward as the hook reaches the lower portion of the cavity. During this entire manipulation the angular portion of the hook should be pretty closely applied to the tympanic ring, so as to avoid injury of important structures upon the internal tympanic wall. A certain number of operators advise the use of the incus hook in a different manner—that is, the instrument is introduced into the canal with its concavity looking backward, and is swept from before backward and downward through the tympanic vault, so as to dislodge the ossicle downward and backward into the lower portion of the tympanic cavity. It can at once be seen that the use of the incus hook in this manner renders it exceedingly possible to dislocate a small fragment of the incus backward into the mastoid antrum or into the *aditus ad antrum*, where it will be beyond the reach of any instrument introduced into the canal.

Another point in the performance of the operation upon which I have always insisted is the perfect removal of the floor of the tympanic vault whenever this portion of the middle ear is diseased, and it is almost always diseased in cases of intratympanic caries.

The floor of the tympanic vault is best removed by a small pair of angular rongeur forceps, cutting antero-posteriorly, which are introduced through the speculum into the canal and made to bite away as much of the inner extremity of the superior bony wall as can be engaged between the blades. It is often wise to institute this procedure immediately after the removal of the malleus in those cases where a moderate search fails to reveal any trace of the incus. Not infrequently, after the removal of the floor of the tympanic vault in this way, a remaining fragment of the incus can be easily seen and extracted.

In addition to what has been said about the thorough search for the incus and the removal of the floor of the tympanic vault, no operator should feel that the operation is completed until the entire middle ear cavity has been thoroughly curetted. While intratympanic caries is sometimes limited to the ossicular chain, most frequently the tympanic walls are, to some extent, involved as well. It is necessary, there-

fore, to curette carefully not only the atrium and margins of the ring, but, by means of the angular curette, the tympanic vault as well, so as to remove every possible focus of diseased tissue. The curette should also be introduced well into the tympanic orifice of the Eustachian tube, so as to cause a closure of this tube if possible, to prevent subsequent infection of the middle ear from the nasopharynx.

While hemorrhage has in many of my cases prolonged the operation unpleasantly, I have never had a case of hemorrhage sufficiently severe to render it necessary for me to stop the operation. In one case, at the very last stroke of the curette, the jugular bulb was wounded. Had this accident occurred earlier in the operation I undoubtedly would not have been able to proceed further; but fortunately both the malleus and incus had been extracted, and the walls of the cavity had been pretty thoroughly curetted before the accident happened. I cannot conceive of hemorrhage sufficiently severe to cause the operator to desist from completing the operation, unless either the jugular bulb or the internal carotid should be accidentally injured. Of course, either accident is possible, as there may be dehiscences in the internal tympanic wall, either congenitally or as the result of a pathological process. All other hemorrhage can be easily controlled by packing the canal and middle ear firmly for a few moments with a strip of sterile gauze. For the last few years I have been in the habit of saturating these gauze strips in a sterilized solution of suprarenal extract, and have found that the hæmostatic effect of this drug materially aids the operator. The bleeding is very quickly checked, and the operation can be proceeded with much more rapidly than where simple packing alone is relied upon.

We now come to considering the so-called radical operation, first proposed by Stacke and since advocated by many prominent otologists. This procedure has already been somewhat roughly described in the early portion of this paper. The results obtained by the Stacke-Schwartze operation compare most favorably with those obtained by the simpler procedure. Out of 37 cases operated upon by the author, 27 were cured, 5 improved, 1 unimproved, 1 unknown, and 3 are still under treatment.

Panse,[1] in discussing the radical operation of which we are at present speaking, reports 57 cases operated upon; of these 31 were cured. Of the remaining cases the author simply states that they have not been under observation long enough after the operation to warrant a report as to their condition. These cases must therefore be looked upon as still under treatment.

Grunert[2] out of 43 cases operated upon by this method reports 24 cured, 18 either unimproved or still under treatment, and 1 death.

[1] Archiv für Ohrenheilkunde, vol. xxxiv. p. 248.

[2] Ibid., vol. xxxv. p. 198.

Regarding the technique of the radical operation, a few remarks may not be amiss. In the first place, the location of the incision through the soft parts is a matter of some importance. For a long time it has been my rule in making the incision in the ordinary mastoid operation to divide the soft tissues down to the bone just behind the line of auricular attachment. In this way the line of incision lies practically in the post-auricular fold, and the deformity caused by the incision is insignificant. In performing the radical operation now under consideration it is best to make the incision much further back. The soft parts should be divided by a curvilinear incision, which should lie at least five-sixteenths or, in some cases, one-half inch behind the line of auricular attachment. Some operators, notably Ballance,[1] prefer, in case the incision is made at a considerable distance from the ear—say half an inch behind the line of auricular attachment—to make this incision only through the integument and subcutaneous areolar tissue. The anterior flap is then dissected up for about a quarter of an inch, and the remaining soft parts are divided down to the bone. In this way the posterior flap is terraced, so to speak, to the margin of the bony external auditory meatus. Personal experience has taught me that there is not much advantage in making the flap in this way. It is, however, wise, to make the incision further back than is usually done in performing the ordinary mastoid operation.

After the soft tissues have been divided by either method the anterior flap is rapidly dissected forward until the posterior and upper margin of the bony meatus is exposed. The fibrocartilaginous meatus is then dissected out of the bony canal by means of a thin, narrow periosteal elevator, the dissection being carried as deeply as possible. The fibrocartilaginous tube will be found to rupture spontaneously close to the drum membrane. Forcible traction is now put upon the anterior flap, and the posterior, upper, and inferior aspects of the cartilaginous meatus are forcibly drawn forward by means of such traction, so as to expose the bony meatus along the superior, posterior, and inferior aspect. If firm traction is applied to the anterior flap the operator will be able to look directly upon the external wall of the middle ear—that is, upon the drum membrane or its remnant. Sometimes the posterior wall of the fibrous meatus is very much thickened, and on retraction of the anterior flap it may be projected backward across the bony meatus, so as to somewhat obscure the view. Under these circumstances it is well to thread a broad strip of sterile gauze through the external auditory meatus, bringing it out posteriorly through the opening in the posterior wall of the canal. Forcible traction on this strip of gauze will pull the obstructing tissues entirely beyond the field

[1] Medico-Chirurgical Transactions, vol. lxxxiii.

of vision and allow a perfect inspection of the parts lying at the fundus of the meatus. The operator may next proceed in one of two ways: he may either enter the mastoid antrum in the typical manner advocated by Schwartze in the performance of an ordinary mastoid operation, or he may proceed, as Stacke advises,[1] by first removing through the external auditory meatus the floor of the tympanic vault. I must confess that experience has taught me to recommend most strenuously entering the mastoid antrum through the cortex as the primary step. When performed upon the cadaver, where there is no hemorrhage, it is perfectly simple to introduce a chisel into the external auditory meatus and to remove the floor of the tympanic vault and a portion of the posterior wall of the canal. Where, however, the field of operation is more or less obscured by hemorrhage—and by this I do not mean the hemorrhage that can be controlled by clamping the principal bleeding points, but that oozing from the entire incised surface, which so frequently follows any surgical interference in this region—the landmarks are so obscured that in quite a large proportion of cases the chisel, if introduced into the external auditory canal, must be used somewhat blindly. In these cases I believe it is always wise to begin by perforating the cortex at the region of election and enter the antrum in this way. After the antrum has once been entered a probe will pass directly forward, downward, and inward into the tympanic vault. The next step is the breaking down of the posterior and upper wall of the external auditory canal, thus making the canal-like passage through the cortex into the mastoid antrum continuous with the external auditory canal and the middle ear. Certain important structures may be damaged in performing this step of the operation. In order to avoid wounding important structures the operator should proceed as follows: The antrum having been opened in the typical manner, the operator should proceed to follow the upper wall of the external auditory meatus down to the middle ear. If the bony tissues could be divided along this line no damage would be done to any important structures. In order to effect this division a certain amount of bone must be removed from below; consequently the operator should enlarge the opening through the mastoid cortex until it assumes a funnel-shaped form, the apex of the funnel lying at the mastoid antrum and the broad base of the funnel including an area of mastoid cortex and the external auditory canal, the vertical diameter of which is equal to that of the vertical diameter of the external auditory canal. In breaking down the wall between the canal and this funnel-shaped opening in the mastoid the operator should remove a wedge-shaped piece of bone, the base of the wedge corresponding to the vertical diameter of the meatus and the

[1] Loc. cit.

apex corresponding to the *aditus ad antrum*—that channel which joins the mastoid antrum with the tympanic vault. The important structures to be avoided lie just below the apex of this wedge-shaped piece of bone to be removed; they are the horizontal semicircular canal, which forms really the floor of the *aditus ad antrum*, and immediately below this the aqueductus Fallopii, which contains the trunk of the facial nerve; lower still we have the oval window, containing the stapes. If the operator proceeds from without inward he may follow the upper wall of the external auditory canal inward until the antrum is reached. He may follow the inferior wall inward for at least two-thirds of its length. The removal of the long bony partition along these lines will then reveal the prominence of the horizontal semicircular canal, and, immediately below this, that of the aqueductus Fallopii. If the posterior wall of the meatus is removed throughout its entire length as far as the internal wall of the middle ear, the horizontal semicircular canal and aqueductus Fallopii must be injured. The point which the operator should remember is to follow inward along the level of the inferior wall of the canal for about two-thirds of the length of the auditory meatus, while the bony tissue can be removed along the upper wall until the *aditus ad antrum* is reached. When this triangular, or really this quadrilateral, piece of bone has been removed the surgeon will be able to see distinctly the prominence of the horizontal semicircular canal and the facial nerve, and close inspection will reveal below this the oval window. After these steps of the operation have been accomplished the operator will then break away the floor of the tympanic vault—that is, the inner extremity of the superior wall of the external auditory meatus. This procedure, when completed, will disclose the entire middle-ear cavity as continuous with the external auditory canal. The head and neck of the malleus, with the short and long process, will be readily seen, the body of the incus, with its short process, resting in the cella incudis, and its long process extending downward; the incudostapedial articulation will likewise be made out. Above the head of the stapes the operator will see the prominent ridge which marks the horizontal semicircular canal, and immediately below, or more frequently amalgamated with it, the ridge of the aqueductus Fallopii, containing the facial nerve. It is then simple, after the parts are so thoroughly exposed, to divide the incudostapedial articulation, if it is still intact, and to remove the malleus and incus as well as any remnants of the drum membrane. All this can be done, in favorable cases, without disturbing the stapes. After the ossicles have been removed the entire cavity exposed should be thoroughly curetted until firm bone is encountered in every direction. In cases where the mastoid is pneumatic the large mastoid cells must be opened up, and these must be explored until firm bone is reached, and until the entire

bony cavity presents smooth walls in every direction. In cases where this operation is applicable we most frequently find the mastoid process sclerosed. The mastoid antrum is small, and most of the pneumatic spaces of the mastoid process are obliterated. In certain rare cases, however, we find the pneumatic cells very much diseased, and in every instance of this kind every vestige of pneumatic structure must be destroyed, so that the bony cavity remaining after the operation will present smooth and firm walls in every direction. (Fig. 1.)

While this procedure, if the operation could be performed as above described, would be exceedingly attractive, certain drawbacks not infrequently present themselves which render the operation difficult. In the first place, hemorrhage is one of the great hindrances to this operation, as it is to the simpler operation of ossiculectomy, already

FIG. 1.

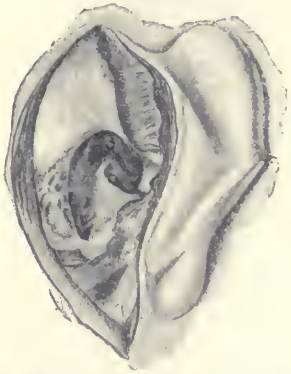

FIG. 2.

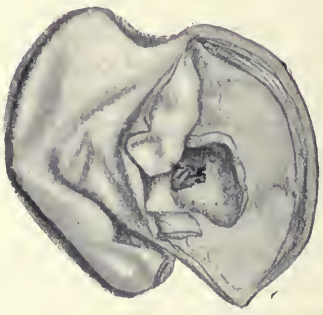

Fig. 1 is a complete Stacke-Schwartze operation. The mastoid cells and middle ear have been thrown into one large cavity continuous with the external auditory meatus. Dench Diseases of the Ear, third edition. (From dissections by the author.)

Fig. 2 is a Stacke-Schwartze operation. Formation of flaps by Panse method. Dench, Diseases of the Ear, third edition. (From dissections by the author.)

detailed in the early part of this paper. In the large majority of cases hemorrhage does not interfere seriously with the conduct of the operation, although it frequently prolongs the procedure unduly. I encountered one case—among those reported—where the general oozing was so profuse as to make the operation very long and tedious. The only way to control the hemorrhage is by packing the wound firmly with sterile gauze. In cases where the venous oozing is troublesome the operator must simply content himself with prolonging his operation until the hemorrhage ceases.

After all carious bone has been removed and the hemorrhage stopped from all bleeding points, the operator next proceeds to line the cavity with epithelial flaps derived from the posterior wall of the fibrocartilaginous meatus and from the concha. Several methods are much in

vogue in forming these flaps. Stacke, in his earlier operation, advocated the splitting of the fibrocartilaginous meatus along the posterior aspect and tucking the two triangular flaps thus formed, the one upward and backward and the other downward and backward, into the bony cavity formed by the enlargement of the fundus of the canal.

Panse modifies this procedure, converting the horizontal incision along the posterior wall of the canal into a T-shaped incision, by making one cut upward and another downward where the horizontal incision along the posterior wall of the meatus extends to the concha. In this manner two quadrilateral flaps are formed—one, which is turned upward, and the other downward, so as to more perfectly line the cavity formed by the extensive removal of the bone. (Fig. 2.) These two flaps are held in position by means of sutures which pass through the flaps and bend the upper flap forward and upward upon itself, while the lower flap is bent backward and downward upon itself. All sutures pass through the quadrilateral flaps and through the soft structures in the anterior flap.

FIG. 3.

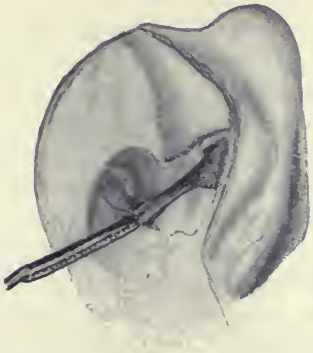

Fig. 3 is a Stacke-Schwartze operation. The long tongue-shaped flap, formed according to the Körner method, is seen drawn outward and backward by means of a clamp. Dench, Diseases of the Ear, third edition. (From dissections by the author.)

Another modification of the plastic operation is that of Körner, who, instead of dividing the fibrocartilaginous meatus by a single horizontal incision, makes one horizontal incision along the upper and posterior margin of the fibrocartilaginous tube, and the other along the posteroinferior margin. This incision is extended into the concha. In this way a single quadrilateral flap is formed which can be forced backward into the bony cavity. (Fig. 3.)

The cartilaginous structure of the concha interferes materially with the reflection of this flap backward into the bony cavity which it is supposed to line. In order to obviate this difficulty, Jansen, of Berlin,

advocated the dissecting out of the cartilage, thus making the flap thin and allowing of its easy displacement into the bony cavity.[1] I have attempted this method in one case, and the result was fairly successful.

Still another method is that recommended by Ballance,[2] in which a tongue-shaped flap is formed which includes practically the entire area of the concha. This flap is cut from the auricle by passing a thin knife into the external auditory meatus just behind the tragus. The knife is then passed downward and made to divide the integument along the entire anterior, inferior, and posterior aspects of the concha, the incision stopping just below the anterior crus of the antihelix. The tongue-shaped flap thus formed is dissected up from the underlying cartilage, and the cartilage is excised. This tongue-shaped flap is then turned upward and backward, and is held in position by retention sutures against the corresponding raw surface of the anterior auricular flap—that is, the two raw auricular surfaces are brought together. It will be seen that in this way a cutaneous flap is formed which, on turning the auricle backward, fits for a considerable distance into the upper and posterior portion of the bony cavity, and thus serves to line this with integument.

Ballance also advocates the subsequent lining of the entire bony cavity, at a period of ten days after the primary operation, with skin grafts after the Thiersch method.

From my own experience I can say I have formed flaps in all of the above-mentioned ways, and believe that the exact flap to be formed must depend upon the particular conformation of the parts in each individual case. I might say, in regard to the Panse method, that for some time I have adopted a modification which has been very valuable to me. Instead of bending the upper and lower flaps backward upon themselves and suturing them to the anterior flap, to which they are already attached, I have passed deep sutures through the entire depth of these flaps and sutured them to the periosteal margin behind the mastoid wound. These sutures have been buried, and have served to hold not only the flaps in place and to force them, respectively, well upward and downward into the canal, but have also served to bring the cutaneous margins of the external wound in pretty close apposition. I have then closed my cutaneous wound with interrupted silk sutures, or, in some cases, with catgut or silkworm-gut sutures, and the results have been very favorable. In a number of cases, for the last year, I have dissected out more or less of the cartilage of the concha, and in every instance have found the results of the plastic operation were much better when this was done than when the flaps were allowed

[1] Verhandlungen der Deutschen Otologischen Gesellschafte Siebenten Versammlung in Würzburg, p. 196.

[2] Loc. cit.

to remain in their original thickness. I have also made use of the tongue-shaped flap, with the dissecting out of the cartilage after the Ballance method, but have slightly modified the manner of holding the flap in position. I have never attempted to line the middle-ear cavity by means of the Thiersch grafts, by reopening the posterior wound, as advocated by Ballance, but in one instance secured an admirable result by lining the entire wound through the external auditory meatus, the opening which was left after the plastic operation being so ample that the grafts could be inserted without great difficulty.

As before stated, I do not believe that any one method of forming the flaps or of securing them in position is applicable to every case. The operator should bear in mind the different methods which can be employed, and should modify these in such a way as will best conserve the purposes of the operation in any individual case.

Certain accidents may occur during the course of the radical operation. These are injury to the facial nerve, injury to the horizontal semicircular canal, injury to the labyrinth, exposure or perforation of the dura in the middle cranial fossa, exposure or wounding of the lateral sinus.

The facial nerve is most frequently injured in curetting the middle ear. If the rule given in the early part of this paper—as to the procedure to be adopted for removing the posterior wall of the canal until the horizontal semicircular canal is seen—be uniformly followed, and if curettement of the atrium is delayed until the operator has made sure that he sees the semicircular canal, it will be almost impossible for either the facial nerve or the horizontal semicircular canal to be injured. Where this accident has happened in my own cases—and it has occurred in several—the fault has always been that I have been too cautious in removing the outer portion of the posterior canal wall. If the posterior wall of the bony meatus is removed carefully no damage can be done, as the hard, dense covering of the horizontal semicircular canal and of the facial nerve will be seen before they can be injured. When seen they are easily recognized and avoided. After these structures have been exposed great care should be exercised in curetting the tympanum, and the edge of the curette should be invariably directed upward, forward, and downward, but never upward, backward, and outward. A backward stroke of the curette may open the facial canal and injure the nerve.

The labyrinth may be injured either by forcible curettage of the internal tympanic wall, in cases where there has been extensive caries in this region, or this portion of the perceptive apparatus may suffer violence by the entrance of instruments through the oval window, or, in rare instances, through the membrane of the round window. It is a well-known fact that in most cases of intratympanic caries the foot-plate

of the stapes seldom suffers. The crura of the ossicle may disintegrate as the result of the intratympanic caries; but the foot-plate, owing to the fact that it receives its blood-supply both from its tympanic and labyrinthine surface, is seldom cast off. The injudicious use of the curette in the neighborhood of the oval window may injure the labyrinth either by crowding the ossicle inward and actually dislocating it into the labyrinthine chamber, or, in cases where the crura have been destroyed, a small curette may really destroy the foot-plate of the stapes and enter the vestibule. While in certain instances such an injury may be unavoidable, the operator should always bear in mind that the curette is to be used with extreme caution in this region. Too much force should not be employed, either, over the promontory, or particularly should not be used in the neighborhood of the oval window. The results following the incautious use of instruments in this region may result not only in an impairment of the hearing, but also in an infection of the labyrinth, which, spreading to the meninges, may lead to a fatal termination.

The exposure of the dura mater, in the middle cranial fossa, is not to be regarded as of any consequence. It is frequently necessary to expose the dura in this region, in order to remove all carious bone. In certain cases, where the internal table is perfectly normal, the operator will find it practically impossible to expose the tympanic vault and the *aditus ad antrum* without removing the thin lamella of bone which separates these spaces from the middle cranial fossa. Under strict aseptic precautions there is practically no danger of infection of the meninges if the dura is exposed. If the dura be accidentally perforated, thus exposing pia mater and brain substance to infection, the accident is certainly one of considerable gravity. In one case upon which I operated the middle cranial fossa was exceedingly low, and in removing the external wall of the vault by means of the chisel the internal table was involved in the section as well. A thin spicule of bone perforated the dura, and upon cautiously probing the wound I found that the probe entered through the dural perforation and penetrated the brain substance. As the case was one of purulent otorrhœa of long standing, I was naturally much disturbed, but proceeded with the operation, exposing freely the dura, and assuring myself that the perforation through this membrane was very small, and that no serious injury had been done to the brain substance. The operation was then carried out in the ordinary manner, great care being taken to remove every vestige of diseased bone, so that no secondary infection of the brain could result from the middle-ear suppuration. The operation wound was then drained entirely through the canal by means of gauze packing, and the line of incision was completely closed by means of sutures. This patient made a perfect and rapid recovery.

Injuries to the lateral sinus in cases where the radical operation is performed are extremely rare. Not infrequently, however, when the sinus lies far forward this vessel will be exposed during the operation. This has happened to me in several of my cases, but I have never seen any unfavorable results from this exposure.

It is much wiser to do a thorough and complete operation in these cases, exposing the dura in the middle cranial fossa or the lateral sinus in the posterior portion of the wound, rather than do a less complete operation in order to avoid the exposure of these structures. Accidental wounding of the lateral sinus will, of course, occasionally occur; and while the wounding of the vessel is more grave than its simple exposure, it need not necessarily be followed by any serious results. A firm tampon of iodoform gauze will invariably control the hemorrhage, and if the operation has been conducted aseptically there is very little danger of infection of the sinus.

In any operation conducted according to aseptic principles the occurrence of any of these accidents need not deter the operator from closing the posterior wound throughout and trusting to drainage through the external auditory meatus.

It is always wise to pack off either the area of dural exposure or any wound of the lateral sinus with a separate strip of gauze, to guard against subsequent infection through the packing which is introduced deep into the tympanic cavity at the site of original infection. It is always wise in these cases to change the dressing at the end of at least forty-eight hours after the operation, and then to dress the case every twenty-four or forty-eight hours until the wounded areas are completely protected by a firm layer of granulations.

I have gone into this subject rather fully, because I have desired to bring before you the advantages which accrue from each operation having for its purpose the removal of diseased bone from the middle ear. Both from the statistics of others and from my own statistics we may conclude that the simpler operation of ossiculectomy has a permanent place in the surgery of the middle ear.

In those cases reported by Panse[1] we find, as the result of the radical operation, 54 per cent. of cures, while Grunert[2] reports 52 per cent. In my own cases the reports show 72 per cent. of cures. Referring again to the statistics of the simpler operation, it will be remembered that of Grunert's cases, 46 per cent. were cured; in Ludwig's cases 51 per cent., in Schroeder's cases 48 per cent., while in the author's cases 57 per cent. were cured. It will be seen, therefore, that with few exceptions the percentage of cures is not so much greater for the radical operation than it is for the more simple procedure. I can easily

[1] Loc. cit. [2] Loc. cit.

explain the apparent discrepancy in the ratio of cures in my own cases from the fact that in my earlier operations I was more inclined to perform the simpler operation of ossiculectomy, and therefore probably operated on many cases by this method which should more properly have been operated upon by the radical procedure. Of late years I have operated upon many cases by the radical method which might possibly have been cured by simple ossiculectomy. These cases would naturally recover perfectly after the radical operation. For this reason the percentage of favorable results following the radical operation is considerably higher than that of favorable results following ossiculectomy, and is also considerably higher than reported by other operators. I believe that the value of each procedure will depend upon the individual case. Where caries is limited, and where there is no history of recurrent attacks of acute inflammation of the middle ear, with marked symptoms of imperfect drainage, the simpler procedure is the one to be resorted to. On the other hand, where we have a history of recurrent attacks of acute inflammation of the middle ear in a case of purulent otitis media, and where, also, these acute attacks are accompanied by a train of symptoms which make one suspect that there may be beginning infection of the mastoid, of the labyrinth, or possibly of the intracranial structures, these cases should be invariably subjected to the radical operation.

One point which has not been mentioned in discussing these various operations is the effect which each procedure has upon the function of audition. In the more severe cases of purulent otitis media the hearing is often so poor that the operator may exclude entirely the possible effect of any operative procedure upon audition, and may feel that the only problem to deal with is the cure of the suppuration. In a certain proportion of cases, however, where the evidences of septic absorption are not very pronounced, and where the hearing in the affected ear is fairly good, the surgeon must bear in mind the possible effect of any operative procedure upon the function of that organ.

While I cannot give the exact percentages in my own cases, as many of the records have not been kept accurately, I will say that in my experience the result of an ossiculectomy has seldom been to reduce the hearing, but has in many cases materially improved the power of audition. Conducted carefully, the surgeon can practically promise the patient that, barring accidents, the hearing, after the removal of the ossicles, will be no worse than it was before, and will probably be somewhat improved. This statement applies to cases in which functional examination shows that the labyrinth has not been involved secondarily. In cases where secondary labyrinthine involvement has occurred the effect of ossiculectomy is not infrequently to cause an additional impairment of audition.

Referring to the work of others, I find that out of 130 cases of ossiculectomy reported by Schroeder, the hearing was improved in 65 per cent., in 22 per cent. it remained the same as before the operation, and in 13 per cent. it was impaired as the result of the operation.

Out of 43 cases reported by Ludwig the hearing remained the same after the operation as it was before in 19 cases, it was improved in 17, it was made worse in 3, the result was unknown in 2, while in 2 other cases the patients died.

Regarding the results of the radical operation, Grunert[1] says that in the greater proportion of cases the hearing remains the same after operation as before, while in certain cases it is considerably improved. My own experience with the radical operation leads me to believe that the surgeon is not warranted in promising the patient that the hearing will be as good after the operation as it was before unless at the time of operation the power of audition is very greatly dimininished in the affected ear. While during the course of the operation the surgeon may not injure any of the delicate structures within the tympanum, in those cases where the motility of the stapes approaches anything like the normal standard a certain rigidity of this ossicle must necessarily take place as the result of the epidermization of the tympanic cavity. The surgeon, therefore, should always caution the patient, prior to the performance of the radical operation, that the function of audition upon the affected side may be very decidedly impaired after the operation. In cases where the audition is good the possible effect upon the hearing, other things being equal, will cause the surgeon to choose the simpler operation of ossiculectomy rather than the more radical procedure. It must always be remembered, however, that in most of these cases which come to us the question is not so much one of either the preservation or improvement of the function of the organ as the removal of a serious menace to life. Here, where the hearing in the opposite ear is good, the surgeon should not hesitate to advise the radical procedure, in spite of the fact that the function of the organ will be thereby materially interfered with.

THE ENTRANCE OF AIR INTO THE VEINS.

By H. A. Hare, M.D.,

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I have read with a good deal of interest a paper upon this subject contributed by Dr. Malcolm Goodridge, of New York, to The American Journal of the Medical Sciences for September, 1902. So far as

[1] Archiv für Ohrenheilkunde, vol. xxxv. p. 209.

I am aware, the most exhaustive experimental work which has been done in connection with this subject is that of Dr. Nicholas Senn, which was published in the *Transactions of the American Surgical Association* for 1885, and my own work, reported in the *Therapeutic Gazette* for 1889, page 606. Dr. Senn's experiments involved the use of different kinds of animals, but my own were confined almost entirely to dogs, and were made in ignorance of the very valuable research which had previously been carried out by Dr. Senn.

Having been taught as a student of medicine that the entrance of air into a vein, even in a minute amount, was followed by most disastrous results during surgical operations—having been warned that should such an occurrence take place while giving an hypodermic injection death might ensue—I was struck with the fact that when intravenous injections of various substances were given to some of the lower animals, and considerable quantities of air entered a vein, no appreciable results took place even if the jugular vein received the air. After these observations on my part had been confirmed by a large number of experiments in which the injection of air took place inadvertently, I carried out quite an exhaustive study in which I deliberately injected air into the jugular vein of dogs for the purpose of seeing how large quantities could be borne without producing death, and demonstrated the innocuousness of these injections to medical students of the University of Pennsylvania, where I was then teaching, to several of my colleagues, and finally before the Philadelphia County Medical Society, on that occasion injecting as much as sixty cubic centimetres of air into the jugular vein of a small dog that weighed about twelve pounds without the production of any symptoms whatever. I mention these preliminary facts, as they have some bearing upon the remarks which are to follow, which remarks, to a certain extent, take issue with those of Dr. Goodridge, both as to his quotations from Dr. Senn and from myself and as to the conclusions which he draws from his own experiments.

In the early part of Dr. Goodridge's paper he states that the researches of Dr. Senn and myself impress him with the fact that the personal equation of an investigator plays no insignificant part; for, "on the one hand, Hare, after experimenting with some seventy dogs, asserts that even large quantities of air do little harm; . . . on the other hand, Senn found that small quantities of air when injected into the jugular vein proved fatal in a large percentage of his dogs." As a matter of fact, this statement in regard to Senn's results is incorrect, as will be seen when page 72 of Dr. Senn's brochure on this subject is examined, where, in his remarks on his experiments, he states that a small amount of air in the right side of the heart in a healthy animal gives rise only to temporary symptoms referable to the heart's action

and the pulmonary circulation; and, again, when he states, a few lines below, "that the danger attending the insufflation of air into the veins is proportionate to the amount of air introduced as well as the capacity of the right ventricle to resist intracardiac pressure." It is interesting in this connection, although not directly in point at this time, to remark that Dr. Senn found it practically impossible in all his experiments to cause the entrance of air into a vein of the neck or into the longitudinal sinus unless he employed a syringe for the purpose of injecting it.

At the close of Goodridge's paper he concludes that the entrance of air into the veins even in small amounts is to be dreaded, as it results in death. Whether this conclusion is correct as it relates to man is doubtful. As is well known, there are a number of cases on record in which air embolism is supposed to have been responsible for death in the human being, although, as far as I know, the possibility of ordinary embolism having produced death in these cases has not been excluded. There are other cases of air embolism in man which were not disastrous.

The point is that Dr. Goodridge is not justified in making the assertion quoted, nor do his experiments justify him in the still more radical assertion that he believes the statement that large quantities of air may be introduced into the veins without unfavorable results to be "pernicious teaching, and not supported by fact." The results of my work and that of Senn seem to prove that air embolism in small amounts is not usually lethal, while Goodridge's own experiments support our earlier researches instead of controverting them.

When we come to examine the experiments upon which Dr. Goodridge has based his conclusions we find that a serious error has occurred as to the amounts of air which he has injected. Surely a wounded vein would not be apt to draw in very large quantities of air, even if the patient was struggling violently, and the experiments of Senn and myself certainly prove that small amounts of air introduced into the veins of animals practically never result fatally; while if any further proof of the fact that air may enter a vein without producing death is required, I may state that I have in my own experience seen a considerable quantity of air—amounting to as much as from two to three cubic centimetres—injected into the median basilic vein of two human beings without producing any symptoms whatever; while a third patient, who received a similar dose, shortly afterward had a decided rigor, which at the time was supposed to be due to the fact that the saline solution was unduly cold, and not to the air embolus which entered inadvertently. It is a noteworthy fact that in all Dr. Goodridge's experiments enormous quantities of air were injected into the veins, and, furthermore, that this injection was completed within a very few moments. Thus in one dog, weighing forty pounds, seventy-five cubic centimetres was injected into

the femoral vein, which would be equivalent to the injection of three hundred cubic centimetres in a man of one hundred and sixty pounds—an amount which could scarcely enter a wounded vein during an operation by any possibility unless it was deliberately forced into it. So, too, in his Experiment No. 10, notwithstanding the fact that seventy-five cubic centimetres was injected into a dog weighing thirty-four and one-half pounds, recovery took place, so that five days later the animal was recorded as being perfectly well, and on the sixth day was again subjected to an injection of seventy-five cubic centimetres, with the result that the dog "died." It is a noteworthy fact, however, that in Dr. Goodridge's report of this experiment he states that when the thorax was opened, after the supposed death of the dog, the auricles were spasmodically contracting, the right ventricle was distended with air, the heart was fibrillating, and that this continued for fifteen minutes. It would seem possible, therefore, that had the "autopsy" not been performed so soon, the dog might have survived even the second injection, since other dogs that did not come to immediate "autopsy" recovered. In his thirteenth experiment the animal received altogether two hundred cubic centimetres of air, in injections varying from fifty to seventy-five cubic centimetres each; and although the animal was apparently dead, it eventually recovered and was killed with chloroform. This animal received an amount of air in twenty-four minutes, which is equivalent, in a man weighing two hundred pounds, to a litre, or about one quart; while in Experiment 15, three hundred cubic centimetres given to a dog weighing less than forty pounds did not produce death, and it required a total of four hundred cubic centimetres to produce this result. The equivalent to this injection in a man of 160 pounds would be about three pints of air.

It is not necessary to quote further experiments which illustrate the fact that the doses of air which were employed by Dr. Goodridge were so massive that their effects cannot be compared with those which are produced by those minute quantities of air which might, perchance, be drawn into a vein. It is also a noteworthy point that not only did some of Dr. Goodridge's dogs survive these enormous injections, but in several instances he states that they recovered so rapidly that subsequent experiments were made upon the same animals. According to his own summary of his results, nine dogs recovered after aspiration of their hearts, while two others, which finally recovered, required large quantities of air—"two hundred and fifty to four hundred cubic centimetres"—to be injected forcibly before the pulse disappeared temporarily.

Dr. Goodridge also states that rapid injection of air is an important factor in producing bad results, and *that considerable quantities of air may be slowly injected without any serious effect.*

I do not doubt that such a quantity of air as eight hundred cubic centimetres, or nearly a quart, would produce a disastrous effect if it found entrance to the jugular vein of a man, and I do not deny that much smaller amounts may cause alarming symptoms, or even death. My claim is—and it is supported by the exhaustive experiments of Senn and myself, my personal experience with air embolism in man, and by Goodridge's own observations—that even a large air embolus is not as fatal as a small air embolus has been thought to be, and that the danger of the occurrence of air embolism is very slight. As was proved by Senn's researches, it is useless to conclude from massive injections in dogs that small ones in man are deadly.

Finally, it is not to be forgotten that in all probability different resistance to air embolism exists in different animals. Rabbits and monkeys are very susceptible, whereas dogs and goats are extraordinarily immune.

THE RELATION OF THE THYMUS GLAND TO MARASMUS.

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In 1877, Parrot described a condition of wasting in infants under the name of athrepsia. Since then this condition has been the subject of considerable investigation and thought. Many different names have been given to it, such as marasmus, simple atrophy, and atrophia primitiva infantum, etc.

The term inanition should be used only for those cases of acute starvation occurring in infants, with their rather characteristic symptoms and course.

There are two conditions in which we see atrophy in infants: The primary cases, where the cause is as yet unknown, and those following definite pathological conditions, or the secondary cases. The dividing line cannot at this time be definitely drawn. All cases occurring in the course of the easily recognized diseases may at once be placed in the group of secondary cases—those following tuberculosis, for example. Clinically, most cases are seen in infants who have had improper food and care. Some authors would place these in the list of secondary cases. Such authors would consider these from another standpoint and regard the process of nutrition as twofold—digestion

as the first step, and assimilation as the second. They would place under the head of primary atrophy only those where the second factor was at fault; or, in other words, those cases receiving proper care and a physiologically correct diet. This is, we think, a division practically useless; and for the present, until we have definite information, the cases should be divided, from a pathological basis, into those where there are lesions of definite diseases, and those where there are no special and constant lesions heretofore described except the wasting of the muscles and body fat.

The more important contributions to the pathology of the condition are as follows:

Baginsky thought that the disease was due to an atrophy of the mucous membrane of the intestine, and that it was owing to this condition that absorption was interfered with, and hence the atrophy. He estimated the amount of nitrogen ingested and that excreted, and found the nitrogen absorbed in these atrophic infants was about 50 per cent. below the normal. Similar anatomical studies were made by Soltau Fenwick, in London.

Since that time many investigators have disproved this anatomical statement. In the majority of cases the changes observed were due to the stretching of the intestinal wall by distention with intestinal gases, and also partly, in many cases, due to post-mortem change.

Bendix found that Baginsky's estimate concerning the nitrogen was exaggerated; and Heubner and Rubner, as the result of experiments carried out in a somewhat different manner, formulated the idea that there was sufficient food taken and absorbed, but that the trouble was due to the auto-intoxication from the decomposition of food in the intestinal tract. Czerny is of the same opinion, but holds that the intoxication is of an acid nature. The French writers regard the condition as an infection or intoxication due to a subacute or chronic infection of the intestinal tract. Marfan has more recently stated that the condition is due to a lack of or a lessened activity of the nutritive ferments; this in turn being due to intestinal infection.

Escherich and Marfan both claim that the reason that mother's milk is a better food for a child, and that breast-fed children more rarely get severe atrophies, is that there are more nutritive ferments in mother's milk than there are in cow's or goat's milk.

Our ideas concerning nutritive ferments are as yet too vague to be of great value.

We may safely assert, we think, that the trouble is not due to the amount of food ingested, nor to the amount absorbed from the intestinal tract, but that it is due to malassimilation of the food material in the body.

Herard, at a subsequent date, Friedleben, and recently Mettenheimer, have pointed out that the size and condition of the thymus gland was

an index to the state of the nutrition of the body. Of this there can be no doubt; the fact rests upon a firm basis of trustworthy observations. In the course of our autopsy experience in infants we observed this same fact independently, and have noted also changes which, as far as we have been able to ascertain, have never before been especially described in connection with infant atrophy.

The function of the thymus is as yet unknown. It has been the cause of considerable thought and investigation, the results of which may be briefly stated as follows:

Kölliker and Beard think that it is the parent source of the leucocytes; Chiari and Ziegler that it acts in place of the lymphatic system in intra-uterine life until it is replaced by other lymph-forming organs (pharyngeal and faucial tonsils) taking up its function. It is intimately connected with the lymphatic system, as it is enlarged in the general lymphatic enlargement of Hodgkin's disease and in leukæmia and Paltauf's status thymicus. It atrophies in atrophy of the lymphatics as in that following thyroidectomy.

It has also some relation with the spleen. Friedleben found that as the spleen got larger the thymus grew smaller. Schaffer found that when there were numerous nucleated red blood cells in the spleen there were few in the thymus, and *vice versa*.

The thymus may be the seat of changes in general diseases, such as tuberculosis and syphilis, and may be the seat of tumors of various kinds, and of abscesses. Hemorrhages are not of infrequent occurrence, especially in infants who have been asphyxiated.

It has been found to be hypertrophied in some, but not all cases of acromegaly (43 per cent.), gigantism, Graves' disease, chlorosis, epilepsy, and somewhat in infections, although authors differ on this point. In thymic asthma resulting in death in young infants it has been found very much hypertrophied, and also in the cases described by Paltauf and others under the name of Paltauf's status thymicus. In these cases, in young adults dying rather suddenly of œdema of the brain, there is found to be enlarged thymus, general hypertrophy of the lymphatic system, and hypoplasia of the vascular system, particularly of the aorta, and a chlorotic condition.

It is apt to persist where there is goitre.

It has been found atrophied in atrophic conditions and in rickets. In idiots Bourneville found that it was present in only 27 per cent. Katz found it present in every case in sixty-one autopsies on mentally sound children.

Friedleben extirpated the thymus in dogs, and found that there were changes in the blood, disturbances of the growth, particularly of the bone, nervous symptoms, and hyperidrosis; in other words, a condition resembling rickets.

Friedleben also noted the atrophy of the thymus gland in atrophic conditions. His wonderful monograph, published in 1858, contains the results of eight years' investigation on three hundred autopsies. It is one of the most valuable treatises ever published.

D'Abelous and Billard, and later Camia, removed the thymus in frogs, and found that there occurred a pigmentation of the skin of the back and œdema. The frogs died in about twenty days of a myasthenia gravis like the Erb-Goldflam syndrome.

Carbone extirpated the gland in rabbits, and found that there was no influence on the growth, and that there was apparently no blood-forming function.

In thymic asthma a portion of the gland has been removed a number of times. Siegel took off a part in a boy, aged two and a half years, who had suffered from laryngismus stridulus, and Koenig took out a portion from a child, aged two months, who had dyspnœa from the eighth day. Both recovered.

Perrucker took out the entire gland in a child, aged two and a half years, who had stridor from fifteen days after birth. He had aphonia and dyspnœa. He recovered, and eight months later was perfectly well and showed no symptoms from the loss of the gland.

The thymus gland has been used therapeutically in a number of conditions—in Graves' disease with questionable results, probably none. Blondel claims to have got good results in chlorosis. Mettenheimer used it in a large series of cases of rickets, and could not come to any conclusion except that it seemed to improve the nervous symptoms. Mendel, of Essen, claims good results in over a hundred cases. Mettenheimer got no result in cases of infantile myxœdema, but cured a case in an adult. It has been used without result in acromegaly. Mikulicz claims to have got good results in goitre.

In dogs fed on thymus Minkowski found a new substance in the urine, with the formula of $C_4N_4H_7O_3$.

Svehla found that it contained a substance that could be extracted with water, and when injected it produced an increase of the pulse-rate and a lowering of the blood pressure—results similar to those produced from the thyroid.

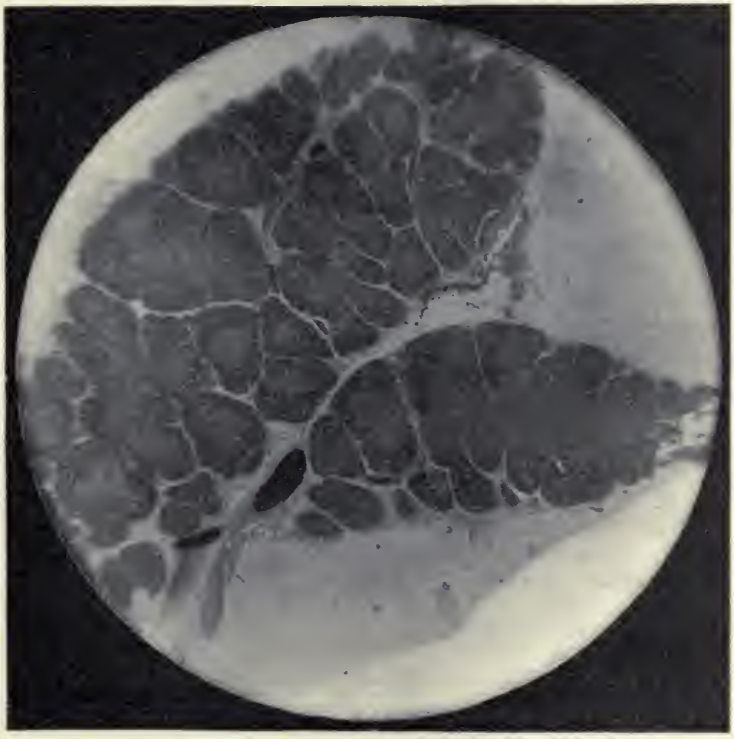
Bauman fed a dog on thymus, and found that the iodine in the thyroid was increased. He thinks that the two glands may have some antagonistic action.

Anatomy of the Thymus Gland. The thymus gland is a flat organ consisting of two lobes joined by an isthmus. These lobes are subdivided into many lobules separated by bands of fibrous tissue. It is situated in the anterior mediastinum, just above the pericardium and between the innominate and the left common carotid arteries. It is usually about 2 centimetres below the thyroid gland, and receives its

blood supply from the inferior thyroid artery. Its nerve supply is derived from the sympathetic system. In two cases of sudden death just after birth Mettenheimer found the glands weighing 12 grammes and 13.6 grammes, respectively. In young adults the average weight of the gland is about 22 grammes, and it generally measures 10 centimetres in length, 5 centimetres in breadth, and 1 centimetre in thickness.

Embryological Development. The thymus develops in the embryo from the evagination of the entodermal epithelium of the third

Fig. 1.



Magnification same as Fig. 2. Normal thymus gland from a six months' fœtus, showing the contrast between the cortex and medulla of the lobules.

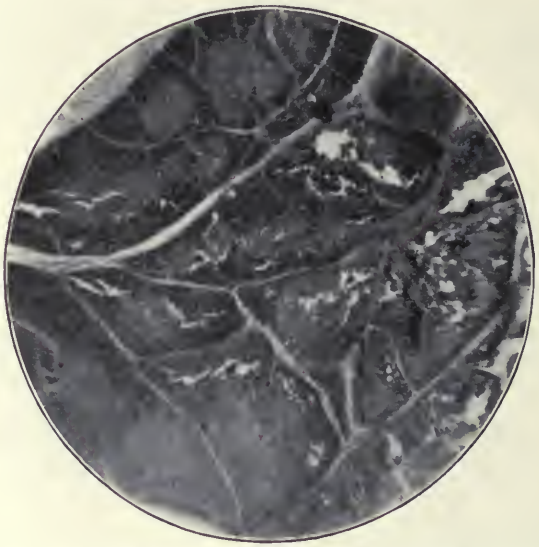
pouch of the gut tract. This layer of epithelial cells, by repeated branching, forms a structure similar to an acinous gland, which later becomes surrounded by mesodermic connective tissue and bloodvessels. Soon lymphoid cells make their appearance, when the gland assumes the structure found in extra-uterine life. The epithelial character thus soon becomes lost, and these cells only remain as the concentric masses known as Hassall's bodies, to be described later. The gland

assumes the structure of a lymphatic gland, and loses its previous epithelial character.

Histological Structure. The thymus gland is surrounded by a loose fibrous capsule containing fibres of elastic tissue. This capsule penetrates between the lobules, forming trabeculæ, which serve as the framework of the structure, and stain by Van Gieson's connective-tissue stain.

The gland consists of a cortex and medulla, and the essential structure of the lobules of both cortex and medulla are similar. The lobule consists of a network of stellate endothelial cells with terminal

Fig. 2.



Projection ocular, No. 2, Zeiss; objective, a-2, Zeiss. Magnification, 23 diameters. Normal thymus gland from well-developed infant, showing sharp outline of cortex and medulla and normal trabeculæ separating lobules.

interlacing fibrils. These cells form the outer boundary of spaces which resemble the reticular spaces of lymphatic structures, and which contain many small lymphocytes. A few neutrophilic and eosinophilic leucocytes and giant cells are also found in these spaces. Here and there throughout the lobules there are islets of epithelium, and in the medulla of the gland the epithelial cells are arranged in a concentric manner, resembling in appearance the concentric bodies of an epithelioma. These are called the corpuscles of Hassall, or Hassall's bodies. They are the remains of the embryonic epithelial cells, which form the main portion of the gland during intra-uterine life.

During extra-uterine life these concentric bodies measure from 13μ to 175μ in diameter, and they usually consist of flat, concentric masses of

epithelium. The centre of these bodies often contains a number of shining, homogeneous granules, resembling hyalin. This material is produced by changes in the epithelial cells in the peripheral zone of the bodies. The most compressed, central cells first turn to keratohyalin, and are then transformed to true hyalin.

The gland is very rich in bloodvessels, and the adventitia of these vessels gradually becomes lost in the connective-tissue framework of the organ.

The arteries enter the central zone of the medulla of the thymus and break up into capillaries, which especially permeate the cortex. Those on the edge of the medulla break up into capillaries, which form anastomosing branches perpendicular to the surface. Immediately beneath the surface of the gland these capillaries spread out into a network of wide vessels, which join the venous radicles of the structure.

There is also a second system of veins which proceeds from the arteries in the medulla, and thus gives to the structure a double venous system.

The lymphatic system seems to begin in the lymph spaces scattered through the interlobular connective tissue. These gradually form lymph vessels, which assume a muscular coat, and soon show valves. These join the arteries which enter the gland, and convey the lymph from the organ.

Relationship between Infantile Atrophy and the Thymus Gland. Mettenheimer cites two cases of infantile atrophy in which the weights of the gland were 3.6 grammes and 2.1 grammes. The microscopic examination showed a great interlobular fibrous tissue increase, and the lobules had lost their normal lymphoid structure, the lymphocytes being supplanted by a proliferation of the endothelial cells resembling the precursors of connective-tissue increase. The concentric bodies were increased, and showed various stages of degeneration. Durante and Farret each found similar atrophic glands, weighing 1.5 grammes and 1.6 grammes, in a case of athrepsia or infantile atrophy.

The Pathological Changes in the Thymus Gland during Infantile Atrophy. Our investigations include the study of 18 cases of infantile atrophy or marasmus, in all of which cases autopsies were made.

The lowest weight of the thymus gland was 1.2 grammes (3 cases), and the highest weight was 7.5 grammes. The average weight in 16 cases was only 2.2 grammes. These present a great contrast to 2 cases with normal glands, in the table, which weighed 15 grammes and 19.5 grammes, respectively, and the general normal weight of 18 grammes.

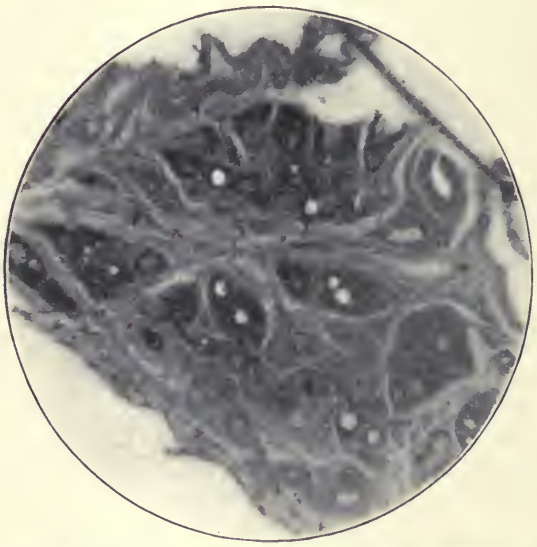
In all of the cases sections were studied from the heart, liver, kidney, spleen, lungs, stomach, and large and small intestines; and studies from some of the cases were made of the pancreas, adrenal gland,

thyroid gland, brain, various lymph glands, diaphragm, spinal cord, bladder, and aorta.

These specimens did not show any abnormal changes except occasional acute congestions or inflammations of the lungs due to terminal infection.

Cultures were made in 12 cases from the lung, heart, liver, kidney, and spleen, and they were all free from bacteria (an occasional infection excepted) except 4 cases. In 2 of these cases the lung contained pneumococci, and in the other case there was a streptothrix abscess of the lung present.

FIG. 3.



Magnification same as Fig. 2. Specimen of extreme atrophy from a case of severe marasmus (primary atrophy). This shows a great decrease in the number and size of the lobules, combined with great increase in the interlobular connective tissue. The hyaline degeneration of the Hassall bodies is well seen.

Excepting in the cases of terminal infection, the atrophy of the thymus gland was the only pathological process found, and the changes present in this gland will follow.

HISTOPATHOLOGY. The atrophied glands when examined under the microscope show conditions which differ widely from the normal. These changes also differ from those found in the normal involution of the gland.

The fibrous capsule of the gland is thicker than normal, and the trabeculæ are also greatly thickened, and the increased interlobular tissue frequently cuts up the lobules into irregular masses. This increase of connective tissue is often very apparent about the blood-

vessels, and even surrounds the dilated capillaries of the gland. Sometimes there is more fibrous tissue than lymphoid structure present in the field of the low-power lens.

In well-marked cases there is more reticular tissue present than normal, and the endothelial cells lining the reticular spaces are more numerous; consequently the lymphocytes and other cellular elements present in these spaces are decreased in number, and often the normal lymphoid structure of the gland is greatly altered.

This alteration of the lymphoid lobules at times entirely changes their appearance, and the changes can be described by reference to a description of one of the glands from a case of extreme atrophy:

"THYMUS GLAND. The capsule of the gland is greatly thickened, and the interlobular fibrous tissue proceeds from this area. The thickened bands between the lobules contain numerous veins and arteries, and the adventitia of these bloodvessels seems to thicken and produce an increase of connective tissue between the lobules, which is richly infiltrated with spindle-shaped or oval connective-tissue cells.

"All grades of atrophy can be made out in the lobules. Those least affected contain from five to fifty Hassall bodies containing many granular hyaline masses with leucocytes, often surrounded with an outer zone of more or less compressed epithelial cells. The lymphocytes are decreased in number, and the reticular endothelium is increased.

"The next stage seems to result in an almost entire disappearance of the lymphoid structure of the lobule and an increase in the reticular endothelium. These areas often contain many polymorphonuclear leucocytes and newly formed bloodvessels. This tissue greatly resembles fresh granulation tissue. This process continues until the lobule is transformed to a mass of capillaries separated by proliferated endothelial cells of various shapes and sizes. There are numerous loose spaces in the gland, separated by thin, fibrous walls, which almost resemble the air cells of the lung."

The state of nutrition of infants may be estimated by a microscopic examination of the thymus. In those of normal infants the structure of the thymus is unaltered, and the differentiation between cortex and medulla is plainly visible. In moderate atrophy the medulla and cortex are not easily distinguished, while in severe atrophies the changes described above are to be seen.

The connective tissue is often richly infiltrated with newly formed tissue cells, but no mast cells were seen on staining by polychrome methylene blue. Sometimes this tissue is infiltrated with fat cells.

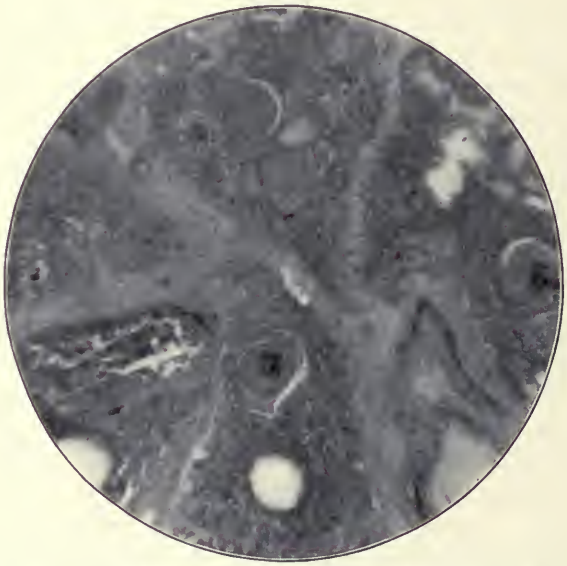
One of the most striking features present is the hyaline degeneration and increase in the size of the bodies of Hassall. These usually take up a bright rose-red stain by Van Gieson's method, although sometimes they stain an orange color.

We thought that these changes might be caused by a transformation of the epithelium of the bodies from keratohyalin into true hyalin, and in order to study this subject Dr. McCleary stained specimens from a number of cases of epithelioma of the skin.

When stained by Van Gieson's method the surface of the skin or horny layer stains a light yellow, and can be considered as true keratin.

The epithelial concentric bodies of the epithelioma which are regarded as keratohyalin stain an orange-yellow. A moderate number of these "pearls" contain globular masses which stain a rose-red color, and

FIG. 4.



Specimen same as Fig. 3. Magnification, 70 diameters. This shows enormous hyaline Hassall bodies stained by Van Gieson's method.

this is considered as the stain for true hyalin. As a distinction between true hyalin and colloid it was found that the colloid bodies of the prostate gland and the secretion of the thyroid gland give an orange color by Van Gieson's stain, and are therefore not true hyalin.

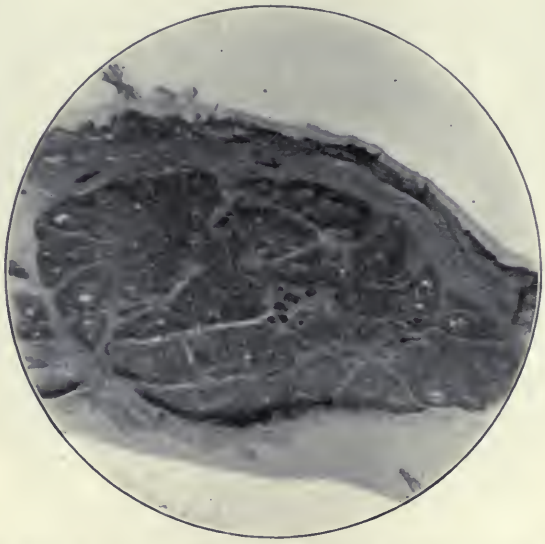
The study of the changes which take place in the Hassall bodies can be best done in atrophied glands, and the changes from epithelium to true hyalin were mainly observed in such specimens.

The thymus gland from fourteen case of infantile atrophy were stained by Van Gieson' method, and in one case the Hassall bodies stained orange, no true rose-red hyalin being present. This was from a case of only moderate severity. It can be stated as a general rule that the hyaline degeneration of Hassall's bodies is more marked in the glands showing the greatest atrophy.

In four cases the concentric bodies contained some material staining orange and some staining rose-red, showing the gradual transition from keratohyalin to true hyalin. These cases showed a moderate degree of glandular atrophy, and were taken from children in whom emaciation was only moderate in degree.

Nine cases showed a complete transformation into true hyalin, and in many of these glands the large rose-red masses measured from 200μ to 400μ in diameter. They at times appear as cysts, described by Chiari, and are always surrounded by a layer of flat epithelial cells. These degenerated structures are often infiltrated by polymorphonuclear leucocytes. These masses are sometimes homogeneous, and are sometimes made up of granules and compressed flat scales of various shapes and sizes.

FIG. 5.



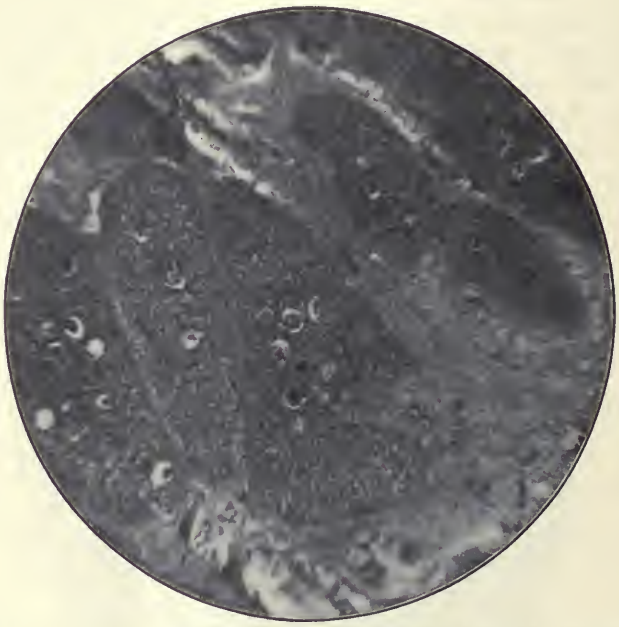
Magnification same as Fig. 2. Thymus gland, showing moderate atrophy from a case of secondary atrophy following tuberculosis. Differentiation of cortex and medulla absent. The increase of connective tissue most marked in the capsule. Hassall's bodies increased in number and size.

We paid special attention to the pathological changes in the stomach, duodenum, and small and large intestines. In a few cases we found certain areas in the mucous membrane and submucous coat which were completely necrotic, and sometimes the mucous membrane was missing from the surface. This often gives the appearance of great increase in the intertubular tissue, with only an occasional gland present separated by connective tissue.

If these changes were ante-mortem one should expect some inflammatory reaction or ulcer formation.

We did not find any such lesions, and are inclined to agree with the authors cited above in considering these nothing more than post-mortem changes. In many of our cases of marked infantile atrophy the mucous membrane of the intestinal tract was well preserved, and we do not associate such histological changes with infantile atrophy.

FIG. 6.



Same case of atrophy. Projection ocular, No. 2; objective, AA, Zeiss. Magnification, 70 diameters. This shows areas of increased fibrosis separating the lobules and many hyaline Hassall bodies.

SECONDARY ATROPHY OF THE THYMUS GLAND. By secondary atrophy of the thymus gland we wish to embrace those changes which take place in the organ during any of the chronic wasting diseases of children. Mettenheimer has shown in such diseases as tuberculosis, gastro-enteritis, rhachitis, and congenital syphilis that the thymus gland is decreased in weight. He made a number of microscopic examinations of the gland in these cases, and found fibrous increase, with marked hyaline degeneration of the Hassall bodies.

This author studied the thymus gland in 37 cases in children from three days to eleven years of age. From his examinations and tables he concluded that the weight of the thymus gland is the best index of the condition of the body nutrition.

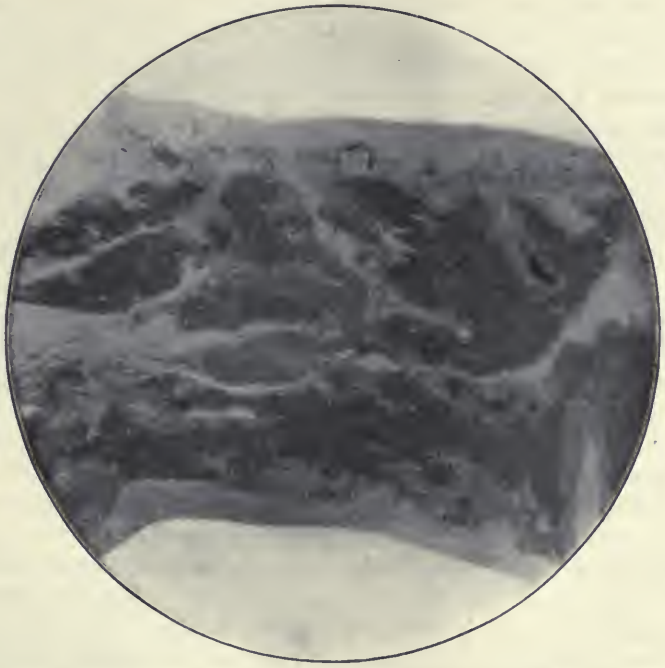
The normal weight of the thymus during the first two years of life, although subject to certain variations, seems to be about 18 grammes.

Mettenheimer found a certain reduction in weight during the acute diseases, but a much greater reduction occurred in the chronic wasting diseases.

The average weight in 7 cases of fatal diphtheria was 14.35 grammes, and in 11 cases of scarlet fever the weight was 12.05 grammes. These weights show a certain decrease as compared to the normal cases cited by various authors. The length and breadth of the gland were also diminished.

In 13 cases of such wasting diseases as miliary tuberculosis, congenital lues, and chronic enteritis the average weight was 4.5 grammes.

FIG. 7.



Magnification same as Fig. 2. Normal involution from adult, extensive fatty infiltration.

No special changes were found in the glands from the acute cases, but in the chronic diseases the following changes were noted:

The bloodvessels showed endarteritis, and the interlobular connective tissue was greatly increased. This caused an atrophy of the lobules and an obliteration of the lymphoid spaces by a proliferation of the endothelial cells. The lymphoid cells were decreased in number, and the gland had lost its normal structure. The Hassall bodies showed various stages of degeneration.

In two cases of tuberculosis of the lungs with general acute miliary tuberculosis, and in one case of tuberculous meningitis, we have been able to study the pathological changes in the thymus gland consequent upon the emaciation present.

We found that the difference was only one of degree between the changes in the gland of infantile atrophy and those of secondary atrophy. The thymus glands weighed, respectively, 3 grammes, 4 grammes, and 3.25 grammes, or an average of 3.41 grammes, the cases all being under one year of age. These weights show a marked contrast to the normal weight at birth of 12 grammes and 13 grammes given by Mettenheimer, and the normal of the first two years of life of 18 grammes.

All of these glands showed increased fibrosis, and hyaline degeneration and swelling of the Hassall bodies. In one case of tuberculosis these bodies contained calcareous deposits, which cleared up on adding 10 per cent. hydrochloric acid.

Although we have only studied a few cases of secondary atrophy, we can add those to the large number cited by Mettenheimer as a proof of the dictum that the weight of the thymus gland is the best index of the nutrition of the body.

Normal Adult Involution of the Thymus Gland. The thymus gland attains its greatest weight at the age of puberty, and from then on it undergoes a normal involution. The gland never entirely disappears, and traces of it can be found even in elderly persons.

The tissue undergoes a normal fatty infiltration, which begins first in the capsule, and gradually encroaches upon the cortex of the organ. The medulla resists this invasion longest, and persists as strips of lymphoid tissue with many hyaline Hassall bodies.

Sometimes the normal gland persists in adults and shows no retrogressive changes. Fig. 7 shows this condition well.

Clinical Observations. The fact that the thymus gland has been used with apparent success in the treatment of some cases of myxœdema might lead one to think that it would not be of value in a condition like infantile atrophy. The fact, however, that it has been used extensively in rhachitis without producing untoward results led us to a trial of it. With such marked changes in the gland it seems rational to think that it might be of value. Our cases have been too few to allow us to draw any conclusions.

In one set of cases the infants were under only fair hygienic conditions and the feeding not any too good. It was impossible to get the weights of the infants, and so the results were only to be measured by the eye. Twelve cases were given doses three times a day, starting with a grain and increasing until the dose had reached three grains of the dried gland. There was no appreciable change. Two of the infants

died—about what would have been expected without the treatment. After a month the treatment was discontinued. There was nothing of note in the condition of the children after the withdrawal of the drug. All of the other children are still living (two months later).

In another set the patients were admirably cared for, with the best of nursing, food, and surroundings. With the exception of the first case noted they were of the severe type of atrophy, and were not gaining under the best of conditions.

1. A very severe marasmus; died three days after admission. This case received six doses of thymus. The case was regarded as absolutely hopeless from the onset, and on admission was expected to die any minute.

2. *Severe Marasmus.* Age, three months; weight, 8¼ pounds; ½ grain t. i. d. After eight days had lost a quarter of a pound; dose increased to 3 grains; after a week had regained his original weight; three days later had a diarrhœa, apparently from intestinal indigestion. This persisted, and he lost ground, and finally died two weeks and a half later. At the time of death he weighed 6⅞ pounds. During the time of his intestinal disturbance he was also given subcutaneous injections of normal salt solution and other indicated treatment.

3. *Marasmus.* Age, two months; weight, 8⅜ pounds; thymus gland, 3 grains t. i. d.

Semiweekly weighings: 8⅜, 8⅜, 8½, 8¾, 8⅞, 9, 9¼, 9¼, 9¼, 8¾*x*, 8½, 8½, 8½, 8½, and 8½ pounds. Died.

At the 8¾ weighing marked *x* the child had a temperature the cause of which could not be explained. It was transient, but the child never recovered from the effects of the hyperpyrexia.

4. *Marasmus.* Age, four months; weight, 8½ pounds; thymus gland, ½ grain; later, 1 grain t. i. d. Child gained steadily, and was discharged, cured, two months later, weighing 11 pounds.

Conclusions. 1. Atrophy of the thymus gland is always found in cases of infantile atrophy.

2. The condition of the thymus gland is an index of the general nutrition in infants.

3. The state of nutrition of infants may be estimated by a microscopic examination of the thymus at autopsy.

The authors are indebted to Dr. John S. Fulton for the photomicrographs in this article.

TABLE I.

No.	Anatomical diagnosis.	Weight of gland, grams.	Microscopic condition.	Other lesions.	Cultures.	Age.	Body weight.
1	Capillary bronchitis, atrophy of thymus.	1.4	Fibrosis, atrophy of lobules, hyalin degeneration of Hassall bodies.	Capillary bronchitis.	Pneumococci in lung.	3 mos.	5.1 lbs. 1.9 kilog.
2	Atrophy of thymus.	1.3	Fibrosis, few hyalin Hassall bodies.	Sections from 17 viscera normal.	Colon bacilli in lungs and liver.	14 dys.	2.75 lbs. 1.05 kilog.
3	Atrophy of thymus.	2	Interlobular and intralobular fibrosis; atrophy, hyalin degeneration.	Viscera normal.	Cultures 0.	7 wks.	5.5 lbs. 2.1 kilog.
4	Atrophy of thymus.	2.1	Interlobular fibrosis, hyalin degenerat'n.	Viscera normal.	Cultures 0.	15 dys.	4.62 lbs. 1.77 kilog.
5	Atrophy of thymus.	1.5	Interlobular fibrosis. hyalin degenerat n.	25 specimens of viscera normal.	.....	40 dys.	4.5 lbs. 1 5 kilog.
6	Abscess of left lung, atrophy of thymus.	2	Interlobular and intralobular fibrosis, marked atrophy of lobules, and hyalin degeneration.	Abscess of lung, red hepatization.	Streptothrix of lung.	18 dys.	4.0 lbs. 1.5 kilog.
7	Pneumonia of left lung, atrophy of thymus.	1.4	Same as above.	Purulent bronchopneumonia, other viscera normal.	Cultures 0.	3 mos.	6.0 lbs. 2.3 kilog.
8	Bronchopneum'nia, atrophy of thymus.	1.2	Interlobular fibrosis, hyalin degenerat'n, fatty infiltration.	Bronchopneumonia, other viscera normal.	Pneumococci in blood, aureus and pneumococci in lung and liver.		
9	Atrophy of thymus.	2	Interlobular fibrosis.	.....	Viscera sterile.	14 hrs.	6.0 lbs. 2 3 kilog.
10	Atrophy of thymus.	1.9	Interlobular fibrosis, atrophy, hyalin degeneration.	Viscera normal.	Streptococc. in lung by Weigert's method.	1 mo	4.25 lbs. 1.6 kilog.
11	Bronchopneum'nia, serous pleurisy, atrophy of thymus gland.	3.2	Slight fibrosis and hyalin degenerat'n.	.....	.....	8 mos.	
12	Atrophy of thymus.	.....	Same as above.	.....	.....	18 mos.	
13	Atrophy of thymus.	4	Same as above.	Viscera congested otherwise normal.	.....	Premature.	3.5 lbs. 1.3 kilog.
14	Atrophy of thymus.	7.5	....	.....	.....	3 dys.	5.0 lbs. 1.9 kilog.
15	Atrophy of thymus.	1.2	Fibrosis and hyalin degeneration.	Viscera normal.	.....	5 wks.	4.75 lbs. 1.8 kilog.
16	Atrophy of thymus.	1.8	.....	Purulent bronchopneumonia, other viscera normal.	.....	1 mo.	5.5 lbs. 2.1 kilog.
17	Purulent bronchitis, atrophy of thymus.	.....	.....	Viscera normal.	.....	67 dys.	
18	Atrophy of thymus.	1.2	Interlobular and intralobular fibrosis, marked atrophy of lymphoid tissue, and hyalin degeneration.	Necrotic areas in mm. of small intestine, other viscera normal.	.....	2 mos.	

TABLE II.—NORMAL GLANDS FOUND AT AUTOPSY.

No.	Anatomical diagnosis.	Weight of gland, grams.	Microscopic condition.	Other lesions.	Cultures.	Age.
1	Congenital cyanosis.	15	Normal (see Fig. 2).	Thrombosis of left coronary artery, subdural hemorrhages; patent foramen ovale.	Negative.	14 hrs.
2	Meningocele, sudden death.	19 5	Normal.	.....	Blood and viscera sterile.	45 dys.

TABLE III.—SECONDARY ATROPHY OF THYMUS GLAND.

No.	Anatomical diagnosis.	Weight of gland.	Microscopic condition.	Other lesions.	Cultures.
1	Chronic pulmonary tuberculosis, acute miliary tuberculosis, tubercular meningitis.	3 grams.	Intralobular fibrosis, hyalin degeneration.	Tuberculosis of lungs, liver, spleen, and meninges.	Terminal infection with aureus.
2	Bronchopneumonia, retropharyngeal abscess, tubercular caries of spine, basilar meningitis.	(Atrophied.)	Marked interlobular and intralobular fibrosis, hyalin degeneration, atrophy of lymphoid tissue.	Bronchopneumonia, tuberculosis of the vertebræ, proliferative exudate in meninges.	Terminal streptococcus infection.
3	Chronic tuberculosis of lungs.	3.25 grams.			

LITERATURE.

Below is found a partial list of references used in the preceding work. It has not been thought advisable at this time to publish the complete bibliography of the thymus gland.

Especial attention is called to the following: For a complete review and literature to 1858, see Friedleben; for historical facts and a comprehensive article, read Hennig; for modern ideas and list of references, see Mettenheimer and Klein.

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THE ANATOMY OF THE OPERATION OF REACHING THE ETHMOID CELLS THROUGH THE ANTRUM.

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In working over some anatomical material I was struck with the ease with which the ethmoid cells—especially the middle and the posterior cells, which usually are so hard to get at—could be reached from the antrum through the upper part of its inner wall. Not only can these cells be opened up from here, but the sphenoidal sinus also. On the cadaver it is very satisfactory to see how directly and effectively this inaccessible region can be dealt with. It has been known for a considerable time that the antrum gives a good route to the sphenoid. In 1897, at the International Congress of Medicine at Moscow, Jansen reported a case of suppuration of the sphenoidal sinus which he had treated through the antrum. He found the ethmoid cells also diseased, and treated them likewise from the antrum. He was pleased with the method and advocated it. What I wish to do is to call attention to this route again, to consider briefly the applied anatomy of the operation, and to make it clear by means of diagrams.

If the antrum is opened from the canine fossa and the upper part of its inner wall along the line of the junction of the inner wall, and the roof of the antrum is examined, the following structures are found: The first quarter of an inch of the wall makes the outer boundary of

the lacrymal canal. The position of the canal is often indicated by a swelling. Just internal to this, or, if there is no swelling present, one-fourth to three-eighths of an inch from the surface, the ostium is placed. The ostium in some cases may be as much as one-half of an inch in; three-eighths of an inch, however, will usually clear the lacrymal canal. Beyond the ostium the upper part of the inner wall of the antrum is almost entirely membranous, except for the paper-like

FIG. 1.

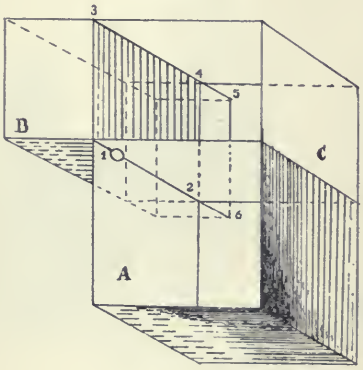

FIG. 2.

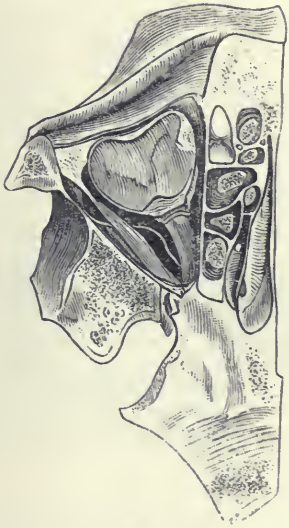

Fig. 1 shows in a diagrammatic way the relations of the orbit (C), the antrum (A), and the ethmoid cells (B). For the sake of clearness the sphenoidal sinus is represented as continuous with the ethmoid parallelogram. The figure shows particularly well the position of the ostium of the antrum (1) and the line of the incision for approaching the ethmoid region. The incision should start in the ostium and run directly backward about one-half of an inch, guided by the lower inner angle of the orbit. It would be represented by the line 1–2. In front of the ostium is the lacrymal duct. If the curette, therefore, is entered at the ostium, and not farther forward, the lacrymal duct is not in danger.

Fig. 2, a horizontal section through the orbit and the nose at the level of the cribriform plate—that is, the section is passed about one-eighth of an inch above the inner canthus of the eye. It shows the ethmoid parallelogram. The anterior boundary of this is the frontal bone, the posterior boundary the sphenoid; the outer boundary is the inner wall of the orbit, and the inner boundary the inner surface of the middle turbinal bone for the greater part, with just a little of the frontal. In a section made through the inner canthus of the eye (one-eighth of an inch below the section which is figured here) this sphenoid ceases to be a boundary.

process of the ethmoid (the uncinate), which projects downward and strengthens it. In 10 per cent. of the cases the antrum has a second ostium. This has no definite position. A knife, therefore, entered at the ostium, inclined toward the horizontal as much as the opening in the canine fossa permits, and carried directly backward, would cut only the membranous part of the wall, except, of course, this unimpor-

taut process of the ethmoid, and would bring up against the maxillary process of the palate bone. In many cases this is extremely thin, so that the knife would penetrate this and be stopped by the ascending process of the palate where it lies against the posterior inner angle of the superior maxilla, like one finger against another, and strengthens it. The lacrymal canal is entirely out of relation to the incision. The incision so made is about one-half of an inch long. No vessels of any size are cut. The inner wall of the antrum hangs like a curtain from the lower part of the inner angle of the orbit. The knife shaves it off

FIG. 3.

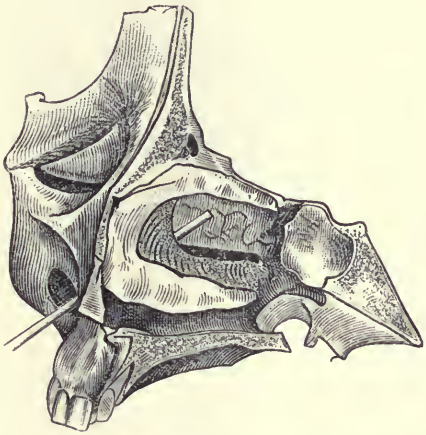

FIG. 4.

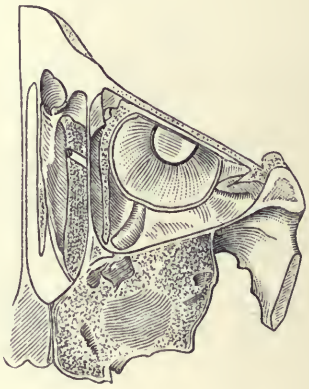

Fig. 3 shows the method of reaching the ethmoid cells from the antrum and the incision in the upper part of its inner wall through which this is accomplished. The anterior end of the incision is at the point where the probe is entered. (This corresponds to the ostium.) The crescentic line in front of this is the anterior border of the hiatus semilunaris. From the probe horizontally backward the heavy black line is the incision through which the cells have been reached Above this the drawing shows how the middle and posterior ethmoid cells have been cleared away, and farther back shows how the front wall of the sphenoidal sinus has been broken down.

Fig. 4 is the same region shown in Fig. 3, but from above. The ethmoid cells have been cleared away from below, as just described. The probe is pushed up into the empty ethmoid region through the ostium of the antrum. The inner wall of the middle turbinate hangs like a curtain on the inner side of the empty ethmoid space.

much as the mesentery is cut from the small bowel. For practical purposes the inner wall of the antrum can be regarded as made up much the same as it is in the disarticulated bone—that is, the first quarter of an inch is the outer boundary of the lacrymal canal; then comes the ostium, next one-half inch of membrane, and finally, for three-eighths of an inch, bone again.

A curette entered through the ostium, inclined toward the septum, and carried back in this incision would strike, first, the ethmoid bulla with the rest of the middle ethmoid cells, then the posterior cells, and,

finally, the anterior wall of the sphenoid. The ethmoid parallelogram is opened from its lower outer angle, and the cells can be removed by working upward and inward, toward the septum and away from the orbit. The height of the working space is the height of the os planum of the ethmoid minus the notch made in the upper wall of the ethmoid parallelogram by the dipping downward of the olfactory groove. This leaves the working space about one-half inch.

FIG. 5.

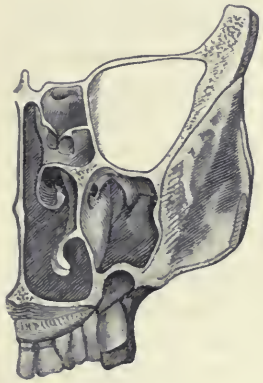

FIG. 6.

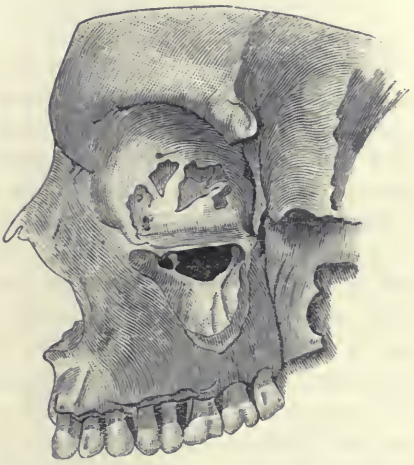

Fig. 5 is a horizontal section through the antrum, about one quarter of an inch behind the ostium. It shows the ethmoid parallelogram nicely, especially the lower outer angle, where it meets the orbit and the antrum. The anterior part of the inner wall of the antrum is also shown. The dark spot in the upper part of this is the ostium. In front of the ostium is the swelling made by the lacrymal duct. From this figure it is plain how an instrument entered at the ostium and pushed diagonally upward at once enters the ethmoid parallelogram.

Fig 6 is copied from Watson Williams. It shows the inner wall of the antrum on the dried and cleaned skull. The dark area represents the membranous part of the inner wall. It is a little large in this specimen, because some of the paper-like uncinate process of the ethmoid has been broken off, as well as the maxillary process of the palate bone. It represents fairly, however, the area of the membranous wall from the operating standpoint.

In combined empyemata of the antrum and the middle and posterior ethmoid cells it would seem that this route should give good results. Where the frontal sinus is the sinus particularly affected I should doubt whether this method of dealing with the ethmoid region would be sufficient; but in those cases where the frontal suppuration is secondary to suppuration in the ethmoid region it might be of value.

TYPHOID FEVER IN CHILDREN OF TWO AND A HALF YEARS AND UNDER.[1]

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So much difference of opinion appears to exist regarding the frequency of the occurrence of typhoid fever in the first two years of life and the nature of the symptomatology, diagnosis, and prognosis at this time, that it has seemed to us possibly of use to study the subject a little more in detail than has hitherto been done.

The statements made in literature are much at variance and not always supported by facts or logic. The experience of one able pathologist is often quoted,[2] to the effect that in 2000 autopsies at the New York Foundling Asylum there was not found a single case with the lesions of typhoid fever. This would be as powerful evidence as negative evidence can ever be, were it not that the same writer[3] in another place makes the claim that the lesions of typhoid fever found at autopsy cannot be distinguished from those of enterocolitis. From this point of view the statements regarding the absence of typhoid lesions lose their value, for we have as good reason to assume that all the numerous instances of lesions supposed to be dependent on enterocolitis were really those of typhoid fever as to insist that they were the result of enterocolitis.

Another very able writer[4] is much quoted as having examined the blood of 50 children who might possibly be supposed to have typhoid fever, finding the serum reaction absent from all but one, an infant aged seven months, whose mother had had a slow fever ten years before. The conclusion appears to be that typhoid fever is rare. It would seem to us that the only conclusion allowable is that the writer possessed good diagnostic ability, since in none of the cases did he base a diagnosis upon clinical appearances. Besides, these observations are largely contradicted by those of Thursfield,[5] who found a typhoid reaction in 42 out of 100 sick children who presented symptoms which were at least more like typhoid fever than any other disease.

[1] Read before the American Pediatric Society, May, 1902.
[2] Northrup. Arch. of Pediat., 1895, vol. xii. p. 918.
[3] Ibid., 1896, vol. xiii. p. 16.
[4] Morse and Thayer. Boston Medical and Surgical Journal, 1899, vol. cxl. p 36.
[5] British Medical Journal, September 7, 1901, p. 596.

With statements, then, which are contradictory or self-destructive we are brought down to the question of mere facts, viz.: Do we find typhoid fever in infancy which by evident symptoms or by blood reaction is proved to be such, and if so how often does it happen? We have for years believed that the disease was of more frequent occurrence in early life than was commonly supposed, and the examination for the serum reaction but tends to confirm this. Not that typhoid fever is at all so common as later in childhood or in adult life. This *relative* infrequency is undisputed. But the statement that it is *actually* very rare under the age of two years certainly gives a wrong impression, and we are convinced that it does not correspond with the facts.

It is certain that the disease is repeatedly overlooked. Our experience has been very convincing in this regard, and is supported by that of many investigators, among whom may be mentioned Cassoute, J. L. Smith, Diem, Schavoir, Montmollin, Stowell and others. The failure to recognize it exists both because the possibility of typhoid fever being present is not thought of by the physician in charge, and because the difficulty of recognition is certainly greater in early life.

Any analysis of data regarding the individual cases which we have seen or have collected is necessarily somewhat unsatisfactory, because in some instances the histories are not complete, while in others no exact records of any sort have been kept. General deductions, rather than percentage figures, are the necessary consequent result.

The following case histories (Table I.) are given in brief. Some of the cases were under our own care; others occurred in the hospital service of colleagues, but were seen by us also; still others are kindly communicated to us by other colleagues. A few of them have been reported in a previous communication by one of us.[1] The others, we believe, have never been published.

TABLE I. PERSONAL AND UNPUBLISHED CASES.

Case 1 (reported in Philadelphia Medical Journal, October 15, 1898).—William H., aged three months, Children's Hospital; service of Dr. Griffith, February, 1897. Occasional vomiting for some weeks without diarrhœa; temperature not above 100°; frequent cough. Then rise of temperature, sometimes to 105°, with diarrhœa, debility, and stuporous condition; death without diagnosis. Duration about eight days from time of rise of temperature, probably longer. Post-mortem examination showed spleen and mesenteric glands enlarged; superficial ulceration of Peyer's patches; Widal reaction found in heart's blood.

Case 2 (reported in Philadelphia Medical Journal, October 15, 1898).—William G., aged seven months, Children's Hospital; service of Dr. Packard, June, 1895. Vomiting, diarrhœa, tympanites, and typical typhoid eruption; temperature, 103° to 105°; numerous furuncles also present; duration two weeks; death from exhaustion.

Case 3.—James D., aged one year, Children's Hospital, Out-patient Department; service of Dr. Packard, August, 1894. Diarrhœa for a week, with fever daily; examination showed abdomen swollen and tympanitic, typical typhoid eruption, mucous râles in chest; child appeared to have headache; lost sight of.

Case 4.—Louise S., aged fourteen months, seen in consultation with Dr. F. A. Baldwin, of New York, September 26, 1901. At thirteen months had milk poisoning, with enterocolitis

[1] Griffith. Philadelphia Medical Journal, October 15, 1898.

and fever; diarrhœa persisted for five weeks. Ten days before death, when apparently convalescing, there occurred a return of diarrhœa, with fever, tympanites, and typhoid eruption; later some spots became hemorrhagic; death ensued; duration five weeks, or ten days if dated from return of fever; no Widal reaction taken; diagnosis based upon eruption and general condition.

Case 5.—Joseph K., aged fifteen months, Children's Hospital; service of Dr. Packard, September 25, 1899. Three other members of the family had typhoid fever. Diarrhœa for a week; typical eruption and cough appeared, but no enlargement of spleen; temperature varied from 101° to 105° for two weeks, then became normal; Widal reaction positive; recovery; duration three weeks.

Case 6 (reported in Philadelphia Medical Journal, October 15, 1898).—Esther S., aged nineteen months, Children's Hospital; services of Drs. Packard and Griffith, October, 1897. Cough, anorexia, diarrhœa, enlarged spleen, eruption; temperature, 102° to 104°; Widal reaction positive; slight bronchopneumonia; recovery; duration about four weeks.

Case 7 (reported in Philadelphia Medical Journal, October 15, 1898).—Harry B., aged nineteen months, Children's Hospital; services of Drs. Packard and Griffith, October, 1897. Diarrhœa, anorexia, enlarged spleen, typhoid eruption, temperature, 100° to 102°; herpes; Widal reaction positive; recovery after complicating diphtheria.

Case 8 (reported by Dr. O'Malley, University Medical Magazine, 1897, vol. ix. p. 636).—Katie H., aged twenty-one months, St. Agnes' Hospital; service of Dr. Griffith, November, 1896. Diarrhœa, anorexia, tympanites, typhoid eruption; temperature up to 106.4°; duration twenty-three days; recovery. Father and mother and two other children ill in hospital with the disease at same time.

Case 9 (reported in Philadelphia Medical Journal, October 15, 1898).—Henry D., aged twenty-three months, seen in consultation with Dr. J. A. Patterson, of Salem, N. J., December, 1895. Vomiting, diarrhœa, cough, tympanites, dulness; temperature up to 104.8°; duration five or six weeks. Mother suffered with typhoid fever just before.

Case 10.—M. C., female, aged two years, St. Christopher's Hospital; service of Dr. E. W. Tully, December, 1895. Been ill one week; herpes, nausea, vomiting, tympanites, typhoid, eruption, diarrhœa; splenic tumor and cough developed; highest temperature, 103.6°; recovery.

Case 11.—Robert B., aged two years, seen in consultation with Dr. I. E. Roberts, March 26, 1899. Fever (104°) for two weeks; no diarrhœa or epistaxis; occasional vomiting and cough; typhoid spots and enlargement of spleen appeared; recovery.

Case 12.—Antonio G., aged two years. Children's Hospital; service of Dr. Stengel, August 26, 1901. Headache, abdominal pain, diarrhœa, tympanites, eruption, and fever (103.6°); lasting sixteen days in hospital; positive Widal reaction; recovery. Brother with typhoid fever.

Case 13.—Fannie B., aged two years and three months, Children's Hospital; service of Dr. Stengel, August, 1901. For a week abdominal pain, headache, and diarrhœa; had splenic tumor, tympanites, and eruption; fever (102.5°) became normal in two days after admission; Widal reaction positive. Scarlet fever then developed, and child was discharged on the 22d.

Case 14.—Marie S., aged two years and four months, seen in University Hospital; service of Dr. Tyson, December, 1897. Fever, diarrhœa, stuporous condition, enlarged spleen, no eruption, pneumonic consolidation; duration ten days. Post-mortem examination showed lesions of pneumonia, enlargement of spleen, Peyer's patches, and mesenteric glands; very slight evidence of ulceration. Mother and brother in hospital with disease.

Case 15.—Edward R., aged two years and five months, seen November, 1901, at close of illness. Had been fretful for two weeks; temperature about 105° for a week, nearly normal when first seen; disease had not been recognized by attending physician; Widal reaction positive; recovery.

Case 16.—Rosie M., aged two years and six months, Children's Hospital; service of Dr. Griffith, August, 1899. Ill six days with fever up to 105°; eruption and enlarged spleen; fever lasted seventeen days in hospital, when diphtheria developed; Widal reaction positive. Removed from hospital; result unknown.

Case 17.—Rachel G., aged two years and six months, Children's Hospital; service of Dr. Carpenter, August, 1899. Vomiting and constipation one day; fever ranging from 102° to 106° for a week; Widal reaction positive. Diphtheria then developed; tympanites, parotitis, otitis media, bronchopneumonia and submaxillary abscess followed; died four weeks from onset.

Case 18.—Evelina F., aged two years and six months, Children's Hospital; service of Dr. Packard, August, 1900. For two days diarrhœa, epistaxis, and fever up to 103°; tympanites splenic tumor, and typhoid eruption followed; temperature reached normal in eleven days; six days later recrudescence followed, lasting three days. Brother with typhoid fever.

From medical literature we have collected a number of cases reported as typhoid fever in which the data are given with sufficient detail to make the reports of some statistical value. Undoubtedly many cases have been overlooked. For convenience of reference we have given the principal data in a series of tables, and have included among the cases those of our own already given in Table I.

In all of the tables we have marked * those cases which have been reported as typhoid fever, concerning the diagnosis of which there may be some doubt, yet which appear to us as probable instances of the disease. Those marked **, although reported as typhoid fever, seem to us to be probably not properly so named. The word "eruption" always indicates typhoid roseola.

The first of the following tables (Table II.) includes cases in which there is reason to believe that the children were suffering from the disease when born.

Table II. Congenital Typhoid Fever.

Case 1 (Freund and Levy, Berlin. klin. Wochenschr., 1895, xxxii. 539).—Male, aged six fœtal months at birth; mother in fourth week of typhoid: died when fifteen minutes old. At autopsy enlarged spleen and typhoid bacilli found (no intestinal lesions).

Case 2* (Manzini, Gaz. Méd. de Paris, 1841, ix. 781).—Aged seven fœtal months at birth; mother with typhoid; died when twenty minutes old. Peritonitis (?) at autopsy.

Case 3 (Legry, Thèse de Paris, 1890).—Aged seven fœtal months at birth; mother in fourth day of relapse; died when four days old in incubator; typhoid bacilli in liver.

Case 4 (H. C. Westervelt, Pennsylvania Medical Journal, 1902, v. 368).—Aged seven and a half fœtal months at birth; mother in third week of typhoid; fever (106°), diarrhœa, convulsions; duration seventeen days; recovery.

Case 5 (Chambrelent and St. Philippe, Journ. de Méd. de Bordeaux, 1896, xxvi. 502).—Aged eight fœtal months at birth; mother with typhoid; cough, enlarged liver, jaundice; Widal reaction positive.

Case 6* (F. W. Lynch, Journal American Medical Association, 1901, xxxvi. 1136).—Aged eight and a half fœtal months at birth; mother in fourth day of typhoid; eruption, symptoms of inanition; Widal reaction negative; died when seventy days old. At autopsy intestinal lesions and colon bacilli found.

Case 7 (Janiszewski, Münch. med. Wochenschr., 1893, 705).—Aged eight and a half fœtal months at birth; mother in tenth day of typhoid; bronchopneumonia; died when five days old. At autopsy typhoid bacilli in spleen, lungs, kidneys, and mesenteric glands (no intestinal lesions).

Case 8 (Paul Ernst, Ziegler's Beiträge zu path. Anat., 1890, viii. 188).—Almost at term; mother in eleventh day of typhoid; jaundice and eruption; died when ninety-three and a half hours old. At autopsy typhoid bacilli in spleen, muscles, spots, and blood.

Case 9 (M. A. Brown, Cincinnati Lancet-Clinic, 1901, N. S., xlvi. 387).—Almost at term; mother in eleventh day of typhoid; enlarged spleen, diarrhœa, fever; Widal reaction positive; died when fourteen days old. At autopsy enlarged spleen and mesenteric glands; typhoid bacilli.

Case 10** (Charcellay, Arch. Gén. de Méd., 1840, 3 s. ix. 65).—Male, at term; died when eight days old. At autopsy enlarged intestinal follicles, Peyer's patches, and mesenteric glands.

Case 11** (Ibid.).—Male, at term; diarrhœa, stomatitis; died when fifteen days old. Typical lesions at autopsy.

Case 12** (A. Beduar, Die Krank. der Neugeborenen und Säuglinge, 1850, i. 111).—Male, at term; eruption, fever, meteorism, vomiting, diarrhœa appearing on fifth day of life; duration eleven days; died when sixteen days old. Typical lesions at autopsy.

Case 13** (Ibid.).—Female, at term; diarrhœa, enlarged spleen; died when eleven days old. Typical lesions at autopsy.

Case 14** (Ibid.).—Male, at term; diarrhœa; died when fifteen days old. Typical lesions at autopsy.

Case 15** (Vibert, Ann. d'Hyg., 1881, vi. 3 s., 353).—Male, at term; died when nine days old. At autopsy enlarged spleen, mesenteric glands, and Peyer's patches.

Case 16* (W. Ignatieff, Medicinskoje Obosrenje, 1883, xx. 341).—Male, at term; mother supposed to have typhoid; fever, diarrhœa, and intestinal hemorrhages; died when nine days old. At autopsy enlarged spleen, ulcerated Peyer's patches and intestinal follicles, ecchymoses.

Case 17* (A. E. Okey, Peoria Medical Monthly, 1886–1887, vii. 419).—At term; mother with typhoid; fever, diarrhœa; died when ten days old.

Case 18* (W. W. Johnston, American Journal of Obstetrics, 1895, xxxi. 283).—At term; mother with typhoid and other cases in house, epidemic; fever, constipation, tympanites; died when five days old.

Case 19 (H. Dürk, Münch. med. Wochenschr., 1896, 842).—At term; mother in twenty-fourth day of typhoid; died in nine hours. At autopsy enlarged spleen, typhoid bacilli, and staphylococci found.

Case 20 (W. Osler [quoted by H. A. Hare, "Complications and Sequels of Typhoid Fever," 31]).—At term; mother with typhoid; died when five days old from perforation.

Case 21 (G. Blumer, Journal of the American Medical Association, 1900, xxxv. 1674).—Female, at term; mother had typhoid four and a half months before birth of child; convulsions, hemorrhages, and purpura; died when nine days old. At autopsy intestinal follicles, spleen, and all organs hemorrhagic; typhoid bacilli found.

Case 22 (J. Finley Bell, Arch. of Pediat., 1901, xviii. 348).—Female, at term; mother in fifth week of typhoid, other cases in house, epidemic; fever (103.6°), eruption, jaundice; Widal reaction positive; duration eight days; recovery.

Case 23 (J. M. Krim, Pediatrics, 1901, xii. 378).—Male, at term; mother in second week of typhoid; fever (103.5°); duration seventeen days; recovery.

Of these 23 cases reported as congenital typhoid fever, 12 may reasonably be considered genuine cases of the affection; 5 (marked*) are doubtful, yet are probably instances of the disease; 6 (marked**) are doubtful, and seem to us as probably not cases of typhoid fever, at least as far as the data given indicate; 8 patients were males, 3 females; in 12 the sex is not stated. In 17 cases the mothers had typhoid fever, and 2 cases occurred during house epidemics in which others in addition to the mothers were affected. Fever was noted in 6, diarrhœa in 8, constipation in 1, eruption in 3, enlarged spleen in 6, cough in 2, convulsions in 2, jaundice in 3, tympanites in 2, hemorrhage in 2, and vomiting in 1.

Recovery ensued in 3 cases, death in 19, and in 1 the result is not given. Typhoid bacilli were found in 6 of the 19 fatal cases. A positive Widal reaction is mentioned in 3 cases; a negative reaction is mentioned once.

We have considered in this group only children born *alive*, omitting from our list instances of purely *fœtal* typhoid, in which the evidence of the disease has been found in the fœtus or in the stillborn child. A number of cases of fœtal typhoid fever have been previously collected and published by one of us (Griffith, *Medical News*, May 15, 1897), and later added to by Morse (*Archives of Pediatrics*, 1900, xvii. 881).

In this connection may be mentioned the fact that newborn or very young infants, born of mothers suffering from typhoid fever, may exhibit the Widal reaction, yet without showing any other symptoms whatever of the disease. In such cases it is possible that the subjects have had typhoid fever *in utero*, or that the agglutinating principle may have

passed from the diseased mother into the healthy child through the placenta, or possibly later through the milk. The following cases (Table III.) may be mentioned as instances in point:

TABLE III. APPARENTLY HEALTHY INFANTS GIVING A POSITIVE WIDAL REACTION.

Case 1 (J. C. Wilson, Keating's Cyclopædia of the Diseases of Children, 1899, v. 168).—At term; mother in third week of typhoid; Widal reaction positive; recovery.

Case 2 (J. P. Crozer Griffith, Medical News, May 15, 1897).—At term; mother in third week of typhoid; jaundice; Widal reaction positive; recovery.

Case 3 (Mossé and Daunic, Compt. Rend. de la Soc. de Biol., 1897, 10 s., iv. 238).—At term; mother had recovered from typhoid one month before birth of child; Widal reaction positive; recovery.

Case 4 (Achard, Bull. et Mém. de la Soc. Méd. des Hôp. de Paris, 1899, xvi. 56).—At term; mother just recovered from typhoid; Widal reaction positive; recovery.

Case 5 (J. L. Morse, Arch. of Pediat., 1900, xvii. 898).—At term; mother in twelfth day of typhoid; Widal reaction positive; recovery.

Case 6 (J. L. Morse, Boston Medical and Surgical Journal, 1899, cxl. 36).—Aged seven months; mother had typhoid ten years before; diarrhœa; Widal reaction positive; recovery.

In the next table (Table IV.) are contained cases of typhoid fever up to but not including the age of one year, and excluding the instances of congenital typhoid fever already detailed. Although the first two may possibly have had the disease in the system before birth, yet, as there were no symptoms at birth, it is but right to include them among the cases of disease acquired later.

TABLE IV. TYPHOID FEVER IN THE FIRST YEAR.

Case 1 (A. Jacobi, Pediatrics, 1899, viii. 527).—Aged nine days; mother with typhoid; eruption, fever, diarrhœa, enlarged spleen; duration seven days; death. Autopsy: swollen Peyer's patches, enlarged spleen, no ulceration.

Case 2* (Hecker [quoted by Henoch, Vorlesung. ü. Kinderkr.]).—Female, aged thirteen days; in a room previously occupied by a typhoid case; fever, diarrhœa; duration three days; death. Autopsy: typically enlarged and ulcerated Peyer's patches.

Case 3 (Gerhardt, Handb. der Kinderkr., 1877, ii. 373).—Male, aged twenty-one days; born prematurely at eight months, on eighth day of mother's typhoid; not nursed, but kept in same room; fever (103.5°), diarrhœa, vomiting, eruption, enlarged spleen; duration four weeks; recovery.

Case 4 (A. Jacobi, Arch. of Pediat., 1892, ix. 763).—Aged three weeks.

Case 5 (Ibid.).—Aged six weeks.

Case 6** (Hauner, Beiträge zu Pediatrik., 1863, 45).—Aged two months; death. Autopsy: typical intestinal lesions.

Case 7** (Vibert, Annal. d'Hyg., 1881, 3 s. vi. 353).—Aged two months; previously healthy child; died suddenly. Autopsy: enlarged spleen, mesenteric glands, and Peyer's patches (no ulcers).

Case 8 (Hölscher, Münch. med. Wochenschr., 1891, 43).—Male, aged two months; mother with typhoid, nursing child.

Case 9 (Vouillemin, Thèse de Nancy, 1892, 12).—Male, aged two months; three other cases in the house; fever and eruption; duration four days; death. Autopsy: typical ulcers in small intestine.

Case 10 (Cassoute, Rev. Mens. des Mal. de l'Enf., 1898, xvi. 628).—Aged two mouths; epidemic, child bottle-fed; diarrhœa and collapse; Widal reaction positive; death. Autopsy: ulcerated Peyer's patches, congestion of the lungs.

Case 11 (C. C. Hubbard, Medical News, 1899, lxxv. 857).—Aged two and a half months; mother with typhoid, nursing child; fever, tympanites, diarrhœa, enlarged spleen; recovery.

Case 12** (Hennig [quoted by Gerhardt, Handb. d. Kinderkr., 1877, ii. 373]).—Aged three months; pneumonia; death. Autopsy: enlarged spleen, swollen Peyer's patches.

Case 13** (Wunderlich, Handb. der Path. und Ther., iv. 289).—Aged three months; eruption; death. Autopsy: typical lesions.

Case 14 (E. Rosenthal, Pediatrics, 1897, iv. 38).—Aged three months; mother with typhoid; recovery.

Case 15 (J. P. Crozer Griffith, Philadelphia Medical Journal, October 15, 1898). Case 1, Table I. —Male. aged three months; diarrhœa, fever, cough; Widal reaction positive after death; duration fourteen days; death. Autopsy: enlarged spleen and mesenteric glands, ulcerated Peyer's patches.

Case 16 (Legry, Thèse de Paris, 1890).—Aged four months; death. Autopsy: typhoid bacilli found.

Case 17 (H. N. Read, Brooklyn Medical Journal, 1889, iii. 599).—Female, aged four and a half months; epidemic; fever (105°), diarrhœa, tympanites, eruption; duration seventeen days; death.

Case 18 (J. G. Ogle, Lancet, 1892, i. 21).—Female, aged four and a half months; one of twins, on condensed milk; fever, vomiting; duration seven days: death. Autopsy: ulcerated Peyer's patches, enlarged mesenteric glands.

Case 19 (R J. Love, British Medical Journal, 1902, i. 961).—Female, aged four and a half months; mother with typhoid, nursing child; fever (103°), enlarged spleen, diarrhœa, tympanites, cough, eruption; duration ten days; death.

Case 20** (Vibert, Annal. d'Hyg., 1881, vi. 353).—Male, aged five months; previously healthy child; sudden death. Autopsy: enlarged Peyer's patches and mesenteric glands (no ulcers).

Case 21 (C. W. Earle, Arch. of Pediat., 1892, ix. 734).—Male, aged five months; fever (103°), diarrhœa, tympanites, collapse; duration thirty days; death. Autopsy: typical lesions (no bacilli found).

Case 22 (W. S. Christopher, Arch. of Pediat., 1892, ix. 757).—Female, aged five months; fever, hemorrhage; recovery.

Case 23 (J. M. Taylor, Philadelphia Polyclinic, 1896, v. 286).—Aged five months; three other cases in house; fever, enlarged spleen, diarrhœa, tympanites; recovery.

Case 24 (S. Davidson, British Medical Journal, 1902, i. 1144).—Aged five months; diarrhœa, fever (102.4°), eruption; duration five weeks; recovery.

Case 25** (J. Abercrombie, Edinb. Med. and Surg. Rev., 1820, xvi. 334).—Aged six months; diarrhœa, vomiting, fever; duration six days; death. Autopsy: ulcerated Peyer's patches, enlarged mesenteric glands.

Case 26* (E. Friedrich, Der Abdominaltyphus der Kinder., 1858, 8).—Male, aged six months; epidemic; fever, diarrhœa, cough, convulsions; duration six days; death. Autopsy: enlarged spleen, mesenteric glands, and Peyer's patches.

Case 27* (Murchison, Transactions of the London Pathological Society, 1864, xvi. 125).—Female, aged six months; mother with typhoid, nursing child; eruption; death. Autopsy: ulcerated Peyer's patches and enlarged mesenteric glands.

Case 28* (E. Henoch, Charité-Annalen, 1875, ii. 510).—Female, aged six months; fever (104°), cough, diarrhœa, otitis, enlarged spleen; death. Autopsy: enlarged spleen.

Case 29* (A. Wiltshire, British Medical Journal, 1879, i. 427).—Male, aged six months; epidemic; fever, eruption, diarrhœa, relapse; recovery.

Case 30* (Ibid.).—Male, aged six months; epidemic; "clinically typical;" recovery.

Case 31** (Vibert, Ann. d'Hyg., 3 s., vi. 358).—Aged six months; previously healthy child; sudden death. Autopsy: typical lesions.

Case 32 (Parrot [quoted by Chantemesse, Traité des Mal. de l'Enf., i. 772]).—Aged six months.

Case 33 (M. P. Jacobi, Arch. of Med., 1884, xi. 30).—Aged six months; diarrhœa, fever, cough, tympanites, vomiting, eruption, enlarged spleen; duration three weeks; recovery.

Case 34 (E. Chenery, Journal of the American Medical Association, 1881, xvi 463) —Aged six months; mother with typhoid, nursing child; typical symptoms; duration three weeks; recovery.

Case 35 (H. J. Lee, Cleveland Journal of Medicine, 1897, ii. 400).—Aged six months; another case in house; fever (104.6°), diarrhœa, tympanites, cough, enlarged spleen; duration five weeks; recovery.

Case 36** (J. Abercrombie, Edinb. Med. and Surg. Rev., 1820, xvi. 334).—Aged seven months; after weaning; fever, vomiting, diarrhœa; duration five days; death. Autopsy: minute ulcers and inflamed intestinal follicles.

Case 37** (Taupin, Journ des Connaiss. Med. et Chir., 1839-40).—Aged seven months.

Case 38* (Schädler [quoted by Gerhardt, Handb. d Kinderkr., 1877, ii. 373]).—Aged seven months; mother died of typhoid, nursing child previously; fever, diarrhœa, tympanites, vomiting, convulsions; duration eleven days; death. Autopsy: enlarged spleen, ulcerated Peyer's patches.

Case 39* (Hérard, L'Union Méd., 1855, ix. 365).—Aged seven months; mother died of typhoid, had nursed child, brother also with typhoid; diarrhœa, vomiting, cough, fever; death. Autopsy: enlarged spleen, intestinal follicles and mesenteric glands.

Case 40** (Hauner, Beiträge zu Pediatrik, 1863, 45).—Aged seven months: death. Autopsy: typical lesions.

Case 41** (Rilliet and Barthez, Traité Clin. des Mal. des Enf., 1861, ii. 713).—Aged seven months.

Case 42** (Ibid.).—Aged seven months.

Case 43* (E. Henoch, Charité-Annalen, 1875, ii. 540).—Aged seven months; fever, diarrhœa, cough; death. Autopsy: enlarged spleen, one swollen Peyer's patch.

Case 44 (L. Römheld, Jahrb. f. Kinderheilk., 1898, xlviii. 198).—Female, aged seven months; five other cases in house; fever, diarrhœa, tympanites; duration, seventeen days; death. Autopsy: enlarged spleen, typhoid bacilli found.

Case 45 (J. P. Crozer Griffith, Philadelphia Medical Journal, October 15, 1898). Case 2. Table I.—Male, aged seven months; fever (105°), diarrhœa, vomiting, eruption, tympanites; duration, two weeks; death.

Case 46 (P. Boobbyer, British Medical Journal, 1889, i. 187).—Aged eight months; mother with typhoid, nursing child; fever, diarrhœa; duration ten days; recovery.

Case 47 (F. R. England, Canada Medical Record, 1890, xix. 25).—Aged eight months; three other cases in house, bottle-fed infant; fever (104°), diarrhœa, eruption, cough, tympanites, enlarged spleen; duration twenty days; recovery.

Case 48 (A. Jacobi, Pediatrics, 1899, viii. 530).—Aged eight months; noma.

Case 49 (Netter, Bull. de la Soc. de Pédiat. de Paris, 1900, 2).—Aged eight months; epidemic; Widal reaction positive; duration nine days; death.

Case 50 (Ibid.).—Eight months; epidemic; Widal reaction positive; duration sixteen days; death.

Case 51 (M. C. T. Love, Journal of the American Medical Association, 1901, 893).—Female, aged eight months; two other cases in house, breast-fed child; fever (104°); eruption; Widal reaction positive; duration twenty-one days; recovery.

Case 52 (J. M. Taylor, Philadelphia Polyclinic, 1896, v. 286).—Male, aged eight and a half months; thirteen other cases in house; fever (104°), diarrhœa, tympanites, eruption; duration fifteen days; recovery.

Case 53** (E. Friedrich, Der Abdominaltyphus der Kinder., 1856, 8).—Male, aged nine mouths; clinically typhoid; recovery.

Case 54* (Lederer, Wien. med. Wochenschr., 1857, 196).—Male, aged nine months; epidemic; clinically typhoid.

Case 55** (Vibert, Ann. d'Hyg., 1881, vi. 353).—Male, aged nine months; previously healthy child; sudden death. Autopsy: enlarged Peyer's patches and mesenteric glands, spleen very large,

Case 56 (E. Chenery, Journal of the American Medical Association, 1891, xvi. 463).—Aged nine months; mother and eight others in house with typhoid, child nursing; typical symptoms; recovery.

Case 57 (Hölscher, Münch. med. Wochenschr., 1891, 43).—Female, aged nine mouths.

Case 58 (J. R. Fuller, Lancet, 1891, ii. 1038).—Female, aged nine months; another case in house; fever (102°), diarrhœa, tympanites, no eruption; duration five days; death. Autopsy: inflamed Peyer's patches, enlarged mesenteric glands and spleen.

Case 59 (H. E. Munn, Columbus Medical Journal, 1894-95, xiii. 52).—Male, aged nine months; epidemic, child bottle-fed; duration two weeks; recovery.

Case 60 (W. L. Stowell, Medical Record, 1895, xlvii. 321).—Female, aged nine months; epidemic.

Case 61 (W. P. Northrup, Medical Age, xviii., No. 9).—Female, aged nine months; other cases in house, exposed to contagion three weeks; fever (103°), diarrhœa, enlarged spleen, eruption; Widal reaction positive; duration twenty-four days; recovery.

Case 62 (A. B. Marfan, Traité des Malad. de l'Enf., i. 308).—Male, aged nine months; fever, diarrhœa, eruption, enlarged spleen; death. Autopsy: ulcerated Peyer's patches.

Case 63 (E. B. Montgomery, Medical News, 1899, lxxii. 553).—Female, aged nine months; partly bottle-fed; fever (105°), vomiting, tympanites, diarrhœa, convulsions; no leucocytosis; duration five weeks; recovery.

Case 64 (Méry, Bull. de la Soc. de Pédiat. de Paris, 1900, 22).—Aged nine months; partly breast-fed: fever; Widal reaction positive; duration two weeks; recovery.

Case 65** (Bricheteau, Gaz. Méd. de Paris, 1841, ix. 702.—Aged ten months; fever, diarrhœa; death. Autopsy: typical lesions.

Case 66** (Rilliet and Barthez, Traité Clin. des Malad. des Enf., 1861, ii. 713).—Aged ten months.

Case 67** (Löschner, Prager Vierteljahrschr., 1846, ix. 6).—Aged ten months; mother with typhoid; death. Autopsy: typical lesions.

Case 68 (W. B. West, Texas Medical Journal, 1892-93, viii. 135).—Male, aged ten and a half months; epidemic; fever (103°), tympanites, diarrhœa, cough, eruption; duration twenty-five days; recovery.

Case 69 (H. Leroux, La France Méd., 1889, i. 517).—Female, aged eleven months; taking cow's milk three weeks; fever, vomiting, diarrhœa, tympanites, eruption; duration three weeks; recovery.

Case 70 (W. B. Noyes, Medical Record, 1894, xlvi. 1).—Male, aged eleven months; epidemic, child on milk; fever (104°), diarrhœa, eruption, cough, vomiting, collapse; duration twenty-two days; death.

Case 71 (Ibid.).—Male, aged eleven months; another case in house; fever (102°), tympanites, diarrhœa, eruption; duration sixteen days; recovery.

Case 72 (Nobécourt and Bertherand, Bull. de la Soc. de Pédiat. de Paris, 1900, 195).—Male, aged eleven months; mother with typhoid; fever, cough, tympanites, albuminuria; Widal reaction positive; death. Autopsy; typical lesions.

Case 73 (A. D. Blackader, Arch. of Pediat., 1900, xvii. 641).—Aged eleven months; several cases in family, milk infection; fever (103°), enlarged spleen, eruption, diarrhœa; duration three weeks; recovery.

Cases 74 to 80 (Vogel, Lehrb. der Kinderkr., 1890, 152).—Under twelve months.

Cases 81 and 82 (H. Lebert, Deutsch. Archiv für klin. Med., 1870, vii. 487.—Males under twelve months; epidemic.

Cases 83 and 84 (Steffen, Lehrb. der Kinderkr.).—Under twelve months; epidemic.

Case 85 (M. Röth, Arch. für Kinderheilk., 1881, ii. 365).—Under twelve months; epidemic.

Cases 86 and 87 (Von Starck, Berlin. klin. Wochenschr., 1885, xxii. 621).—Males under twelve months; epidemic.

Cases 88 to 91 (Pennsylvania Board of Health, 1885 [quoted by W. B. Noyes, Journal of American Medical Association, 1895, xxv. 530]).—Under twelve months; epidemic.

Cases 92 and 93 (J. F. Goodhart, Diseases of Children, Starr, 1889, 328).—Under twelve months; two deaths. Autopsy: diagnosis confirmed.

Cases 94 to 98 (I. Rudisch, Mt. Sinai Hospital Reports, 1899, quoted by A. Jacobi [Pediat., 1899, viii. 516]).—Under twelve months; three died, two recovered.

Cases 99 to 134* (Brouardel, Rec. du Comité Consult. d'Hyg., 1891).—Under twelve months; deaths in all. Autopsy: typical lesions.

Case 135 (W. B. Noyes, Journal of the American Medical Association, 1895, xxv. 529).—Male, under twelve months; epidemic.

Cases 136 to 138 (Berg, Deutsch. Arch. f. klin. Med. 1895, liv. 161).—Under twelve months; epidemic.

Case 139 (L. Römheld, Jahrb. f. Kinderheilk., 1898, xlviii. 198).—Under twelve months; epidemic.

Of the 139 reported cases, not congenital, occurring in the first year and collected in the preceding table, 111 may reasonably be considered typhoid fever; 46 (marked*) are doubtful, yet are probably instances of the disease; 17 (marked**) are doubtful, and seem to us probably not cases of typhoid fever; 24 are males, 15 females, and in 100 the sex is not mentioned; 52 occurred in general or house epidemics, in 14 of these the mothers having typhoid, and in 14 cases there being other cases not mentioned as the mother, or in addition to her. Fever was noted in 46, diarrhœa in 42, constipation in 1, eruption in 26, enlarged spleen in 26, tympanites in 18, vomiting in 11, collapse in 3, cough in 5, pneumonia in 1, noma in 1, convulsions in 4, hemorrhage in 1, otitis in 1, relapse in 1, and albuminuria in 1.

Recovery is noted in 28, death in 77, and the result is not mentioned in 34.

Of the 77 fatal cases, typhoid bacilli were reported in 2 cases only.

A positive Widal reaction was reported in 8 cases.

In the next table (Table V.) are included cases of typhoid fever in the second year of life—*i. e.*, in children of one year up to but not including the age of two years.

Table V. Typhoid Fever in the Second Year of Life.

Case 1* (A. Flint, American Journal of Medical Sciences, 1845, x. 28).—Female, aged twelve months; epidemic, two other cases in house; fever, constipation, cough; recovery.

Case 2 (W. Diem, Jahrb. f. Kinderheilk., 1882, xviii. 270).—Female, aged twelve months; epidemic, taking cow's milk; fever, diarrhœa, eruption, cough, enlarged spleen, otitis media, convulsions; duration four weeks; recovery.

Case 3 (Parrot, Prog. Méd., 1883, xi. 467).—Aged twelve months; typical illness, with relapse; recovery.

Case 4 (J. W. Long, Arch. of Pediat., 1893, x. 53).—Male, aged twelve months; mother died of typhoid, father and eight others in house with it; fever (104.5°), cough, tympanites, constipation followed by diarrhœa; recovery.

Case 5 (Griffith and Ostheimer).—Case 3, Table I.—Male, aged twelve months; diarrhœa, fever (100.8°), tympanites, cough, eruption.

Case 6 (W. L. Stowell, Medical Record, 1895, xlvii. 321).—Female, aged twelve months; both parents with typhoid; cough, fever, diarrhœa; duration ten days; recovery.

Case 7 (Ibid.).—Male, aged twelve months; epidemic, taking milk; fever (105°), eruption, convulsions; duration twenty-two days; death.

Case 8** (C. M. Billard, Traité des Malad. des Enf., 1835, 229).—Male, aged thirteen months; fever, diarrhœa, tympanites, vomiting, collapse; death. Autopsy: ulcerated Peyer's patches.

Case 9** (Rilliet, Thèse de Paris, 1840).—Aged thirteen months.

Case 10 (W. L. Stowell, Medical Record, 1895, xlvii. 321).—Female, aged thirteen months; epidemic; fever (105.5°), eruption, diarrhœa, enlarged spleen, meningeal symptoms; duration nineteen days; recovery.

Case 11 (W. P. Northrup, Arch. of Pediat., 1896, xiii. 11).—Aged thirteen months; father and brother in house with typhoid; breast- and bottle-fed; milk epidemic; fever (104°), constipation, enlarged spleen, eruption; duration thirteen days; recovery.

Case 12 (Howell, Transactions of the Luzerne County Medical Society, 1896, 91).—Aged thirteen months; epidemic.

Case 13 (E. C. Seufert, New York Medical Journal, 1899, lxx. 233).—Aged thirteen months; enlarged spleen, fever, eruption; Widal reaction positive; duration fourteen days; recovery.

Case 14 (A. D. Blackader, Archiv. of Pediat., 1900, xvii. 641).—Aged thirteen months; fever, cough, diarrhœa, enlarged liver and spleen, tympanites; Widal reaction negative; duration five days; death. Autopsy: typical lesions, typhoid bacilli found.

Case 15 (W. P. Northrup, Archiv. of Pediat., 1900, xvii. 651).—Aged thirteen months; eruption.

Case 16 (J. L. Morse, Arch. of Pediat., 1900, xvii. 894).—Aged thirteen months; mother with typhoid, child taking milk; diarrhœa, eruption, enlarged spleen; Widal reaction positive; duration three weeks; recovery.

Case 17 (W. S. Lazarus-Barlow, British Medical Journal, 1901, ii. 792).—Male, aged thirteen months; five other cases in house; eruption, diarrhœa, tympanites, cough; Widal reaction positive; duration twenty-five days; death. Autopsy: enlarged spleen, typhoid bacilli, no intestinal lesions.

Case 18 (Chambard-Henon, Lyon Méd., 1897, lxxxiv. 409).—Female, aged thirteen and a half months; child taking breast milk and water; fever (104°), vomiting, diarrhœa, cough, eruption; duration twenty days; recovery.

Case 19* (Bernheim, Leçons Cliniques, 1877).—Aged fourteen months; diarrhœa; death. Autopsy: enlarged spleen, Peyer's patches, and mesenteric glands.

Case 20 (M. Röth, Arch. f. Kinderheilk., 1881, ii. 365).—Female, aged fourteen months; epidemic; fever (104°), epistaxis, convulsions; relapse; duration six weeks; recovery.

Case 21 (Mercier, Allg. Wien. med. Zeit., 1895, xl. 516).—Aged fourteen months; milk infection; fever, diarrhœa, eruption, enlarged spleen, tympanites; duration thirteen days; recovery.

Case 22 (G. J. Martz, Cleveland Medical Gazette, 1896–97, xii. 510).—Male, aged fourteen months; three months after weaning; epistaxis, enlarged spleen, fever (103.5°), desquamation; duration twenty-seven days; recovery.

Case 23 (H. A. Fairbairn, Journal of the American Medical Association, 1897, xxix. 1149).—Aged fourteen months.

Case 24 (W. P. Northrup, Archiv. of Pediat., 1900, xvii 651).—Aged fourteen months; other cases in house, child nursing

Case 25 (Nobécourt and Bertherand, Bull. de la Soc. de Pédiat. de Paris, 1900, 195).—Female, aged fourteen months; five other cases in house; fever, diarrhœa, tympanites, eruption; Widal reaction positive; duration two weeks; recovery.

Case 26 (Griffith and Ostheimer).—Case 4, Table I.—Female, aged fourteen months; fever (106°), tympanites, diarrhœa, eruption; relapse; duration five weeks; death.

Case 27** (Bierbaum [quoted by Gerhardt, Handb. d. Kinderkr., 1877, ii. 373]).—Aged fifteen months; typical symptoms; relapse.

Case 28 (A. D. Walker, British Medical Journal, 1879, i. 347).—Aged fifteen months; mother developed typhoid one week after child; fever, diarrhœa, eruption, tympanites; recovery.

Case 29 (X. E. Wagner, Deutsch. Arch. f. klin. Med. 1882–83, xxxii. 288).—Male, aged fifteen months; four other cases in house; fever, diarrhœa; duration two weeks; death Autopsy: typical lesions found.

Case 30 (B. Lewy, Arch. f. Kinderheilk., 1888–89, x. 81).—Male, aged fifteen months; fever, diarrhœa, laryngeal ulceration, convulsions; duration eight days; death. Autopsy: enlarged spleen and mesenteric glands, ulcerated Peyer's patches, typhoid bacilli and staphylococci found.

Case 31 (A. B. Marfan, Traité des Mal. de l'Enf., i. 318).—Aged fifteen months; death.

Case 32 (Cadet de Gassicourt, Rév. Mens. des Mal. de l'Enf., 1890, 204).—Aged fifteen months.

Case 33 (W. O. Bridges, New York Medical Record, 1896, xlix. 428).—Aged fifteen months; typhoid in milkman's family; fever (104.6°), epistaxis, diarrhœa, cough, enlarged spleen; duration twenty days; recovery.

Case 34 (C. Kasel and K. Mann, Münch. med. Wochenschr., 1899, xlvi. 581).—Male, aged fifteen months; two other cases in house; typical "symptoms;" Widal reaction positive; recovery.

Case 35 (Griffith and Ostheimer).—Case 5, Table I.—Male, aged fifteen months; three other cases in house; fever (105°), diarrhœa, cough, eruption; Widal reaction positive; duration three weeks; recovery.

Case 36 (Cadet de Gassicourt, Rév. Mens. des Mal. de l'Enf., 1890, 204).—Aged sixteen months.

Case 37 (Goldberger, Aerztes Cent.-Anzeig., 1896, viii. 209) —Aged sixteen months.

Case 38 (J. I. Roe, Transactions of the Luzerne County Medical Society, 1896, 91).—Aged sixteen months; both parents with typhoid; recovery.

Case 39 (W. P. Northrup, Arch. of Pediat., 1896, xiii. 11).—Female, aged sixteen months; another case in house, milk epidemic; fever (104°), diarrhœa, eruption; recovery.

Case 40 (E. C. Seufert, New York Medical Journal, 1899, lxx. 233).—Aged sixteen months; enlarged spleen, eruption; Widal reaction positive; duration sixteen days; recovery.

Case 41 (F. Sbrana, Arch. de Méd. des Enf., 1899, ii. 29).—Aged sixteen months; epidemic.

Case 42 (Netter, Bull. de la Soc. de Pédiat. de Paris, 1900, 2).—Aged sixteen months; Widal reaction positive; duration fifteen days; recovery.

Case 43 (A. D. Blackader, Arch. of Pediat., 1900, xvii. 641).—Aged sixteen months; other cases in house, milk infection; fever (104°), diarrhœa, enlarged spleen; duration three weeks; recovery.

Case 44 (A. A. Strasser, Medical Record, 1901, lx. 286).—Female, aged sixteen months; fever, constipation, enlarged spleen; relapse; duration five weeks; recovery.

Case 45 (E. F. Brush, New York Medical Journal, 1902, lxxv. 583).—Aged sixteen months; mother with typhoid, child given water; recovery.

Case 46 (W. L. Stowell, New York Medical Record, 1895, xlvii. 321).—Female, aged seventeen months; mother with typhoid, milk epidemic; fever (105°), relapse; duration five weeks; recovery.

Case 47 (Netter, Bull. de la Soc. de Pédiat. de Paris, 1900, 2).—Aged seventeen months; recovery.

Case 48** (Bürkner [quoted by Gerhardt, Handb. d. Kinderkr., 1877, ii. 373)].—Aged eighteen months; high fever.

Case 49 (H. N. Reed, Brooklyn Medical Journal, 1888–89, iii. 599).—Female, aged eighteen months; fever (105.5°), diarrhœa, eruption, tympanites; duration four weeks; recovery.

Case 50 (J. E. Reeves, Transactions of the Association of American Physicians, 1890, v. 18).—Aged eighteen months; mother with typhoid.

Case 51 (Cadet de Gassicourt, Rév. Mens. des Mal. de l'Enf., 1890).—Aged eighteen months.

Case 52 (J. R. Fuller, Lancet, 1891, ii. 1038).—Aged eighteen months; another case in house; fever, diarrhœa, vomiting; recovery.

Case 53 (Huber, Arch. of Pediat., 1892, ix. 763).—Aged eighteen months; five other cases in house.

Case 54 (Ibid).—Aged eighteen months; five other cases in house.

Case 55 (W. B. Noyes, Medical Record, 1894, xlvi. 1).—Female, aged eighteen months; two other cases in house, epidemic; fever, constipation, cough, no eruption; duration twenty-eight days; recovery.

Case 56 (I. N Love, Journal of the American Medical Association, 1895, xxiv. 1).—Female, aged eighteen months; fever (105°), diarrhœa, vomiting; duration ten days; death. Autopsy: marked ulceration of Peyer's patches.

Case 57 (W. O. Bridges, New York Medical Record, 1896, xlix. 428).—Aged eighteen months; fever, eruption, enlarged spleen; duration three weeks; recovery.

Case 58 (Howell, Transactions of the Luzerne County Medical Society, 1896, 91).—Aged eighteen months; epidemic.

Case 59 (G. Hadot, Rév. Méd. de l'Est., 1896, xxviii. 468).—Aged eighteen months; epidemic; Widal reaction positive.

Case 60 (Haushalter, Rév. Méd. de l'Est., 1896, xxviii. 750).—Aged eighteen months; epidemic; typical symptoms; Widal reaction positive.

Case 61 (A. B. Marfan, Traité des Mal. de l'Enf., i. 333).—Male, aged eighteen months; weaned at three months; fever, diarrhœa, vomiting, tympanites, eruption, convulsions; recovery.

Case 62 (J. C. Wilson, Keating's Cyclopædia of Diseases of Children, 1899, v. 168).—Aged eighteen months.

Case 63 (From Long Island College Hospital, Yale Medical Journal, 1899, vi. 95).—Aged eighteen months; mother and sister with typhoid; eruption, enlarged spleen; Widal reaction positive; duration twenty days; recovery.

Case 64 (A. Samuels, New York Medical Journal, 1900, lxxii. 4).—Aged eighteen months; aphasia during last week of fever, constipation, enlarged spleen, typhoid bacilli in feces; Widal reaction positive; duration twenty days; recovery.

Case 65 (A. D. Blackader, Arch. of Pediat., 1900, xvii. 641).—Aged eighteen months; epidemic; eruption, diarrhœa, tympanites, enlarged spleen; duration sixteen days; recovery.

Case 66 (Netter, Bull. de la Soc. de Pédiat. de Paris, 1900, 2) —Aged eighteen months; fever; duration twenty-eight days; recovery.

Case 67 (Haushalter, Gaz. Hebd. de Méd. et de Chir., 1901, N. S. 6, xlviii. 321).—Female, aged eighteen months; vomiting, diarrhœa, tympanites, eruption, laryngeal ulceration, with tracheotomy; death. Autopsy: characteristic lesions.

Case 68 (M. Gershel, New York Medical Record, 1901, lx. 811).—Aged eighteen months; Widal reaction positive.

Case 69** (Med.-Chirurg. Rev., 1858, [quoted by Stowell Medical Record, 1898, xlvii. 324]).—Aged nineteen months.

Case 70 (J. P. Crozer Griffith, Philadelphia Medical Journal, October 15, 1898).—Case 6, Table I.—Female, aged nineteen months; fever (104°), diarrhœa, cough, enlarged spleen, eruption; Widal reaction positive; duration four weeks; recovery.

Case 71 (J. P. Crozer Griffith, Philadelphia Medical Journal, October 15, 1898).—Case 7, Table I.—Male, aged nineteen months; diarrhœa, cough, fever (102°), enlarged spleen, eruption, diphtheria; Widal reaction positive; recovery.

Case 72 (A. A. Strasser, Medical Record, 1901, lx. 286).—Female, aged nineteen months; fever, cough, constipation; Widal reaction positive; recovery.

Case 73 (Kissel, Dietsk. Med., Moscow, 1896, i. 118).—Aged twenty months; perforation.

Case 74 (G. J. Martz, Cleveland Medical Gazette, 1896–97, xii. 510).—Male, aged twenty months; another case in house; fever, tympanites, no eruption or epistaxis; duration twenty-seven days; recovery.

Case 75 (Barbier and Herrenschmidt, Gaz. des Malad. Inf., 1899, i. 408).—Male, aged twenty months; duration twenty-four days; recovery.

Case 76* (E. Henoch, Charité-Annalen, 1875, ii. 540).—Female, aged twenty-one months; developed diphtheria during convalescence; death.

Cases 77 and 78 (Archambault, Gaz. Méd. de Paris, 1880, 6 s. ii. 42).—Aged twenty-one months.

Case 79 (F. D. Drewitt, British Medical Journal, 1894, ii. 809).—Male, aged twenty-one months; another case in house a month before; vomiting, cough, tympanites, perforation, no eruption or enlarged spleen; duration three weeks; death. Autopsy: ulcerated perforated Peyer's patch found.

Case 80 (J. M. O'Malley, University Medical Magazine, 1896–97, 636).—Case 8, Table I.—Female, aged twenty-one months; two other cases in house; fever (106°), diarrhœa, tympanites, eruption; duration twenty-three days; recovery.

Case 81 (J. H. Bryant, British Medical Journal, 1899, i. 776).—Male, aged twenty-one months; two other cases in house; fever (105°), diarrhœa, vomiting, tympanites, cough, enlarged spleen; Widal reaction positive; duration twenty-two days; death. Autopsy: typhoid bacilli cultivated from intestinal lesions.

Case 82** (Littré, Dictionnaire. Article on "Dothiénentérie," 1835).—Aged twenty-two months; recovery.

Case 83** (Rilliet and Barthez, Arch. Gén. de Méd., 1840, 3 s. ix. 155).—Male, aged twenty-two months; fever, diarrhœa; duration seventeen days; death. Autopsy: typical lesions.

Case 84** (Bricheteau, Gaz. Méd. de Paris, 1841, ix. 702).—Aged twenty-two months; recovery.

Case 85 (Rilliet and Barthez, Traité Clin. des Mal des Enf., 1891, iii. 352).—Aged twenty-two months; laryngeal ulceration with tracheotomy; duration five days; death. Autopsy: enlarged mesenteric glands and solitary follicles, with ulcers.

Case 86 (W. P. Northrup, Arch. of Pediat., 1896, xiii. 11).—Male, aged twenty-two months; mother with typhoid, milk epidemic; fever (104.5°), eruption, cough, enlarged spleen, diarrhœa; death. Autopsy: swollen Peyer's patches, follicles, mesenteric glands and spleen.

Case 87 (Ibid.).—Aged twenty-two months; other cases of typhoid in house, milk epidemic; fever (105°), eruption, diarrhœa, enlarged spleen, cough, tympanites; duration fifteen days; recovery.

Case 88 (G. J. Martz, Cleveland Medical Gazette, 1896–97, xii. 510).—Female, aged twenty-two months; another case in house; fever, diarrhœa, eruption, epistaxis, intestinal hemorrhage, parotitis; duration seventeen days; recovery.

Case 89 (F. Nachod, Prager med. Wochenschr., 1897, xxii. 528).—Male, aged twenty-two months; two other cases in house; fever, cough, diarrhœa, enlarged spleen; Widal reaction positive; duration four weeks; death. Autopsy: enlarged spleen and mesenteric glands, no intestinal lesions.

Case 90 (W. L. Stowell, Medical Record, 1895, xlvii. 321).—Aged twenty-two months; other cases in house, epidemic; duration six weeks; recovery.

Case 91 (Netter, Bull. de la Soc. de Pédiat. de Paris, 1900, 2).—Aged twenty-two months; Widal reaction positive; duration eleven days; recovery.

Case 92 (H. A. Fairbairn, Journal of the American Medical Association, 1897, xxix. 1149).—Aged twenty-three months.

Case 93 (J. P. Crozer Griffith, Philadelphia Medical Journal, October 15, 1898).—Case 9, Table I.—Male, aged twenty-three months; mother with typhoid; fever (104.8°), vomiting, diarrhœa, cough, tympanites; no eruption or enlarged spleen; duration six weeks; recovery.

Case 94** (Friedleben, Arch. physiolog. Heilk., 1848, xiix. 28).—Male, under two years; death.

Cases 95 to 97* (E. Friedrich, Der Abdominaltyphus der Kinder., 1856, 8).—Males, under two years; epidemic; one death, two recoveries.

Cases 98 to 102* (Ibid.).—Females, under two years; epidemic; two deaths, three recoveries.

Cases 103 to 109* (Lederer, Wien. med. Wochenschr., 1857, 196).—Under two years; epidemic.

Case 110* (E. Henoch, Charité-Annalen, 1875, ii. 540).—Under two years.

Cases 111 and 112 (M. Röth, Arch. f. Kinderheilk., ii. 365).—Under two years; epidemic.

Cases 113 to 126 (Pennsylvania State Board of Health Report, 1885, quoted by W. B. Noyes, Journal of American Medical Association, 1895, xxv. 530).—Under two years; epidemic.

Cases 127 to 141 (G. de Montmollin, Thèse de Neuchatel, 1885).—Under two years; epidemic.

Cases 142 and 143 (Von Starck, Berlin. klin. Wochenschr., 1885, xxii. 621).—Males, under two years; epidemic.

Cases 144 and 145 (Ibid.).—Females, under two years; epidemic.

Case 146 (H. Schultz, Jahrb. der Hamburger Staatskr. Anstalt., 1889).—Male, under two years; epidemic.

Cases 147 to 152 (Ibid.).—Females, under two years; epidemic.

Case 153 (J. F. Goodhart, Diseases of Children, Starr, 1889, 328).—Under two years.

Case 154 (Bergquist, Eira, 1895, xix. 11).—Under two years.

Cases 155 and 156 (Berg, Deutsch. Arch. f. klin. Med., 1895, liv. 161).—Under two years; epidemic.

Cases 157 to 159 (Ollivier, Leçons Clin. sur les Malad. des Enf., 355).—Under two years; two deaths, one recovery.

Cases 160 to 164 (L. Römheld, Jahrb. f. Kinderheilk., 1898, xlviii. 198).—Under two years.

Cases 165 to 170 (I. Rudisch, Mt. Sinai Hospital Report, 1899, quoted by A. Jacobi, Pediatrics, 1899, viii. 546).—Under two years; six recoveries.

Case 171 (F. Sbrana, Arch. de Méd. des Enf., 1899, ii. 29).—Under two years; epidemic.

Cases 172 to 187 (T. M. Rotch, Arch. of Pediat., 1900, xvii. 653).—Under two years; eight deaths, eight recoveries.

Of the 187 cases occurring in the second year of life collected in the preceding table, 171 may reasonably be considered typhoid fever; 7 (marked*) are doubtful, yet are probably instances of the disease; 7

(marked**) are doubtful, and seem to us probably not cases of typhoid fever; 26 are males, 34 females, and in 127 the sex is not mentioned; 101 occurred in general or house epidemics, in 11 of these the mothers having typhoid, and in 32 cases there being other cases in the house, not mentioned as the mother, or in addition to her. Fever was observed in 50, diarrhœa in 40, constipation in 6, eruption in 27, enlarged spleen in 26, tympanites in 18, vomiting in 9, collapse in 1, cough in 20, convulsions in 6, hemorrhage in 1, relapse in 6, parotitis in 1, meningeal symptoms in 1, perforation in 2, desquamation in 1, epistaxis in 4, aphasia in 1, laryngeal ulceration in 2, otitis in 1, and diphtheria in 2.

Recovery was noted in 69, death in 32, while the result in 86 was not mentioned.

Of the 32 fatal cases, typhoid bacilli were found in 3 cases only. In 1 case they were present in the feces in a child who recovered.

A positive Widal reaction was recorded in 19 cases. In 1 case the reaction was negative during life, though typhoid bacilli were cultivated post-mortem.

In the final table (Table VI.) we have placed the cases of typhoid fever in the third year of life up to and including the age of two and a half years. After that age the number reported multiplied so rapidly that we decided not to extend our investigations beyond it.

TABLE VI. TYPHOID FEVER IN THE THIRD YEAR OF LIFE UP TO THE AGE OF TWO AND A HALF YEARS.

Case 1** (Rilliet and Barthez, Arch. Gén. de Méd., 1840, 3 s. ix. 155).—Male, aged two years; fever, diarrhœa, vomiting; duration forty-three days; death. Autopsy: typical lesions.

Case 2** (Ibid.).—Male, aged two years; fever, diarrhœa, vomiting; duration over two months; death. Autopsy: typical lesions.

Case 3** (Taupin, Journ. des Connaiss. Med. et Chir., 1840, 198).—Aged two years.

Cases 4 to 11* (Lederer, Wien. med. Wochenschr., 1857, 196).—Aged two years; epidemic.

Case 12** (Med.-Chirurg. Rev., 1858 [quoted by Stowell]).—Medical Record, 1895, xlvii. 324 Male, aged two years.

Case 13* (Fiedler, Arch. f. Kinderheilk., 1862, iii. 155).—Female, aged two years; epidemic; recovery.

Case 14 (A. Jacobi, Arch. of Pediat., 1885, ii. 129).—Aged two years.

Case 15 (A. E. Okey, Peoria Medical Monthly, 1886–87, vii. 419).—Female, aged two years; nine other cases in house; recovery.

Case 16 (L. H. Taylor, Annals of Hygiene, 1892, vii. 393).—Male, aged two years; other cases in house, milk infection; typical symptoms; death.

Case 17 (Ibid.).—Male, aged two years; epidemic, milk infection; recovery.

Case 18 (A. Moussous, Arch. Clin. de Bordeaux, 1892, i. 149).—Aged two years; epidemic; fever, phlegmasia alba dolens, convulsions; duration thirty-four days; death.

Case 19 (C. Vouillemin, Thèse de Nancy, 1892, 12).—Female, aged two years; fever, diarrhœa, vomiting, tympanites, eruption; recovery.

Case 20 (Ibid.).—Aged two years.

Case 21 (S. S. Adams, American Journal of Obstetrics, 1895, xxxi. 175).—Female, aged two years; fever (105°), diarrhœa, cough, relapse; death. Autopsy: typical lesions, typhoid bacilli found.

Case 22 (Haushalter, Rév. Méd. de l'Est., 1895, xxvii. 246).—Aged two years; epidemic; fever; duration eleven days; recovery.

Case 23 (D. R. Emmons, Cincinnati Lancet-Clinic, 1895, n. s. xxxiv. 91).—Female, aged two years; fever (105°), tympanites, convulsions; duration two weeks; recovery.

Case 24 (W. B. Stowell, Medical Record, 1895, xlvii. 321).—Male, aged two years; epidemic: fever (103°), eruption; duration three weeks; recovery.

Case 25 (W. P. Northrup, Arch. of Pediat., 1895, xii. 57).—Aged two years; mother with typhoid; fever (105°), enlarged spleen, eruption; duration five weeks; recovery.

Case 26 (Griffith and Osthelmer).—Case 10, Table I.—Female, aged two years; fever (103.6°), vomiting, tympanites, cough, diarrhœa, enlarged spleen, eruption; duration thirty-two days; recovery.

Case 27 (S. S. Adams, American Journal of Obstetrics, 1896, xxxiii. 720).—Female, aged two years; fever (105°), vomiting, tympanites, diarrhœa, cough, meningeal symptoms; duration four weeks; recovery.

Case 28 (E. Henoch, Vorlesung. ü. Kinderkr., 1897, 771).—Female, aged two years; "typical symptoms;" duration fourteen days; death. Autopsy: enlarged Peyer's patches.

Case 29 (L. Römheld, Jahrb. f. Kinderheilk., 1898, xlviii. 198).—Male, aged two years; father with typhoid; fever, cough, tympanites; duration twenty-four days; death. Autopsy: typhoid bacilli found.

Case 30 (Griffith and Osthelmer).—Case 11, Table I.—Male, aged two years; fever (104°), cough, vomiting, enlarged spleen, eruption; recovery.

Case 31 (J. C. Thresh and E. R. Walter, British Medical Journal, 1899, ii. 1669).—Male, aged two years; recovery.

Case 32 (G. Cagliari, Journal of the American Medical Association, 1899, xxxii. 881).—Aged two years; others in house with typhoid; "clinically typical."

Case 33 (A. Jacobi, Pediatrics, 1899, viii. 530).—Aged two years; hemorrhage.

Case 34 (C. Kasel and K. Mann, Münch. med. Wochenschr., 1899, xlvi. 581).—Aged two years; Widal reaction positive; recovery.

Case 35 (J. Comby, Bull. de la Soc de Pédiat. de Paris, 1900, 65).—Aged two years; death.

Case 36 (Netter, Bull. de la Soc. de Pédiat. de Paris, 1900, 2).—Aged two years; duration twenty-one days; recovery.

Case 37 (J. F. Bell, Arch. of Pediat., 1901, xviii. 345).—Aged two years; another case in house; fever, diarrhœa; Widal reaction positive; duration two weeks; recovery.

Case 38 (Ibid.) —Male, aged two years; case of typhoid next door; fever (103°), diarrhœa, vomiting, enlarged spleen, eruption; Widal reaction positive; duration twenty-eight days; recovery.

Case 39 (Griffith and Osthelmer).—Case 12, Table I.—Male, aged two years; brother in house with typhoid; fever (103.4°), diarrhœa, tympanites, eruption; Widal reaction positive; duration twenty-two days; recovery.

Case 40 (A. O. J. Kelly, Pediatrics, 1897, iv. 37).—Aged two years one month; mother with typhoid; fever, diarrhœa, enlarged spleen, tympanites, eruption; recovery.

Case 41 (W. P. Northrup, Arch. of Pediat., 1896, xiii. 11).—Female, aged two years three months; five other cases in house, milk infection; cough, eruption, alternate constipation and diarrhœa; recovery.

Case 42 (Griffith and Osthelmer).—Case 13, Table I.—Female, aged two years three months; fever (102.5°), diarrhœa, enlarged spleen, tympanites, eruption, scarlatina; Widal reaction positive.

Case 43 (J. P. Crozer Griffith, Philadelphia Medical Journal, October 15, 1898).—Case 14, Table I.—Female, aged two years four months; mother and brother with typhoid; fever (105°), diarrhœa, enlarged spleen, pneumonia; duration ten days; death. Autopsy: enlarged spleen mesenteric glands and Peyer's patches, slight ulceration.

Case 44 (W. L. Stowell, Medical Record, 1895, xlvii. 321).—Aged two years five months; other cases in house, epidemic; eruption; recovery.

Case 45 (Griffith and Osthelmer.)—Case 15, Table I.—Male, aged two years five months; fever (105°); Widal reaction positive; duration two weeks; recovery.

Case 46 (A. Kühn, Deutsch. Arch. f. klin. Med., 1876, xvii. 221).—Male, aged two and a half years; fever, diarrhœa, cough, eruption, enlarged spleen; recovery.

Case 47 (M. Röth, Arch. f. Kinderheilk., 1881, ii. 365).—Male, aged two and a half years; fever, meningeal symptoms, pneumonia; duration five days; death. Autopsy: typical lesions.

Case 48 (P. Kohlstock, Berlin Thesis, 1882, 10).—Female, aged two and a half years; epidemic; fever, vomiting, diarrhœa, collapse; duration three weeks; death. Autopsy: typical lesions.

Case 49 (H. N. Read, Brooklyn Medical Journal, 1888–89, iii. 599).—Male, aged two and a half years; fever (104°), diarrhœa, tympanites, eruption; duration thirty days recovery.

Case 50 (W. B. Noyes, Medical Record, 1894, xlvi. 1).—Female, aged two and a half years; milk epidemic; eruption, tympanites, fever (103°); duration two weeks; recovery.

Case 51 (Ibid.).—Female, aged two and a half years; two other cases in house, milk epidemic; fever (104°), eruption; duration two weeks; recovery.

Case 52 (J L. Morse, Boston Medical and Surgical Journal, 1896, cxxxiv. 205).—Aged two and a half years; fever (103°), diarrhœa, eruption; duration ten days; recovery.

Case 53 (B. Boyer, Lyon Méd., 1896, lxxxiii. 361).—Male, aged two and a half years; epidemic; fever, eruption, diarrhœa, tympanites; duration four weeks; recovery.

Case 54 (W. P. Northrup, Arch. of Pediat., 1896, xiii. 11).—Female, aged two and a half years; six other cases in house; typical, mild; recovery.

Case 55 (L. Guinon, Rév. Mens. des Malad. de l'Enf., 1897, xv. 236).– Female, aged two and a half years; fever (104°), constipation, tympanites, enlarged spleen, eruption, meningeal symptoms, collapse; Widal reaction positive; duration three weeks; recovery.

Case 56 (E. Henoch, Vorlesung. ü. Kinderkr., 1897, 771).—Female, aged two and a half years; fever: relapse; duration eight weeks; death. Autopsy: typical lesions.

Case 57 (E. Rosenthal, Pediatrics, 1897, iv. 381).—Aged two and a half years; Widal reaction positive; recovery.

Case 58 (H. A. Fairbairn, Journal of the American Medical Association, 1897, xxix. 1149).—Aged two and a half years.

Case 59 (Meinecke, Münch. med. Wochenschr., 1898, xlv. 435).—Female, aged two and a half years; fever (104°); Widal reaction positive; duration seven days; death. Autopsy: typhoid bacilli found in spleen.

Case 60 (G. Cagliari, Journal of the American Medical Association, 1899, xxxii. 881).—Aged two and a half years; other cases in house; "clinically typical."

Case 61 (C. Kasel and K. Mann, Münch. med. Wochenschr., 1899, xlvi. 581) —Male, aged two and a half years; Widal reaction positive; recovery.

Case 62 (Ibid.).—Male, aged two and a half years; Widal reaction positive; recovery.

Case 63 (Barbier and Herrenschmidt, Gaz. des Malad. Inf., 1899, i. 403).—Female, aged two and a half years; fever, diarrhœa; duration twenty-two days; recovery.

Case 64 (Ibid.).—Female, aged two and a half years; fever, diarrhœa; duration seventeen days; recovery.

Case 65 (Griffith and Ostheimer).—Case 16, Table I.—Female, aged two and a half years; fever (105°), eruption, enlarged spleen, diphtheria; Widal reaction positive.

Case 66 (Griffith and Ostheimer).—Case 17, Table I.—Female, aged two and a half years; fever (106°), vomiting, tympanites, constipation, otitis, pneumonia, diphtheria; Widal reaction positive; duration four weeks; death.

Case 67 (Griffith and Ostheimer).—Case 18, Table I.—Female, aged two and a half years; brother also with typhoid; fever (103°), epistaxis, diarrhœa, tympanites, enlarged spleen, eruption; recrudescence; Widal reaction positive; duration three weeks; recovery.

Case 68 (Netter, Bull. de la Soc. de Pédiat. de Paris, 1900, 2).—Aged two and a half years; fever; duration twenty-one days; recovery.

Of the 68 cases collected in the preceding table, 55 may be fairly considered to be typhoid fever; 9 (marked*) are doubtful, yet are probably instances of the disease; 4 (marked**) are doubtful and seem to us probably not cases of typhoid fever; 19 are males, 24 females, and in 35 the sex is not mentioned; 30 occurred in general or house epidemics, in 3 of these the mothers having typhoid, and in 17 instances there being other cases in the house, not mentioned as the mother, or in addition to her. Fever was observed in 42, diarrhœa in 24, constipation in 3, eruption in 23, enlarged spleen in 13, tympanites in 12, vomiting in 8, collapse in 2, cough in 6, pneumonia in 3, convulsions in 2, hemorrhage in 1, relapse in 2, recrudescence in 1, otitis in 1, meningeal symptoms in 3, epistaxis in 1, phlegmasia alba dolens in 1, diphtheria in 2, and scarlatina in 1.

Recovery was noted in 36, death in 14, while the result in 18 cases was not mentioned.

Of the 14 fatal cases, typhoid bacilli were found in 3 cases only.

A positive Widal reaction was recorded in 14 cases.

The following summary of the cases of typhoid fever in children up to two and a half years expresses in brief the most prominent features as far as the reports, often incomplete, make these manifest:

Cases in the first year of life—congenital	23
other cases	139
Total	—162
Cases in the second year of life	187
Cases from two to two and a half years inclusive	68
Total	417
Of these we must consider extremely doubtful	30
Leaving	387
Even if we subtract the doubtful yet probable cases	62
We have remaining a total of	325

Out of 153 in which the sex was known, 77 were males, 76 females. 185 are said to have occurred during general or house epidemics, in 97 of these there being other cases in the house, of which 45 occurred in the mothers.

Fever was noted in	143	Jaundice in	3
Diarrhœa in	113	Hemorrhage from the bowel in	5
Constipation in	11	Diphtheria in	4
Eruption in	78	Otitis in	3
Enlarged spleen in	71	Scarlet fever in	1
Tympanites in	50	Perforation in	2
Cough in	33	Laryngeal ulceration in	2
Pneumonia in	4	Parotitis in	1
Vomiting in	29	Recrudescence in	1
Convulsions in	14	Desquamation in	1
Meningeal symptoms in	4	Aphasia in	1
Relapse in	9	Noma in	1
Collapse in	6	Phlegmasia alba dolens in	1
Epistaxis in	5	Albuminuria in	1

A positive Widal reaction was noted in 44 cases only; in 2 cases it was negative during life, but typhoid bacilli were found post-mortem.

Of the 145 in which fever was observed, the highest temperature is recorded in 65, as follows:

	Cases.		Cases.
100° to 101°	1	103° to 104°	24
101° to 102°	3	104° to 105°	20
102° to 103°	11	105° to 106°	6

The duration is stated in 117 cases as follows:

Under one week	12	4 to 5 weeks	14
1 to 2 weeks	28	5 to 6 weeks	5
2 to 3 weeks	29	6 to 7 weeks	1
3 to 4 weeks	26	7 to 8 weeks	2

Out of 278 cases in which the result is recorded, 136 recovered, 142 died.

Out of 98 autopsies performed, typhoid bacilli were found in 14 cases.

No relative figures can be given regarding the frequency of symptoms, owing to the meagre details which attend the reports of many of

the cases. For instance, although more cases in our table are reported to have died than to have recovered, it is certain that this by no means indicates the actual relative mortality of the disease in childhood. This is partly explained by the fact that in 39 cases the result is not stated. It may be assumed that recovery took place in nearly all of these. There is also probably a greater disposition to report the fatal cases as being more unusual. The failure to recognize the milder cases has already been alluded to.

It seems to us that the main point at issue, the fact that typhoid fever is *not* so uncommon in early life as often claimed, may be considered established, not only by our own individual experience, but still more strongly by the reports of cases in medical literature.

ADDENDUM.—Since the reading of the above paper, details of at least half a dozen cases of typhoid fever in children of two years and less have been given to us by several colleagues who have not considered publication of the matter worth while. There has also occurred in the experience of one of us a well-marked and fatal case in a child of nine months. All these cases sustain the point which we have advanced, namely, that the disease is much more frequent in early life than the common belief or even published reports would indicate.

CLINICAL OBSERVATIONS ON CONGENITAL AND ACQUIRED TRANSPOSITION OF THE VISCERA.

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CASES of situs viscerum inversus have until recent years been discovered, studied, and reported chiefly by anatomists and pathologists. As a result of a correspondence with a large number of medical men of experience and prominence it would seem to me that the pendulum has swung about of late years, and that now a much larger percentage of these cases is discovered by the clinician. This fact is a natural result of the much more frequent and careful physical examinations that are now being made. However, even with this improvement, all physicians know that a very small percentage of even sick people submit to careful physical examination, and that the percentage of the entire population who are thus examined is extremely small.

Situs viscerum inversus is of great interest to the embryologist and anatomist. To the internist it presents very instructive problems in physical diagnosis.

Gruber made a remarkable collection of all cases found in the literature up to the year 1865. Of the seventy-nine cases which he reports only five or six were discovered during life. This fact seems rather remarkable, since his report covers more than two centuries. In 1643 Petrus Servius reported the first case as occurring at Rome.

Küchenmeister, up to the year 1888, collected 149 cases. The majority of these were discovered in the anatomical laboratory and on the post-mortem table. Pic, in 1895, increased the number of reported cases to 190.

Cases of partial situs inversus are not so common as those of complete transposition. Lochte, up to the year 1894, collected thirteen cases of this incomplete variety. In more than half very poor descriptions were given.

An attempt to collect all of the cases of situs viscerum inversus is extremely difficult and unsatisfactory, because they are reported in the literature under numerous headings. Perhaps something like 300 of these cases have been reported.

Since the spring of 1897 I have seen in hospital and private practice four cases of transposition of the viscera. It is a rather remarkable fact that three of these rare cases were seen within the short period of six months, an experience which I doubt being equalled even in the largest hospitals of the country. I am also familiar with three other cases of situs inversus discovered in the living subject by members of the internal medical staff, two by Dr. Warthin and one by Dr. Cowie.

The case which I saw first was with Dr. Chadbourne, in June, 1897, and has been reported by him and perhaps by a number of others, as he was a professional freak who went the rounds of medical schools exhibiting his anatomical abnormality for a compensation. This same patient, Schupfel by name, again presented himself at the hospital in July, 1902, and was demonstrated to my summer school section. He showed a complete transposition of the viscera, so far as could be demonstrated by clinical means. Inflation of the stomach and colon showed these viscera to be transposed. (Fig. 1.)

The three cases which I present in this article are bona fide patients —two farmers and a dental student—who learned for the first time of their peculiar abnormality.

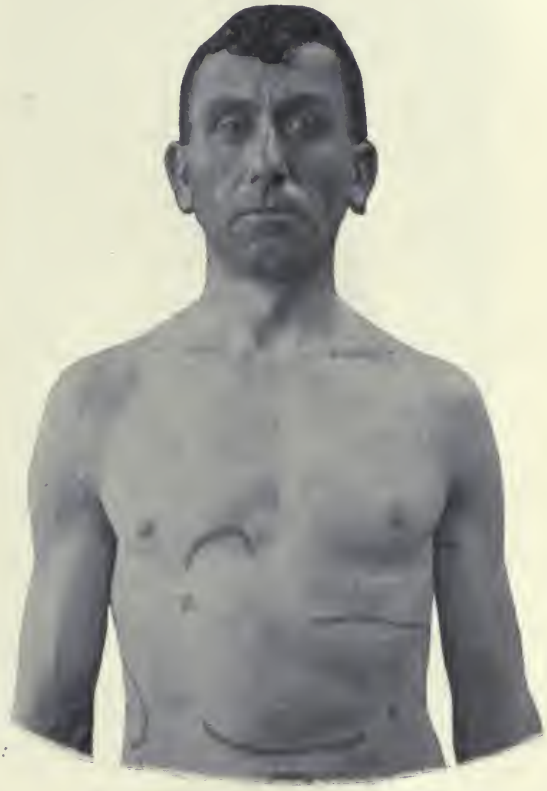
My experience inclined me to believe that this condition was much more frequently detected in the living patient than one would infer from the literature. Acting upon this belief, nearly two years ago I sent letters to a number of prominent clinicians asking them the number of cases of congenital transposition of the viscera they had encountered in their work. Letters were also sent to a number of anatomists. The following interesting statements were received:

Dr. William Osler, Johns Hopkins: "Since the opening of the hospital we have seen, I should say, at least six cases."

Dr. Eshner, Philadelphia Polyclinic: "I beg to state that I cannot recall having seen a case of transposition of the viscera."

Dr. J. C. Wilson, Jefferson Medical College, Philadelphia: "I have encountered three demonstrable cases of transposition of the viscera, all adult males."

FIG. 1.



The upper curved line on the patient's right indicates the area of absolute cardiac dulness. The × just below this indicates the apex-beat. The curved line on the patient's right side indicates the splenic dulness. The straight line on the patient's left side indicates the upper border of the liver dulness; the small × indicates the lower border. The lowest curved line indicates the greater curvature of the stomach.

Dr. R. H. Fitz, Harvard Medical College: "I do not recall the number of living cases seen; I have no recollection of having examined after death a case of dextrocardia."

Dr. Warren Coleman, New York: "I do not recall having seen a case with transposition of the viscera."

Dr. I. N. Danforth, Chicago: "I never saw such a case in my life."

Dr. Allen Jones, Buffalo: "I have not seen a case of dextrocardia."

Dr. Frank Billings, Rush Medical College, Chicago: "I have seen

three cases of congenital transposition of the heart and abdominal viscera in my private and hospital work—one discovered in a babe about two weeks old, one in a young man between twenty and thirty years, and one in a man aged sixty-six years. The last suffered from gallstones, and was operated upon by Dr. Fenger, of Chicago. All three were unrecognized until the time when I first saw each case. Besides these three I have seen a case in a young man who travelled about exhibiting himself in medical schools."

Dr. John H. Musser, University of Pennsylvania, Philadelphia: "I have never seen any cases of congenital dextrocardia except those belonging to and reported by other physicians, as Dr. J. Dutton Steele and Dr. Joseph Sailer."

Dr. J. M. Anders, Medico-Chirurgical College, Philadelphia: "Three cases, but they have been seen while visiting various institutions here and elsewhere."

Dr. R. C. Cabot, Harvard Medical College: "I have seen two cases of transposition of the viscera. They were hospital cases in the service of Dr. Shattuck."

Dr. H. B. Newberry, Denver: "I have seen two cases—one a child, aged two or three years, also reported by Dr. J. A. Hall, and seen in consultation with him; a second in a young adult whom I was examining for life insurance. The abdominal viscera were displaced in both cases, as shown by the liver."

Dr. James Tyson, University of Pennsylvania, Philadelphia: "I recall only one well-remembered instance of transposition of the viscera occurring in my clinical experience. I remember seeing one other case years ago in a dissecting-room."

Dr. James Munson, Superintendent Michigan Insane Asylum at Traverse City: "While a member of the staff of the Pontiac (Michigan) Asylum I saw a case in which the diagnosis of complete transposition of the viscera was not made *intra vitam*, but at autopsy. During the last year of his life he had Addison's disease. I recollect that previous to his death the diagnosis of an enormously enlarged spleen had been made, and that the displacement of the heart had also been recognized; but my recollection is that it was thought to be due to dilatation."

Dr. Robert Preble, Chicago Medical College: "I have seen four cases of transposition of the viscera—three clinical, one post-mortem. Two of the clinical were stock cases in Vienna, the third is now a student at the Northwestern. In addition to these there is another case, in which the examination is incomplete, discovered while examining the heart for anæsthesia."

A Jacobi, College of Physicians and Surgeons, New York: "Only two that I remember."

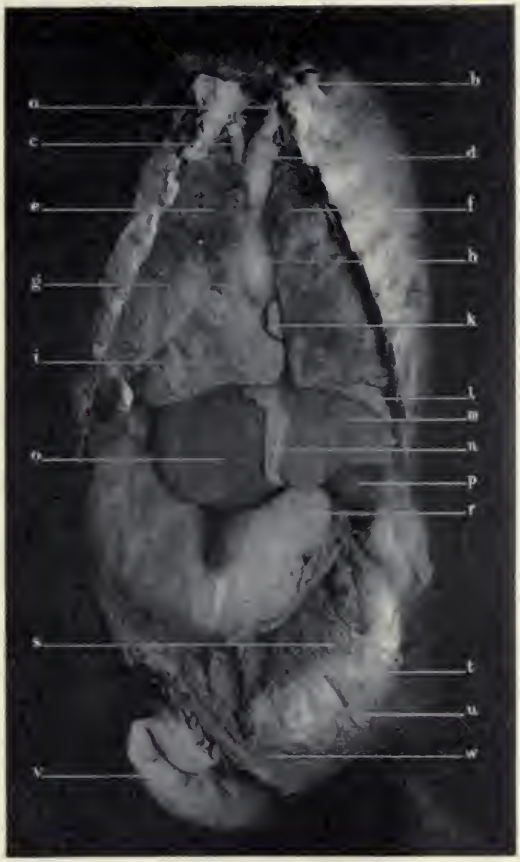
Dr. Atkinson, Baltimore: "Two cases of transposition of the viscera appearing at my clinic, and who travelled widely, exhibiting themselves."

Dr. C. G. Jennings, Detroit Medical College: "I have never met such a case."

Dr. I. W. Blackburn, National Hospital for the Insane, Washington, reported in the *Washington Medical Annals*, 1902, No. 2, vol. i., a very interesting case of transposition which came to autopsy. With his permission, an excellent photograph of this case is presented in this article. (Fig. 2.)

Dr. Nancrede, Ann Arbor: "One case, seen in the anatomical laboratory of the University of Pennsylvania, of which I helped to prepare a wax model. This case was reported by Dr. N. Hickman."

FIG. 2.



Transposition of viscera. Terms transposed in description: *a*. Right common carotid artery. *b*. Innominate vein. *c*. Left common carotid artery. *d*. Innominate artery. *e*. Left lung (?). *f*. Right lung (?). *g*. Pulmonary artery. *h*. Aorta. *i*. Right ventricle of heart. *k*. Appendix of right auricle. *l*. Diaphragm. *m*. Right lobe of liver. *n*. Suspensory ligament of liver. *o*. Left lobe of liver. *p*. Gall-bladder. *q*. Cardiac end of stomach and situation of spleen. *r*. Pyloric end of stomach. *s*. Gastrocolic omentum. *t*. Transverse colon dragged downward. *u*. Situation of cæcum. *v*. Sigmoid flexure. *w*. Omentum.

Dr. Irving Haynes, Professor of Anatomy, Cornell Medical College: "Although I have superintended the dissection of about 2500 subjects, I have never seen a case of transposition of the viscera."

Dr. Frederic H. Gerrish, Professor of Anatomy, Bowdoin Medical College, Portland, Me.: "I have never encountered a case of transposition of the viscera."

Dr. D. K. Shute, Washington, D.C.: "It has never been my good fortune to see any cases of transposition of the viscera."

Dr. S. Yutzy, Instructor in Anatomy, University of Michigan: "I have seen one case of transposition in ten years' service in the anatomical department. During this period about 750 subjects have been dissected. The case was a middle-aged man."

Members of the staffs at the four Michigan State Asylums inform me that the Pontiac case reported by Dr. Munson is the only case to be found on their records.

The above writers are all men of large experience.

Five well-known internists and four professors of anatomy replied that they had never seen a case of transposition.

Of the thirty-seven cases noted in the above letters all save six were discovered during life. In a few instances (travelling freaks) the same cases have probably been examined and reported by several of the writers. The majority, however, were discovered for the first time, and did not make a practice of exhibiting themselves.

In this country, at least, cases of transposition are nowadays much more frequently discovered during life than after death. Note the contrast between Gruber's report and my own. He collected seventy-nine cases, of which only five or six were discovered during life. In my collection, which simply covers the cases reported in the above letters, together with those with which I am personally familiar, there are forty-four cases, of which thirty-eight were discovered during life.

Report of Unpublished Cases.

CASE I.—Wm. B. consulted me June 13, 1900, complaining of symptoms of indigestion. He is a farmer, aged thirty-two years; is tall, slender, and poorly nourished. On examining his lungs by percussion tympany was encountered in the sixth intercostal space, right nipple line, there being no liver dulness. On the left side dulness is encountered on the sixth rib, nipple line, and eighth rib, mid-axillary line. Litten's phenomenon is present on both sides. Auscultation of both lungs shows good vesicular breathing.

Heart. I was much surprised to find the apex-beat in the fifth intercostal space one inch inside of the right nipple line, easily seen and felt after exercise.

Percussion shows tympany in the normal area for heart dulness. On the right side, however, there is an area of dulness encountered on the fifth rib, sternal line, and extending about one inch to the right; no dulness to the left.

Abdomen. Liver dulness encountered on the left side, nipple line, lower border of the sixth rib; extends down to the margin of the ribs in this line. In middle line, one-third of the distance from ensiform to navel. Just to the right of mid-line liver dulness merges with heart dulness. The liver is not felt.

Spleen. In the right mid-axillary line dulness is encountered at the upper border of the ninth rib, and extends down to the tenth inter-

costal space. It is about the size of a silver dollar. The spleen is not palpable.

Kidneys are not palpable.

Stomach was distended, but unsatisfactorily.

Testicles. Right hangs lower than the left.

CASE II.—A. G. S., dental student, aged twenty-one years, was sent to me by Director Fitzpatrick, of the gymnasium, who suspected some cardiac anomaly. There is no history of disease of the lungs, pleura, or heart. He was never a good distance runner because of shortness of breath. For years he has thought that his heart was on the right side, because he could feel it beating there. This patient is in good health, but does not look robust. Examination of lungs is negative.

Heart. Apex-beat is felt in the fifth intercostal space, just inside of the right nipple; dulness begins on the fourth rib, right sternal line, extends out to right parasternal line. There is no heart dulness on the left or under the sternum. Auscultation is negative except that at times the rhythm is somewhat irregular. The second sound in the right second intercostal space is louder than that in the left. The sounds are heard best to the right, but there are weak heart sounds heard in the location of normal apex-beat.

Abdomen. Liver dulness is encountered on the left side. Upper border, left sternal line, seventh costal cartilage; nipple line, seventh rib; mid-axillary line, eighth intercostal space. This dulness extends down to the margin of the ribs.

Spleen. In outlining the lower border of the right lung I was surprised to find no liver dulness. On percussing in the right mid-axillary line I found a small area of dulness beginning at the ninth rib, extending down about two inches and forward to the anterior axillary line.

Stomach was distended with acid and soda, showing a dislocation. The greater curvature is about three inches below the navel, lesser curvature one inch above. The fundus of the stomach seems to be on the right side, there being a broader area of distention here than on the left.

Colon was distended with air and filled first on the left side, extending about two inches above the navel. There was very little distention on the right side.

Testicles. Left hangs lower than the right.

Spinal Column. No curvature.

X-ray Examination. With the fluoroscope I obtained a good view of the heart beating to the right of the sternum.

CASE III.—I. C., merchant, aged sixty years, patient at the University Hospital. This patient had a chronic bronchitis and chronic rheumatism. He never suspected any dislocation of his organs. He is emaciated. Percussion and auscultation of the lungs reveal signs of emphysema and bronchitis, but of no condition which could have caused a dislocation of his heart to the right.

Heart. Apex-beat cannot be seen or felt on the left side, but in the fifth intercostal space, right side, nipple line, a faint pulsation is seen and felt.

Percussion. Along the left sternal line there is good resonance down to the sixth rib, where liver dulness is encountered. On the right side absolute heart dulness is encountered on the fourth rib, sternal line;

extends to the right, on a level with the fourth rib, to the parasternal line; with the fifth rib to within one inch of the nipple.

Auscultation. Over apex on the right side the sounds are strong; no murmurs are detected. In the second intercostal space, right, the second sound is much accentuated; in the second intercostal space, left, the second sound is very weak.

Abdomen. Unfortunately, a complete examination was not made.

CASE IV.—I am indebted to Dr. Cowie for the following report of this case. S., a travelling salesman, aged fifty years. His symptoms point to a chronic gastritis. An interesting point in his history is the fact that he was examined for life insurance five times without having this anomaly discovered. Examination of the lungs is negative.

Heart. Apex-beat not seen or felt in normal position. There is no dulness to the left of the sternum. Apex-beat is plainly seen and felt in the fifth intercostal space, just inside right nipple.

Auscultation shows heart sounds loudest to the right of the sternum.

Abdomen. In place of liver dulness in right hypochondrium there is a tympanitic note. In this region succussion sounds are brought out by deep palpation. In the left hypochondrium liver dulness is encountered—upper border of nipple line, seventh rib. This extends down to the margin of the ribs and far forward as the sternum.

Stomach. On distention with air it is seen to lie in the right hypochondrium, partially in the epigastrium, near the median line. It is not dislocated downward.

Kidneys are not palpable.

Testicles. The right much lower than the left. The genitals have a right-sided position with trousers on.

CASE V.—The notes on this case are very brief. Patient was colored, male, aged over twenty years; was examined in the out-patient department by Dr. Warthin. The condition of congenital dextrocardia was satisfactorily determined, but so much enthusiasm and interest were manifested in his case that he refused to return for a complete examination of the abdominal viscera, fearing that he was to be subjected to experimentation.

Acquired dextrocardia is a fairly common condition, resulting from contracting disease of the right lung or pleura, which pulls the heart over under the sternum, or even beyond. Again, it may be due to large collections of fluid (serous or purulent) in the left pleural cavity, which push the heart to varying degrees to the right. Inflammatory adhesions may fix the heart in this position, even after the cause has been removed by absorption or operation. A less common cause is the presence of a new-growth involving the left lung and pleura, or mediastinum.

A very striking case of this latter variety came under my observation last spring, in Dr. Dock's clinic. Fig. 3 well illustrates the conditions which were present.

The patient is a small woman, aged forty-five years. She is emaciated, weighing only ninety pounds. Three years ago she weighed about 115 pounds. On inspection of the thorax the left side is a trifle

fuller than the right. On deep breathing expansion is practically limited to the right side. Percussion shows absolute dulness over the entire left chest, front and back, except a very small area at the apex, which gives a tympanitic note. The dulness also extends across the sternum in front to the right parasternal line above the fourth rib, while below this it reaches almost to the nipple line. This dulness and the liver dulness are continuous. As the photograph well shows, resonance was obtained over only a very small part of the thorax in front. Behind, the right lung gives a hyperresonant note over its entire extent down to four fingers below the angle of the scapula. Litten's

FIG. 3.

O = apex-beat. The entire area between the dark lines was absolutely dull.

phenomenon is very distinct on the right, the shadow line moving from the eighth rib down three inches in the mid-axillary line. On the left side it is absent.

Auscultation. Over the dull area, front and axilla, breath sounds are practically absent; behind there is extremely weak vesicular breathing, perhaps conducted from the right side by the spinal column. Over the resonant area of the right lung there is exaggerated vesicular breathing.

The voice sounds are well transmitted over the right resonant area, while practically absent over the left dull area.

Vocal fremitus is very strong over right, but absent over the left chest.

Heart. Apex-beat is felt in the fourth intercostal space, nipple line, right side, most distinctly one inch inside of nipple line. There is also a distinct pulsation in the second and especially in the third intercostal space, right, extending almost to the nipple line.

Heart dulness is continuous with the large area of dulness to the left and below. It extends to within an inch of the right nipple, on a line with the fourth rib.

Auscultation. Over the dislocated apex the first and second sounds are moderately strong. The third intercostal space, right parasternal, first sound is murmurish; second sound is accentuated. Second intercostal space, left, sounds are weak. Pulse is small, of low tension, and regular.

After a consideration of these signs I concluded that there was an enormous collection of fluid in the left pleural cavity, which caused a dislocation of the heart to the right. A large exploratory needle was used twice by the medical interne, Dr. Pray, with no results beyond withdrawing a small amount of blood. Three days later I also used exploratory aspiration twice, but with negative results.

As a result of these findings I came to the conclusion that the cause of the dulness and dislocated organs was a new-growth involving the left pleura, lung, and perhaps the mediastinum.

Another possibility which must be considered is that of an old empyema, with greatly thickened pleura, and a large collection of thick, purulent material. However, it seems most likely that we would have been able to demonstrate pus had it been present.

A striking physical sign was the remarkable clubbing of the fingers, which is shown in the photograph.

The patient came to the hospital complaining of great weakness, a bad cough, and shortness of breath on exertion.

The present illness began four years ago with a cold. She was then troubled with shortness of breath on bending over, with pains in the left side and shoulder. The cough has become much more troublesome during the past two or three years. It has always been dry until a few weeks ago, when the patient caught cold; since then she has raised some sputum. During the past few weeks she has had very little pain in the left side, but there is a feeling as if the lungs were compressed.

During the patient's stay in the hospital her temperature has seldom reached 100° F. She came to the hospital with the diagnosis of consumption. Examination of the sputum for tubercle bacilli while here was always negative. This patient died in January, 1902. Her attending physician, Dr. Fay, of Carlton, Mich., writes me that autopsy revealed an enormous mediastinal tumor, about the shape and size of a medium-sized watermelon.

Another striking case of acquired dextrocardia is well illustrated by Fig. 4. The change in the position of the heart is secondary to an empyema of the left chest of long standing, with extreme retraction of the entire left side. The left side of the chest, with the exception of the apex, does not expand at all. The right side expands fairly well.

Heart. Forcible pulsation is seen to the right of the sternum, in the second, third, fourth, and fifth intercostal spaces; strongest in the fourth. The apex-beat is in the fifth intercostal space, nipple line.

Auscultation. At the apex both first and second sounds are loud and clear-cut. In the second intercostal space, right, the second sound is accentuated. In the second intercostal space, left, both first and second sounds are murmurish. In this area splashing sounds could be heard with each pulsation of the heart during forced inspiration, due in all probability to the sudden movement of the purulent fluid and air in the empyemic cavity (open pneumothorax).

The patient was taken sick in December, 1900. Two months later he noticed the heart beating on the right side, in about the same position which it occupies at present. In December, 1901, Dr. Nancrede resected six ribs. Marked retraction of the left chest followed, but the position of the heart was not altered by the operation.

FIG. 4.

× = areas of cardiac pulsation.

Theories Explaining the Development of Congenital Transposition of the Viscera. These are chiefly of interest to the embryologist and anatomist, and will hardly be understood except by those who have devoted special study to embryology. The following are some of them:

Von Baer explains transposition by the turning of the embryo in the opposite direction—that is, the embryo normally lies on the left

side of the umbilical vesicle; but if it lies on the right side, then we have transposition. According to him, this occurs at the beginning of the developmental period.

Förster considers situs inversus a malformation in which the transposition of the anlagen takes place in the first embryonal formation. In the double monster the fœtus of the right side shows a complete transposition, while the fœtus on the left side shows a normal situs.

Rindfleisch believes that the spiral turning of the blood column is responsible for the displacement of the heart. Normally it flows from left to right, but in situs inversus an opposite direction must obtain. The asymmetry of the heart is made responsible for all asymmetry in the animal body.

Virchow emphasizes the influence of the umbilical cord. In situs inversus it is wound spirally to the right; in the situs solitus to the left.

Küchenmeister thinks that the location of the fertilized disk at the surface of the egg is the essential thing. The normal situs in single birth probably depends upon the growth of the germ from below upward instead of from above downward. He says that from this it must be self-evident that the turning of the embryo has been inverted. This must also affect the later spleen side and the side of the arterial heart. Concerning the congenital partial situs viscerum—solito inversus—which shows itself either in the chest or belly, but not in both places at the same time, he believes that the growth, on the whole, follows the type for the situs inversus. The rarer partial situs is an inhibition formation which grows according to the type of the normally projected embryo.

Martinotti in the transversus of the single born emphasizes the condition of the vena omphalomesenterica, first mentioned by Dareste. The direction which the heart loop takes depends upon the dissimilar growth of the two halves of the vascular area. Under normal conditions a dissimilar formation of the two halves exists. The left omphalomesenteric vein is more developed than the right; the right gradually disappears. The heart reacts in a very sensitive way toward the cause of situs transversus.

Marchand says that the loop formation of the venæ omphalomesenterica about the intestines under normal conditions prevents the intestines from slipping toward the right; so a right turning takes place if the loop formation is absent. He considers the left-sided persistent vena omphalomesenterica the cause of the right position of the stomach. In a more recent article Marchand does not believe that the development of the vena omphalomesenterica can have an influence upon the rotation of the stomach.

Lochte advances the view that the growth of the organ, considered in the sense of situs solitus, is associated with a persistence of left-sided omphalomesenterica and umbilical veins, while those of situs transversus totalis, on the other hand, are associated with corresponding right-sided veins.

To the clinician, transposition of the viscera presents many interesting problems in differential diagnosis. The displacement of the heart to the right makes it necessary to examine the lungs and pleura carefully in order to exclude acquired displacements. The discovery of an enlarged area of dulness in the left hypochondrium suggests a number of possibilities. It is most likely an enlarged spleen, either of leukæmia, malaria, splenomegaly, etc. This point is illustrated by actual cases in practice. In Munson's case, referred to above, the diagnosis of an enormously enlarged spleen had been made, and the displacement of the heart was thought to be due to dilatation.

In the normal patient it is a very common experience to find an entire absence of liver dulness in the right hypochondrium. It is also common to find the apex-beat neither seen nor felt on the left side, especially if the patient is quiet and in the horizontal position. Heart dulness is also frequently absent. So it is easy to understand how these cases of transposition are often overlooked.

It is possible to mistake an aneurism of the arch for a dislocated heart. This fact was recently brought to my attention.

Gruber refers to the following errors in diagnosis: In one case of transposition a pain in the right hypochondrium led to the diagnosis of a chronic inflammation of the liver. In another case a soldier was wounded in a duel in the right hypochondrium; from the position of the wound and the vomiting of green fluid it was thought that the liver had been penetrated. In a third case in the Würzburg clinic the transposed liver was diagnosed as a splenic tumor. In a fourth case—one of a cancer of the pylorus in a transposed stomach—the hard tumor felt deep in the left hypochondrium, and was thought to belong to the stomach or the pancreas.

Gruber arrived at a number of interesting conclusions from a study of 79 cases. Concerning the sex, there were 49 men, 19 women, and 11 in which sex was not mentioned. These individuals lived as long as those with normally placed organs; 5 of the 19 women lived to an age between 70 and 84 years. The women were normally fruitful; one gave birth to twelve children. Among the 79, 4 died an unnatural death, and only 4 were extremely malformed. There was transposition of both chest and abdominal organs in 71; of the abdominal organs alone in 8. In the first kind the transposition was complete, in the latter incomplete. Lungs were transposed in 35 of 71 cases;

the right had two lobes and the left three. In 2 cases they were not transposed; in 2 both lungs had two lobes; in 1 the right had one lobe and the left 2 lobes. Spine: curvature of the dorsal portion is mentioned in only 11 cases. In 7 of these it was to the left; in four to the right, as normally. We cannot draw the conclusion that persons with transposition are more likely to be left-handed than those with normally located viscera. The position of the testicle was mentioned only 7 times. In 4 the right was lower; in 1 the left; in 1 the left had not descended. The lower position of the right testicle is unimportant as a sign of situs inversus. In only 9 cases were there notes on the position of the kidneys. In 7 the left was lower, in 2 the right. In 32 cases in which the vessels arising from the arch of the aorta are mentioned these were transposed 29 to 30 times.

H. Steinhaüser mentions the fact that in the operation of œsophagotomy it is well to know that the œsophagus lies over the right trachea in persons with transposition.

In situs partialis the transposition of the abdominal organs may be very irregular. In one case the stomach and duodenum were normally located, while the other organs were transposed. In another case the liver alone was transposed.

In 1888 a case of pure dextrocardia, with congenital pulmonary stenosis, without malposition of the viscera in general, was shown to the Vienna Medical Society by Dr. Gruss. In discussing the case, Von Bamberger concurred in the diagnosis, and remarked that Professor Schrötter had lately stated that no single case of pure dextrocardia had ever been proved; whereas all anatomists of experience—for example, Rokitansky, Friedberg, Förster, etc.—had mentioned such cases, and he himself had seen two.

The above quotation emphasizes the fact that partial situs is a much rarer condition than complete. If the transposition is located in the abdominal cavity it will most likely be overlooked in the physical examination.

REVIEWS.

LECTURES ON THE HISTORY OF PHYSIOLOGY. By SIR MICHAEL FOSTER, M.P., M.D., Professor of Physiology in the University of Cambridge. The Macmillan Company, 1901.

FOR the "Lane Lectures" at the Cooper Medical College, San Francisco, for 1900, Sir Michael Foster most happily chose the history of physiology during the sixteenth, seventeenth, and eighteenth centuries. In many ways, for many good deeds, the profession is indebted to Michael Foster. His text-book has taught both teachers and students; to him more than to any one man is due the rise of the new school of physiology in England, while largely as a result of his efforts the university which can boast of Caius, Harvey, and Glisson has a first-class medical school.

These lectures form a contribution to medical literature of the highest order. The style is so charmingly lucid, and Sir Michael has such a power of seizing the salient points in a story, and has given such a human interest to the tale, that the work is destined to be a classic in the history of medicine. There has been nothing of the same kind in our literature, and the title could have been just as well the history of scientific medicine during these centuries. It is a work which cannot be too widely known; teachers should read it carefully, and should recommend it to their senior students, who will find in these stories of the heroes of medicine just the right kind of instruction.

The book opens with an account of Vesalius, the founder of modern anatomy, the story of whose life has often been told, but never by a more sympathetic writer. The essential feature of his work is thus told in a paragraph: "The 'new birth' of the fifteenth and sixteenth centuries was in essence a revolt against authority as the guide in knowledge; and the work of Andreas Vesalius, of which I am speaking, marks an epoch, since by it the idol of authority in anatomical science was shattered to pieces, never to be put together again. Vesalius describes the structure of the human body such as he found it to be by actual examination, by appealing to dissection, by looking at things as they are. He dared not only to show how often Galen was wrong, but to insist that when Galen was right he was to be followed, not because he had said it, but because what he said was in accordance with what anyone who took the pains to inquire could assure himself to be the real state of things."

When one examines the *De Fabrica*, with its accurate plates and beautiful letter-press, it is hard to believe that this was the work of a young man not yet thirty. Vesalius had a high and imperious spirit, and the bigoted opposition which his great work aroused, even in his friends, entered like iron into his soul. "If the work on which he had

labored so long, and which he felt to be so full of promise, met with such a reception, why should he continue to labor? Why should he go on casting his pearls before swine? He had by him manuscripts of various kinds the embodiment of observations and thoughts not included in the *Fabrica*. What they were we can only guess; what the world lost in their loss we shall never know. In a fit of passion he burnt them all, and the Emperor Charles V. offering him the post of court physician, he shook from his feet, in 1544, the dust of the city in whose university he had done so much, and still a youth, who had not yet attained the thirties, ended a career of science so gloriously begun."

Vesalius was the first modern anatomist. Harvey was the first modern physiologist. As one reads the *Exercitatio de Cordis Motu* to-day there is a feeling that the author approaches his problems in a truly scientific spirit, and there is nothing in the work which jars or which suggests mediævalism. Harvey demonstrated the circulation of the blood. Vesalius, Servetus, and Fabricius led up to Harvey, and the author gives due credit to the work of Columbus and Servetus; but Harvey took up the experimental method used by Galen and by the Alexandrian physicians, and demonstrated in a way that the simplest could follow, the complete circulation of the blood. It is not necessary to dwell on this well-known chapter further than to call attention to the fairness and the clearness with which the history of this great discovery is presented.

One of the most interesting lectures (III.) is that on the "Influence on Medicine of the New Science of Physics." In his treatise on *Man*, Descartes, whom Foster calls the Herbert Spencer of the age, maintained the theory that man was an earthly machine governed by a rational soul, and attempted to apply to the interpretation of the phenomena of living beings the philosophy of exact mathematics and physics. The lecture is largely devoted to the life and work of a remarkable man, never before introduced so fully or so ably to an English reading audience—Borelli, mathematician, physician, astronomer, and physicist. Born in 1608, he came under the influence of Galileo, and in 1656 was elected to the chair of mathematics at Pisa, where he had as colleagues Malpighi and Redi. Borelli was the first to apply the exact mathematical and physical knowledge which had grown so greatly in explanation of the problems of the living body. In his great work *De Motu Animalium*, "he treats in succession of the various problems of muscular mechanics, of flexion and of extension, and of the more complex problems of standing, walking, running, and other forms of locomotion; he investigated these in the same rigid, exact manner, calling in the aid of mathematical figures and calculations, as he and others had investigated the problems of falling bodies, and of the action of various propulsive and other machines."

He discusses the mechanism of the circulation of the blood, of the action of the heart, and his work is really the foundation of all our knowledge of animal mechanics. "When we consider the effect which a perusal of Borelli's book has upon the reader now, we can easily understand how he was a founder of a great school which flourished long after him. He was so successful in his mechanical solutions of physiological problems that many coming after him readily rushed to the conclusion that all such problems could be solved by the same methods; and, as is often the case, the less qualified, alike as regards mechanical as

well as physiological knowledge and insight, to follow in Borelli's path, were the men of succeeding times the more loudly did they often proclaim the might of Borelli's method. Thus there came in the times after Borelli a school who, imitating and often mimicking Borelli, proposed to explain all physiological phenomena by the help of mathematical formulæ, and of hypotheses concerning forces and the shapes and sizes of particles, the iatro-mathematical or iatro-physical school."

The structure of muscle was first clearly demonstrated by Nicholas Stensen, a Dane, whose Latin name, Steno, is given to the duct which he discovered. His romantic story matches almost that of Vesalius. After publishing, in 1662, his *Observationes Anatomicæ*, while as yet a young man of twenty-four years, he seems to have wandered about, teaching here and there, and in 1666 he became court physician to Ferdinand II. at Florence. He worked at comparative anatomy and geology, to which science he made an important contribution. In 1672 he returned for a time to Copenhagen, but two years later he was again in Florence. Then, while still a young man of thirty-six summers, came a sudden and profound change. In Paris he had come under the influence of the great Bossuet, and, though brought up a staunch Protestant, the seed had fallen on a good soil. "One day, visiting at Florence the pharmacy attached to the Sancta Maria Novello (the same pharmacy at which to-day you may buy orris root and other preparations), in order to buy some drug, the holy brother who sold him the medicine dropped some words about the remedies for the soul. The stray arrow entered between the joints of the harness. New thoughts were stirred in the mind of the man of science and of the world, and within a year, to the astonishment of his friends and the dismay of all the friends of the new learning, he forsook all his old studies, gave up all inquiry into the works of nature, and, taking orders, solemnly devoted himself henceforth to the works of God and religion." Made subsequently a Roman Catholic Bishop, he for a time resumed his old work as Professor of Anatomy in the University of Copenhagen, but "he soon gave up all attempts to work his old life into his new calling." He devoted himself to the usual duties of a priest, and, at Schwerin, lived a life of severe self-denial, laboring constantly for the welfare of the poor. "The privations which he laid upon himself and the toils which he underwent for others were too much for the body which had once filled so much of his thoughts, and which he now held as a thing of naught. He wore himself to death, and died in 1686, at the relatively early age of forty-eight."

The invention of the microscope revolutionized the study of anatomy in the seventeenth century, and the labors of Malpighi, Leeuwenhoek, Swammerdam, and Hooke founded the new science of histology. Malpighi was the strong man of the period, and the pen-picture of the great histologist is drawn with singular felicity. Take the contrast between two friends: "Borelli, twenty years older than Malpighi, self-asserting, confident, claiming as his own not only what he had done, but at times what had been done by others; angry if his own merits were not fully acknowledged, impatient of the praises of others, bore himself, as we have said, in daily life with a taciturn coldness if not with a rough fretfulness which kept many who admired his talents from looking upon him as a friend. Malpighi, kindly even to softness, ready to give his affections to those who seemed drawn to him, devoted wholly to those who had won his love, modest and retiring even to timidity, bold only in the

interests of truth and right, never in his own, lived a life such as the sweet, delicate outlines of his face bespoke; beloved for the sake of himself, even by those who were not competent to judge of his talents and his work." Malpighi was a great biologist, and his researches in embryology, comparative anatomy, and vegetable morphology were characterized, as Foster says, by the light of genius and by the deepest philosophic insight. He completed the link in Harvey's demonstration by discovering the capillary circulation. He described the vesicular structure of the lungs, and gave the first scientific account of the finer anatomy of the liver, pancreas, spleen, and kidneys. A professor of medicine, a busy practitioner, an ardent investigator, yet of delicate habit of body, Malpighi illustrates as well as anyone in the history of science how much may be accomplished by a man who has what Donne calls "the sacred hunger of science."

"The Rise of Chemical Physiology," the subject of Lecture V., introduces us to the alchemist, Basil Valentine, and his three elements; to Paracelsus, the first great pharmacologist, the leader of the revolt against Galenic practice; and particularly to Van Helmont, one of the founders of modern chemistry, a careful, exact student, who is remembered by his *Archæus*, and whose doctrine of fermentation influences medical opinion at the present day.

The chemistry of digestion, as studied by Sylvius and his pupils, carries us on to a more modern stage and to the conception of the identity of the chemical processes in dead and living things. De Graaf, Stensen, Peyer, von Brunner (names on our lips daily) helped to clear the mysteries of intestinal digestion, and the salient features of the work of each are presented in a most attractive way. Here, again, it is simply delightful to have the dry bones of old and long-forgotten views live again by the personal interest we are compelled to take in the men who announced them.

The physiology of respiration, to which Borelli has made such important contributions, was worked out largely by a group of English physiologists of the seventeenth century. Boyle, Hooke, Lower, and Mayow were worthy children of the great Harvey. The story of Mayow and his remarkable contributions to the physiology of respiration will be read with exceptional interest by teachers, to a majority of whom, as to the writer, there will be the added interest of novelty. His work, with certain changes in phraseology, could be incorporated in a modern textbook. At a time when the men of chemistry were battling with the spiritualistic fermentations of Van Helmont and the material effervescences of Sylvius, Mayow, by a series of brilliant experiments, had grasped the essential truths of the subject. "He saw that the nitro-aërial particles of the air, or oxygen, as we would say, formed only a part of the atmosphere; that it was essential for burning; that it was essential for all the chemical changes on which life depends; that it was absorbed into the blood from the lungs, carried by the blood to the tissues, and in the tissues was the pivot, the essential factor of the chemical changes by which the vital activities of this or that tissue are manifested. It was essential in muscle to the occurrence of muscular contractions; it was essential in the brain to the development of animal spirits."

In Lecture VIII., which deals with the physiology of digestion in the eighteenth century, we have graphic pictures of Boerhaave and his great pupil, Haller, and of Reaumur and of Spallanzani.

Mayow's seed of truth fell on uncongenial soil, and, as Foster says, the world had to await for more than one hundred years until his thoughts arose, as it were, from the grave in a new dress and with a new name. The modern doctrines of respiration (Lecture IX.) date from the researches of Black, Priestley, and Lavoisier. The story of phlogiston, and of the discovery of oxygen, of carbon dioxide, and of nitrogen is skilfully drawn. Here, again, the human interest absorbs our attention, and the sad fate of the brilliant Lavoisier haunts the memory. "On the morning of May 9, 1794, there passed in carts from the Conciergerie to the Place de la Révolution a procession of men to meet their death. As the sharp stroke of the guillotine severed in turn the neck of the fourth of these, there passed away from this world, in his fifty-first year, this master mind of science, who had done so much to draw aside from truth the veil of man's ignorance and wrong thought; and there passed away, too, the hope of his drawing aside yet other folds of that veil—folds which perhaps wrap us round even to-day."

The concluding lecture is upon the older doctrine of the nervous system. The visionary reasoning of Descartes and of Willis are well contrasted with the sensible moderate views of Vesalius and of Stensen. For the first time, so far as I remember, justice has been done by an Englishman to Glisson, and to his position as the founder of the doctrine of irritability of tissues. Virchow has repeatedly referred in addresses to Glisson's great merit in this matter, and it is pleasant to see his views clearly set forth by the author. Physiologists will read with interest of Glisson's early plethysmographic experiment demonstrating the shrinkage of muscle during contraction.

In this much too brief outline we have endeavored to show the human interest with which the author has clothed these admirable lectures. The story of such men as Vesalius, Harvey, Malpighi, Borelli, Stensen, Mayow, Lower, Lavoisier, and others, with their love of truth and their capacity for patient, honest work, should be in the hands of every student of medicine. As the stream of knowledge grows more rapid, we teachers live too much—we have to, I suppose—in the swift current, and few of us have time, too few the inclination, to go up stream to the sources of our art and science, and yet there is not a question which comes before us which cannot be most safely approached from the historical side. Even when time and opportunity are lacking for personal investigation, as they often must be to busy teachers, the attitude of mind counts for much, and this work will, I am sure, help many of us to a proper appreciation of the great masters of medicine. W. O.

A Text-book of the Practice of Medicine. By James M. Anders, M.D., Ph.D., LL.D., Professor of the Practice of Medicine and of Clinical Medicine in the Medico-Chirurgical College, Philadelphia; Attending Physician to the Medico-Chirurgical College and Samaritan Hospitals of Philadelphia, etc. Fourth edition, thoroughly revised. Philadelphia and London: Wm. B. Saunders & Co.

The rapid exhaustion of the various editions of this work, making a fifth necessary within a period of four years, speaks eloquently for its popularity. Few authors are so highly complimented. But this marked

popularity is not without its drawbacks to both the author and the reader. It does not give the former time to carefully revise his work, while it results for the latter in the production of a work of less merit. In the present edition, however, the author has succeeded in making quite a number of valuable additions, especially along the line of recent developments, and in carefully rewriting the articles to which the most extensive additions have been made. In so doing he has aimed at the elimination of all superfluous words and sentences, and by thus securing greater conciseness of expression he has succeeded in adding extensively to the articles on Typhoid Fever and Variola without increasing the number of pages. This same slashing process applied to the remaining chapters would result in making the book much more readable. Many of the articles have been more or less changed.

In the chapter on Yellow Fever are given the most recent views on its bacteriology and modes of infection, especial reference being made to the recent extensive studies of Reed. The adoption of the latter's views has necessitated changes in the paragraphs relating to prophylaxis and quarantine. It would scarcely seem advisable, however, until these researches are more widely confirmed, to do away entirely with quarantine methods, as is recommended. The recent advances in the serum therapy of yellow fever are noted. The paragraph on the bacteriology of cerebro-spinal meningitis has been modified in accordance with the most recent investigations, and a paragraph on Kernig's sign, more fully describing its cause and method of elicitation, has been added. The description of lumbar puncture has been changed, and this procedure and laminectomy have been included among the remedial agents recommended.

The changes introduced contain some striking alterations of ideas, doubtless the result of more extended experience. Thus, in the article on Neurasthenia in the fourth edition, it is written under the heading of Symptoms: "The subjective symptoms are protean and varied, but these are often learned after close interrogation, the patient being unduly reticent as a rule;" in the present edition, under the same heading, the following appears: "The subjective symptoms are protean and varied, and are usually described with great detail, for the patients are, as a rule, exceedingly voluble." The classification of diseases used in the former editions have been retained in this. The chief objection to it is the arrangement of muscular rheumatism, chronic articular rheumatism, Weil's disease, Malta fever, febricula, milk sickness, miliary fever, foot and mouth disease, and glandular fever, under the heading, "Infectious Diseases of Unknown Etiology." In the first place, the infectious nature of some of these conditions is improbable; and, in the second place, one would infer from finding such diseases as variola, syphilis, parotitis, etc., in the preceding chapter, under the heading Infectious Diseases, that the etiology of these conditions is definitely known.

The book contains many excellent chapters, especially those devoted to descriptions of the infectious diseases and to the diseases of the nervous system. As a text-book for students it is too comprehensive; that is, it contains entirely too much material which is purely speculative, of no use to the student, and only tends to confuse his mind, which is already overburdened with essential facts. It must serve a useful purpose as a book of reference, since it presents in a readable manner the results of most of the work of value that has been done in recent years. S. M. H.

THE PRACTICAL MEDICINE SERIES OF YEAR BOOKS, COMPRISING TEN VOLUMES ON THE YEAR'S PROGRESS IN MEDICINE AND SURGERY. Issued monthly. Under the general editorial charge of GUSTAVUS P. HEAD, M.D., Professor of Laryngology and Rhinology, Chicago Post-Graduate Medical School. Vol. I., General Medicine. Edited by FRANK BILLINGS, M.S., M.D., Head of Medical Department and Dean of the Faculty of Rush Medical College, Chicago, with the collaboration of S. C. STANTON, M.D. Pp. 270. Chicago: The Year Book Publishers, 40 Dearborn Street.

THE editors of this volume have made a readable book, covering part of the ground of general medicine from January to October, 1901, giving summaries of many important articles, in the choice of which their judgment has been good in the main. The abstracts are written in a smooth and even style, which, with the orderly arrangement and the small size of the book, makes the reading of it easy and pleasant.

The plan of the publishers is to issue a volume monthly for ten months of the year, different subjects being assigned to each volume. This makes a certain unevenness in covering the ground which appears detrimental. Thus, consideration of the diseases of the alimentary tract, and allied organs and the summer diseases are postponed until May, 1902. A. H.

THE ROLLER BANDAGE. By WM. BARTON HOPKINS, Surgeon to Pennsylvania Hospital and to the Orthopædic Hospital and Infirmary for Nervous Diseases. Fifth edition, revised. Philadelphia: J. B. Lippincott Company, 1902.

IN this little book is condensed the vast experience of its author as a teacher and as a surgeon to a hospital with one of the largest accident services in this country. The book has already won for itself a most enviable reputation, and for many years has been used as a standard in the branch whereof it treats. The fifth edition is materially changed, the plates and electrotypes of the former editions having been destroyed by fire, consequently rendering necessary the rewriting and reproduction of the letter-press and pictures.

The book should really be considered as an exposition of the principles of bandaging, accompanied by illustrations which show the proper way of practising the art. The text is noticeable for its extreme conciseness and lucidity; there is not an unnecessary word to be found throughout. This brevity is rendered possible by the truly remarkable illustrations which accompany the text. These are not only artistic, but they have been adopted by the author with a skill akin to genius to the exigencies of the case. Although the illustrations are most profuse, we have been unable to find a single one which could be considered as inserted for the purpose of padding. A glance at any of those which are used for illustrations of the method of applying any particular bandage is sufficient to show the way of application in such a manner that the student cannot fail to grasp the idea. The author has evidently so familiarized himself with the needs of students and, it might be added,

of practitioners of medicine, for this book may be well used to advantage by many a man who has long since possessed a diploma, that his book is admirably adapted to meet their requirements.

Dr. Hopkins' book may be regarded as the standard work on the roller bandage in this country. For many years it has held a pre-eminent position, and, though previous editions have seemed incapable of improvement, the present edition has demonstrated that it has been possible for the author to surpass even his former efforts. F. R. P.

A Manual of Otology. By Gorham Bacon, A.B., M.D., Professor of Otology in Cornell University Medical College, N. Y.; Aural Surgeon New York Eye and Ear Infirmary. With an Introductory Chapter by Clarence John Blake, M.D., Professor of Otology in Harvard University. Third edition, revised and enlarged, with 120 illustrations and 7 plates. Philadelphia and New York: Lea Brothers & Co.

The previous editions of this manual have been so recently reviewed at length in these columns, and the book has assumed such an assured position as a standard authority, and is so familiar to all teachers and students of the subject, that an extended notice is hardly required at the present time. Suffice it to say that the chief changes made in the present revision consist in additions to the already large number of illustrations and a consideration of lumbar puncture and the significance of leucocytosis.

Dr. Bacon's book fulfils its purpose in every respect. It well deserves to be called the standard manual of otology in the English language. The author's concise yet lucid style has enabled him to present within its limits an epitome of aural surgery comprising all the essentials of that art. The book is a model for all works of a similar nature. It has been universally adopted by teachers, and is deservedly popular with students and general practitioners who desire a readily comprehensible presentation of the subject of which it treats.

The author has been particularly happy in his choice of illustrations to accompany the text. While generous in number, there is not one which does not elucidate and add to the value of the letter-press.

F. R. P.

Mother and Child. By Edward P. Davis, A.M., M.D., Professor of Obstetrics in the Jefferson Medical College; Professor of Obstetrics and Diseases of Infancy in the Philadelphia Polyclinic; Visiting Obstetrician to the Jefferson, Philadelphia, and Polyclinic Hospitals, etc. Second edition. Philadelphia: J. B. Lippincott Company, 1902.

We know of no book which could better be placed in the hands of the prospective mother. One of our reasons for the above statement is that it does not attempt the rôle of the family physician, but simply aims to supply information which every intelligent mother should know, thus lightening the work of the doctor, and also rendering his orders

more intelligible. There is a most gratifying avoidance of all pathological and anatomical data, and even a description of the female generative organs is omitted, for which lack of completeness we are very thankful.

On the other hand, the book contains full and complete directions upon all subjects relative to the care of the mother and child, even including chapters upon emergencies, contagious diseases, and the proper use of external applications. A very satisfactory appendix, giving the method of preparation of various articles of diet suitable for the young child, is included. The text is very acceptably illustrated by a number of pictures which the feminine mind cannot but consider charming. Of special value are the portions of the book devoted to the feeding and clothing of the infant. W. R. N.

SUNSTROKE DURING MARCHES, WITH STATISTICS FROM THE ACTS OF THE MEDICAL DIVISION OF THE PRUSSIAN MINISTRY OF WAR. By DR A. HILLER, Chief Staff Physician. With 6 wood-cuts and 3 charts. Berlin: August Hirschwald, 1902.

THE main portion of the book is based upon the records of sunstroke cases occurring in the Prussian army. Taking this mass of material as a basis, the author has added many series of cases collected from literature, beside experimental researches, and has formed out of the whole a most complete and interesting monograph upon the subject. No important new facts are added, but as a compilation the book accomplishes its purpose. All the important phases of the subject are considered in some detail, but owing to the fact that the author views the subject from a military standpoint, much space is given to discussions of the predisposing factors of sunstroke, and especially to the part played in this connection by improper clothing and physical exhaustion. The chapter devoted to the clinical description of the affection is complete, and embraces a summary of the complications and sequelæ following sunstroke. That portion of the book allotted to the pathology of the disease is likewise good, and various observations made upon the pathological changes in the blood of these cases are brought together for the first time. Practically no new methods of treatment are suggested, but statistics of the results of those therapeutic measures most in use are given in full. W. T. L.

THE ROENTGEN RAYS IN MEDICINE AND SURGERY AS AN AID IN DIAGNOSIS AND AS A THERAPEUTIC AGENT. By FRANCIS H. WILLIAMS, M.D. Second edition, with 410 illustrations and enlarged appendix. New York and London: The Macmillan Co., 1902.

THE second edition of this book has few new features, the chief addition upon the subject of radiotherapy being placed in the appendix. The therapeutic uses of the X-ray have become so numerous and remarkable that only a book revised every few months can be kept abreast with the times.

The results obtained and the methods used in the treatment of various diseases, both by the author and by others, are fully but concisely stated, being briefly illustrated with reports of cases. The surgical uses of the X-ray in the diagnosis of fractures, dislocations, and the detection of foreign bodies are well demonstrated.

Too little attention has been given to the subject of X-ray photography, since we must depend in great part upon photography for records and for accurate diagnosis. The author seems to be impressed with the idea that this information can be got best by experience. Experience would also give the other information needed, but would be slow and expensive.

The diagnosis of thoracic lesions is most ably described and illustrated. The author points out the importance of the use of the X-ray in diagnosing affections of the chest, and calls attention to the most common mistakes that may be made in the interpretation of the shadows. The author has not yet recognized the value of the X-ray in the diagnosis of brain lesions, and dismisses the subject with a short paragraph. Abdominal lesions have, however, been given their due share of attention.

The author's general experience and his recognition of the needs of the clinician are shown throughout the work. As a whole, it is a valuable addition to the literature upon the subject, and can be recommended both to the practitioner and to the student. The fact that the first edition was exhausted in three months' time is evidence that the book meets a popular demand. G. E. P.

Études sur la Tuberculose et son Traitement. Par Le Docteur G. P. Coromilas. Paris: A. Maloine, editeur, 1902.

For upward of fourteen years Coromilas has been treating tuberculosis in its various forms with sulphite of carbon (sulfure de carbone.) This compilation of several memoirs deals in turn with the various forms of tuberculosis, and is divided into five general parts, dealing successively with tuberculous coxalgia (osteo-arthritis), tuberculous arthritis, complicated and doubtful cases of tuberculosis, pulmonary tuberculosis, and finally intestinal tuberculosis.

In cases of coxalgia the general tuberculous diathesis should be treated with syrup of sulphite of carbon, and the local lesions by immobilization and injections of carbon sulphite into the focus of disease.

Cases of tuberculous arthritis are treated in the same way by local injections, and the sulphite of carbon is found to be strongly bactericidal, to facilitate the breaking down of tuberculous areas, and finally to aid in the restoration of the part to a healthy condition.

The results claimed for the treatment of pulmonary tuberculosis are even more remarkable. The sulphite of carbon mixed with olive oil or turpentine is used for inhalation or direct injection into tuberculous cavities, and it is found to be non-toxic, to neutralize the virulence of the tubercle bacillus, to dissolve and cicatrize small tubercles, and to contract large ones. Intestinal tuberculosis and tuberculous peritonitis are treated by small doses per os and lavage.

In spite of the astounding efficacy of his panacea, the author does not fail to mention the value of feeding, fresh air, and rest as additional factors in the cure. F. P. G.

PROGRESS

OF

MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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The Treatment of Diabetes Mellitus and Its Complications by the Use of a Diet Containing Potatoes.—Mossé (*Revue de Médecine*, 1902, pp. 107, 278, 371, and 621) in a series of articles deals with his experiences in the use of potatoes in the treatment of diabetes mellitus. He starts out with the statement that the object sought for in the treatment of diabetes mellitus is the prevention or reduction of the hyperglycæmia. This may be brought about either by stimulating organic combustion, and thus hastening the destruction of the grape sugar, or by suppressing from the diet or reducing to a strict minimum the sugars and carbohydrates convertible into glucose.

Mossé says that potatoes are generally held to be *injurious* in diabetes, and are usually placed in the list of forbidden articles. He believes, on the contrary, that they are not only *permissible*, but even *useful*. Potatoes may, with advantage to the patient, be given in substitution for wheat bread in the proportion of 2.5 to 3 of the former (weighed raw) to one of the latter. In his dietetic experiments he allowed his diabetic patients to have the enormous amount of 1 to 1.5 kilogrammes of potatoes (weighed raw) daily. In some instances the amount was increased up to 3 kilogrammes, or about six pounds. Wheat bread contains from 47 to 55 per cent. of starch, whereas fresh potatoes contain from 16 to 24 per cent., or an average of 20. The potatoes may be given in various ways, but in all his cases Mossé had them baked. In his experiments usually from 1 to 1.5 kilos of potatoes were substituted for about 350 to 500 grammes of bread. After the potatoes were substituted there was always a definite drop in the curves representing the urine and sugar excretion. In none of his cases did the sugar entirely disappear. Mossé states that there was also a marked amelioration in the patient's symptoms. The thirst became less, neuralgias disappeared, and the strength

increased. He found that after potatoes had been substituted for bread for several days, and then the patient placed on the original amount of bread the excretion of sugar never reached the limit attained previous to the potato régime. The writer consequently holds that a potato diet has a similar beneficial effect to the "hunger-day" of Naunyn.

Good results have followed the use of the potato régime in not only the mild, but also the severe forms of diabetes. Mossé claims that traumatic wounds and those following surgical operations heal much more rapidly on a potato diet, and cites cases attempting to demonstrate this view.

Mossé advances two hypotheses to explain the beneficial effect of the potato diet. The first is that the potato produces a sugar more easily warehoused than that produced from bread; and second, that it introduces a substance into the organism which favors the glycolytic function of the body. The diminution in the thirst is attributed to the greater amount of water contained in the potatoes. The increased glycolysis is believed by the writer to be due to the much greater quantity of potash introduced into the system as a result of the potato diet.

From the series of charts published it seems quite certain that potatoes are better tolerated by diabetics than wheat bread.

On the Typhoid Psychoses.—Farrar (*The American Journal of Insanity*, July, 1902, p. 17) reports four cases illustrating various types of psychoses observed in connection with typhoid fever. Esquirol at the end of the eighteenth century was the first to call attention to the fact that not infrequently psychoses develop during or following the course of the acute febrile diseases. Since Esquirol's day considerable attention has been paid to the relation between the infections, particularly typhoid fever, and mental disturbances, but its importance has been underestimated. Farrar, in his contribution, endeavors to emphasize the current teaching concerning the effects of typhoid fever on mental functions as expressed particularly by the Kraepelin school.

Typhoid fever attacking a sane individual may leave him free from psychic symptoms or give rise to all gradations of mental disease. The severity of the symptoms does not necessarily stand in relation to the height of the fever or the intensity of the infection. Persons belonging to families with psycopathic tendencies are more prone to alienation, especially the initial delirium, than those not thus burdened. A second or third attack of typhoid is more likely to present mental troubles than the first.

The *initial delirium* is the rarest form of psychical disturbance in typhoid, but it presents the most rapid course and the worst prognosis, over 50 per cent. of the cases ending fatally. The delirium may precede for several days the onset of fever, or the cases may remain afebrile throughout. These cases often lead to errors in diagnosis, and occasionally result in the commitment of the patients to an insane institution.

The *febrile psychoses*, that is, those occurring during the course of the fever, are the commonest. These present the best outlook, although in 25 per cent. the psychical disturbance persists for varying lengths of time into or after convalescence. The febrile psychoses may be divided into two groups. The first comprise the *true fever delirium*, those standing in closest relation with

rise of the fever and disappearing as the temperature becomes normal. They comprise, according to Kraepelin, 75 per cent. of the cases. The second include the psychoses not associated with the development of fever, and outlasting the latter by months or even years. These make up the remaining 25 per cent.

There are lastly the *asthenic psychoses* or those which develop during the period of convalescence. The conditions of exhaustion, anæmia, and malnutrition especially favor the development of some psychical disturbance. According to Kraepelin there are three principal divisions of this type: (1) Isolated delusions or fallacious sense perceptions; (2) conditions of exaltation; (3) conditions of quiet depression, including states of mental weakness. The prognosis of the asthenic forms is slightly better than in the cases with initial delirium, but much less favorable than in the fever psychoses. Kraepelin found that 71.8 per cent. of the patients recovered, 20.5 per cent. developed chronic insanity, and 7.7 per cent. died. In many of the cases which become chronic, inherited predisposition has been noted.

Pulsation in the Second Left Intercostal Space.—For a number of years there has been a difference of opinion as to the part of the heart that causes the localized pulsation in the second left interspace in mitral stenosis. Two main views have been held. Balfour and Sansom still support the view originally advanced by Bouillaud, that the pulsation is due to the systole of the left auricle. The majority of recent writers on this subject, however, agree with the opinion originally brought forward by Hope, that this pulsation arises from the contact of the conus arteriosus of the right ventricle and the pulmonary artery with the chest wall in the vicinity of the second left interspace. This view is supported by Gibson and Osler.

Gibbes (*Edinburgh Medical Journal*, September, 1902, p. 246) publishes the clinical and pathological records of a case of mitral stenosis that support very strongly the latter view. The patient was a male, aged thirty years. On deep expiration, an impulse was plainly visible in the second left interspace, its nearest point to the mid-sternal line being 2¼ inches from the left border of the sternum. The area of pulsation was 1 inch in length, and on auscultation was found to be *presystolic* in rhythm. It was not visible on inspiration. When the heart was inspected *in situ* at autopsy the left auricle and its appendix were invisible. The right auricle and ventricle were very considerably engorged. The conus arteriosus of the right ventricle was markedly dilated and extended well into the second left intercostal space. These relations are well illustrated by a photogravure of the heart *in situ*, and seem to confirm the view that the pulsation is due to the conus arteriosus of the right ventricle. Clinically, it had been observed that this pulsation was presystolic in time. Gibbes' explanation for this was that he believed that the systole of the right ventricle occurred while the left was in diastole. In other words, that a partial asynchronism occurs. He admits that this doctrine is very heterodox, as the upholders of strict synchronism deny the possibility of one ventricle beginning the systole before the other. In support of his theory he says: "At the same time they accept asynchronism as a cause of the reduplicated second sound, and thereby admit that the systole of one ventricle may end before the other—a distinction without a difference."

The So-called "Spotted Fever" of the Rocky Mountains.—Wilson and Chowning (*Journal of the American Medical Association*, July 19, 1902, p. 131) have published the results of their study of eleven cases of so-called spotted fever. This malady is confined to a limited area situated on the eastern foothills of the Bitter Root Mountains, a range along the top of which runs the Idaho-Montana line. So far as known it is confined to circumscribed areas of Montana and Idaho on the western side of the Bitter Root Valley.

This spotted fever prevails in the spring months only, and has been known in Idaho for thirty years. There is a preliminary malaise, and the disease is ushered in by a severe chill. The chills recur at intervals throughout the disease. The eruption appears from the second to the fifth day, appearing first on the wrists, ankles, and back and extending over the whole body in twelve hours. The macules are first rose-colored, not elevated, and vary in diameter from 1 to 5 millimetres. At first they disappear, but later persist on pressure. They become dark blue and purpuric in character. The eruption is subsequently confluent and gives a marbled appearance to the body. Desquamation begins in the third week. The spots do not entirely disappear until weeks or months after convalescence is established. The fever may reach 105°. In the cases which recover it begins to fall by lysis at the end of the second week, and reaches normal about the end of the fourth week. The pulse and respiration are high, out of all proportion to the fever. The spleen is always enlarged and tender. There is usually nausea and vomiting in the second week. Jaundice frequently occurs. The bowels are constipated. The urine contains albumin, coarsely granular and blood casts. Hypostatic pneumonia, arthritis, and gangrene of the skin occasionally occur as complications. There is a leucocytosis of about 12,000. The hæmoglobin is in the neighborhood of 50 per cent. The Widal reaction is negative for typhoid fever. The great majority of the cases belong to a very severe type, of which from 70 to 80 per cent die.

The observers were able to make autopsies on six cases. The only striking gross lesion is the enlarged spleen and petechiæ of some of the serous membranes. There are no intestinal ulcers; no evidences of meningitis.

The investigators were most interested in the etiology of the disease. The cases were studied very carefully bacteriologically, but no organisms of importance were found. The results of the study of the blood were most interesting and important. They found that the red blood cells in practically all the cases contained a hæmatozoon. This in the early stage is ovoidal and resembles somewhat the hyaline body of malaria, but is not amœboid. Sometimes they are in pairs in the red cell. In the second stage they are larger, 2 to 3 microns thick to 3 to 5 microns long. At this stage they are markedly amœboid, protruding and withdrawing pseudopodiæ actively. In a later phase they are again seen in pairs resembling diplococci, and exhibiting active Brownian movement. At no stage is the organism pigmented. These organisms are many times more numerous in the visceral bloodvessels. They stain with the basic aniline dyes. Two rabbits were inoculated with spleen pulp and heart's blood of a fatal case, and these organisms were found in the red cells of the rabbits' blood subsequently. They believe that this organism is very closely related to the Cyrosoma bigeminum, the organism causing Texas fever.

All the eleven cases that they observed had been bitten by ticks, and Wilson and Chowning believe this insect is the means of transmitting the disease. This tick becomes active about the time the first cases of "spotted fever" appear, and remains active about the same time. They are inclined to the view that the gopher is the host of this parasite among the lower animals and that the disease is transmitted from this animal to man by the tick.

SURGERY.

UNDER THE CHARGE OF

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Lung Complications in Appendicitis.—SONNENBURG (*Centralblatt für Chir.*, 1902, No. 26) states that his experience with cases of perityphlitis shows that the greater number of cases in which there are lung complications originate from emboli; Gussenbauer has had a similar experience. In the hospital at Moabit, out of 740 cases 28 had some lung complication, and of these 14 were cases of thrombosis; and in the private clinic out of 260 cases 19 had some lung complication. In the causation of this complication the anæsthetic plays an entirely subordinate part. Practically every case of perityphlitis has a thrombus, whether pus is present or not. If, in the course of the operation, the thrombus is broken up emboli may make their way into the general circulation. It is certain that these originate in the portal system, probably from the region of the vena cava. The pelvic veins are situated close to the veins of the extremities, and in many cases the usual symptoms, such as pain, œdema, etc., are not present. Septic emboli may appear immediately after the operation or as late as the eighth day; as a rule they are accompanied by a more or less great rise in the temperature. The proper and early diagnosis of lung emboli is of the utmost importance so that a proper treatment may be carried out.

The Covering of the Amputation Stump with the Tendo Achilles.—WILMS (*Centralblatt für Chir.*, 1902, No. 24) states that although Bier has reported satisfactory results from his osteoplastic method of covering in the amputation surface, still the all-important question of stump formation and treatment is still open to discussion. The author states that he has had good results in amputations of the log by covering in the end of the tibia with the tendo Achilles. Experience with the method of Bier has shown that it is not always possible to strengthen or render hypertrophic the under sur-

face of the skin by appropriate massage or exercise. In the majority of cases atrophy from pressure is the result. The author performs the amputation in the usual way, except that the tendon is carried over the stump and swerved to the interior surface of the tibia. The one case in which this method was used was a complete success in every way.

The Treatment of Syphilis by the Injection of Yellow Oxide of Mercury.—Loison (*Archives de Méd. et de Pharm. Militaires*, 1902, No. 1) states that the principal advantages of this method are: 1. The exclusion of all deceit upon the part of the patient in the application of the treatment. 2. It permits of exact dosage. 3. The avoidance of irritation of the intestinal canal. 4. The skin and linen of the patient are not soiled, as happens when inunctions are used. 5. The therapeutic results are rapid and effectual.

Spinal Anæsthesia with Tropa-cocaine.—Neugebauer (*Wiener klin. Woch.*, No. 50–52, 1901, abstracted in *Centralblatt für Chir.*, 1902, No. 31) states that Schwartz has reported very satisfactory results with this drug in doses of 0.25 c.cm.; Bier has had a similar experience. The solution should be freshly prepared each time. The instruments should not be laid in carbolic solution before use, for in two cases in which this was done poisoning resulted. Anæsthesia usually begins at the end of a minute, and appears first in the perineum, then the genitalia, the posterior portion of the thigh, the feet, the legs, and finally in the inguinal and abdominal regions. In the lower extremities one may be sure of absolute anæsthesia of the skin incisions, and almost always of the deeper tissues and bones. The serosa remained painful in a Bassini operation and also in an extirpation of the rectum. The anæsthesia remained longer in many cases in operations on the extremities in the leg which was full of blood than in the other one in which the circulation was normal. In 39 cases a 0.005 c.cm. solution was used with success, and in 18 cases 0.006 c.cm. The stronger solution undoubtedly gives a longer period of anæsthesia. The author states, in conclusion, that a freshly prepared dose of 0.05 or 0.06 c.cm. of tropa-cocaine is an absolutely sure and harmless method of inducing anæsthesia of the lower extremities, perineum, and neighboring regions.

The Surgical Treatment of Diseases of the Lungs.—Gerulanos (*Deutsche Aerzte Zeitung*, 1902, Nos. 9 and 10, abstracted in *Centralblatt für Chir.*, No. 30, 1902) states that the great thing to be avoided in all lung operations is pneumothorax. Either one of two methods may be employed: 1. Wall off with tampons the parts surrounding the field of operation. 2. Bring the area of disease out through the incision, and then suture the surrounding region to the parietal pleura. All other methods of promoting artificial adhesion are time-wasting as well as uncertain. The incision into the lung itself is not dangerous; the danger of bleeding never great, and can always be controlled by tampons, for the blood pressure here influences only about one-third of the arteries. The separation of the tissues must not be done with knife or scissors, for the thermocautery cannot be used to stop bleeding from the larger vessels. The chances for the healing up of cavities are better when they are situated in the under portion than when they are in the

upper. The rigidity of the upper portion of the thorax makes necessary an immobilization of the breast wall so as to avoid the intrapulmonary cavity which otherwise results from centrifugal cicatricial atrophy.

Perforation of the Bladder by a Calculus.—LAUWERS (*Jour. de Chir. et Annales de la Soc. Belge de Chir.*, 1902, No. 5) quotes Legueu, who has aptly stated: "Perforation of the bladder may be the result of the ulceration of the bladder by a calculus." Chapplain has reported 29 cases in which the perforation was almost always in the posterior wall, and usually terminated fatally. Peritonitis usually resulted, but in women one may observe the calculus eliminated, without fatal results, through the vagina, and the result is a vesicovaginal fistula. Lauwers in reviewing the literature has found four cases in which the calculus perforated the anterior wall of the bladder, with a resulting abscess of the space of Retzius and urinary fistula of the anterior abdominal wall. The author's case was a youth, aged nineteen years, of poor physical and mental development. Examination showed a urinary fistula of the abdominal wall, situated in the median line about five or six finger-breadths above the symphysis pubis. The skin opening was the size of a fifty-centime piece. A metal catheter was introduced through the urethra, and on entering the bladder it came against a large calculus, fixed and occupying practically all of that organ. The patient stated that his disease began as an abscess in the hypogastric region which opened spontaneously and which, after prolonged suppuration, became a urinary fistula. Undoubtedly the way in which this fistula originated was by the calculus causing ulceration and eventually perforation of the anterior wall of the bladder, through which the infected urine passed and caused the prevesical abscess which opened spontaneously, and the fistula resulted. Operation being decided upon the calculus was removed by the hypogastric route. The bladder was thoroughly irrigated with a hot solution of boric acid, and then a metal catheter was introduced through the urethra into the bladder between the calculus and the anterior wall of the bladder. This catheter was held exactly in the median line by an assistant. The abdominal wall was rendered as aseptic as possible and the orifice of the fistula closed with a sterile compress. The transverse incision of Kocher was then made at the level of the superior border of the symphysis pubis. This incision was gradually deepened, and examination showed that the infection had destroyed the prevesical space, and the loose connective tissue of the space of Retzius was transformed into a hard pad of fibrous tissue through which passed the fistula. On opening the peritoneal cavity it was found to be walled off to the right by adhesions between the parietal peritoneum and the peritoneal covering of the posterior surface of the bladder. Some omentum was adherent to the top of the bladder —this was tied off and cut. The peritoneal cavity above and to the left was walled off with sterile pads, and then the greatly thickened posterior wall of the bladder was incised in the median line, and a large phosphatic calculus weighing a little more than forty grammes was removed. The wound in the bladder was closed, as also that in the peritoneum, and finally that in the skin, except for a small area through which a drain of iodoform gauze was passed. The patient made an uninterrupted recovery. Chapplain has reported four similar cases with three deaths. The author states, in conclusion, that early

surgical interference should be followed by success in the greater majority of such cases. This should consist in opening and thoroughly draining the inflammation of the space of Retzius just as soon as it appears, and if possible the calculus should be removed. If of small size it should be removed through the fistulous tract, but if the stone is large or the fistula is small, long, or tortuous the calculus should be removed by either the perineal or suprapubic routes, and of the two the perineal route is, as a rule, the method of choice.

The Primary Suture Treatment of Fractures.—Völcker (*Centralblatt für Chir.*, 1902, No. 26) states that it is an assured fact that a good result in a case of fracture depends upon the replacement of the fragments, and the experience of the last few years has shown that under careful asepsis one may cut down on the fractures when there has been a bad result, break up the adhesions, freshen up the ends of the bone, and then place and maintain the fragments in good position by either wires, or screws, or some other appropriate appliance. Experience in the Heidelberg clinic has shown that the indications for the operative treatment of subcutaneous fractures are only limited. In many cases, especially those of separation or fracture of the epiphyses, is the operation a difficult one, and in every case there is the danger of infection. The cases so treated, as a rule, unite much more slowly than when not sutured, and a fistula may result. The principal indication for the use of the primary suture is in those cases of compound fracture where operative interference is a necessity. This operation is indicated in double fractures of the same limb. Experience has shown that those fractures where one is most anxious to get a good result, as in those involving a joint, the primary suture method has not proved to be a success, but future experience may prove that it will have some value in this type of cases.

THERAPEUTICS.

UNDER THE CHARGE OF

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Physiological Action of Male Fern.—Dr. W. Straub has been experimenting on the extract of male fern, the active ingedients of which are now considered to be filicic acid, flavaspidic acid, albaspidin, aspidinol, and derivatives of phloroglucin. By experiments on frogs he found that the lethal dose for filicic and flavaspidic acids was 2 mg., and for aspidinol and albaspidin 1 mg. for every 50 grammes of body weight of decomposition

products. The filicinic acid butylamin proved to be about five times weaker than filicic acid, while filicinic acid itself was innocuous. To study the effects of these various substances it was not considered advisable to note the irritability of the poisoned muscles toward the electric current, but, instead, the "demarcation current" of Du Bois-Raymond was employed, which occurs when one end of the muscle is suspended in a solution of the drug to be tested. Since with proper concentration a maximum current was obtained, the immersion acted like an artificial transverse division of the muscle; in other words, that portion which came in contact with the solutions was dead, and the principles of male fern were direct muscle poisons. The action on nerve tissues was much less pronounced, and it seemed as if the primary irritability of the nerve trunks was not altered. In arranging the different principles and their derivatives in order of their strength it was found that phloroglucin, filicinic, and butyric acids were inactive; of the remainder the filicinic acid butylamin was least active, then followed aspidinol, flavaspidic acid, albaspidin, and finally filicic acid as most potent. For protozoa the order of toxicity was somewhat different; thus, albaspidin, filicic acid, flavaspidic acid. A number of other non-vertebrates were tested, from colenteates to crustaceæ, and in all, with the exception of certain echinodermata, the great virulence of male fern was demonstrated, and its active principles proved to be strong poison for all kinds of organized plasma, but more particularly for muscle tissue. This was most beautifully shown in the case of worms, and the empirical use of male fern as an anthelmintic finds its scientific proof in these experiments. Since the general experience was that pure filicic acid was much less reliable for therapeutic purposes than the extract, attempts were made to follow its destiny in the organism, and it was found that most of it suffered decomposition, most probably in the intestines.—*Archiv für Experimental Pathologie und Pharmacologie*, 1902, Band xlviii., p. 10.

Alcoholism in Children.—Dr. J. Grosz says that acute alcoholism which is seen occasionally in children presents similar symptoms to those seen in adults. He saw two patients who were brought to the hospital unconscious, with tonic and clonic convulsions, who were controlled by enemata of chloral. The diagnosis was made by the odor of the breath. Several hours of deep sleep followed the disappearance of the convulsions, and one of the patients—a child, aged three years—on awaking asked the nurse for some brandy. In children, therefore, acute alcoholism takes a more intense form than in adults, as convulsions are not seen in the latter. Stimulation of the central nervous system follows the use of small doses of alcohol in children; but this is only apparent, for invariably it is followed by paralysis. The temperature of the body is lowered only by large doses of alcohol, which are very injurious to the organs of the body. Many parents, having the false point of view that alcohol strengthens the body, give small doses to children for a long time, and sometimes it is even given during the nursing period. From one-half to one teaspoonful or more of cognac or tokay, concentrated or diluted, are the quantities usually given. The stimulation of the gastric mucosa produces a dyspepsia which may go on and produce a severe gastritis. Beer and light wines may have the same

result. While parents among the higher and middle classes give their children wine, beer, and cognac, those among the poorer classes usually give brandy and whiskey. Cases of alcohol habituation are seen in infancy when, without regard to the presence or absence of fever or to the weakness or strength of the heart, physicians order or sanction the use of alcohol in sickness. Continuous use of alcohol frequently produces cirrhosis of the liver, and four of such cases, in which malaria and lues had been excluded, were observed by the author. The profound effect which the early use of alcohol in large quantities has upon the nervous mechanism is shown by the cases of epilepsy, chorea, and severe neurasthenia traced directly to its use. In children the production of alcoholism is due largely to heredity, several cases having been described, in the literature, of children who, although removed from their alcoholic parents to favorable surroundings, still in the course of time betrayed unmistakable propensities for alcohol. Demme has found that among the offspring of alcoholics the mortality is extraordinary; that those who survive constitute a sad class of idiots, epileptics, and otherwise neurotic individuals, and that only a very small proportion become useful members of society. Alcohol, in spite of the baneful results of its vicious use in childhood, has distinct therapeutic uses, such as in the cardiac asthenia accompanying diphtheria, measles, scarlet fever, and typhoid, in the collapse associated with intestinal diseases, and with severe hemorrhages. Binz has shown that in the failure or in the total cessation of nutrition the administration of alcohol tends to save the destruction of the tissues. When given greatly diluted in water it is rapidly broken up and totally consumed in the tissues, with the production of carbon dioxide and water. Hence alcohol may serve, not as a nutriment, but as a powerful preserver of the tissues in conditions of permanent disturbances of nutrition, in cases of rickets, scrofula, tuberculosis, and in general in all chronic diseases with lowering of the vital resistance.—*Archiv für Kinderheilkunde*, 1902, Heft 1, S. 15.

Mercury in the Cure of Syphilis.—Dr. Leredde says that on account of the widespread extension of syphilis, acquired and hereditary, and of its being regarded as the active or contributory cause of a larger number of other conditions, its treatment is of primary and essential importance. He lays down the following principles: (1) It is necessary to treat severe symptoms of syphilis by injections of mercury alone; (2) it is necessary to increase the dose of mercury so given until symptoms are influenced by it. He argues that the injection of mercury is better than any other means of administration, because by it the quantity given is absolutely known—a fact which is absent alike in administering it by inunction or by the stomach, as no one can tell how much will be absorbed either by the skin or by the digestive apparatus. The therapeutic effect of injection of mercury depends somewhat upon the dose of the drug given and also upon the form. The disease in one person will not, of course, be influenced by the same quantity as would cure another; and, too, in a given patient the dose must be slowly raised until the desired effect is reached. He recommends, as a preventive of the bad results of mercury, that early in the treatment of syphilis every patient should be sent to a competent dentist to have his teeth cleaned

and filled and to be instructed in the care of his mouth, as he believes that all mercurial inflammations of the mouth start from bad teeth and bad oral hygiene. This he states very emphatically, saying that a dose which causes trouble when the mouth is dirty and the teeth decayed will cease to inconvenience when these conditions are removed. At present, mercury by injection is given usually in a single dose of large size, once or twice a week; but Leredde states that, in order to gain complete and rapid control over the serious signs of this dreaded disease, it is better to give a smaller dose every day for a short time, so balanced as to come just within the signs of chronic mercurial poisoning: for example, if the stronger salts be employed (the cyanides or sublimide), doses of $\frac{1}{2}$ or $\frac{2}{3}$ of a grain should be given; of the weaker salts (benzoate or biniodide), practically twice the above quantities may be employed daily, instead of the larger doses of salts, like calomel, twice a week, of 1 or $1\frac{1}{2}$ grains each. He believes that the profession underestimate the influence of mercury upon syphilis, and that the quantity given in grave cases is too small, and this is the cause of unsatisfactory results.—*La Semaine médicale*, 1902, No. 17, p.137.

Action of Oil of Turpentine in Phosphorus Poisoning.—Dr. V. Plavec found the lethal dose of phosphorus for a dog weighing 6 to 9 kilogrammes to be 0.02 to 0.03 grammes. Dogs which had received larger doses succumbed in approximately the same time (nine to thirty-six hours), though some of them had received the oil. Of animals with just fatal doses, seven were observed without treatment, while to ten the antidote was administered. Of the first series six died, and of the second, seven, and all those that survived showed severe symptoms. In all cases the commercial rectified oil, poor in oxygen, was employed. The autopsy showed transudation into both pleuræ and into the periœsophageal tissues, pulmonary œdema, passive hyperæmia, clouding of the parenchymatous organs, and hemorrhagic injection of the mucous membrane of the duodenum. In older cases, fatty degeneration and hemorrhage were pronounced. Phosphorus could never be detected in the urine, but where oil of turpentine was given the reaction for this was positive. The author comes to the conclusion that the administration of the rectified oil has no antidotal action on absorbed phosphorus, or at least only such a remote chemical action that would render it valueless for therapy. The same facts have been already determined by others for the oxidized oil.—*Archiv für Pathologie und Pharmacologie*, 1902, Band xlviii., p. 150.

Action of Digitalin by Exocardial Application.—Dr. A. Benedicent, stimulated by the difference in results which certain authors obtained by applying helleborin to the exterior of the heart than when it is allowed to affect the interior of that organ by its presence in the circulating fluid, has repeated the experiments with the drugs of the digitalis group. When digitalin was applied to the normal heart of a frog, no change except a slight increase in the pulse-rate is noticed for a time. This soon sinks very markedly, however, and, while the pulse-volume reaches its maximum, increases slowly until complete stoppage occurs for a short period. This is soon followed by a series of pulsations, and then again by stoppage; then

occur, instead of groups, single contractions interrupted by long periods of inactivity, which increase gradually up to cesssation of all heart action in diastole. When, instead of digitalin, other members of the digitalis group —such as strophanthin, scillain, convallamarin, and others—were employed, the same phenomena were observed. There was also noticed a tendency of the heart to attain a systolic position when the poisons were applied both to the inner and the outer side of the heart. The pulse-curve given by the combined application of digitalin and atropine is the same as when digitalin alone was used. From further experiments made to ascertain the effect of an increased temperature on the inner and outer surface of the heart it was found that the outer surface is rendered warmer, the pulse-volume first diminishing, and then increasing with an increase in the pulse frequency. The diastoles finally increase, and the systoles become more and more weak and incomplete. If, however, the rise of temperature be permitted to act upon the heart cavity, simply an exaggerated action of the heart occurs. It beats regularly for hours, and only gradually do the systoles become incomplete until the heart stops in a half-systolic position. These experiments all prove a different arrangement of the inner and outer muscular fibres or a different innervation of the two surfaces.—*Archiv für Experimental Pathologie und Pharmakologie*, 1902, Band xlvii., p. 360.

Acute Alum Poisoning.—Dr. Julius Kramolik reports the case of a young man, aged thirty years, who by mistake drank a swallow of an approximately 10 per cent. solution of alum which he had prepared as a gargle for a sore-throat. Neither the mouth nor the throat showed any marked reaction to the irritant, but the patient vomited thirty-nine times within the forty-eight hours following the ingestion of the alum. Palpation of the stomach was painful. Mucus was found in the vomitus, mingled with blood, imparting a chocolate color to the mass. The urine was stained by blood, and showed morphologically numerous red blood cells, few leucocytes, and few hyaline casts. Traces of albumin were also present. The patient was ill for at least thirteen days.—*Pester Medicinisch-chirurgisch Presse*, 1902, No. 11, p. 242.

Treatment of Addison's Disease.—Dr. Edgard Hirtz suggests that the antituberculous treatment of this affection is entitled to consideration. On this theory, superalimentation and attention to the renal secretions are very essential. Milk, eggs, and light wines are advisable. Lecithin, sodium cacodylate, glycerophosphates, and inhalations of oxygen are useful. Reports from various observers would seem to show the value, in some instances, of opotherapy. The author gives the suprarenal capsules of one-sixth of a grain, two to four times a day. Subcutaneous injections as employed by D'Arsonval are also recommended.—*La Médecine Moderne*, 1902, No. 21, p. 169.

Difference Between Illuminating Gas and Carbon Monoxide Poisoning.—Drs. F. Ferchland and E. Vahlen have found fundamental differences in the symptoms of these two gases which do not permit of the generally accepted conclusion that the average composition of illuminating gas having

been found to be hydrogen 45 to 50 per cent., hydrocarbons 35 per cent., carbon monoxide 2 to 3 per cent., of these the hydrocarbons have only a slight narcotic effect, and all the other ingredients, except carbon monoxide, are harmless, so that it would seem safe to ascribe to this latter constituent the toxicity. They found in experimenting with frogs that the illuminating gas proved to be much more poisonous than pure carbon monoxide, despite the fact that the former in this instance contained but 9.7 per cent. of the latter. To what illuminating gas owes its increased toxicity it was impossible to decide, owing to its complex composition.—*Archiv für Pathologie und Pharmakologie*, 1902, Band xlviii., p. 106.

PEDIATRICS.

UNDER THE CHARGE OF

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Two Cases of Congenital Disease of the Left Heart.—THEODORE FISHER (*British Medical Journal*, March 15, 1902, p. 639) reports two cases of congenital disease of the left heart in infants, with the post-mortem findings in each case. The first case was a rather small, anæmic male infant, aged fifteen months. There was a slight degree of cyanosis, but no clubbing of the fingers. The mother stated that at birth the child was very blue, and at frequent intervals since had suffered attacks of dyspnœa, upon which occasions cyanosis was marked. The apex-beat was in the fifth interspace, about one-quarter of an inch outside the nipple line. A high-pitched systolic murmur was heard over the entire cardiac area, but was not transmitted beyond the limits of the heart nor heard behind. The second sound at the pulmonary cartilage was sharp, but elsewhere was rather dull. At the apex three sounds were audible, with something of a *bruit de galop* rhythm. At autopsy the heart was found much hypertrophied, the enlargement being mainly of the right ventricle. The pulmonary artery was double the size of the aorta. The tricuspid orifice was unusually large, while the mitral was stenosed, the latter measuring but 5 mm. across. In addition to the thickened and drawn-together flaps of the valves, as in ordinary mitral stenosis, there was present a perforated diaphragm formed by a circular membrane, and attached to the bases of the mitral flaps. The aorta was constricted above the point of entry of the ductus arteriosus. The ductus arteriosus was patent, while the septum ventriculorum and foramen ovale were normal.

The second case was one of aortic stenosis, in an infant, aged four and a half months, in which the segments of the aortic valves were much thickened

and adherent to one another. The left ventricle was hypertrophied; the other valvular orifices were normal. An interesting fact in connection with this case was that about three months before the birth of the child the mother had suffered from a painful swelling of the knee, which lasted a few days.

The writer has been able to find few records of cases of congenital mitral stenosis. In the first case described the origin of the perforated diaphragm is obscure. It is difficult to see how it could have been produced by endocarditis, since the membrane did not occupy the usual site of rheumatic vegetations. Instances of congenital aortic stenosis are more numerous, Rauchfuss having recorded twenty-four cases, the majority of which were apparently due to endocarditis. Cases in which two segments of an aortic valve are adherent to one another are not rare, but whether such a condition is due to endocarditis or is a malformation is not clear. It is a curious fact that when only two aortic segments are present the valve is more likely to become affected with endocarditis during adult life than when the normal three segments are present. Parkes Weber argues from this that in some of the cases of aortic disease in adults, where two segments are found adherent, the adhesion has really existed from fœtal life. On the other hand, Fisher has met with specimens in the post-mortem room which illustrate various stages in the development of such adhesions during adult life. The disease is one of adult life, yet it is possible that a similar inflammation may attack the valves of the fœtus. This would be especially probable if one could connect the valvular disease with syphilis, but of such an association there seems to be little evidence. While, however, other causes of fœtal endocarditis besides rheumatism may exist, in the case of congenital disease of the aortic valves recorded above, the thickening, although well marked, resembled that commonly seen in rheumatism, and the history given by the mother leaves little doubt that rheumatism was the cause.

Euquinine in Pediatric Practice.—Rocaz, in a communication to the Société de Médecine et de Chirurgie de Bordeaux, February 14, 1902 (*Revue Mensuelle des Maladies de l'Enfance*, July, 1902, p. 330) considers the availability of this drug for administration to children, because of its almost total lack of unpleasant taste. Euquinine is the ethylcarbonic ether of quinine, occurring as white, needle-like crystals, melting at 203° F., sparingly soluble in water, but very readily in ether, chloroform, and alcohol. With acids it forms salts which are equally insoluble in water, except the chlorhydrate, which is very soluble and has a very unpleasant taste, presenting no advantages over the chlorhydrate of quinine. In his investigations Rocaz has always used the euquinine, and not its salts, administering it in suspension in a coffeespoonful of sugar-water. It was always taken without repugnance. In several cases in which it was thus prescribed and readily taken, the administration of quinine by the mouth had been impossible. It also has the advantage of being well tolerated by the digestive tract even when given in massive doses.

Experiments to test the absorption of euquinine showed that elimination by the urine began between the first and second hour after administration, reaching its maximum after seven hours. These conclusions agree with

those of Gamarelli, in Italy, except that this observer found elimination to begin from the ingestion of the drug.

Euquinine is therefore absorbed and produces all the effects of quinine medication. Its indications in pediatric practice are the same as those of the alkaloid from which it is derived. Its contraindications are not so numerous, since it is better borne by the digestive organs.

The dosage is higher than that of quinine—from one and a half to twice as great. Thus, during the first year Rocaz uses from 10 to 15 centigrammes a day (1½ to 2¼ grains); from one to two years, 20 to 30 centigrammes (3 to 4½ grains); from two to four years, 30 to 60 centigrammes (4½ to 9 grains); from three to six years, 40 to 80 centigrammes (6 to 12 grains), and from six to ten years, 60 centigrammes to 1 gramme (9 to 15 grains).

GYNECOLOGY.

UNDER THE CHARGE OF

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ASSISTED BY

WILLIAM E. STUDDIFORD, M.D.

The Mesometrium.—Theilhaber and Meier (*Archiv für Gynäkologie*, Band lxvi., Heft 1) think that too little attention has been paid to the pathology of the mesometrium (muscular wall of the uterus). Many cases of menorrhagia and leucorrhœa are due not to inflammatory changes—the so-called chronic metritis—but to muscular insufficiency, leading to blood stasis and hypertrophy of the mucous and muscular layers, with their resulting symptoms.

They distinguish several clinical types, viz.: "Hypoplasia" in anæmic girls; "myo-degeneration" following infection; "myofibrosis," or the physiological change occurring at the menopause; changes in the uterus accompanying disease of the adnexa, and myomatous conditions.

Sixty-one uteri were examined by the authors with special reference to the relation of the muscles to the connective tissue and vessels. In the majority of the cases in which menorrhagia and leucorrhœa had been marked there was an excess of connective tissue. Atheroma of the vessels was present in the hemorrhagic cases as well as atrophy of the uterine muscles. The changes in the vessel walls indicated physiological arteritis obliterans rather than true arterio-sclerosis.

Prophylaxis of Gonorrhœa.—Greife (*Centralblatt für Gynäkologie*, 1902, No. 28) divides all cases into two classes—prostitutes, and married women who are infected through their husbands. He urges the necessity of more careful training of young men in regard to sexual morality, as well as the

systematic inspection of all public women, whether healthy or unhealthy, including routine microscopic examinations of vaginal discharges. The use of prophylactic urethral injections of a 20 per cent. solution of protargol after coitus is recommended.

Men who contemplate matrimony should be taught that they may infect their wives long after all visible evidences of the disease have disappeared; hence the physician should not pronounce the patient cured until repeated examinations have failed to show the presence of gonococci. The bride's parents should refuse to allow her to marry without positive evidence from the young man's doctor (!). A man who marries after having once had gonorrhœa should observe the following rules: To pass his urine immediately before intercourse; never to perform the act while intoxicated; to avoid repeated coitus, and if it takes place again within twenty-four hours the woman should take an antiseptic douche afterward. Such injections should also be frequently repeated.

[While we agree heartily with most of the writer's conclusions, it would seem as if marriage should be absolutely forbidden as long as these precautions against possible infection must still be observed.—Ed.]

Acute Oophoritis.—Skrobansky (*Journ. Akusch. i shensk. bolesnig; Centralblatt für Gynäkologie*, 1902, No. 30) examined twenty-five ovaries removed from females between one and twenty-seven years of age who had died from infectious diseases. The majority of cases were those of scarlatina and diphtheria. The writer concludes that the ripe as well as primordial follicles are destroyed. The membrana granulosa of the younger follicles, however, sometimes persists for a long time, the flat cells being changed to cylindrical. In follicles in which the ova undergo granular degeneration of the protoplasma and chromatolysis of the nucleus these cells may assume a phagocytic power. The destruction of the ripe follicles resembles the physiological atrophy. The histological changes are the same, without regard to the nature, severity, or duration of the infection.

Colpotomy in Pyosalpinx.—Treub (*Revue de Gynécologie*, 1902, No. 6) reports seventy-nine cases of vaginal incision and drainage, sixty-six being cases of pyosalpinx and thirteen of hydrosalpinx. Two patients died of pyæmia (puerperal). Many were only temporarily benefited; forty-four patients were cured, often only after several months had elapsed.

The writer does not believe that hydrosalpinx can be cured by simple incision any more than hydrocele. Tuberculosis is, of course, not affected. He concludes that total vaginal extirpation is the only treatment for pyosalpinx and tuberculosis of the tubes.

Treatment of Pruritus.—Siebourg (*Centralblatt für Gynäkologie*, 1901, No. 26) recommends hypodermic injections of saline solution over the affected area, with the view of causing cutaneous anæsthesia, as much as 10 ounces being used at a time. He speaks highly of an ointment containing 30 grains of muriate of cocaine, 20 grains of orthoform, 8 grains of menthol, and 15 grains of carbolic acid to 5 drachms of vaseline.

In chronic cases in which the skin and mucous membrane are unbroken he applies a solution containing 1 per cent. of salicylic acid and 2 per cent.

of resorcin. He also injects hypodermically weak solutions of cocaine and carbolic acid.

LEREDDE (*Société de Thérapeutique; La Gynecologie*, 1901, No. 6) speaks highly of the interrupted current in long-standing cases of pruritus which have resisted all methods of treatment. Two or three séances weekly, lasting fifteen minutes, effected a cure in every case treated by him within from two to four weeks. The writer emphasizes the importance of frequent interruptions.

Tuberculosis of the Vagina.—SPRINGER (*Zeitschrift für Heilkunde*, Band iii., Heft 1) states that only twelve cases of vaginal tuberculosis had been recorded by Chiari in the course of ten years, representing 15 per cent. of all cases of genital tuberculosis. This fact would seem to show that the vagina offers a powerful barrier to the invasion of the bacilli, due to the resistant epithelium, the absence of glands, the reaction of the secretions, or the natural drainage of the canal.

The writer suggests the following ways in which tuberculous infection of the vagina may occur: 1. Direct infection from a tuberculou uterus or urinary tract, from the tuberculous bowel, Douglas' pouch, peritoneum, or vulva. 2. Infection through the blood. 3. By direct contact, coitus, infected fingers, pessaries, etc.

Peritonization in Laparotomy.—Under this term JUDET (*La Gynécologie*, April 15, 1902) refers to the covering of all raw surfaces within the pelvis with flaps of healthy peritoneum, in order to prevent septic infection and intestinal adhesions. He discusses at considerable length the advantage of this method as compared with gauze tamponade, and the technique of different operators, but lays more stress upon immediate than remote results.

[While operators will agree with the writer in his recommendation to cover all raw surfaces with peritoneum wherever this is possible, it must be confessed that he touches but lightly on the difficulty of accomplishing this in cases in which there are extensive intrapelvic adhesions.—H. C. C.]

Ileus Cured with Atropine.—MÜNCHMEYER (*Centralblatt für Gynäkologie*, 1902, No. 16) reports a case of intestinal obstruction occurring on the third day after myomectomy, the symptoms by the fifth day becoming so serious that it was proposed to establish an artificial anus. Previous to adopting this procedure, atropine, gr. $\frac{1}{3}$ (0.002 gm.), was administered hypodermically, although the patient was fifty-two years of age. Six hours later flatus passed, and twenty hours after the administration of the drug the patient had several normal dejections and made a rapid convalescence. The author recommends that this treatment be adopted in all similar cases before resorting to a secondary operation.

In the discussion following the report of this case Osterloh did not favor the atropine treatment, preferring lavage of the stomach. The reporter replied that the serious nature of the case and the rapid relief of the obstruction fully justified it.

[Remembering the intolerance of some patients to this powerful alkaloid, it would seem wiser to give small and repeated doses, and not to wait until the case has progressed so far that heroic treatment becomes necessary.—H. C. C.]

OBSTETRICS.

UNDER THE CHARGE OF

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Removal of Uterine Myoma Through the Vagina without Interrupting Pregnancy.—In the *Centralblatt für Gynäkologie*, 1902, No. 21, SEELIGMAN reports a case illustrating the extraordinary tolerance displayed by the pregnant uterus to manipulation.

The patient was a multipara, aged thirty-four years, who was pregnant about four weeks. She was seized with violent uterine hemorrhage, and examination revealed a large, firm, submucous myoma in the lower portion of the womb. The hemorrhage was so excessive that a firm tampon was applied, transfusion with salt solution practised, and five days were allowed to pass before an effort could be made to remove the tumor. The tumor was removed in pieces, and to check the hemorrhage the uterine cavity was firmly tamponed with iodoform gauze. The patient made a good recovery, and was discharged from the hospital in three weeks. Her pregnancy remained uninterrupted, and she was delivered spontaneously of a living child at term.

The most rational explanation for this remarkable case is that the ovum had embedded in the upper and anterior wall of the uterus, while the tumor was upon the posterior and inferior portion. In spite of this, it is remarkable that the pregnancy was not interrupted.

The Treatment of Postpartum Hemorrhage.—HENKEL, in the treatment of postpartum hemorrhage (*Centralblatt für Gynäkologie*, 1902, No. 21), has found it of value to tampon the lower uterine segment and cervix only, carrying the cervix strongly backward and bringing the fundus forward against the pubes. He has found this better than tamponing the entire cavity of the uterus, because this method brings about anteflexion and places the tampon upon the most relaxed portion of the womb.

He has also found it of value, in cases in which hemorrhage was threatened, to give ergot during the latter portion of labor in tonic doses. In cases of retained placenta where hemorrhage begins and the placenta must be removed he finds it of advantage to employ chloroform anæsthesia during the expression of the placenta. In lacerations of the cervix where bleeding occurs from the cervical arteries he has applied tenaculum forceps to the two lips of the cervix, allowing them to remain from twelve to twenty hours. In addition, he uses a tampon of iodoform gauze, and has seen none but good results from this practice.

[We fail to observe the advantage in the use of tenaculum forceps to check hemorrhage from the cervix over the application of one or more

stitches of chromicized catgut. The use of stitches has an additional advantage that certainly in some cases union of a torn cervix is thereby promoted. The passing of stitches is attended with little difficulty, and to our minds is far more satisfactory than the application of forceps.]

Albuminuria in Pregnancy.—At a meeting of the Obstetrical Society of Berlin, VEIT (*Centralblatt für Gynäkologie*, 1902, No. 21), in a paper upon this subject, calls attention to the influence exerted in the production of albuminuria by syncytial cells and by other embryonal tissues carried to different parts of the mother's body in emboli and thrombi. This question suggested the possibility of producing artificial immunity to this malignant action of the embryo by the injection of placental tissue.

Veit's paper calls attention to some modern researches upon the rôle played by the placenta which lead us to believe that the after-birth is not a medium for the passage of oxygen only, but that it is analogous to the thymus or thyroid in its influence upon the metabolism of the mother.

In the discussion of this paper, Gottschalk drew attention to his paper in the *Archiv für Gynäkologie*, Band xlvi. p. 56, in which he ascribed the changes found in the kidneys of the pregnant patient to emboli of syncytial cells. Diseases of the placenta or accident to the placenta would lead to the involvement of the kidneys which might result in eclampsia.

Albuminuria during Labor.—In the *Archiv für Gynäkologie*, 1902, Band lxvi., Heft 2, ZANGEMEISTER contributes an extensive paper upon this subject based upon observations made at the Leipsic clinic.

In estimating the frequency of albuminuria occurring in patients actually in labor widely differing results are reported. Thus Meyer reports 41 per cent. of patients in labor having albumin in the urine; Litzman, 44 per cent.; Winckel, 20 per cent.; Petit, 15 per cent.; Möricke, 37 per cent.; Ingersley, 33 per cent.; Lantos, 59 per cent.; Fleischlen, 17 per cent.; Meyer in 1138 cases, 25 per cent.; Aufrecht, 56 per cent.; Trantenroth, 99 per cent.; Friedeberg, 45 per cent.; Pajikull, 100 per cent.; and Saft, 28 per cent.

So far as the quantity of urine voided is concerned, the greatest quantity is seen in the morning, the least at night. So far as the period of pregnancy is concerned, the diuresis increases in the thirty-ninth week, and is less from thence on until labor.

In estimating the occurrence of albuminuria during pregnancy the results of various observers differ from 1 to 50 per cent., the average showing that from 4 to 0.7 per cent. have albumin during pregnancy. After describing the methods employed in the study of these cases, Zangemeister states his conclusions, which are essentially as follows: During pregnancy in healthy women a progressively increasing diuresis occurs, which is notably greater as labor approaches. When parturition begins the diuresis diminishes, and the quantity of urine voided is about one-third of that previously voided during the last months of pregnancy. Immediately after labor there is another increase in the quantity of urine excreted, which gradually gives place to the normal quantity. Zangemeister found in the last months of pregnancy albumin in the urine of 10 per cent. of cases examined. If repeated examinations were made, albumin was found persistenly during the

last three months of pregnancy in 40 per cent. of cases examined. About 20 per cent. of pregnant women have urine containing casts.

The belief that primiparæ have casts more frequently in the urine than multiparæ with albumin is not accepted by the writer, who found very little difference between primiparæ and multiparæ. During the last two weeks of pregnancy albumin and casts are much more frequent in all classes of pregnant patients. Small quantities of albumin cannot be considered as abnormal during the last months of pregnancy. The persistent presence of casts indicates an essential lesion of the kidney. The influence of labor upon the constitution of the urine is shown in the presence of epithelia in a condition of cloudy swelling, which comes from the kidneys. These are more frequent, and seem more altered as labor proceeds. White and red blood corpuscles are often found in the urine secreted during labor. In small quantities casts are found during labor in the urine of 40 per cent. of cases, both primiparæ and multiparæ. In considerable quantities casts occur in 23 per cent. of primiparæ and in but 12 per cent. of multiparæ. Until the excessive quantity is present, albumin and casts occur in parallel quantities during labor, and the presence of casts at this time cannot be considered pathological. They must be referred to some lesion of the kidneys in existence before labor.

The albuminuria of pregnancy and the albuminuria of labor are by no means identical. Patients showing albuminuria in pregnancy more frequently have albumin during labor. The most reasonable explanation for the albuminuria of pregnancy lies in some failure in the perfect metabolism of the organism and excretion through the kidney.

The albuminuria occurring during labor must be referred to increased blood pressure in the kidneys, caused by uterine contractions and by the disturbance of the circulation seen during labor.

Pneumococcus Meningitis Simulating Puerperal Eclampsia.—Wilson (*Transactions of the Obstetrical Society of London*, 1902, Part I. p. 5) reports the case of a patient admitted to the Birmingham Hospital in a comatose condition. Her pulse was 140, respiration 38, and temperature 100.8° F. She died without recovering consciousness. Examination showed that she was a multipara, between six and seven months pregnant. There was no œdema of the lungs, and the heart was normal. The urine obtained by catheter was of acid reaction; specific gravity, 1032; contained a large quantity of albumin and 1.5 per cent. of sugar. There were no casts or blood corpuscles.

The history was that the patient had borne seven children, and that five days before admission she complained of severe headache and malaise. The day before admission she was found unconscious in her bedroom; passed through a succession of fits, in which the face was drawn to the right side, and feces and urine voided during the attack. The convulsions continued incessantly until the patient was put under the influence of chloroform. The urine was highly albuminous, and the physician called to see the case diagnosed puerperal eclampsia.

On post-mortem examination it was found that death was due to a purulent meningitis caused by the pneumococcus.

DISEASES OF THE LARYNX AND CONTIGUOUS STRUCTURES.

UNDER THE CHARGE OF

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Tuberculous Granuloma of the Nose.—In a paper entitled "Tuberculous and Syphilitic Granulomata of the Nose," by Dr. William Lincoln, of Cleveland, Ohio (*Laryngoscope*, January, 1902), two cases are reported, occurring in the cartilaginous nasal septum of two women, aged, respectively, forty and forty-five years.

In the first case a piece of tumor removed for microscopic examination revealed typical tuberculous granulation tissue, with the presence of giant cells; nevertheless, syphilitic clinical history, the presence of ulcers on the hard palate, and the scarred sites of many others led to the treatment by potassium iodide in increasing doses, under which recovery took place, with complete disappearance of the growth, leaving a slight depression at its site.

In the second case the piece of tumor submitted for microscopic inspection showed the ordinary structure of tuberculous granuloma, with giant cells, but without evidence of bacilli. Administration of potassium iodide for a month, alone and combined with mercury, not having produced any diminution in the growth, the whole mass was removed with a sharp curette. Eight months later the patient returned with an exactly similar granuloma occupying an exactly similar site on the opposite side of the cartilage; and at this time she gave unmistakable evidence, physically and bacteriologically, of tuberculosis of the lungs, from which she died four months later. Removal of the tumor had left an ulcer rebellious to treatment. It is presumed by Dr. Lincoln that the first granuloma in this case was an instance of primary tubercle of the nose. A summary of the literature on this subject is incorporated in the paper.

Cyst of the Inferior Turbinal.—Dr. Richmond McKinney, of Memphis, Tenn., reports this case (*Journal of the American Medical Association*, March 22, 1902). It occurred in a stout colored woman, between thirty and thirty-five years of age, and completely occluded the passage. The growth was incised, giving exit to a thin, seropurulent discharge, about a teaspoonful in bulk. The cavity of the cyst was then freely curetted and cauterized. Recovery was uninterrupted.

Cystic Fibroma of the Nasal Cavity.—Dr. McKinney also reports a case of cystic fibroma in a boy, aged twelve years. It presented as a reddish, polypoid tumor, about the size of a hazelnut, pedunculated and apparently springing from about the junction of the cribriform plate of the ethmoid with the anterior cartilaginous septum. It was removed by divulsion, discharging dark, grumous, foul-smelling material, while hemorrhage was very free. The site of implantation, which proved to be the cribriform plate, was

cauterized with the electric cautery. Histological investigation of the growth showed it to be a fibroma.

The X-ray in Determining the Limits of the Frontal Sinus.—Dr. John Howard Philip, of San Francisco, recommends (*Journal of the American Medical Association*, March 22, 1902) this method of determining the character of the diseased sinus before operation, and illustrates his remarks with a reproduction from a radiograph taken for that purpose at the San Francisco Polyclinic.

In view of the fact that there are no frontal sinuses in a great many individuals—in some series of autopsies as many as 14 per cent.—this preliminary investigation would, as suggested by Dr. Philip, prevent injury to cranial contents in such cases about to be operated upon for supposed disease of the sinus.

Morbid Growths of the Maxillary Sinuses.—At the late meeting of the American Laryngological, Rhinological, and Otological Society (*American Medicine*, March 15, 1902) Dr. Robert C. Myles reported four cases of polypi attached to the upper wall of the maxillary sinus and protruding into the nose and rhinopharynx. In each instance relief was obtained by curetting the sinus, and, so far as has been ascertained, there has been no recurrence.

Foreign Bodies in the Accessory Nasal Sinuses.—Löhnberg (*Münchener medicinische Wochenschrift; American Medicine*, March 15, 1902) reports two cases: 1. A man, aged forty years, had his eye destroyed twenty years previously by a bursting gun, the iron splinter lodging finally in the right ethmoid sinus and giving rise to chronic inflammation and nasal polyps. The growth and iron splinter were easily removed by operation.

2. A man, aged thirty-two years, had a piece of a felt hat-band driven through the outer table of the skull into the right frontal sinus during a street brawl. Subacute traumatic empyema of the cavity ensued, which disappeared after operative removal of the piece of felt and drainage into the nasal cavity.

Malignant Disease of the Nose and Accessory Sinuses.—In an extensive paper upon this subject, including tabulations of 188 cases from published records, Prof. Joseph S. Gibb, of Philadelphia (*New York State Journal of Medicine*, January and February, 1902), describes and depicts two cases of his own—one of sarcoma of the nares and the other carcinoma of the nose.

Empyema of the Sphenoidal Sinus.—Dr. Jonathan Wright, of Brooklyn, reports (*Annals of Otology, Rhinology, and Laryngology*, February, 1902) a case of isolated, unilateral, latent empyema of the sphenoidal sinus, with delirium and mental symptoms. Operation; recovery. The patient was a physician, fifty-seven years of age, who had an attack of influenza in January, 1901, accompanied with severe coryza and intense pain at the vertex of his head, progressing toward the occiput and down to below the left eye.

After recovery from the influenza this same sort of pain recurred at intervals, becoming more and more severe and almost unbearable. On November 30, 1901, he was first examined by Dr. Wright, who, without detecting anything significant on exploration, came to the conclusion that there was some intracranial difficulty, due most likely to pus under pressure in the left sphenoidal sinus, and perhaps in the posterior ethmoidal cells. Under ether the sphenoidal sinus was opened through the anterior nares and gave exit to dark, cheesy, foul-smelling secretions, and then the middle turbinate was amputated to facilitate drainage. For details the reader is referred to the original.

Spasm of the Larynx.—Under the title of "Vertigo and Ictus of the Larynx" Dr. Moncorgé, of Mont-Dore, reports (*Annales des Maladies de l'Oreille, du Larynx*, etc., May, 1902) 10 additional cases, which brings up his personal record to 32 out of 120 published cases.

[This variety of laryngismus is usually allied with asthma, whatever the exciting cause of the asthma. When it merely proceeds to giddiness without loss of consciousness it is called by the profession vertigo; when loss of consciousness follows the vertigo, then they call it ictus.]

Myxoma of the Larynx.—Prof. Joseph S. Gibb, of Philadelphia, reports (*Annals of Otology, Rhinology, and Laryngology*, February, 1901) a case of myxoma of the larynx occurring in a healthy man fifty-five years of age, who applied for relief of hoarseness of some months' duration. Several masses of a clear homogeneous structure loosely attached by a pedicle were seen beneath the vocal bands, or perhaps attached to the under surface of the left one, which, during phonation, were forced up between and over the vocal bands, preventing proper approximation. The growths were removed in a number of sittings, and were found, upon microscopic examination, to be myxomatous, or, as described by the pathologist, œdematous fibromas or polyps.

OPHTHALMOLOGY.

UNDER THE CHARGE OF

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AND

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The Pathogenetic Eventuations of Chalazial Tumors —Dr. M. P. Weyman (*Annals of Ophthalmology*, October, 1901), makes the following deductions:

Chalazia, from the nature of their structure and pathology, tend to degenerate. This degeneration may be suppurative, more or less acute, and

result in either obliterative inflammation, perforation, and spontaneous cure, or non-obliterative inflammation, perforation, and re-formation. Perforation of this type is usually external.

Chalazia more often break down by a very slow softening and erosive disintegration. During this disintegration the morbid secretions establish fistulous tracts for the purpose of drainage. Chalazia may change in size owing to the intermittency of drainage and the consequent damming up of the irritant discharges and the reactive inflammatory tumefaction. The fistulous drains are of two kinds—natural (by gland ducts) and artificial (by perforation). They show the same pathological conditions as sinuses and fistulæ elsewhere, viz., reactive softening of the inner lining and induration of the circumfistulous tissue, according to the degree and duration of the biochemical irritation of the morbid secretions, lip eversion, and unhealthy granulations of their orifices.

A nipple-like orifice of a Meibomian gland denotes a fistulous duct carrying discharges from a chalazion degenerating within the cartilage; this is mostly observed in the upper lid.

Granulation masses around a conjunctival perforation are not everted chalazial tissue, but unhealthy granulations springing from the bordering edges of the conjunctiva from the constant bathing in irritating discharges.

A hordeolum internum—internal or hardened stye—is a nodular induration around a chalazial sinus. They are most frequent on the lower lid, because gravity, opposing evacuation, keeps the lumen constantly filled, whence the extensive induration. Ordinarily an internal stye shows its true nature by a grayish vesicle upon its body, or a yellowish translucency from within, which often causes them to be incised for regular stye abscesses.

The stagnating morbid secretions in fistulous ducts may soften the septal partitions, and irruptions into healthy glands may take place until the whole cartilage is furrowed and honeycombed. The writer terms this general infection tarsadenitis Meibomica.

Subcutaneous lid abscesses should be attributed to tarsadenitis when the latter exists.

Smooth, dark colored polyps not springing from the internal canthal region are very apt to be the result of old chalazial drains.

Some Functional Disorders of Vision.—Eales (*Birmingham Medical Review*, January, 1902), under the above title, reviews scintillating scotoma, homonymous hemianopsia, temporary monocular blindness, neurasthenic asthenopia, traumatic amblyopia, and hysterical amblyopia.

In scintillating scotoma the attack commences by a sparkling spot or scintillation which suddenly appears near the fixation spot of each eye, persisting upon closure of the eyes. This spot rapidly enlarges, the scintillations being encircled by a bright zigzag line like those of fortifications, while the vision is almost lost. The attack is often accompanied by a feeling of giddiness. This condition persists from a few minutes to half an hour, when it rapidly passes off. Upon recovery of vision headache sets in, which becomes very severe, even prostrating. The visual attack is only the early symptom of an attack of migraine, which commonly but not invariably follows. This affection is very common. Such patients, on account of the pronounced

eye symptoms, seek the advice of the oculist in the hope that their trouble is due to some ocular disorder—a vain hope, usually destined to disappointment.

Homonymous hemianopsia: It is interesting and important to note that a large percentage of these cases of scintillating scotoma pass rapidly into a condition of homonymous hemianopsia. These attacks of hemianopsia last for ten minutes or a quarter of an hour (rarely as long as three-quarters of an hour), and then pass off, usually followed by headache. In the early stage of a fainting fit, before loss of consciousness, hemianopsia is also complained of.

Homonymous hemianopsia can only be produced by some cause affecting the central nervous system posterior to the chiasm, of which it is absolutely pathognomonic. A similar cause would also account for the simultaneous occurrence of identical scintillations near the fixing point of each eye. As these phenomena are so often associated, it seems reasonable to assume that both are due to the same central cause.

The evanescent and recurrent nature of these attacks point to the circulatory disturbance as the cause, while the loss of function and the occurrence of these attacks during fainting point to anæmia of the nerve centres as the actual condition that sets it up, the anæmia being due to vasomotor spasm *per se* in the case of migraine, while in fainting the spasm is due to the tendency of arteries to contract if the intravascular tension is lowered.

The treatment should be the general treatment of migraine, which is often unsatisfactory. By giving saline aperients an attack may be warded off or mitigated. If excitement or fatigue seem to predispose to an attack they should be avoided. If any optical defect is present it should be corrected by means of glasses. In many cases such correction reduces the frequency of attacks. Care should be taken to maintain the general health of these patients.

Temporary monocular blindness: These attacks usually last only a few moments, or from ten minutes to half an hour at most. On examination the eye will be found to be quite normal in all respects. These failures of vision are of daily occurrence, or even several in one day. Such patients are usually anæmic young women.

The fact that many patients suffer frequent attacks for years without any permanent damage to vision justifies the term functional, though a physical basis may be suspected.

The loss of vision appears to be due to a failure of retinal circulation from vasomotor spasm of the retinal artery. Such contraction has been actually observed during an attack. (Benson, *Transactions of the International Ophthalmological Congress.*) In some the failure of vision would seem to be preceded by faintness, which by lowering the general vascular tension facilitates the failure of retinal circulation from vasomotor contraction.

Occasionally an attack, unlike many previous ones, is not followed by recovery of vision. Examination shows all the signs of a block in the artery, with cessation of retinal circulation and œdema of the retina. Such sudden block of the artery until recently was attributed to embolism, but now there is a consensus of opinion that it is due to thrombosis rather than

embolism. These cases where there is a history of previous attacks of temporary loss of vision are taken as strong evidence in favor of thrombosis.

It would seem that blindness ensues when, from a lowered arterial force, the circulation in the retinal artery, whose lumen is diminished by endarteritis, falls below the point required to maintain the visual function. The fact that when a block in the vessel occurs it is usually found at the point where it enters the eye, suggests that the anatomical and physiological condition at this point predisposes it to arteritis and thrombosis.

The prognosis is favorable in the young, where arterial spasm is the usual cause, but in middle life permanent loss of vision, due to thrombosis, may be feared. Iron, nitroglycerin, and strychnine seem indicated in young patients. In middle life a history of syphilis or gout will suggest the line of treatment.

Neurasthenic asthenopia: The patient complains that the eyes are tender to the touch and tire easily; also of pain in the eyes, blurred near vision, lacrymation, and intolerance of light. These symptoms persist after the most perfect correction of any optical error by glasses. The vision will be found normal at first, but can only be maintained a few minutes. The symptoms of general neurasthenia are usually present. The form field is contracted concentrically, and not unequally, as in atrophy of the optic nerve or structural disease of the eye. If the taking of the field is prolonged it becomes smaller, and a fatigue field is obtained. The fields are pathognomonic of this condition.

The most important treatment is the promotion of the general health of the patient.

Traumatic amblyopia is identical with neurasthenic asthenopia, only there has been a history of injury to start the nervous symptoms, which may be as pronounced as those seen in hysteria; so that neurasthenic asthenopia, traumatic amblyopia, and hysterical amblyopia may be considered as degrees of the same affection.

In hysterical amblyopia the color fields may retain their normal relation, but usually the field for red is as large as that for blue or even white. Such a field is pathognomonic of this affection. Frequently there is great difference in the size of the two fields. There often occur in these cases spasms of the various muscles, producing diplopia; spasm of the accommodation, causing myopia. Hemianæsthesia or other symptoms of hysteria are generally present. Hemianæsthesia being on the same side as the supposed blind eye, it is noteworthy that these patients never have an hemianopic field of vision.

The visual defect is regarded as due to a central nervous disturbance. In order to explain the fact that it never conforms to the type of hemianopsia so generally found in structural disease of the cerebrum, it is assumed that there is a second decussation of the fibres of the optic tract, probably about the neighborhood of the corpora quadrigemina, by which the two halves of the fields of vision are reunited, these ending in a higher psychical visual centre, located in the region of the angular gyrus, which thus becomes a visual centre for the eye on the opposite side, and also to some extent for the same side; and that the suppression of the function of this centre leads to the loss of vision in the opposite eye, together with the contraction of the field of vision of the eye on the same side.

DERMATOLOGY.

UNDER THE CHARGE OF

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Parapsoriasis.—Brocq (*Annales de Dermatologie et de Syphiligraphie*, 1902, No. 4) proposes to call by the above title a series of rare eruptions which have been described by various authors under the names *parakeratosis variegata, exanthème special psoriasiforme et lichénoïde, dermatite psoriasiforme nodulaire, pityriasis lichénoïde chronique, erythrodermies pityriasiques en plaques disséminées*, and *lichen variegatus*. He divides the cases into three principal varieties, viz., guttate parapsoriasis, lichenoid parapsoriasis, and parapsoriasis in plaques. Histologically these cases are characterized by an infiltration of round cells around the papillary vessels which are dilated, by flattening of the papillæ, by marked œdema of the upper part of the derma and the epidermis, by an almost complete disappearance of the germinating layer, by dilatation of the intercellular spaces of the prickle-cell layer and the presence of leucocytes in these spaces, and by œdema of the granular layer which is absent in many places, at which points nuclei are found in the cells of the corneous layer. The duration of these affections is very long. They are not accompanied by itching, nor do they affect the general health. The most effective local application is pyrogallol employed perseveringly and energetically.

Acne and Sycosis Treated by Exposures to Roentgen Rays.—Pusey (*Journal of Cutaneous and Genito-Urinary Diseases*, May, 1902) reports eleven cases of acne vulgaris and one of sycosis vulgaris treated by exposure to the X-rays. In no case of acne in which such treatment has been carried out for a reasonable period have beneficial results failed to appear, and the author considers this form of treatment an advance over all other methods hitherto employed. All the cases were exposed to a very weak light, using a current just strong enough to illuminate a fairly soft tube. The cases were unusually susceptible, and upon the first sign of erythema or pigmentation the treatment was suspended. The author warns those wishing to use this method of treatment against employing any but the weakest light. In a case of sycosis treated in this manner all evidence of disease had disappeared at the end of three months, and no new lesions have appeared since.

Radiotherapy and Phototherapy.—Freund (*British Journal of Dermatology*, September, 1902, p. 339) states that all radiant phenomena have the same physical basis. The physical properties of rays as applied to the skin

possess chemical, fluorescent, and electrical properties, the effect varying with the dosage, from mere stimulation to destruction of tissues. In weak dosages the rays favor organic processes, such as growth of hair and production of pigment, but in stronger dosage they lower vitality, produce inflammation or actual necrosis.

Radiant heat, light, electricity, and X-rays similarly influence cell-life. As to the clinical effects of radiotherapy, the physiological effects are in direct proportion to the intensity of the "raying," but are in inverse proportion to the wave lengths. The reactions appear after a latent interval, the length of which is also inversely proportional to the wave-lengths and intensity of the "raying." Those rays which have the property of exciting fluorescence are also physiologically the most powerful. The action of the rays is long persisting. Freund believes that in so-called "D'Arsonvalisation" the effects are solely due to the spark-discharges accompanying the use of the apparatus. All spark-discharges may cause physiological effects, which may result from (*a*) the mechanical bombardment of the tissues, (*b*) the production of heat, (*c*) chemical effects—formation of ozone, and (*d*) ultra-violet ray formation. The effects of sparking vary according to its intensity, being either stimulating or destructive. On the skin they affect the vasomotor system and tend to cause necrosis of the epidermis.

The action of D'Arsonval's apparatus is superficial and due only to the accompanying spark-discharge, and is useful in pruritus, lupus erythematosus acne vulgaris, and pigmentary abnormalities. A simple spark-apparatus consists of a test-tube filled with water and connected with the negative pole of a coil, the positive pole being earthed. With this apparatus Brush-discharges can be obtained equal to those of Oudin's apparatus. The Brush-discharge is useful for widespread areas of disease and in the case of nervous people, the spark-discharge being applicable to more circumscribed areas. Treatment with the "electrified hand" is another spark-method, but a very mild one.

The effective factors in the X-ray method are probably the X-rays themselves and the electric surface tension of the tubes. Vasomotor effects are produced as in ordinary spark discharges. The skin diseases suitable for X-ray treatment are ringworm of the scalp, tinea favosa, sycosis, and hypertrichosis - all diseases in which the chief therapeutic feature is the removal of hair. In this class the X-rays are much more effective than the light rays, but both methods stand much on an equal footing in the remaining class of cases. The depilatory properties of the X-ray tube are due to direct destructive action or to alteration in the blood supply of the follicles. X-rays possess no bactericidal properties.

In comparing the X-ray method and Finsen's light method for lupus vulgaris, Freund states that about the same length of time is required in the two methods, and that the results of both are equally good as regards the scarring. Practically identical results can be obtained with either hard or soft tubes by adapting the time of exposure, strength of current, and distance of the tube. With hard tubes the radiation can be pushed until visible effects are produced, whereas with soft tubes one must work more in the dark and make allowance for reactions before they are visibly manifest. The author regards Finsen's apparatus as superior to Bang's lamp.

PATHOLOGY AND BACTERIOLOGY.

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On the Pathological Anatomy of Chorea Minor.—M. RICHARD (*Deutsch. Arch. f. klin. Med.*, 1902, Band lxxii., Heft 5 and 6, p. 504) reports two cases of chorea minor, with detailed histological descriptions. The first case followed an attack of acute articular rheumatism, while the second case was characterized by previous attacks of chorea. At autopsy an acute endocarditis was found in both cases, due probably in the first case to the staphylococcus pyogenes aureus, and in the second to the streptococcus pyogenes. A bacteriological examination was made of the fluid from the ventricles of the brain in both cases, with practically negative results. The nervous system in neither case presented any gross pathological changes, but microscopically there was a degeneration of both anterior and posterior root fibres in the cord, and even more marked alterations in the brain. No lesions were found in the spinal ganglia. Throughout the brain there was a small-cell infiltration, most marked in the perivascular spaces; this invasion in places extended over moderately large areas. Small hemorrhages were also found, appearing most numerous in the region of the basal ganglia and beneath the ependymal cells of the ventricles. Within the last few years Pianese has described an "ependymyelitis" occurring in a case of chorea minor, and Neuwerck has called attention to areas of inflammation and hemorrhage in a similar case. The author believes the changes which he reports should be considered as dependent upon a general toxæmia.—W. T. L.

Bacteria in the Bile Passages of Dogs.—GILBERT and LIPMAN (*Presse Médicale*, June 18, 1902), at a meeting of the Société de Biologie, report their results of a series of bacteriological examinations of the bile passages in dogs. Cultures were taken from the gall-bladder and various parts of the bile ducts, and, while uniformly sterile for aërobes, showed constantly the presence of various anaërobic bacteria. In view of the fact that the bile passages have been supposed to be sterile, and on account of the significance of bacteria in many diseases of the bile passages, the authors regard their results as of more than passing interest.—F. P. G.

On the Transplantation of a Sarcoma of the Thyroid Gland of a White Rat.—LEO LOEB (*Virchow's Archiv*, 1902, Band clxii., Heft 2, p. 175) reports

on the experimental transplantation of portions of a sarcoma of the thyroid gland of a white rat into the abdominal cavity of other white rats. The original tumor was quite vascular, and was further characterized by areas of softening in which secondary hemorrhages were often found. In the first transplantation the tumor nodule became partially necrotic, and was surrounded by a zone of connective tissue. Cells arising probably from the transplanted tumor were found in the connective-tissue zone, where they showed pyknosis and mitosis. When the growth was again transplanted into other rats it gave rise to tumors closely resembling in their structure the original sarcoma. During their development a myxoid degeneration was noted, together with the formation of cysts. By inoculating fluid from these cysts into the abdominal cavity of rats the author succeeded in producing in some cases single sarcomatous nodules, and in others a general sarcomatosis of the peritoneum. Thus successive transplantations were made intraperitoneally and subcutaneously over a period of fifteen months. In all 150 animals were used.

During the development of these tumors it was found that if they became infected their growth was much more extensive than if bacteria were excluded. For instance, a nodule embedded in the deeper subcutaneous tissues of the rat was soon surrounded by connective tissue and ceased to grow, while another nodule which involved the skin and became infected increased rapidly in size and produced extensive contact metastases. Again, it was found that if an incision was made, and small pieces removed from an encapsulated tumor which had stopped growing, rapid growth again took place, with the formation of small metastatic nodules in the surrounding tissues. No metastases ever developed by means of the bloodvessels or lymph channels. Throughout the experiments the sarcoma retained in general its original morphological and physiological characteristics, but certain modifications were observed from time to time. Occasionally the tumor cells assumed the characters of cells from endothelial origin, although the original growth was a spindle-celled sarcoma. By further transplantation, however, the spindle-cell type was again restored. Giant cells were also occasionally found.—W. T. L.

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THE TREATMENT OF PLEURISY WITH EFFUSION.

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I wish to call attention to the propriety of treating cases of pleurisy with effusion by aspiration alone, and not by medicine.

The ordinary practice at the present time is to resort to aspiration when the effusion becomes large or if it resists the ordinary methods of treatment.

I believe that aspiration is to be used not simply to remove fluid from the chest, but to cure pleurisy as a morbid process. This means that as aspiration is the treatment of the pleurisy, it is to be performed as soon as the presence of fluid in the chest is made out.

When I began to practice medicine, in 1866, the routine treatment was to give iodide of potash internally and to apply repeated blisters over the affected side of the chest. When the chest was extremely distended the fluid was drawn off with a trocar and canula. The patients, as a rule, did not die, but they were sick for a long time. The extensive pleuritic adhesions and the long-continued compression of the lung left the patients liable to interstitial pneumonia and tuberculous inflammations of the lung.

As late as 1881 I taught as follows: "In those cases in which the invasion of the disease is acute the treatment varies according to the rational symptoms. If the patient is strong and robust, as a rule considerable relief may be afforded by applying wet cups over the affected side of the thorax. If the patient is not strong and vigorous, dry cups or blisters may be used. To relieve the pain and diminish the fever, opium, aconite, and liquor ammoniæ acetatis are given. After the acute symptoms have subsided, the question of getting rid of the fluid in the thoracic cavity comes up.

"In those cases in which the invasion is insidious there are two indications to be met. In the first place, the fluid should be removed from the pleural cavity, and in the second place the nutrition of the patient must be improved. The exact way in which these cases of subacute pleurisy are to be treated depends on the general condition of the patient. If his nutrition has not suffered up to the time he comes under treatment, your attention should be principally directed to the removal of the fluid by means of persistent irritation of the skin of the chest by blisters and by the internal use of the iodide or acetate of potash. If, however, when the patient comes under observation his nutrition is impaired, and he is emaciated and anæmic, less attention should be paid to the fluid in the pleural cavity. The principal effort should be directed to the improvement of his general health. Such a patient will not bear blisters, nor can his condition be improved by the use of diuretics. Iron, quinine, and the mineral acids should be administered, together with cod-liver oil or cream. It may be necessary to send the patient to a warm climate.

"Besides these means of treatment, the question of the mechanical removal of the fluid from the pleural cavity presents itself. In regard to the advisability of aspirating the thorax there is still a considerable difference of opinion in the profession. It is, however, generally agreed that when the dyspnœa is so great as to threaten the life of the patient, and when the fluid in the pleura does not diminish within a reasonable length of time, it is expedient to perform the operation. The reasons given for not aspirating are: That in a considerable number of cases a single aspiration is of very little service, for after the fluid has been drawn off it will reaccumulate, and other aspirations are necessary; that with a number of aspirations there is danger of purulent infection; that a number of sudden deaths have occurred within twenty-four hours after aspiration."

Such a plan of treatment as is outlined above is still followed by many. It has been somewhat modified by the "thirst cure" and by the use of the salicylate of soda. The radical objection to this plan is the intolerable length of time during which the patient remains sick. Deaths, indeed, are few; but two months is an ordinary duration, and six months is not uncommon. Still further than this, the longer the pleurisy lasts and the longer the lung is compressed the greater is the extent of the pleuritic adhesions and the greater the vulnerability of the lung to tuberculous inflammation.

As time has gone on I have been so thoroughly impressed with the idea that aspiration is the only treatment needed for pleurisy with effusion that I have thought it worth while to tabulate 200 ordinary hospital cases of pleurisy with effusion occurring from the years 1886 to 1901.

Cases of Pleurisy with Effusion Treated by Aspiration at the Roosevelt Hospital, from 1886 to 1901.

No.	Age	Condition of the chest on admission.	Day tapped.	Character of the fluid.	Subsequent tappings.	Other treatment.	No. of days from first tapping to end of pleurisy.
1	28	Left chest two-thirds full of fluid.	28th day	Reddish serum 1600 c.c.	None.	Acetate of potash and digitalis, calomel, squills, and digitalin; strapping the chest.	38 days.
2	45	Half full of fluid.	15th "	Clear serum 1400 c.c.	"	Calomel, squills, and digitalin	8 "
3	36	Left chest two-thirds full of fluid.	120th "	Clear serum 1500 c.c.	"	None.	Went home on 9th day with chest still holding a little fluid.
4	30	Left chest three-fourths full of fluid.	60th "	Clear serum 2000 c.c.	"	Digitalin.	14 days.
5	34	Left chest three-fourths full of fluid.	16th "	Clear serum 3000 c.c.	"	None.	14 "
6	18	Left chest full of fluid.	60th "	Clear serum 1800 c.c.	One 400 c.c.	"	24 "
7	46	Right chest half full of fluid.	35th "	Clear serum three pints.	One 975 c.c.	"	13 "
8	33	Right chest three-fourths full of fluid.	9th "	Dark serum 3000 c.c.	None.	"	14 "
9	57	Left chest two-thirds full of fluid.	21st "	Clear serum 1900 c.c.	"	Digitalin.	7 "
10	23	Left chest half full of fluid.	14th "	Clear serum 1000 c.c.	"	"	6 "
11	27	Left chest full of fluid.	35th "	Reddish ser. 3150 c.c.	"	"	20 "
12	22	Right chest full of fluid.	90th "	Clear serum 24 ounces.	"	"	19 days; improved.
13	31	Left chest full of fluid.	12th "	Dark red ser. 3875 c.c.	"	"	30 days.
14	51	Right chest half full of fluid.	8th "	Clear serum 2100 c.c.	"	Potassium iodide.	14 "
15	32	Left chest half full of fluid.	14th "	Clear serum 825 c.c.	"	None.	6 "
16	25	Right chest half full of fluid.	30th "	Clear serum 1750 c.c.	"	Sodium salicylate; strapping the chest.	5 "
17	8	Right chest two-thirds full of fluid.	14th "	Reddish ser. 4 ounces.	"	None.	16 "
18	23	Right chest two-thirds full of fluid.	12th "	Clear serum 2400 c.c.	"	Digitalin, diuretic pills.	4 "
19	31	Right chest half full of fluid.	14th "	Clear serum 1050 c.c.	Bloody ser. 200 c.c.	Digitalis, squills, strychnia; strapping the chest.	26 "
20	28	Left chest half full of fluid.	42d "	Clear serum 300 c.c.	None.	Digitalin.	7 "
21	33	Left chest full of fluid.	28th "	Brown ser. 3200 c.c.	"	None.	16 "
22	25	Left chest half full of fluid.	14th "	Clear serum 2000 c.c.	"	"	10 "
23	50	Right chest half full of fluid.	28th "	Clear serum 750 c.c.	800 c.c. 90 c c. 575 c.c.	Digitalin.	43 "
24	42	Left chest full of fluid.	14th "	Clear serum 2000 c c.	None.	None.	3 "
25	41	Left chest one-third full of fluid.	11th "	Clear serum 1200 c.c.	"	Digitalis, squills, and strychnia.	6 "
26	27	Right chest half full of fluid.	14th "	Clear serum 800 c.c.	"	"	7 "
27	27	Right chest one-third full of fluid.	21st "	Clear serum 1020 c.c.	"	Strapping the chest.	5 "

No.	Age	Condition of the chest on admission.	Day tapped.	Character of the fluid.	Subsequent tappings.	Other treatment.	No. of days from first tapping to end of pleurisy.
28	25	Left chest half full of fluid.	21st day	Bloody ser. 850 c.c.	None.	None.	18 days; improved.
29	35	Right chest half full of fluid.	28th "	Clear serum 900 c.c.	"	Diuretic pill.	8 days.
30	24	Left chest full of fluid.	19th "	Clear serum 1200 c.c.	"	None.	11 "
31	24	Left chest half full of fluid.	7th "	Clear serum 1650 c.c.	"	Diuretic pill.	5 "
32	34	Right chest one-third full of fluid.	90th "	Turbid ser. 850 c.c.	"	Potassium iodide.	11 "
33	36	Right chest half full of fluid.	60th "	Turbid ser. 38 ounces.	"	Potassium iodide.	12 "
34	31	Right chest half full of fluid.	42d "	Clear serum 1400 c.c.	"	Potassium iodide.	10 "
35	13	Right chest two-thirds full of fluid.	21st "	Clear serum 800 c.c.	Clear serum 1300 c.c.	Potassium iodide.	29 "
36	51	Left chest three-fourths full of fluid.	28th "	Clear serum 1900 c.c.	Clear serum 1750 c.c.	Digitalin.	24 "
37	26	Right chest half full of fluid.	6th "	Clear serum 750 c.c.	None.	"	9 "
38	34	Right chest half full of fluid.	90th "	Clear serum 525 c.c.	"	Potassium iodide.	9 "
39	24	Left chest two-thirds full of fluid.	14th "	Clear serum.	"	Potassium iodide.	11 "
40	30	Right chest two-thirds full of fluid.	75th "	Clear serum 1675 c.c.	"	Potassium acetate and digitalis.	18 "
41	17	Left chest half full of fluid.	18th "	Reddish ser. 900 c.c.	"	Potassium acetate and digitalis.	12 "
42	24	Left chest half full of fluid.	21st "	Clear serum 300 c.c.	"	Potassium acetate and digitalis.	11 "
43	26	Left chest three-fourths full of fluid.	60th "	Reddish ser. 300 c.c.	"	Potassium acetate and digitalis.	28 "
44	34	Right chest three-fourths full of fluid.	14th "	Clear serum 1075 c.c.	"	Diuretic pill.	13 "
45	19	Left chest three-fourths full of fluid.	10th "	Clear serum 1575 c.c.	"	None.	9 "
46	20	Left chest full of fluid.	4th "	Reddish ser. 250 c.c.	"	Potassium iodide.	11 "
47	22	Left chest three-fourths full of fluid.	12th "	Clear serum 2000 c.c.	"	Potassium iodide.	10 "
48	18	Left chest half full of fluid.	13th "	Clear serum 200 c.c.	"	Potassium acetate and digitalis.	8 "
49	23	Left chest half full of fluid.	28th "	Turbid ser. 1400 c.c.	"	None.	15 "
50	50	Right chest half full of fluid.	8th "	Clear serum 575 c.c.	"	Potassium iodide.	4 "
51	57	Left chest half full of fluid.	28th "	Reddish ser. 1600 c.c.	"	Potassium iodide and digitalis.	13 "
52	32	Right chest two-thirds full of fluid.	26th "	Clear serum 1325 c.c.	"	Potassium iodide and digitalis.	4 "
53	30	Right chest two-thirds full of fluid.	14th "	Reddish ser. 1100 c.c.	"	Potassium acetate and digitalis.	26 "
54	53	Left chest two-thirds full of fluid.	42d "	Clear serum 250 c.c.	Clear serum 250 c.c.	Digitalin.	38 days; improved.
55	29	Left chest half full of fluid.	14th "	Clear serum 1300 c.c.	None.	None.	14 days.
56	45	Left chest full of fluid.	8th "	Clear serum 3700 c.c.	"	"	9 "
57	32	Left chest full of fluid.	14th "	Clear serum 375 c.c.	Clear serum 800 c.c.	"	39 "
58	22	Left chest half full of fluid.	30th "	Turbid ser. 700 c.c.	None.	Digitalin.	27 "
59	63	Right chest half full of fluid.	21st "	Clear serum 1000 c.c.	"	None.	16 "
60	30	Right chest full of fluid.	7th "	Clear serum 2000 c.c.	"	Potassium iodide and digitalis.	17 "

No.	Age	Condition of the chest on admission.	Day tapped.	Character of the fluid.	Subsequent tappings.	Other treatment.	No. of days from first tapping to end of pleurisy.
61	40	Left chest three-fourths full of fluid.	90th day	Clear serum 2200 c.c.	None.	Potassium iodide and digitalis.	6 days.
62	8	Left chest half full of fluid.	3d "	Clear serum 675 c.c.	"	Potassium iodide and digitalis.	13 "
63	20	Left chest half full of fluid.	7th "	Clear serum 700 c.c.	"	None.	11 "
64	30	Right chest full of fluid.	7th "	Clear serum 1700 c.c.	600 c.c. 500 c.c.	"	16 "
65	24	Left chest half full of fluid.	21st "	Turbid ser. 250 c.c.	None.	"	9 "
66	22	Left chest half full of fluid.	16th "	Clear serum 1250 c.c.	1250 c.c. 750 c.c.	Potassium iodide and digitalis.	42 "
67	33	Right chest full of fluid.	42d "	Clear serum 900 c.c.	None.	Digitalin.	9 "
68	20	Left chest full of fluid.	14th "	Clear serum 1900 c.c.	800 c.c	None.	9 "
69	33	Left chest three-fourths full of fluid.	7th mo.	Clear serum 1250 c.c.	None.	Digitalin.	12 "
70	50	Left chest full of fluid.	30th day	Clear serum 1725 c.c.	Clear serum 2050 c.c.	"	42 "
71	48	Left chest two-thirds full of fluid.	6th "	Clear serum 1100 c.c.	None.	"	16 "
72	26	Left chest three-fourths full of fluid.	14th "	Bloody ser. 800 c.c.	"	None.	14 "
73	39	Left chest full of fluid.	4th "	Clear serum 1300 c.c.	1500 c.c.	Digitalin.	10 "
74	19	Right chest two-thirds full of fluid.	12th "	Clear serum 1400 c.c.	None.	Diuretic pill.	15 "
75	47	Left chest half full of fluid.	15th "	Clear serum 375 c.c.	1200 c.c.	Potassium iodide and diuret. pill.	38 days: not improved.
76	29	Right chest full of fluid.	14th "	Clear serum 2100 c.c.	None.	Diuretic pill.	9 days.
77	29	Right chest half full of fluid.	1st "	Clear serum 270 c.c.	"	Diuretic pill.	8 "
78	35	Left chest half full of fluid.	10th "	Bloody ser. 2 ounces.	"	Diuretic pill.	6 "
79	36	Right chest half full of fluid.	21st "	Clear serum 850 c.c.	"	Diuretic pill.	13 "
80	22	Left chest half full of fluid.	10th "	Clear serum 24 ounces.	"	None.	12 "
81	18	Left chest half full of fluid.	49th "	Clear serum 435 c.c.	"	Diuretic pill.	11 "
82	29	Left chest half full of fluid.	21st "	Clear serum 30 ounces.	"	Diuretic pill.	17 "
83	42	Left chest full of fluid.	10th "	Bloody ser. 1800 c.c.	1950 c.c. 1500 c.c. 50 c.c.	None.	43 "
84	45	Right chest three-fourths full of fluid.	15th "	Purulent ser. 2200 c.c.	Turbid ser. 500 c.c.	"	12 "
85	27	Left chest half full of fluid.	11th "	Turbid ser. 950 c.c.	None.	"	5 "
86	30	Left chest half full of fluid.	22d "	Bloody ser. 850 c.c.	"	"	8 "
87	48	Left chest half full of fluid.	18th "	Clear serum 320 c.c.	"	"	4 "
88	50	Right chest half full of fluid.	22d "	Clear serum 1600 c.c.	"	"	6 "
89	47	Right chest two-thirds full of fluid.	16th "	Clear serum 2750 c.c.	"	"	11 "
90	29	Left chest full of fluid.	14th "	Clear serum 2200 c.c.	225 c.c.	"	15 "
91	17	Left chest half full of fluid.	22d "	Clear serum 1500 c.c.	None.	"	5 "
92	47	Right chest half full of fluid.	9th "	Clear serum 1500 c.c.	"	"	7 "
93	38	Right chest three-fourths full of fluid.	37th "	Clear serum 1680 c.c.	"	"	10 "
94	48	Left chest half full of fluid.	30th "	Turbid ser. 1600 c.c.	"	"	8 "
95	32	Left chest half full of fluid.	11th "	Clear serum 1100 c.c.	"	"	8 "
96	21	Left chest two-thirds full of fluid.	29th "	Clear serum 700 c.c.	"	"	6 "

No.	Age	Condition of the chest on admission.	Day tapped.	Character of the fluid.	Subsequent tappings.	Other treatment.	No. of days from first tapping to end of pleurisy.
97	49	Left chest half full of fluid.	16th day	Clear serum 850 c.c.	None.	None.	3 days.
98	28	Left chest two-thirds full of fluid.	16th "	Clear serum 1300 c.c.	"	"	4 "
99	25	Left chest three-fourths full of fluid.	19th "	Clear serum 2250 c.c.	"	"	3 "
100	29	Right chest full of fluid.	16th "	Clear serum 2700 c.c.	"	"	9 "
101	19	Left chest full of fluid.	60th "	Clear serum 400 c.c.	"	"	10 "
102	32	Left chest full of fluid.	21st "	Clear serum 800 c.c.	"	"	15 "
103	21	Right chest half full of fluid.	50th "	Clear serum 800 c.c.	"	"	6 "
104	24	Left chest half full of fluid.	11th "	Clear serum 1200 c.c.	Clear serum 1200 c.c.	"	12 "
105	40	Left chest half full of fluid.	60th "	Clear serum 1200 c.c.	Clear serum 1000 c.c.	"	12 "
106	55	Right chest half full of fluid.	19th "	Clear serum 1500 c.c.	Bloody ser. 100 c.c.	"	6 "
107	39	Right chest half full of fluid.	50th "	Clear serum 1400 c.c.	Clear serum 1000 c.c.	"	9 "
108	21	Left chest two-thirds full of fluid.	43d "	Clear serum 950 c.c.	Clear serum 950 c.c.	"	13 "
109	39	Left chest one-third full of fluid.	90th "	Clear serum 500 c.c.	Clear serum 25 c.c.	"	6 "
110	48	Left chest one-third full of fluid.	90th "	Clear serum 800 c.c.	None	"	4 "
111	27	Right chest two-thirds full of fluid.	28th "	Clear serum 900 c.c.	"	"	3 "
112	22	Left chest one-third full of fluid.	46th "	Clear serum 600 c.c.	"	"	10 days; improved.
113	26	Left chest one third full of fluid.	60th "	Bloody ser. 1000 c.c.	"	"	10 days.
114	23	Right chest half full of fluid.	13th "	Clear serum 900 c.c.	Clear serum 300 c.c.	"	9 "
115	16	Left chest full of fluid.	28th "	Clear serum 1100 c.c.	Clear serum 100 c.c.	"	6 "
116	37	Left chest half full of fluid.	11th "	Bloody ser. 100 c.c.	None.	"	Discharged improved.
117	38	Left chest half full of fluid.	15th "	Clear serum 1300 c.c.	Clear serum 750 c.c.	"	28 days.
118	24	Right chest half full of fluid.	30th "	Clear serum 250 c.c.	None.	"	7 "
119	18	Right chest half full of fluid.	6th "	Clear serum 900 c.c.	Clear serum 150 c.c.	"	9 days; improved.
120	23	Left chest one-third full of fluid.	10th "	Clear serum 1200 c.c.	None.	"	6 days.
121	32	Left chest one-third full of fluid.	13th "	Clear serum 1300 c.c.	"	"	17 "
122	34	Left chest half full of fluid.	13th "	Clear serum 1500 c.c.	"	"	36 days; improved.
123	28	Left chest one-third full of fluid.	17th "	Bloody ser. 100 c.c.	Clear serum 100 c.c.	"	22 days; improved.
124	25	Left chest two-thirds full of fluid.	17th "	Clear serum 1150 c.c.	Clear serum 1100 c.c. 1100 c.c.	"	35 days.
125	26	Right chest one-third full of fluid.	33d "	Bloody ser. 1000 c.c.	None.	"	5 "
126	29	Left chest one-third full of fluid.	34th "	Clear serum 1250 c.c.	"	"	6 "
127	7	Left chest one-third full of fluid.	17th "	Turbid ser. 300 c.c.	"	"	12 "
128	37	Left chest full of fluid.	9th "	Clear serum 1750 c.c.	Clear serum 1100 c.c.	"	9 "
129	35	Left chest one-third full of fluid.	17th "	Clear serum 1300 c.c.	Clear serum 900 c.c.	"	12 "
130	58	Right chest two-thirds full of fluid.	20th "	Clear serum 1160 c.c.	None.	"	12 "
131	35	Left chest full of fluid.	31st "	Clear serum 1200 c.c.	Clear serum 1400 c.c. 250 c.c.	"	9 days; improved.
132	11	Right chest two-thirds full of fluid.	16th "	Cloudy ser. 400 c.c.	None.	"	21 days.
133	29	Right chest two-thirds full of fluid.	31st "	Clear serum 270 c.c.	"	"	8 "
134	29	Right chest full of fluid.	16th "	Clear serum 2100 c.c.	"	"	9 "

No.	Age	Condition of the chest on admission.	Day tapped.	Character of the fluid.	Subsequent tappings.	Other treatment.	No. of days from first tapping to end of pleurisy.
135	19	Right chest half full of fluid	19th day	Bloody ser. 5 ounces.	None.	None.	4 days.
136	45	Right chest two-thirds full of fluid.	30th "	Greenish ser. 1560 c.c.	"	"	7 "
137	27	Left chest half full of fluid.	16th "	Brownish ser. 315 c.c.	"	"	7 "
138	30	Right chest half full of fluid.	23d "	Clear serum 600 c.c.	"	"	8 "
139	47	Left chest half full of fluid.	31st "	Clear serum 900 c.c.	"	"	4 "
140	34	Right chest two-thirds full of serum.	37th "	Greenish ser. 2640 c.c.	"	"	20 "
141	40	Right chest three-fourths full of fluid.	46th "	Clear serum 2160 c.c.	"	"	23 "
142	31	Left chest two-thirds full of fluid	12th "	Clear serum 7 ounces.	"	"	6 days; improved.
143	50	Left chest half full of fluid.	29th "	Bloody ser. 200 c.c.	"	"	3 days.
144	33	Right chest two-thirds full of fluid.	72d "	Clear serum 900 c.c.	"	"	7 "
145	48	Right chest two-thirds full of fluid.	17th "	Clear serum 300 c.c.	"	"	4 "
146	33	Left chest half full of fluid.	72d "	Clear serum 2000 c.c.	"	"	17 "
147	22	Left chest half full of fluid.	22d "	Clear serum 1250 c.c.	Clear serum 1100 c.c, 1000 c.c.	"	10 "
148	38	Right chest half full of fluid.	24th "	Brown ser. 400 c.c.	None.	"	6 "
149	23	Right chest three-fourths full of fluid.	29th "	Clear serum 900 c.c.	"	"	6 "
150	48	Right chest half full of fluid.	20th "	Clear serum 1500 c.c.	"	"	22 "
151	28	Left chest two-thirds full of fluid.	61st "	Clear serum 1100 c.c.	Clear serum 750 c.c.	"	10 "
152	18	Left chest half full of fluid.	4:d "	Clear serum 1000 c.c.	None.	"	4 "
153	31	Left chest half full of fluid.	11th "	Clear serum 1100 c.c.	450 c.c.	"	10 "
154	17	Right chest two-thirds full of fluid.	17th "	Clear serum 800 c.c.	None.	"	9 "
155	61	Right chest half full of fluid.	11th "	Clear serum 1600 c.c.	850 c.c.	"	13 "
156	24	Right chest two-thirds full of fluid.	15th "	Clear serum 600 c.c.	800 c.c.	"	30 "
157	46	Right chest half full of fluid.	20th "	Clear serum 1200 c c.	480 c.c.	"	20 "
158	24	Right chest half full of fluid.	8th "	Clear serum 900 c.c.	None.	"	13 "
159	42	Left chest half full of fluid.	12th "	Clear serum 1250 c.c.	1350 c.c.	"	16 "
160	49	Left chest half full of fluid.	43d "	Turbid ser. 500 c.c.	125 c.c.	"	7 "
161	27	Right chest two-thirds full of fluid.	21st "	Clear serum 700 c c.	20 c.c.	"	5 "
162	32	Left chest half full of fluid.	14th "	Clear serum 1000 c.c.	None.	"	1 "
163	38	Left chest two-thirds full of fluid.	17th "	Clear serum 1530 c.c.	64 c.c.	"	8 "
164	49	Left chest two-thirds full of fluid.	17th "	Clear serum 1920 c.c.	1856 c.c.	"	6 "
165	29	Right chest two-thirds full of fluid.	54th "	Clear serum 1920 c.c.	480 c.c.	"	6 "
166	30	Right chest half full of fluid.	12th "	Bloody ser. 840 c.c.	None.	"	5 "
167	56	Left chest two-thirds full of fluid.	23d "	Clear serum 1728 c.c.	1.8 c.c.	"	7 "
168	18	Left chest two-thirds full of fluid.	14th "	Turbid ser. 1984 c.c.	None.	"	2 "
169	60	Right chest two-thirds full of fluid.	19th "	Clear serum 1920 c.c.	"	"	8 "
170	38	Right chest half full of fluid.	23d "	Turbid ser. 460 c.c.	"	"	17 days; improved.
171	22	Right chest two-thirds full of fluid.	13th "	Turbid ser. 1400 c.c.	"	"	2 days.
172	24	Left chest half full of fluid.	51st "	Turbid ser. 550 c.c.	"	"	2 "

No.	Age	Condition of the chest on admission.	Day tapped.	Character of the fluid.	Subsequent tappings.	Other treatment.	No. of days from first tapping to end of pleurisy.
173	8	Left chest full of fluid.	15th day	Clear serum 600 c.c.	None.	None.	1 day.
174	39	Left chest half full of fluid.	23d "	Clear serum 2200 c.c.	"	"	2 days.
175	57	Left chest two-thirds full of fluid.	51st "	Clear serum 2100 c.c.	1600 c.c.	"	6 "
176	41	Left chest half full of fluid.	41st "	Clear serum 1475 c.c.	None.	"	1 "
177	16	Left chest half full of fluid.	68th "	Turbid ser. 600 c.c.	"	"	3 "
178	30	Left chest two-thirds full of fluid.	24th "	Clear serum 1100 c.c.	"	"	2 "
179	30	Right chest one-third full of fluid.	14th "	Bloody ser. 380 c.c.	"	"	2 "
180	29	Left chest half full of fluid.	6th "	Clear serum 200 c.c.	"	"	1 "
181	23	Right chest half full of fluid.	31st "	Bloody ser. 875 c.c.	"	"	1 "
182	26	Whole right chest full of fluid.	32d "	Turbid ser. 900 c.c.	1800 c.c. 576 c.c.	"	23 "
183	12	Right chest two-thirds full of fluid.	11th "	Clear serum 1000 c c.	None.	"	13 "
184	25	Left chest half full of fluid.	7th "	Clear serum 1000 c.c.	"	"	10 "
185	25	Right chest half full of fluid.	22d "	Clear serum 900 c.c.	100 c.c.	"	8 "
186	37	Left chest three-fourths full of fluid.	8th "	Clear serum 2100 c.c.	500 c.c. 100 c.c.	"	39 "
187	33	Left chest full of fluid.	56th "	Clear serum 1100 c.c.	2000 c.c. 1350 c.c. 400 c.c.	"	34 days; improved.
188	38	Right chest two-thirds full of fluid.	56th "	Clear serum 1100 c.c.	500 c.c.	"	15 days.
189	50	Left chest two-thirds full of fluid.	23d "	Clear serum 1100 c c.	Clear serum 960 c.c.	"	10 "
190	23	Right chest two-thirds full of fluid.	17th "	Clear serum 1350 c.c.	None.	"	15 "
191	57	Left chest two-thirds full of fluid.	21st "	Clear serum 1100 c.c.	3400 c.c. 1450 c.c. 525 c.c.	"	36 days; improved.
192	61	Left chest half full of fluid.	8th "	Clear serum 1600 c.c.	None.	"	7 days.
193	26	Left chest half full of fluid.	9th "	Clear serum 1900 c.c.	400 c.c.	"	8 "
194	22	Left chest two-thirds full of fluid.	7th "	Clear serum 1600 c.c.	150 c.c.	"	11 "
195	35	Right chest half full of fluid.	29th "	Clear serum 2500 c.c.	None.	"	32 "
196	71	Right chest half full of fluid.	5th "	Clear serum 1150 c.c.	"	"	14 "
197	37	Left chest half full of fluid.	23d "	Clear serum 550 c.c.	"	"	25 days; improved.
198	26	Right chest half full of fluid.	17th "	Clear serum 300 c.c.	400 c.c.	"	23 days.
199	40	Left chest two-thirds full of fluid.	24th "	Clear serum 300 c.c.	500 c.c. 550 c.c.	"	24 days; improved.
200	39	Left chest two-thirds full of fluid.	9th "	Clear serum 1150 c.c.	1650 c.c. 550 c.c.	"	28 days; improved

In the first 82 cases of the table, besides the aspiration, medical treatment was employed; in the subsequent cases aspiration was the only treatment.

It will be noted, in the first place, that none of the patients died, none of them were injured by the operation, and in none of them was the chest infected.

In all of the patients the quantity of fluid in the chest was considerable and occupied the lower part of the pleural cavity.

The fluid taken from the chest was bloody in 25 cases, turbid in 18 cases, and clear serum in the rest. The character of the fluid seemed to make no difference. Those with bloody or turbid serum did as well as those with clear serum.

In 121 of the cases the pleurisy was on the left side, in 79 on the right side.

The quantities of fluid aspirated were as follows: 6 cases, 3000 to 3500 c.c.; 23 cases, 2000 to 2500 c.c.; 37 cases, 1500 to 2000 c.c.; 55 cases, 1000 to 1500 c.c.; 49 cases, 500 to 1000 c.c.; 30 cases, 100 to 400 c.c.

Of the 200 cases 182 left the hospital entirely cured; 6 left the hospital within ten day after the aspiration, and probably recovered; 6 left the hospital at periods of from seventeen to thirty-six days after the aspiration, the pleurisy was better, but the results were uncertain; 6 left the hospital at the end of from twenty-four to thirty-eight days, not at all improved.

Of the 182 cases which were cured, the length of time which elapsed from the beginning of the pleurisy to the day of aspiration was as follows:

		7 months	. . . . .	1 case.
		90 days	. . . . .	5 cases.
70	to	75 "	. . . . .	3 "
60	"	70 "	. . . . .	9 "
50	"	60 "	. . . . .	6 "
40	"	50 "	. . . . .	9 "
30	"	40 "	. . . . .	15 "
20	"	30 "	. . . . .	39 "
10	"	20 "	. . . . .	71 "
5	"	10 "	. . . . .	20 "
		4 "	. . . . .	2 "
		3 "	. . . . .	1 case.

It will be seen that in more than one-half of the cases the duration of the pleurisy before aspiration was between ten and thirty days.

In all of the cases the pleurisy was going on as an inflammation up to the time of the aspiration; the patients had not been at all improved either by nature or by the different medicines which they had taken.

The length of time which elapsed from the aspiration to the entire cure of the patient was as follows:

Within	one week	. . . . . 64 cases.
"	two weeks	. . . . . 138 "
"	three weeks	. . . . . 158 "
"	four "	. . . . . 169 "
"	six "	. . . . . 179 "

As to the number of aspirations: The operation was done once in 142 cases, twice in 45 cases, three times in 9 cases, and four times in 4 cases.

In private practice the results are better than in the hospital. In the fortunate cases, within twenty-four hours after one aspiration there is no more fluid and no more pleurisy. In a large number of cases the pleurisy is cured within a week, and none of them ought to be sick longer than two weeks.

PANCREATIC LITHIASIS, WITH REPORT OF A CASE.*

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The scanty literature of pancreatic lithiasis, as well as general pathological records, give little exact information on the frequency with which pancreatic concretions are found in the gland after death.

Decisive evidence *intra vitam* of the existence of pancreatic lithiasis by the recovery of the characteristic concretions from the stools is exceedingly rare.

The literature contains the record of only six cases in which either a positive diagnosis of pancreatic lithiasis was made, or such a pathological process was suspected during life. The cases are so rare that a brief abstract of them is permissible.

Case I.—Capparelli's.[1] An abscess developed in the epigastric region, and through a fistulous opening which was established and persisted for six years, over 100 small prancreatic calculi were passed from time to time. The fistula finally closed, and a month later the existence of a glycosuria was discovered, which, it is stated, yielded to treatment. Capparelli believed that an interstitial pancreatitis was produced by the inflammatory affection, which in turn was the cause of the glycosuria.

Case II.—Lancereaux's.[2] Eight years before the patient, a female, came under observation, there had been several attacks of sharp abdominal colic, and the stools were stated to have been "fatty." No further disturbance of health occurred until eighteen months before admission to hospital, when symptoms of glycosuria developed, and the patient finally was admitted presenting all the symptoms of advanced diabetes mellitus.

The existence of a pancreatic lithiasis was regarded as probable from the development of a diabetes subsequent to the attacks of abdominal colic.

At autopsy, the body of the pancreas was found to be reduced to a simple fibrous cord, and occupied almost exclusively by the pancreatic

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duct. The head was better preserved. The canal of Wirsung opened into the duodenum 2 centimetres above the ampulla, and its orifice was occluded by a calculus of the size of a small pea.

Case III.—Leichtenstern's.[3] Following a severe attack of what was believed to be biliary colic without jaundice, three concretions, varying in size from a millet-seed to a pea, were recovered from the stools. Chemical analysis showed that these were composed of the carbonate of lime without traces of bile pigment or cholesterin.

Case IV.—Leichtenstern's.[3] The patient had suffered during a period of two years from periodic and exceedingly severe attacks of abdominal colic, with vomiting. On one occasion icterus had been present. A diagnosis of cholelithiasis was made by several physicians, a cholecystotomy was performed, but no biliary calculi were found. The attacks of pain continued and made life unendurable. A second laparotomy was done, and no biliary calculi being discovered the pancreas was explored. It was found to be enlarged. At autopsy, on section, the pancreas was found to be riddled with small abscesses varying in size from a millet-seed to a pea, in which, as well as in the ducts, there were numerous pancreatic concretions.

The sequence of events was evidently pancreatic lithiasis, secondary infection, suppurative pancreatitis.

Case V.—Lichtheim's.[4] A definite and correct diagnosis was made during life in this case.

The patient, a male, thirty-six years of age, gave a history of attacks of severe pain in the epigastric region, accompanied by vomiting and fever, beginning fourteen years before admission to the hospital, and recurring at intervals during a period of six years.

Following this period he remained well until one year before admission, when he began to suffer from diarrhœa, sudden in onset, and without apparent cause. There was an absence of pain and fever. Appetite and thirst were increased. Emaciation and weakness progressively increased.

On admission to hospital, physical examination was negative, except as to the lungs, which showed evidence of tuberculosis.

The urine contained a large amount of sugar which disappeared after two weeks of strict diet, and remained absent.

The patient died three weeks later as a result of exhaustion from the diarrhœa and the tuberculous infection.

The diagnosis of pancreatic lithiasis was made by Lichtheim previous to the death of the patient.

This diagnosis was based upon the attacks of severe colic with fever and vomiting in the previous history of the patient. These symptoms were clearly those of calculi. Gallstones were excluded by the absence of signs of biliary stagnation notwithstanding the long duration of the attacks. Renal calculi were excluded by the site of the pain and the absence of urinary signs.

In consideration of the subsequent diabetes, Lichtheim believed the attacks of colic to have had their origin in the pancreas, and assumed them to have been due to calculi, and the resultant diabetes to pancreatic cirrhosis. The diarrhœa was also attributed to the pancreas, through disturbance of intestinal digestion from failure of pancreatic secretion. Intestinal tuberculosis had been excluded by the absence of bacilli in the stools.

"Typical fatty stools" were not observed, although fats were administered experimentally. The abundant muscle fibres found in the stools were considered to be of doubtful diagnostic value, through the restriction of the patient to a strict meat diet, and in the presence of a free diarrhœa.

Autopsy showed marked dilatation of the main pancreatic duct, which was filled with a grayish fluid in which were three large and many small mortar-like concretions.

The dilatation extended to the lesser ducts and as far as the cauda. The substance of the pancreas consisted chiefly of firm connective tissue, in which, however, small lobules of glandular tissue were distinctly visible.

Lichtheim believes his case to be the first in which the significance of the symptoms was appreciated during life, with the exception of Capparelli's. He quotes Friedreich, who asserts the impossibility of differentiating between biliary and pancreatic colic, inasmuch as the pancreatic calculi must exert compression simultaneously on the common bile-duct when they occlude the pancreatic duct. Lichtheim points out that his case demonstrates that this does not invariably occur, and that under some conditions the differential diagnosis can be made. In Case VII. of this series, also, occlusion of the common bile-duct did not occur.

Case VI.—Minnich's.[5] A correct diagnosis of pancreatic lithiasis *intra vitam* was made in this case also.

The patient, a male, aged sixty-eight years, gave a history of prolonged attacks of biliary colic, demonstrated to be such by the recovery of typical gallstones from the stools on two occasions, twenty-eight and eighteen years, respectively, before admission to the hospital. Two slight attacks of a similar nature, apparently, occurred six months before admission. A month before admission there was a slight attack of epigastric pain, lasting a fortnight, followed by a severe attack of diarrhœa without pain.

On admission to hospital the patient stated that he had suffered from a severe pain located in the left epigastric region since the previous day. The sclera presented a slightly yellowish tinge, but the skin was not discolored. Careful abdominal palpation gave entirely negative results.

The patient described his pains as follows:

"There is at first a dull, oppressive, constricting sensation in the epigastrium and under the left costal arch within the nipple line, which at times impels him to take deep inspirations, and at times causes him to press upon the painful region with his hand. The pains soon increase until they become true paroxysms, and become more and more localized at a point close under the left costal arch and inside of the nipple line. At the height of the attack, the pain radiates from this point along the costal arch to the spine, and spreads with severity up under the left shoulder-blade.

"As the pain subsides it retreats to the point described, under the left costal arch, the area of which can be covered by a five-franc piece."

A careful examination of this area, as well as of the other painful regions, elicited nothing positive except a slight sensitiveness on deep palpation.

The attack ceased suddenly after two hours, and the patient felt perfectly well and was decidedly hungry.

An examination of the urine passed immediately after the attack showed it to be free from albumin, sugar, and biliary pigment.

Subsequent attacks occurred almost daily, and were variable in severity.

The stools were carefully searched during twelve consecutive days, with the result of finding concretions varying in size from that of a cherry-pit to irregular detritus. The concretions were tough, semi-solid in consistence. They were fractured by the pressure of the finger, but not reduced to powder. They were too coherent to be amalgamated by pressure. Nearly smooth superficially, gray externally, and of a dull white lustre on section, resembling fruit-seed. No stratification or nucleus discerned. Microscopically, amorphous. Chemically, easily soluble in chloroform, giving a turbid fluid. On heating in a tube, a thick smoke of strong aromatic odor was given off, yellowish tinged water condensed in the cooler portion, and a residue of carbonate and phosphate of lime was obtained.

The attacks gradually abated in severity and frequency. After a time concretions were no longer detected.

The patient recovered his usual health at the end of a month.

No sugar or albumin was detected at any time in the urine. There was no loss of weight, and there was no fever at any period.

I am able to present to the Association the clinical report of an additional case, in which characteristic pancreatic calculi were recovered from the stools.

Case VII.—Mrs. H., aged forty-two years. Family history unimportant. Personal history: In 1888 the patient suffered from a slight attack of the following nature:

A sudden onset of pain, first felt in the back between the shoulders, thence gradually extending from the point of origin around the right side along the lower intercostal spaces, accompanied by nausea and vomiting, uncontrollable for a number of hours. Gradual subsidence of all the symptoms without medication; a slight diarrhœa accompanied and followed the attack; duration of the attack eight or nine hours. Similar though severer attacks in August and May, 1897 and 1898, respectively—three altogether. None of the attacks described were accompanied by jaundice, and biliary calculi were not found in the stools. They were believed to be due to a cholelithiasis. No further attack until January, 1901, when one of an exceedingly severe character occurred. The pain was first felt between the shoulder-blades, thence extended through and not around the body into the epigastrium, and became localized rather to the right of the median line. Vomiting occurred only once; the pain was very acute, necessitating the use of large hypodermic injections of morphine, which afforded only partial relief. The bowels were constipated throughout the attack, which was of three days' duration. More or less abdominal pain and much general abdominal sensitiveness were experienced for four weeks subse-

quent to the acute attack. Jaundice was not present at any period. On the sixth day from the beginning of the attack, six small stones, the size of a pea, were passed by the bowel. The patient had been under the care of a New York physician, and was seen in consultation by Dr. Janeway. It was believed that she was suffering from biliary colic. Dr. Janeway's attention was attracted by the appearance of the concretions passed, and he secured them for chemical analysis. Four of the concretions were analyzed and were found to consist of the carbonate and phosphate of lime without traces of cholesterin or bile pigment, indicating their origin in the pancreatic ducts. A similar though less severe attack occurred three weeks later, and others in August, October, and November, 1901—five in all. The attack in August occurred in Berlin under the observation of Professor Leyden's assistant, Dr. Wohlgemuth. A small fragment of a calculus and considerable detritus were recovered from the stools, and the patient states that their origin in the pancreas was asserted. The attack in November occurred in San Francisco under the observation of Dr. McMonagle. Although no concretions were recovered from the feces, considerable detritus was obtained, which was found to be composed of the carbonate and phosphate of lime.

The patient first came under my observation on December 25, 1901, on her arrival from San Francisco, whence she had come for further medical treatment.

One of the concretions passed by the bowel in the attack of January, 1901, was given to me for examination. A chemical analysis showed it to be identical in its composition with those analyzed by Dr. Janeway. The only concretion unanalyzed and which is identical in its appearance with the others, I am able to show you. It weighs 7 centigrammes, with diameters 5.8 millimetres by 5.9 millimetres by 6.2 millimetres. It will be seen that its surface is slightly rough, with several deep grooves. The material of which the surface is composed is found by chemical analysis to be phosphate of lime without admixture of the carbonate. The whole stone is very friable. The patient stated that she had suffered almost continuously from intestinal indigestion and from epigastric discomfort since the last attack in November, and for the previous ten days there had been more or less continuous epigastric pain. She had also lost much in weight. Careful physical examination only elicited the signs of a moderate degree of displacement of the right kidney and distinct sensitiveness over the region of the gall-bladder. Its palpability was considered doubtful. On the following day an acute attack occurred.

As in all previous attacks, the pain began in the middle of the back between the shoulder-blades and extended through and not around the body, locating itself in the central epigastric region. There was accompanying nausea and vomiting. There were recurring paroxysms for forty-eight hours, when they ceased. The urine even at the beginning of the attack contained traces of bile pigment, but no glucose. Later a slight degree of jaundice was appreciable, which speedily disappeared.

Similar attacks occurred on January 13th and 18th, except that they were preceded by a sharp chill, followed by a rise of temperature to 104° F., which was again normal at the end of eight hours. No jaundice accompanied these attacks. All the stools from the beginning were passed through a very fine sieve, but no concretions were recovered.

Following the last attack, a few white particles were recovered, which on chemical analysis were found to consist of calcium soaps (calcium oxide, 7.9 per cent.; higher fatty acids, including moisture and foreign matter adherent, 92 per cent.).

Finally, two very severe attacks accompanied by jaundice occurred during the subsequent three weeks, and a calculus was recovered from the stools on each occasion. Their composition was found to be nearly identical. Chemical analysis of the central portion of one concretion gave 92.44 per cent. cholesterin, and other organic and mineral matters, including moisture, 7.56 per cent., indicating its biliary origin. It is of interest to note that cultures of the central portion gave no growth.

There has been an absence of attacks since those last described, but there has been continuous epigastric discomfort and pain located in the central portion of the back.

Throughout the period that the patient has been under observation very frequent examinations of the urine have never revealed any trace of sugar.

Immediately subsequent to the attack of January 18th, the color of the feces indicating a free flow of bile into the bowel, an investigation was undertaken to determine the utilization of the fat of a known diet. The report of the details of the investigation is appended: 101 4 grammes of fat were ingested during a period of forty-eight hours, and 11.1 grammes were recovered from the feces, indicating a normal absorption.

On the other hand, the composition of the fat was: neutral fat, 42.6 per cent.; fatty acids, free, 19.2 per cent.; fatty acids, soaps, 38.2 per cent. According to Müller,[6] 42.6 per cent. of neutral fat in the feces is much above the normal and indicates an at least *diminished* flow of pancreatic secretion into the intestine.

The clinical history of the case presents many points of interest. The decisive evidence *intra vitam* of the existence of a pancreatic lithiasis and its alternation with a cholelithiasis, are of special interest. In view of the origin of biliary calculi in many instances in an infection of the gall-bladder, an origin of pancreatic calculi in an infection of the ducts would not seem improbable. The clinical history of the patient in the past and her present symptoms suggest an explanation of the deficient utilization of the ingested fat. A pancreatic lithiasis *preceded* the cholelithiasis. It would seem probable that it also *coexisted* with the cholelithiasis, and that it is still present with partial occlusion of the pancreatic duct or ducts.

A study of the cases related indicates the difficulties of differential diagnosis between pancreatic lithiasis and cholelithiasis, in the absence of concretions in the stools. As Oser[7] remarks, almost as great difficulties obtain in the diagnosis of pancreatic disease in general, due to the fact that only extensive destructive processes in the organ or the closure of both ducts, produce characteristic symptoms. Coincident disease of neighboring organs, either a cause or a result of pancreatic disease, may produce symptoms more distinct and impressive

than those of the latter. A biliary calculus may lead to a chronic pancreatitis through its obstruction in part or wholly to the outflow of the pancreatic secretion into the intestine, and in itself produce symptoms which mask those of the pancreatitis.

It will be of interest to consider the symptoms which have been described by various authorities as those of occlusion of the pancreatic ducts.

1. None of the subjective symptoms, such as nausea, vomiting, diarrhœa, can be regarded as characteristic. The belief that a ptyalism of varying degree accompanies a deficient secretion of the pancreatic juice, either through occlusion of the ducts or disease of the gland, is not borne out by clinical experience.

2. Clinical evidence indicates that the pain present in pancreatic lithiasis probably differs neither in kind nor location from that of cholelithiasis. In the single case of Minnich, the location of the pain along the left costal arch was possibly suggestive. On the other hand, in my own case, the patient was very positive that the pain in the attacks preceding the passage of the pancreatic concretions, and in the attack in which the concretions were recovered, began either along the right costal arch or in the back, finally becoming localized to the right of the median line.

3. The presence of an unusual number of undigested striated muscle fibres in the stools cannot be regarded as a basis for positive diagnostic conclusions. Abnormal quantities of muscle fibres are often passed in other disturbances of the intestinal digestion. In any free diarrhœa this may occur.

4. *Fatty Stools.* An abnormal amount of fat in the feces is by no means a constant or even frequent symptom of pancreatic disease. In 330 cases collected by Ancelet,[8] it was found only twenty-eight times. When present, it is often due to the existence of jaundice in which the absorption of fat is enormously diminished (as much as three-quarters of the fat ingested may be returned in the stools, one-tenth being the maximum normal amount—Müller[6]), or to various affections of the absorbents of the intestines. In Case VII. the *absorption* of fat was found to be normal. A deficient *splitting up* of the ingested fat into fatty acids and soaps, on the other hand, apparently is a symptom of great value in the diagnosis of occlusion of the pancreatic ducts from any cause. Müller's[6] investigations, corroborated by Weintraud[9] and Katz,[10] show that normally 75.8 per cent. of the fat contained in the feces is split up and appears, not in the form of neutral fat, but of fatty acids or soaps, and that this also occurs in jaundice and in other pathological conditions, with the exception of cases in which the pancreatic secretion is diminished or is prevented from reaching the intestine. In such cases the decomposition into fatty acids and soaps is greatly

diminished; the average in three cases was found by Müller[6] to be only 39.19 per cent., instead of 75.8 per cent.*

A deficient splitting up of the ingested fat into fatty acids and soaps, therefore, would seem to be the only fact, so far as the feces are concerned, which points with certainty to the absence of the pancreatic secretion in the intestinal digestion. In Case VII. the fatty acids and soaps in the feces were considerably below the normal amount.

5. The presence or absence of jaundice in itself cannot be considered of diagnostic import. It is absent in a large number of cases of cholelithiasis; it may be present in pancreatic lithiasis. Jaundice in pancreatic lithiasis permits of a simple explanation. The large pancreatic duct and the common bile-duct are separated near their junction only by a thin membranous septum, and a calculus impacted in the terminal portion of the former might readily suffice to occlude the ductus choledochus by pressure. Again, a concretion small enough to pass through either the pancreatic duct or bile-duct may be too large to pass their common duodenal opening.

6. *Glycosuria.* It is well known that a glycosuria associated with obstruction of the pancreatic ducts by calculi or otherwise is the result of the superinduced interstitial pancreatitis, and the recent investigations of Opie[13] indicate that in the interlobular form, which is the prevalent form in such occlusions, glycosuria apparently only occurs when the sclerotic process has reached a very advanced grade. The absence of glycosuria, therefore, can only be regarded as a negative sign in the diagnosis of pancreatic lithiasis. Its presence is certainly suggestive.

The decisive evidence of the existence of pancreatic lithiasis in the recovery of the characteristic concretions from the stools, it has been shown, is exceedingly rare. This may be due partly to the composition of the calculi; they are small, very easily disintegrated, and may pass by the bowels in fragments or particles not readily recognized. In a number of reported cases, minute gritty particles have been found in the smaller ducts, with or without the presence of larger concretions in the main ducts.

If the symptoms described, with the single exception of the presence of pancreatic concretions in the stools, separately fail to furnish evidence of pancreatic lithiasis, their various combinations may be diagnostically suggestive.

Attacks of epigastric colic of an obscure nature, with or without jaundice, associated with large numbers of muscle fibres in the stools, accompanied or followed by a glycosuria, should be regarded as a reasonable basis for a diagnosis of pancreatic lithiasis.

* Deuscher[11] and Albu[12] in three observations of pancreatic disease claim to have found no departure from the normal.

Müller's investigations indicate that a greatly diminished splitting up of the ingested fat *per se* positively indicates the absence of pancreatic juice in the intestinal digestion. In this case, therefore, in the absence of a cachexia or other signs of a neoplasm of the pancreas or of neighboring organs which would occlude the ducts by pressure, a pancreatic lithiasis should be suspected.

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WOLFF'S LAW AND THE FUNCTIONAL PATHOGENESIS OF DEFORMITY.*

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THE correspondence between the structure of bone, under normal and abnormal conditions, and the calculations of graphic statics has been made the foundation upon which a doctrine of "functional pathogenesis" has been built. It has, however, formed also the basis of numerous attacks upon this theory. The theory of the functional pathogenesis of deformity and that of the functional shape of the bones have been made corollaries to the "law of bone transformation"[1] by its author, Jul. Wolff. The "law of bone transformation" is considered by its author as deriving its greatest strength from the remarkable resemblance existing between the internal structure of the normal human femur and the graphostatic diagram of a Fairbairn crane drawn by the mathematician Cullmann. This was given an outline similar to that of the human femur deprived of its trochanter major and viewed in coronal section, sustaining a load of 30 kilogrammes. This load is supposed to approximate that which is borne by the femur of an adult and to be applied to the crane in a manner consistent with the conditions in the human subject. The striking analogy

* Read before the American Orthopedic Association, June, 1902.

between the courses of the bone trabeculæ in the frontal section of the femur and those of the trajectories of Cullmann's diagram was first insisted upon by von Meyer. The arrangement of the spongiosa in the sagittal section of the femur, corresponding to the " neutral plane " of the diagram, was foretold by Wolff in conformity with the demands of the graphostatic figure, and was substantiated by him later, anatomically. After the most painstaking study of the various bones of the body under normal and abnormal conditions Wolff was able to formulate his " law," which might be translated as follows:

" Every change in the form and function of the bones, or of their function alone, is followed by certain definite changes in their internal architecture, and equally definite secondary alterations of their external conformation, in accordance with mathematical laws."

Before the promulgation of Wolff's law the generally accepted theory of the development of acquired deformity was that of Volkmann[2]-Hueter,[3] namely, that consequent upon muscular weakness faulty attitude was assumed, in consequence of which one side of a joint—*e. g.*, the external in genu valgum—was subjected to greater pressure than normal; the opposite side—the internal in genu valgum—sustained less pressure than normal. Assuming that during growth the normal development of the joint depends upon the maintenance of normal conditions of intra-articular pressure, it was explained that the increased pressure on the concave side interfered with the normal growth of bone or even caused atrophy of that bone already formed; while on the convex (internal) side the subnormal pressure permitted an overgrowth of bone. In spite of the fact that Mikulicz[4] and Macewen[5] showed, quite long ago, that these changes in the articular surfaces and epiphyses are not constantly present in genu valgum, but that the principal deformity exists in the diaphyses of the femur and tibia, most authors continued, nevertheless, to describe the pathogenesis of this deformity in conformity with the theory of Volkmann-Hueter. We shall later see how it is better explained by reference to Wolff's law and in agreement with the anatomical conditions present.

The first corollary which Wolff's theory has associated with it is that of the " functional shape."[6] The external form and internal architecture are determined by function solely. The internal architecture and external contour always correspond exactly, the latter representing, mathematically, simply the last curve uniting the ends of the various trajectories which make up the internal structure. The compact substance is to be regarded simply as a condensation of spongiosa.

From the theory of the " functional shape " it is an easy step to that of the " functional pathogenesis " of deformity. If the internal structure and external contour correspond exactly, and if they represent an adaptation to normal function only, then an alteration in static

demands made upon the bones must be followed by the proper transformations of structure, both internal and external, and as the result of these we have the "deformity in the narrower sense." The deformity is therefore to be regarded as a physiological adaptation of structure to pathological static requirements, therefore to pathological function.

The agreement of the structure of bone, both under normal and abnormal circumstances, with mathematical laws, and in particular with those of graphic statics, is insisted upon by Wolff to such an extent that it has formed the basis of attacks upon the doctrine by Bähr[7] and Ghillini,[8] as well as others. It is their object to show that Wolff's mathematical conclusions are erroneous, and that therefore it is not permissible to make deductions from them regarding the structure of the bones in their normal or pathological relations.

We may well ask ourselves, on this account, whether mathematical proof of the competency of nature's design in bone structure has been brought by Wolff in Cullmann's drawing of the Fairbairn crane and the deductions following. What is required to enable us to construct the graphostatic diagram of the femur? It must be understood, as a preliminary in answering this question, that when "mathematical proof" is spoken of mathematical accuracy is implied. It is by no means enough to say that a striking similarity exists between the diagram and the bone whose mechanics we are trying to solve. There must be absolutely no divergence between the two.

In order that the mechanics of the femur shall be submitted to mathematical proof, we must know every possible stress to which the bone is to be submitted under normal conditions, and these stresses must be expressed in figures. There must be possible of expression in figures the physical characteristics of the material used in the structure. But bones are evidently constructed of sufficient strength to withstand unusual stress without giving way. This fact is demonstrated in every-day life. How shall we calculate this "factor of safety." We may believe, with Wolff, that the femur is burdened like a crane, or with his opponents that this is not so; but the fact remains that Cullmann's diagram is computed without mention of the muscular stresses upon the bone—without reckoning with the stresses put upon the bones in other positions than the upright. The great trochanter has been omitted from consideration altogether. This is obviously not permissible in a mathematical calculation, because it is always present, because it is the means of transmitting very considerable stress to the femur, and because its internal structure is evidently continuous with that of the upper end of the femur. I am assured by experts that the proper calculation of the construction of the femur upon exact mathematical lines is a work of great magnitude, requiring not only uncommon ability, but, on account of the enormous complexity of the problem,

demanding a very large expenditure of time. To my knowledge, no such exact mathematical demonstration has yet been made. In addition to this, it is by no means certain that the "factor of safety" could be calculated; this factor might well make the mathematical solution impossible. Until exact mathematical proof is brought, however, there would seem to be no warrant for saying thus definitely that the external contour of a bone represents mathematically the last curve uniting the ends of the various trajectories which make up the internal structure—for assuming that the compact substance is to be regarded simply as a consolidation of those trajectories coming from the spongiosa.

If we are unprepared, however, to acknowledge that a truly mathematical demonstration of the structure of the bones has been made, we are, on the other hand, entirely unwilling to reject the law of transformation and its corollaries on this account without further investigation. In declining to accept the analogy between Cullmann's diagram and the structure of the femur as a truly mathematical demonstration of the latter, we are, furthermore, far from saying that if such computation and graphostatic figure were made it would not coincide with the architecture of the bone. On the contrary, the structure of the femur having been shown by many years of observation to be constant, the similarity between it and the mathematical figure is so striking as to make it seem reasonably certain that the trabeculæ do represent lines of force which nature aims to resist by the laying down of the bone tissue. This is, however, far from being mathematical proof, and, as it seems to us, does not afford justification for considering some of Wolff's other conclusions as "mathematical," however true they may be otherwise shown to be.

In view of the necessarily great variation in the factors of weight-bearing and muscular stresses which must exist in mammals other than man—because of the deviation from the erect position of the trunk and because of the participation of the thoracic extremities in the weight-bearing function, it would seem likely that much information could be obtained from the study of their bones. Able and exhaustive investigation has already been made in this direction by Zschokke,[10] Schmidt,[11] and others. It has seemed worth while to independently repeat some of this work as well as to seek further for information in the structure of other mammalian bones. The femur has been chosen as the bone for further comparison, because of its size and static importance and because it has formed the basis for most of the conclusions which have already been drawn. In examining the femora to be presently described the method reported by Wolff[9] was employed. Sections were cut by hand by means of a saw. These sections were then photographed by means of the Röntgen ray, and from the nega-

tives thus obtained the photographs were made which are herewith presented. As is the case with many radiographs, the negative is more instructive than the print made from it. In the smaller femora it was quite difficult to obtain prints the finer details of which would lend themselves to satisfactory reproduction.

In the description of the specimens which have been examined care has been taken to avoid as much as possible the repetition of details which coincide with the descriptions of Zschokke and Schmidt, above referred to. The following femora have been examined:

I. Ruminantia.
   (*a*) Ox.
   (*b*) Llama.
   (*c*) Sheep.

II. Carnivora.
   (*a*) South African leopard.

III. Primates.
   (*a*) Baboon (papio hamadryas).
   (*b*) Orang (simia satyrus).
   (*c*) Gibbon (hylobates).
      (Humerus of gibbon also.)

For the privilege of examining into the architecture of the femora of the orang and gibbon, as well as the humerus of the latter, I wish to acknowledge my indebtedness to the administration of the Smithsonian Institution. Many of the other bones examined have been taken from the museum of the Cincinnati Society of Natural History.

Remarks on the Specimens Examined.

I. Ruminantia. (*a*) *Femur of the Steer.* (Fig. 1.)

Relative length of the neck is short. Capital epiphysis extends laterally to a point corresponding practically with the axis of the shaft. It is covered with cartilage to this point, and is to this extent a bearing surface. The angle made by the neck is about 112°.

Arrangement of trabeculæ is perfectly constant, and corresponds with the description of Zschokke and Schmidt. The spongiosa of the young adult is composed of exceedingly fine trabeculæ. As the age increases the trabeculæ become coarser and less numerous, so that the internal structure is more easily read. In old animals this change has continued, so that the difference between their spongiosa and that of the young animal is most striking (see Zschokke). The three most striking systems of trabeculæ seen are:

1. *Principal pressure* trajectories (converging from the mesial part of the head to the adductor compacta).

2. Trabeculæ from adductor and abductor compacta arch toward the axis of the bones, forming a series of gothic arches whose apices

are in a straight line with the lateral boundary of the capital epiphysis. Such a series of arches also exists in the trochanteric epiphysis. Orthogonal crossings can be distinguished in the system of arches.

FIG. 1.

Femur of young adult steer.

FIG. 2.

Femur of llama.

(*b*) *Femur of the Llama.* (Fig. 2.)

There is practically no neck to the bone. Capital epiphysis extends to the axis of the shaft, as in the steer, but the head is set more obliquely, making an angle of 120° with the shaft.

Although the animal is comparatively young (shown by imperfect union of epiphysis), the trabeculæ are comparatively coarse, their meshes large. The arrangement of gothic arches is lacking.

The marrow cavity extends comparatively high into the upper end of the bone. There are three systems of trabeculæ:

1. Principal pressure trabeculæ.
2. Two systems diverging from the base of the great trochanter.
   (*a*) Toward the head.
   (*b*) Downward to the abductor compacta.

(*c*) *Femur of the Sheep.* (Fig. 3.)

In general shape and plan of internal structure we have the steer's femur in miniature. The angle of the neck is somewhat greater (115° to 117°), otherwise the same arrangement of capital epiphysis and gothic arches, though sometimes not so easily made out. Orthogonal crossings can in part be distinguished.

FIG. 3.

Sheep.

II. CARNIVORA. (Fig. 4.)

The only specimen examined was the femur of a South African leopard. The femur is characterized by its proportionately long,

slender, and somewhat curved neck, which makes an angle of 130° with the shaft. The spongiosa is made of plates.

The femoral neck presents a triangular cavity of considerable size,

FIG. 4.

Leopard.

and which in position and boundaries would correspond with Ward's triangle of the human femur. This is separated from the marrow cavity below by a small number of arches coming from the adductor

FIG. 5.

Baboon.

compacta and corresponding to pressure trajectories. The crossings here are orthogonal.

Shorn of the trochanter major the outline is very like that of Cullmann's diagram; the internal arrangement is, however, very different.

III. Primates. (*a*) *Femur of Arabian Baboon* (*Papio Hamadryas*). (Fig. 5.)

The bone is remarkably heavy for its size, and of very dense texture, so that it is difficult to saw. The neck is curved, and makes an angle of about 124°.

The trabeculæ are massive, largely in the form of plates. In the head they are fairly typical as principal pressure trabeculæ, and here show orthogonal crossings, with a few tension plates. There is here, too, a cavity in the neck, separated by a few plates only from the cavity of the shaft below. The compacta of the shaft is relatively very heavy and thick, so that it is difficult to bring it into comparison with the amount of spongiosa.

(*b*) *Orang.* (Fig. 6.)

Both in external conformation and internal structure the upper femoral end is strikingly like the human. The angle made by the

Fig. 6.

Orang.

femoral neck is 135°. Both pressure and tension trajectories are found projected in a fairly typical manner, though the reticulum is much coarser than in man, the trabeculæ more plate-like. Orthogonal crossings can be made out to a limited extent. The condensation of spongiosa known as the "intermediary epiphyseal disk" (Recklinghausen), and which is constant in the adult femur, is lacking.

(*c*) *Gibbon.* (Fig. 7.)

In general outline the upper femoral end greatly resembles that of the orang and man. The bone is remarkably light, however, its shaft

very smooth and round, reminding one very forcibly of the bones of larger birds. This comparison seems all the more apt upon bisecting the bone, because of the relatively large marrow cavity, with no spongy structure whatever save at the extreme ends. The angle of the neck is 140°.

The section shows a spongiosa of lamellar character, in which it is extremely difficult, if at all possible, to find an arrangement in any way similar to that of man or, indeed, of any of the femora previously described. The neck proper is practically free from spongy structure, a cavity being here found which extends to the spongiosa of the head above and to that at the base of the great trochanter below. The cellular spaces of the spongiosa are relatively very large.

In view of the contrast in functional importance between the femur and the humerus in the gibbon, great interest must attend the com-

FIG. 7.

Femur of gibbon.

FIG. 8.

Humerus of gibbon.

parison of their internal structures. The result of it is in accord with our anticipation. The internal structure consists of a lamellar spongiosa of comparatively coarse mesh, but in its general arrangement strikingly that of the human humerus. This is true even to the existence of a place near the great tuberosity in which the spongiosa is quite rare, almost to the degree of being considered a cavity. The remains of the epiphyseal line correspond both in direction and position, and the outline is simply a miniature of the human. (Fig. 8.)

In addition, it is to be noted that the gibbon's humerus is, in comparison with its femur, heavier and denser. On holding the bones close to a bright light the shaft of the femur is seen to be quite translucent; that of the humerus is not at all so. While the humerus is a longer bone, its density is disproportionately greater than that of the femur. The volume of the two bones was determined by ascertaining their displacement of water. This was found to be 25 c.c. for the humerus

and 22 c.c. for the femur. The weight of the humerus was 30.45 grammes against 21.67 grammes for the femur. Their ratio of weight is therefore 1.405, while their ratio of volume is 1.045. It is easily seen that the humerus is an organ of greater strength and usefulness than the femur.

In making a general comparison of the specimens in hand, it is well to remember that in graphic statics:

1. The courses of the various trajectories are dependent upon the external shape of the structures, and conversely,

2. The number of the trajectories and their size depend upon the varying factors of weight and the character of the material.

It was remarked by Zschokke—and the statement is to day equally true—that it was not possible to estimate the stresses in bone more than approximately up to that time, but that it was necessary as a matter of scientific reasoning to show, at least in some bones, that the trabeculæ truly correspond to the trajectories in direction and strength. Ten years have elapsed since this was written, but the task has not yet been performed.

Bähr, Ghillini, and the latter in co-operation with Canevazzi, have offered certain calculations in opposition, but these by no means present the solution which we seek. It would appear, therefore, that we are not yet provided with exact data to attempt a truly mathematical solution of the mechanics of the femur. If we cling too closely to the mathematical concept of bone structure we shall find it impossible, for example, to reconcile the structures in the upper femoral ends of the gibbon and the orang. We have here a striking similarity of outline, with an equally marked incongruity of internal formation.

If, however, we depart from the strictly mathematical notion and examine into the environment and habits of the gibbon and orang we shall find an admirable adaptation of structure to these and an explanation of the great variation in internal structure. According to Flower and Lydekker,* the gibbon is by nature an arboreal creature of great lightness, accustomed to maintain itself almost entirely by the thoracic extremities. Its movements are extremely rapid, and it is able to project its body through long distances in space in swinging from bough to bough and from tree to tree. When pursued on the ground and unable to reach a tree it moves forward chiefly on its pelvic extremities, and practically in the upright position, but so awkwardly and uncertainly that it is easily overtaken by man. The humerus of the gibbon, however, belongs to the extremity of greater power and use, and is manifestly of corresponding build. In the orang, on the other hand, we find great muscular power in the posterior extremities

* Mammals, Living and Extinct.

and comparative slowness in movement. We may similarly compare the femora of the leopard and the baboon, although possibly not so aptly, the former possessing wonderful agility and ability to make enormous leaps, the latter being contrasted by the great muscular development in proportion to its size. According to Zschokke, the femora of bears able and accustomed to maintain themselves frequently in the upright position possess great resemblance to the human in their structure. So in the ruminants, also, we find the modifications of internal structure in accordance with the shortness of the femoral neck, adapted, as this is, to weight-bearing purely rather than a large range of motion.

From the above we should be justified in concluding that while external conformation and internal structure represent admirable adaptation to use, their mutual interdependence is not so exact as the strictly mathematical concept would require. If we are to modify the doctrine of the functional shape of the bones to this extent, it is probable that the doctrine of functional pathogenesis must likewise be qualified.

Valuable evidence for the theory of functional pathogenesis should be found where the function of a bone has been changed for a considerable time without any gross solution of its continuity. It is believed that such evidence can be found in the specimen of old unreduced dislocation of the hip which is next presented, and in which we have the advantage of comparison with the normal femur of the same individual.

Description of Specimen of Old Unreduced Dislocation of the Hip, from the Museum of the Cincinnati Hospital (Series VII., No. 127 f).

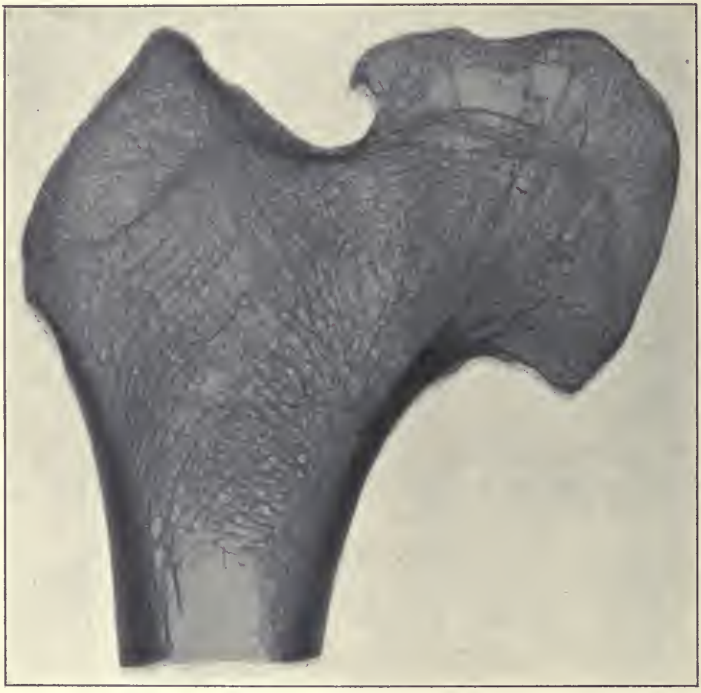
The specimen has been in the Museum for many years, and all clue to the history of the case has been lost. The board has wired upon it:

The Os Innominatum of the Side of the Luxation. This shows the acetabulum to have been unoccupied by the femoral head for a long time. The floor has become roughened by the presence of small osteophytes. The acetabular cavity appears to have become smaller by the thickening of its rim and the formation of new bone in its floor. Just behind the acetabulum there is seen a rather flat, though slightly concave, bone mass of roundish outline, with a diameter of 5 to 3.5 cm., and elevated 0.52 to 0.53 cm. above the surface of the surrounding bone. This rests upon a buttress of bone thrown out from the ilium and ischium. It is evidently the representation of an attempt at forming a new acetabulum.

The Upper End of the Right (Dislocated) Femur. (Fig. 9.) This has been sawed through about 8 cm. below the tip of the great trochanter. It has also been bisected in coronal section.

The Upper End of the Left Femur (Normal). (Fig. 10.) This has been sawed through at 6.7 cm. below the tip of the great trochanter, the cut just striking the tip of the lesser trochanter. It has also been bisected in coronal section. Upon joining the halves of the right (luxated) femur and attempting to fit the head, in its dislocated position, into the new acetabulum, it is readily seen that its superior surface—that which formerly was the chief means of transmitting weight—was no longer a bearing surface, but that the joint bearing under the new conditions

FIG. 9.



Dislocated femur.

was displaced downward. It can be seen that the position of the femur could not have been maintained by the bony socket alone, but that the soft parts must have played an important if not the chief rôle in this.

The examination of the femoral head shows at once that it may be divided, functionally, into an anterior and posterior, an upper and lower segment. The anterior segment is characterized by the smoothness of its external contour and its roundness when compared with the posterior segment, which is rough, presenting irregular elevations. The

margin of the head in the posterior segment is considerably mushroomed; this is not so in the anterior. The corticalis of the posterior segment is very thin, and in one place has disappeared, so that the spongiosa is exposed. (This is not broken.) The head is no longer nearly spherical, but bullet-shaped, with a rounded apex in the line of the cervical axis. Crossing the anterior segment is a slight ridge which divides the anterior segment into an upper and lower portion. The upper portion is somewhat rougher and flatter than the lower, and this division will be later referred to in the description of the section.

FIG. 10.

Normal femur from same subject.

From the anterior half of this femur a section was cut varying from 3 to 4 mm. in thickness. A similar section was taken from the left femur. Through a mishap the spongy portion in the lower portion of this section was broken. The spongy tissue should be intact through the section. The following measurements show in part the decided differences existing between the right and left femurs: Diameter from the circumference of the head to the base of trochanter major: right, 8.75 cm.; left, 10.40 cm. Height of trochanter major from tip to base: right, 4 cm.; left, 4.46 cm. Greatest thickness of adductor compacta: right,

0.58 cm.; left, 0.44 cm. Greatest thickness of abductor compacta: right, 0.57 cm.; left, 0.34 cm. Angle between the neck and shaft: right, 122°; left, 127°.

The following changes of external configuration may therefore be noted: (*a*) General diminution in the size of the bone; (*b*) diminution of the angle between the shaft and the neck; (*c*) alterations in the shape of the femoral head, as before described.

The transmutations of the internal structure are, however, more striking, and when taken in conjunction with the above-mentioned alterations of external contour, and in view of the changed conditions of stress from both weight-bearing and muscular action, make it possible for us to present a rational interpretation. These transmutations may be described as follows:

1. The cancellous tissue is of looser mesh than that of the left femur.

2. The tension trabeculæ proceeding from the abductor side are shorter in length, but also of changed (shortened) radii. The pressure trabeculæ, however, seem, if anything, more numerous and of greater strength than those of the left femur. As the result of this, Ward's triangle, which is ordinarily constituted by the convergence of two well-defined groups of trabeculæ coming from the upper part of the head and region of the great trochanter, respectively, has disappeared entirely.

3. The most conspicuous change of the internal composition is, however, to be observed in the head. We have here a considerable cavity in the spongy tissue, corresponding in position to the flattened part of the head, and which is traversed by a few bone plates. The antero-posterior depth of this cavity is 2.50 cm.; its width in the coronal section is 2 cm. The antero-posterior diameter of the head at this part is 3.40 cm. The floor of this cavity corresponds exactly with that ridge on the anterior aspect of the head which divides this into an upper and lower segment.

4. Upon examining the anterior and posterior halves of the bone, it is seen that the cancellous arrangement in the anterior segment is more compact.

Unfortunate as it is for the present inquiry that no record is left to show the exact amount of motion and strength possessed by this dislocated hip, the changes of its structure nevertheless correspond strikingly with the requirements of Wolff's law. The atrophy of the unused parts, and the condensation of those bearing increased stress, as well as the decided change of external conformation, are sufficiently manifest as to impossibly escape notice. Equally evident, however, are the encroachment upon the original size of the acetabular cavity by the formation of new bone, and the irregular surface of the unused part of the femoral head for the same reason. I take it that we have here conditions

analogous to the so-called hypertrophy of the inner condyle in genu valgum, and that we are dealing with an increase in cubical dimensions as an accommodation to altered conditions of space. If this increase of cubical dimensions is to be so regarded it must be looked upon as a result of the deformity and not as one of its causes. Its functional rôle in resisting stress can, from its physical characters, be considered insignificant.

From the researches of Wolff, Zschokke, Schmidt, and others, as well as from the observations herewith presented, it is believed justifiable to conclude as follows:

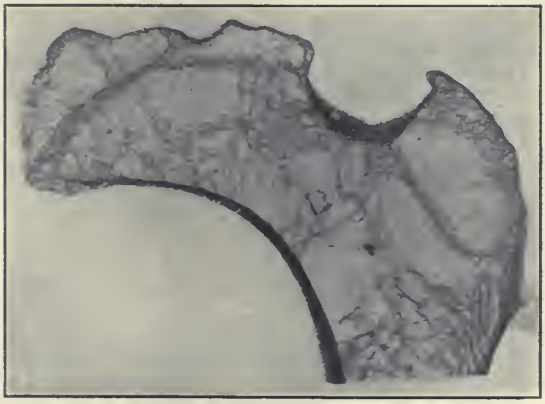
1. The strictly mathematical concept of Wolff's law has not yet been justified by demonstration.

2. Save in their mathematical aspects, the statements of Wolff's law and its corollaries may be accepted as being in agreement with observations hitherto made.

3. If we accept the foregoing statements it does not follow that we must make use of the so-called "functional methods" in our therapeutic endeavors; they are to be chosen not from theoretical considerations only, but for reasons of expediency and practicability.

[NOTE.—In the discussion following the reading of this paper there was presented the right femur of an idiotic woman, thirty-five years

FIG. 11.



Section of femoral head of a paralytic idiot, aged thirty-five years.
(By permission of Dr. R. T. Taylor.)

of age, by Dr. R. Tunstall Taylor, of Baltimore. The specimen is of such interest, and is believed to be corroborative to such a degree, that, with Dr. Taylor's kind permission, the case and section of the bone are herewith briefly presented. The subject from whom it came was

a paralytic, considerably deformed, having severe scoliosis and being greatly underdeveloped. The fibula of this subject was about fifteen inches long and somewhat greater in thickness than a good-sized knitting-needle. The pelvis was likewise deformed. The femur is extremely light in weight. Its extreme length is 38 cm.; the coronal diameter of the shaft at the middle is 1.3 cm. The head is greatly flattened from above downward, as may be seen from the section. The surface is marked by several deep grooves of antero-posterior direction. Otherwise the bone is of fairly normal shape, with the exception of the trochanter minor, which forms a quite long spur projecting anteriorly, leaving a deep groove between it and the upper part of the shaft. The radiogram of the section of the upper extremity of this femur is almost self-explanatory. (Fig. 11.) Vestiges of the normal internal structure are apparent. Such are the intermediary epiphyseal disk, some of the principal pressure trajectories, and some of the arches as well. The upper end of the bone is, however, merely a hollow shell, and expressive, it seems to me, not only of imperfect development, but of general atrophy also. As far as can be ascertained, this person was never able to maintain the upright position.]

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A DISCUSSION OF WOLFF'S LAW.[1]

By R. Tunstall Taylor, B.A., M.D.,

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We should feel much indebted to Dr. Freiberg for bringing the subject of Wolff's law, with its subordinate corollaries, before this Association, if for no other purpose than to promote a discussion of the thoroughness of its proof and its apparent impregnability.

[1] Read before the American Orthopedic Association, at Philadelphia, Pa., June 6, 1902.

To those of us who were fortunate enough to have read Wolff's first paper and his final article in the *Archiv für klinische Chirurgie*, or Freiberg's abstract in the *Annals of Surgery*, fruitful points of view were found for study of the etiological, pathological, clinical, and therapeutical problems that come under our observation.

To those of us, on the other hand, who are not familiar with this work, or who still cling to the theories advanced by Volkmann, Hueter, Roser, Lorenz, and others, known as the "pressure theory," blaming "superincumbent weight" and "atrophy" incident to it with many if not all of the deformities seen, Dr. Freiberg's present paper will at least make us think how much or how little we can apply these preconceived ideas to the pathogenesis of deformity, and how much we are indebted to Wolff for an entirely new aspect of the subject.

Many difficulties confront the majority of us in the study and proof of this law.

First, from a mathematical standpoint, how few of us are in a position to handle, as a well-known physicist put it to me, "the vector analysis, involving the N different variables," entering into the problem of joint motion, use, and function, there being no by-law rendering a Ph.D. acquired in higher mathematics or mechanics as an essential to fellowship in the American Orthopedic Association.

By means of such a "liberal education," to quote one of Dr. Gilman's favorite expressions, we would be in a position to discuss the mathematical and mechanical problem involved in the pressure, shearing stress, and tension trajectories of graphic statics in three dimensions, and Cullmann's discovery of the analogy in arrangement of the trabeculæ in the bone spongiosa and corticalis to his well-known drawing of the crane.

To most of us the mathematical side of this law must remain simply a point of interest, and one which we will not try to prove or disprove.

Second, in regard to the pathological proof.

Howard Kelly once said to me, "You orthopedic surgeons have no mortality in your cases!" This, in comparison with some of the other specialties, is in a sense true, and hence we have fewer opportunities to study the diseases or affections we are called upon to treat, post-mortem, pathologically than (shall I say?) some of our luckier brethren.

Even granting that our medical museums are well stocked with orthopedic preparations—which, alas! is far from the case—how few curators (or surgeons who own these necessarily valuable specimens) are keen to allow them to be cut into sections to study the trabeculæ of the spongiosa or measure the hyperplasia or diminution of the corticalis.

Third, from our training, reading, and preconceived ideas, how few of us are willing to discard entirely the theory of pressure or superin-

cumbent weight, especially in regard to the etiology of scoliosis, when most of our American authors at the present time—notably Bradford and Lovett, Whitman, Young and Judson, and such foreigners as Volkmann, Roser, Lorenz, Hoffa, Schreiber, Redard, and others—have advocated it; and many by experiment on the cadaver or vertebral column have produced a true rotary lateral curvature by superincumbent weight alone when function was, of course, a thing of the past. Whitman's is the only American text-book referring to Wolff's law, and this in an isolated way, and not applied to the diseases themselves.

Now it will be my aim to discuss Wolff's final paper more in detail, as upon it I have understood from Freiberg's abstract that his paper is based.

If we consider the mathematical postulate involved in Cullmann's tension and pressure trajectories of graphic statics, cannot we well question their accuracy if we consider the manifold directions and amount of force (*i. e.*, vectors) involved in the function, for example, of the hip-joint, with its numerous muscles and their dissimilar attachments and modes of action? *Apropos* of this, Wolff says himself, on page 837 of the article in question, replying to the criticisms of Hollander and Korteweg: "I also concede that the conditions in the live organism are much more complicated than they can appear in the mere observation of Cullmann's drawing. Many anatomical and mathematical researches will be necessary to complete our knowledge in this direction."

Atrophy undoubtedly, in its true sense, as shown in sections of diseased or morphologically changed bones and joints, does not take place, but an adaptive thickening of the corticalis and condensation of the spongiosa by transposition of burden-bearing; but can we agree absolutely with Wolff when he says this "cannot be due to pressure, but must be due to function?" Cannot pressure produce a condensation and thickening of bone as it does in the skin, as is shown by the callosities in the latter from pressure?

On pages 853 and 854 Wolff conclusively disproves that atrophy is the result of these conditions; and in his work in 1870 and Roux's observations on the "relation of the external shape to the internal architecture being dependent on the demands made on the part," their views were thoroughly substantiated by pathological evidence. But for the reason that he has found instead of an "atrophy," as the pressure theorists have called it, an osteosclerosis on the concave side of deformities, rendering this situation more suitable for "*burden-bearing*," for him to conclude that function has done it all and superincumbent weight none of it, seems to me open to question.

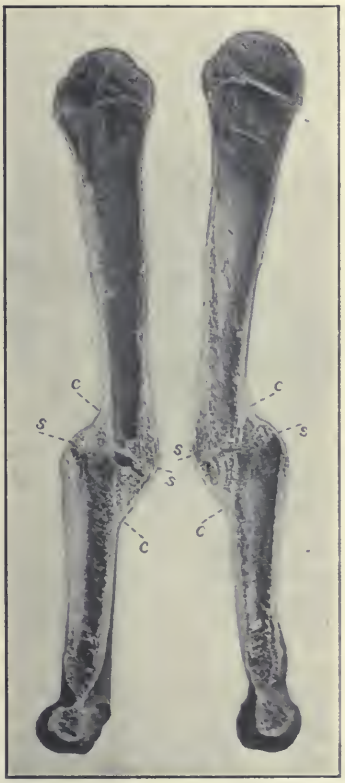
While no one will question, after the examination of pathological specimens, that the concave side of a bone or a series of bones acquires

a density or strength adapted to the burden-bearing required, can we say positively—leaving out the mathematical inferences—from the evidence (pathological) at hand, or as the logical conclusion of his arguments, that function is the only stimulus to this change unless we include both burden-bearing (otherwise called superincumbent weight) and pressure, to which he later adds accommodation to space, under the generic name of function?

In the third chapter, headed "Clinical Observations," Wolff goes on to state that because we find pathologically that both the internal architecture and configuration are changed, and the external form as well, in deformities, that these deformities are caused by and are the result solely of a functional transformation of bone, whether in the "narrower or wider sense of the term;" yet he goes on to state that "the shape of the bones and joints of the deformed part represents nothing else than the expression of a functional accommodation to the faulty *static demands* made upon it."

It seems to me, therefore, that the "static demands," or what we are wont to call vicious or unavoidable attitudes, cause deformities, and the functional bone transformations simply intensify them.

Fig. 1.



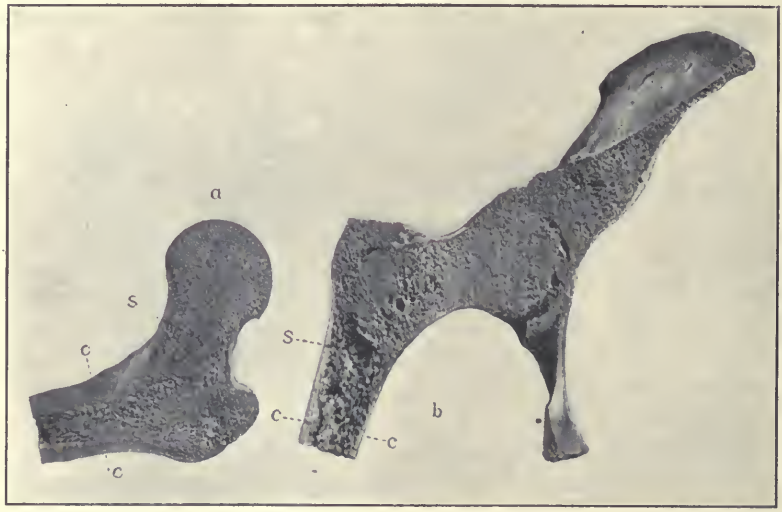
Sections showing deformity following malunion of the humerus. c. Thickening of the cortex at the concavity. s. Thinning of the cortex and greater porosity of the spongy portion of the convexity of the deformity.

He mentions—and we are all familiar with cases of beginning scoliosis without bony change—and would anyone of us expect either the formation of the "scoliotic wedges" or torsion in the vertebræ if superincumbent weight were removed by the habitual recumbency of such an early case of lateral curvature? and, *vice versa*, in such a case, if superincumbent weight were allowed to act continuously, which of us would not fear the pathological changes named?

Further, in a severe case of congenital talipes equino varus before

the child has walked we consider it a deformed foot, but there may be no functional use nor bony change. Wolff says the transformation of bone constitutes deformity, and this transformation is necessary to

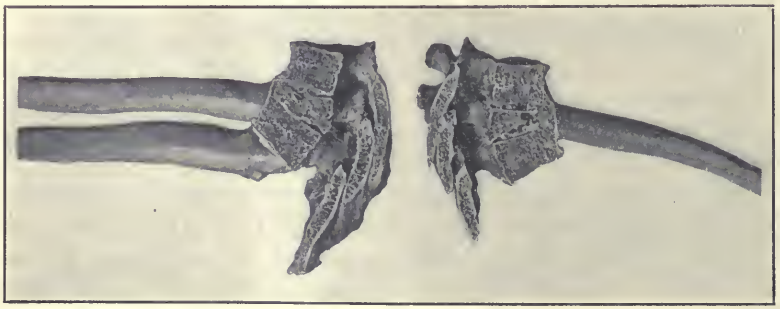
FIG. 2.



Sections of femora: (*a*) Normal; (*b*) tuberculous ankylosis. *a*. Cortex thick at *c c*, with regular trabeculæ in spongiosa at *s*. *b*. Cortex thin at *c c*, with irregular trabeculæ in spongiosa at *s*.

function. This we can accept generally, but can we agree with his statement that in all cases the pathogenesis of deformities is functional?

FIG. 3.



Sections showing ankylosis of vertebral bodies following tuberculous spondylitis (Pott's disease). No marked change in thickness of cortex to meet new functional demands.

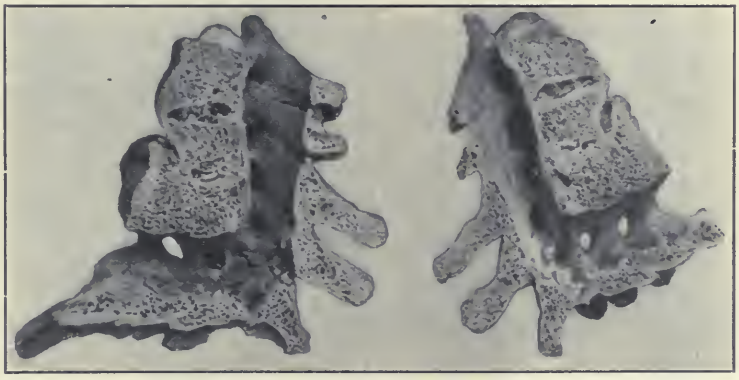
Wolff is correct, so far as we know, in that there is no pathological evidence of an osteomalacia or bone softening in the scoliotic deformi-

ties of adults and the bed-ridden; but cannot we find muscular contractures from various causes producing bone pressure, with ultimate deformity?

Wolff, speaking of the "scoliotic wedge," acknowledges that "pressure from the outside" deprives bone of space to grow in, and hence causes trabeculæ to be formed in abnormal positions and directions. Why should "pressure from the outside" produce such results and pressure from above not do the same thing?

Could we not consider the so-called "atrophy" on the concave side of the scoliotic wedge or the external condyle of genu valgum rather an osteosclerosis or condensation, and on the opposite side an osteoporosis, as better terms, whether due to superincumbent weight or "a functionally limited space to grow in," as Wolff puts it, or, better still, due to both?

FIG. 4.



Sections showing rectangular deformity of spine following Pott's disease, with no narrowing of the lumen of the spinal canal. No marked change is seen in the trabecular arrangement of the corticalis or spongiosa.

In conclusion, I consider that all of us must concur fully with Wolff that pressure does not produce atrophy in bone, as Lorenz has claimed, under pathologically increased or transposed burdening; and also we must admit that functional transformation of bone must and does occur to meet the altered static demands of pressure, tension, and shearing strain.

On the other hand, I am not in a mental attitude—perhaps from incomplete study of this problem or from Wolff's arguments not being clearly logical to me—to admit that we can attribute all deformities to function alone, regardless of superincumbent weight.

That we can have, however, some deformities from functional demands and a functional transformation of bone I do admit, as is

shown in the mal-union of a fractured humerus submitted herewith (Fig. 1), in which, of course, superincumbent weight plays no part and function is the causative factor.

On the other hand, the specimen of ankylosis of the hip-joint shows no additional lamellæ on the concave side of the femoral neck, as we

FIG. 5.

FIG. 6.

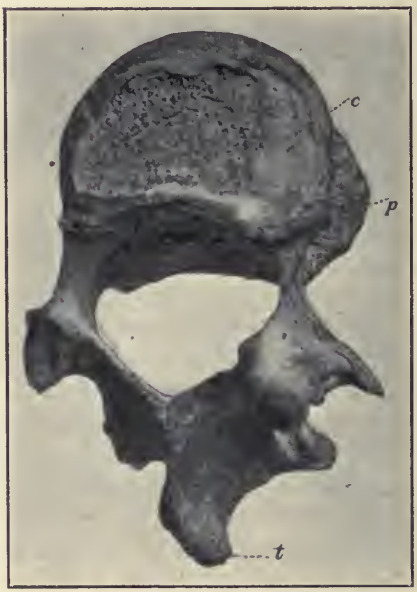


FIG. 5.—Sections showing deformity following mal-union of tibia and fibula. *c.* Functional bone transformation, as in Fig. 1.

FIG. 6.—A scoliotic vertebra. *t.* Torsion of the lateral arches and spinous process is seen. *p.* Growth to the right of the vertebral body, with approximation of its superior and inferior planes on the right side ("scoliotic wedge"). *c.* Osteosclerosis of cortex, to meet the "functional demands" of "superincumbent weight."

would expect, nor condensation of the spongiosa. The trabecular arrangement is altered, however. (Fig. 2.) The specimen of ankylosis of Pott's disease shows but little increased tissue density on the concavity of the curve. (Figs. 3 and 4.) Wolff's functional transforma-

tion is also shown in the specimen of mal-union of tibia and fibula (Fig. 5) and in that of the scoliotic vertebra. (Fig. 6.)

Finally, from a therapeutic standpoint, Wolff's law would seem to teach us the reason for the importance of *overcorrection* in genu varum and valgum, after operation, to promote bone tranformation; also hyperextension in Pott's disease; a fixation position or exercises of *overcorrection* in scoliosis and its application to the correction of conditions like coxa vara, to strengthen weak points in the femoral neck by operation, assisted by functional conformation to meet static demands.

Finally, additional research along this line of thought by different observers would be most helpful to either establish finally Wolff's law or point out its limitations.

THE SURGICAL TREATMENT OF CIRRHOSIS OF THE LIVER, WITH A SUMMARY OF REPORTED CASES.

By Robert B. Greenough, M.D.,
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Few subjects in modern medicine have aroused more interest than the comparatively recent proposal to bring cirrhosis of the liver within the scope of surgical relief, and a comparatively large number of cases have already been reported in which the operation has been performed with varying success. As with many new operations, it has been enthusiastically applied to conditions for which its originators did not intend it, and has suffered in consequence in its professional reputation. The operation, however, has now gone beyond the experimental stage, and a just estimate of its value should be possible from the cases reported. Such an estimate, so far as the published details of cases go, is here offered for consideration.

To Talma, of Utrecht, belongs unquestionably the claim of priority in this procedure, but to Morrison and Drummond, of Newcastle, must be conceded the first practical demonstration of the success of the operation, and its presentation as a reasonable surgical procedure. Talma's theory of operation was based upon his observation at autopsy that cases of liver cirrhosis which showed the least ascites were those in which abundant anastomoses existed, through the pre-existing channels, and through accidental adhesions between the vessels of the portal system and those of the systemic circulation. By increasing the adhesions he hoped to increase the anastomoses and thus diminish the portal congestion. Drummond and Morrison conceived the same idea, quite independently of Talma, and proceeded to put their plan to prac-

tical test. Both of these theories, however, were based upon the mechanical theory of the production of ascites in liver cirrhosis, and were intended to relieve the portal congestion and particularly the symptom of ascites. No one expected to affect in any way the changes which had already occurred in the liver, or in other organs, except so far as to prevent further progress of the disease by establishing by adhesions a more efficient blood supply to and from the liver and the spleen, and thus aiding in the recuperation of the tissues which were not already destroyed beyond repair.

In 1891, however, Terrier, of Paris, performed an operation of an entirely different nature from that of Talma or Morrison for the relief of the condition known as biliary or Hanot's cirrhosis. Terrier's operation, which was later taken up by Delageniere, of Mans, and made popular by him, is commonly spoken of as Delageniere's operation, and some confusion has existed between this procedure and Talma's operation. The two operations, however, are fundamentally different—Delageniere's being based upon the theory, which obtains in France, that hypertrophic or biliary cirrhosis is due to an infection of the bile-ducts proceeding from the intestine. Drainage of the bile-ducts is obtained by cholecystostomy and the maintenance of a biliary fistula. Guillot[65] cites five instances of this condition where culture showed a bacterial infection of the bile-ducts, generally by the colon bacillus, and considerable evidence is presented in support of the angiocholitic origin of biliary cirrhosis. Guillot collected thirteen cases in which the operation of cholecystostomy was performed, ten of which were successful in relieving the disease. To this number four more cases may be added up to the present time, or seventeen cases, thirteen of which were relieved.

TABLE I.—CASES OF BILIARY CIRRHOSIS AND ANGIOCHOLITIS.[64 65 67]

	Operator.	*Date.*	*Operation.*	*Result.*
1.	Terrier	1891	Cholecystostomy.	Recovery.
2.	Le Dentu	1892	"	Died.
3	Quenu	1892	"	No improvement.
4.	"	1895	"	"
5.	Delageniere	1896	"	Recovery.
6.	"	1897	"	"
7.	Michaux	1896	"	"
8.	Delageniere	1898	"	"
9.	"	1899	"	"
10.	"	1899	"	"
11.	Bossowski	1900	"	Improved.
12.	Panchet	1900	"	Recovery.
13.	Lejars	1900	"	"
14.	Delageniere	1900	"	"
15.	"	1900	"	"
16.	Terrier	1900	"	Died.
17.	"	1900	"	Recovery.

It must be said that adhesions between the gall-bladder and the abdominal wall fulfil to a certain extent the conditions of Talma's

operation, but with this exception, the two operations are entirely different and not susceptible of comparison. Three of the thirteen cases relieved, however, presented the symptom of ascites, and it is probable that some fatty enlarged livers of alcoholic cirrhosis are included in this list of cases.

The operation of cholecystostomy and drainage of the bile-ducts is thus seen to promote recovery in a considerable number of cases of enlarged liver. Cases of cure of this condition without operation other than exploratory laparotomy have been reported by Routier, Hartmann, Delbet, Quenu, Segonde, and Faure,[61] and may be taken as indicating that the condition is not one entirely hopeless without surgical relief. The number of reported cases is too few, however, and the pathology of the condition too little understood for definite deductions to be made concerning the value of operation in this disease. Such evidence as exists seems to show that surgical interference in a certain proportion of cases is justified and gives promise of relief. A larger number of observations will be necessary before more definite conclusions can be drawn.

Talma's operation, or suture of the omentum for the relief of ascites, depends, as has been said, upon the theory that the ascites in liver cirrhosis is of mechanical origin. This theory has been generally accepted, but a certain number of observers have contended that the toxæmia resulting from the destruction of liver cells is responsible for the ascites. The tendency to the development of œdema of the legs and feet is cited in support of this latter view, and although attributed by many to pressure of the ascitic fluid upon the vena cava, occasionally occurs independent of ascites. It seems to the writer not impossible that the two factors may be combined, the toxæmia exerting its influence and producing exudation at the point of least resistance —*i. e.*, the already obstructed portal circulation.

Thompson[62] and Hale White[63] bring a new factor into consideration by advancing the theory that ascites in liver cirrhosis, particularly if of long duration, may be due to purely accidental co-existing causes such as chronic peritonitis or perihepatitis. White cites autopsy reports in support of his contention to the effect that of ten cases of cirrhosis with ascites which survived more than one tapping, four were proved at autopsy to have no cirrhosis and six to have had peritonitis in addition to cirrhosis. It must be remembered in this connection that the large number of lymphatic openings on the under surface of the diaphragm would be obliterated by a peritonitis in this region, and the normal facilities for the absorption of peritoneal lymph thereby diminished. Another point, however, must be considered in connection with Hale White's cases, and that is that the chronic peritonitis which he observed at autopsy in his six cases of cirrhosis may well have been

in part itself produced by the numerous tappings which had been performed.

The classical experiments of Eck[55] established the fact that diversion of the portal blood before its passage through the liver into the systemic circulation was accompanied by symptoms of toxæmia and by almost uniformly fatal results. Some of the products of digestion seem to need to be elaborated by the liver cells before they can be safely received into the general circulation. An excess of carbaminic acid, one of the supposed precursors of urea, was thought to be the exciting cause of these toxic symptoms by Hahn,[57] as a result of his experiments. Toxic symptoms of this nature may arise in two ways: (1) By destruction of liver cells; (2) by over-abundant anastomosis and consequent short-circuiting of the liver. From the first cause they are probably not uncommon in terminal stages of many cases of cirrhosis. From one or both of these causes symptoms of toxæmia have been noticed in at least four cases after Talma's operation, although in such cases readily controlled by diminution of proteid diet.

Experimental operations on dogs have been performed by at least three observers—Tillman[54] Kusnetzow,[56] and Pascale.[55] They have proved that after suture of the omentum a dog will survive the gradual cutting off of the branches of the portal vein, whereas a fatal result occurs if the omental anastomosis has not been first secured. Care must be taken, however, in applying the results of experiments on healthy dogs to operations performed upon patients suffering with cirrhosis of the liver, because of the pathological changes of bloodvessels, heart, kidney, spleen, and other organs which so frequently accompany this disease.

The anastomoses commonly found to exist between the portal and the general systemic circulation are given by Frazier[18] as follows:

1. The coronary with the œsophageal and azygos veins.
2. The vessels of the cæcum and colon with the internal mammary branches.
3. The hemorrhoidal with the hypogastric vessels.
4. The vessels in the hepatic ligament and in Glisson's capsule.
5. The umbilical or para-umbilical vein in the round ligament with the epigastric vessels.

The number of reported cases of Talma's operation for ascites which I have been able to collect from all sources up to May 5, 1902, amount to 122 cases. This number does not include the following cases which have been rejected for not fulfilling all the necessary conditions of this analysis: 1. The case of Ries,[51] no ascites, Talma's operation for hemorrhage in cirrhosis, successful in that hemorrhage did not recur, but time elapsed not stated. 2. The case of Bossowski,[50] and one of Delageniere,[67] operation of cholecystostomy (see biliary

cirrhosis). 3. The case of Willems,[52] no ascites, enlarged liver and spleen in a child aged five years, Talma's operation and diminution of liver dulness, twenty-four days after the operation. 4. Three cases of Markoe and one of Dwight where exploratory laparotomy alone was done.[38] 5. The case of Tansini,[53] where Talma's operation was done in addition to splenectomy for so-called Banti's disease, splenomegaly and liver cirrhosis, ascites present, condition improved after lapse of one month. 6. The case reported by Kümmell,[45] in which exploratory laparotomy in a case of cirrhosis was followed by relief to the ascites; the author attributed this relief to probable inclusion of the omentum in the wound, but proof of this was not apparent.*

Of the 122 cases collected, 94 are gathered from the literature in more or less detail, and 23 are taken from the paper of G. E. Brewer,[38] where they were reported in tabular form, being derived from personal communications made to him by the surgeons who operated upon them. Five other cases are here reported for the first time. The total number of cases available for analysis thus amounting to 122.

In the first place the operation as suggested by Talma and Morrison was intended for the relief of ascites in cirrhosis of the liver. It has been applied, however, to many cases of ascites due to other causes, for which in the minds of its originators it was never intended. This has occurred in some cases through errors of diagnosis, and in others through the intentional application of Talma's operation to ascites of any sort. Two cases of adherent pericardium were operated upon, 1 a case of mistaken diagnosis and reported as such (Case 108), the error being discovered at autopsy one year later, no improvement having resulted from the operation; the other being alive and free from ascites two years after the operation (Case 27). One case (Case 52) of ascites of cardiac origin died shortly after the operation. Four cases of ascites thought to be due to renal disease were operated upon. One was improved after seven months (Case 51), and three died within six weeks (Cases 20, 22, and 23). Six other cases showed evidence of renal disease and have been taken from among the number of presumably uncomplicated cirrhosis cases. One (Case 6) was alive and had no ascites two years after the operation, and 5 (Cases 8, 32, 40, 61, and 63) died within two weeks. Two cases are reported in which the ascites was due to chronic peritonitis (Cases 12 and 13). Both died without improvement before six months.

Two other cases are recorded in which the ascites was due to disease of the liver other than cirrhosis, and these cases also have been with-

* The cases reported by Bunge[46] at the Thirty-first German Surgery Congress (American Medicine, May 3, 1902, p. 720) were not published in sufficient detail to be of value. The paper by Eyselsteyn,[47] ten cases, and those of Dalmastri[48] and Landrieux[49] were not obtainable in the originals.

drawn from the uncomplicated cases. One of echinococcus (Case 10) died in four days, 1 of "tuberculous cirrhosis" with undoubted tuberculous peritonitis (Case 70) slightly improved after one year. Three cases of malarial cirrhosis are reported (Cases 29, 66, and 72). This is a condition apparently found more frequently in Italy than elsewhere, but good authority vouches for its existence and states that ascites may result (Hoppe-Seyler). Of the 3 cases, 2 showed no improvement, and one slight improvement several months after operation. Three cases of probable syphilitic cirrhosis are recorded, 1 improved five months after operation (Case 14); 1, no improvement and death in nine months (Case 45); and 1 relieved of ascites, but dying five months later of hemorrhage (Case 50).

The cases of malarial and syphilitic cirrhosis have been included with those of presumably alcoholic cirrhosis as being essentially of the same character. The cases of ascites due to other causes, however, as above described, 17 in number, have been deducted. There are thus left for consideration 105 cases in which at least no good evidence exists to show that we are dealing with other than uncomplicated liver cirrhosis.

Serious deficiencies in the published details of cases are evident, as remarked by Brewer. Such details as are given, however, are here presented.

Of 105 cases, 31 (29.5 per cent.) died within thirty days of the operation; 44 reported improved or slightly improved after the operation (42 per cent.), and 29 (27.6 per cent.) showed no improvement. One case could not be traced. Thus 60 cases (57.1 per cent.) obtained no benefit from the operation.

Forty-four cases are reported to have shown improvement after the operation. This statement is made, as a rule, by the surgeon reporting the result, and may be understood as applying especially to the symptom of ascites. Four among this number (Cases 48, 50, 88, and 116) were relieved of ascites, but died within five months after the operation, of toxæmia, hemorrhage, myocarditis, or unstated causes. These cases although relieved of ascites cannot with propriety be considered as successful results. The amount of time elapsed between the operation and the report of improvement also varies widely, and a considerable number of cases are reported far too soon to allow any estimate of value with regard to the ultimate effect of the operation. Thus, 2 were reported improved before one month had elapsed, 7 between one and three months, 12 between three and six months, and 12 over six months. In 11 cases the actual time elapsed is not stated; 9 cases, however, lived two years after the operation and were then improved (8.5 per cent. of the whole number). It would be manifestly unjust to deny that a case apparently improved three or six months after the

operation might not be permanently relieved, and perhaps more unjust when the time elapsed is not stated. To accept such cases as cured, however, in view of the fact that 16 cases at least of those surviving the operation died from one to twenty-four months later, seems equally unwarranted. For this reason the cases of apparent improvement have been stated to be 44, while those of lasting relief have been reduced to 9.

An analysis of the 9 cases improved after the lapse of two years is of interest. The duration of symptoms before operation was not stated in 3, 2 were of two months duration, 1 six and 1 fifteen months, 1 two years and 1 ten years. Tappings before operation not stated in 3, none in 1, one or more taps and several taps each 1 case, 1 was tapped twice, 1 five and 1 nine times. The condition of the liver was atrophic in 5 cases, cirrhotic in 2, and not noted in 2 cases. Adhesions were present in 1 case, œdema of the feet in 3 cases; 2 had partial return of the ascites after operation, and 1 of these had to be tapped once, but the fluid did not return. One case died after the two years were up of gastroduodenal catarrh, but with no other symptom of cirrhosis. Another died of operation for ventral hernia which followed the first operation. The consideration of the reported details of these 9 cases, therefore, gives no light upon the important question of the reason for their successful outcome as compared with the lack of success in the majority of cases of operation.

In assembling the statistics of this operation it has seemed important to ascertain, so far as possible, which cases offer the most promise of success, and which the least. The condition of the liver was not recorded in 53 of the 105 cases; in 15 the liver was enlarged, and in 37 it was atrophic. Of the 15 cases of enlarged liver, 3 died (20 per cent.), and 9 were improved (60 per cent.). Of the 37 atrophic cases, 11 died (29.7 per cent.), and 13 were improved (36 per cent.), a decidedly better outlook for the cases with enlarged liver.

The contention of Thompson[62] and Hale White,[63] that the cases which survive several tappings are those in which the ascites is due to or increased by a perihepatitis, has great interest in the surgical consideration of these cases. At first glance it might be supposed that the artificial production of local peritonitis, if the ascites were due to such a process would aggravate rather than ameliorate the condition. It is conceivable, of course, that complete adhesion, by closing the cavity entirely, might prevent the re-accumulation of the ascites. Such a case has, indeed, been recently reported by Dalton,[58] in which five years of relief from ascites were due to this cause, as proved by autopsy after death from strangulated hernia. It seems unlikely, however, that any aseptic operation, however thorough, could produce such complete obliteration of the peritoneal cavity as this demands. In these 105 cases of cirrhosis,

adhesions or perihepatitis were noted in only 8 cases, 5 of which received benefit from the operation (62.5 per cent.). In 13 cases the fact that the peritoneal surface was normal was recorded, and of this number, 6, or 46 per cent., were improved. The numbers are too small for the purpose of drawing definite conclusions, but they suggest that the presence of adhesions gives a better prognosis, and that operation in such cases does not aggravate the condition. It was, indeed, such cases of adhesions that suggested the possibility of operation to Talma and to Drummond.

In this connection, it may be said that of 12 cases not tapped more than once before operation, 50 per cent. were improved, and of 35 cases which were tapped twice or more, 42.8 per cent. were improved. The difference is too small to be of importance in prognosis, but the figures are at least evidence that it is not alone the cases of long-standing and continued tapping which have benefited by the operation. Œdema of the feet and legs was reported present in 22 cases; 11 of these, or 50 per cent., were improved after operation. In the 83 other cases in which œdema was absent or not recorded 33 were improved (40 per cent.). Œdema of the feet can, therefore, not be regarded as of especially bad prognostic import.

The technique of operation has been varied to suit the taste of the individual operator in many instances, and not enough operations after any one method can be collected to form an estimate of the value of any one procedure. Talma recommended the suture of the omentum to the margin of the abdominal incision, and the irritation of the peritoneal surface of liver and spleen. Morrison sutured the omentum and rubbed and scratched the peritoneum over liver, spleen, and abdominal wall in order to obtain more extensive adhesions. Turner sutured the omentum between the liver and the diaphragm and further sutured the liver to the abdominal wall. Schiassi and other Italian surgeons have placed the omentum spread out between the layers of the abdominal wall, either between peritoneum and muscle or between the muscular layers. Several operations of this nature have been done in this country. Of 68 cases of suture of the omentum combined with rubbing of the peritoneal surfaces to a greater or less extent, 22 died (32.3 per cent.), and 28 were improved (41 per cent.). Of 23 cases where the omentum was spread out between the layers of the abdominal wall, 4 deaths occurred (17.3 per cent.), and 10 cases were improved (43.4 per cent.). This modification of the original operation, therefore, gives slightly better results without increasing the mortality of the operation.

The operation has been done with ether, chloroform, and cocaine anæsthesia. Sufficient details are not given to allow of a report of the comparative merits of these anæsthetics. Two cases are reported in which the operation was begun under cocaine, but ether had to be

administered, in order to complete the operation. A number of surgeons express themselves as opposed to the use of ether on account of the liability to renal disease among these cases.

Drainage was employed in 20 cases, with 10 deaths (50 per cent.). The wound was closed without drainage in 34 cases, with a mortality of only 5 (14.7 per cent.). These figures bear out the opinion of Weir, Brewer, and several other surgeons, who are opposed to drainage on account of the danger of infection. Of 6 cases which died of peritonitis or sepsis within thirty days of operation, 4 were drained, and in the other 2 the details of operation were not stated. The application of tight plaster strapping to the upper abdomen after operation as recommended by Morrison seems to meet with general acceptance.

Thirty-one cases died within thirty days of operation. The causes of death in these cases were as follows: shock, 4 cases (one of these was operated upon also for umbilical hernia); sepsis, 1 case; peritonitis, 5 cases; toxæmia, 2; uræmia, 1; exhaustion, 5; hemorrhage, 1; pneumonia, 1 (umbilical hernia operated upon at the same time); pleurisy, 1; intestinal obstruction, 2, and unknown cause, 8. Sixteen other cases died without improvement after the operation at a longer interval than thirty days; in 12 the cause of death was not stated. In 3 the cause of death was toxæmia, and in 1 case, phlebitis and embolism of lung. Seven other cases are now dead—2 after two years of relief, 1 of operation, and the other of gastroduodenal catarrh, and 1 after one year of relief, of erysipelas. Four cases died presumably of cirrhosis or its complications, but with relief to the ascites for which they submitted to operation. It is to be noted that the cause of death is given in 2 cases as due to intestinal obstruction. This danger is one of the reasons which has been urged against the operation. In 1 other case, where death occurred nine months after the operation without improvement, impacted feces were found in the colon and were attributed to partial obstruction due to the adhesions. The danger of intestinal obstruction following this operation is thus a real one, although extremely rare.

Summary. 1. The condition known as biliary cirrhosis, with enlarged liver, jaundice, and fever and without ascites, is accompanied in a certain proportion of cases by an infection of the bile-ducts. The drainage of the bile-ducts by cholecystostomy is a proper operation for the relief of this condition when evidence of infection is present and symptomatic treatment has failed to effect relief.

2. Of 105 cases of liver cirrhosis which presented the symptoms of ascites, 42 per cent. were improved and 58 per cent. not improved by Talma's operation or one of its modifications. The mortality within thirty days was 29.5 per cent. Nine cases were improved in health two years after the operation.

3. The nine cases of continued relief presented no marked differences from the general character of all the cases.

4. The cases in which the liver was enlarged gave a lower mortality and a higher percentage of improvement than cases of atrophic liver.

5. Cases of suture of the omentum between the layers of the abdominal wall gave a lower mortality and a slightly higher percentage of improvement than cases where only peritoneal surfaces were brought in contact.

6. Drainage increases the danger of septic infection and peritonitis and is to be avoided. If necessary, tapping may be done after the operation.

7. The presence of adhesions or perihepatitis is of good prognostic import as regards the success of the operation.

8. The number of tappings before operation and the presence of œdema of the feet and legs are of less prognostic importance than the general condition of the patient, the size of the liver and the functional activity of the liver cells.

9. Talma's operation or one of its modifications is of proved benefit in a certain limited number of cases of liver cirrhosis; primarily for the relief of ascites, and secondarily for the relief of other symptoms of portal congestion.

10. The dangers attending the operation are mainly due to the weakened resistance of the patient, rather than to the operation itself. The selection of cases suitable for operation demands more judgment than has been exercised hitherto.

11. The operation is not indicated in cases of ascites due to causes other than cirrhosis of the liver.

12. The operation is contraindicated in the presence of renal or cardiac disease and when good evidence does not exist that sufficient functional liver tissue remains to maintain life. It is also contraindicated when complications exist sufficient in themselves to make the result of operation uncertain.*

* The paper of Ito and Orni (Deutsche Zeitschrift für Chir., lxii. p. 141), (Centralblatt für Chir., 1902, 15, p. 417), five cases, and that of Harris (Journ. Amer. Med. Assoc., May 3, 1902, p. 1137), five cases (2 Harris, 1 Lee, 1 Oswald, and 1 McArthur), were obtained too late for incorporation in this table. The summaries of these cases follow:

1. Ito and Orni. Malarial cirrhosis, jaundice, ascites four months duration, spleen enlarged; suture, adhesions present, no drainage. Recovery; no improvement. Died in three months.

2. Ibid. Cirrhosis, enlarged liver and spleen, ascites (slight); suture. Recovery; improvement one year.

3. Ibid. Alcoholic atrophic liver, enlarged spleen three years duration, ascites tapped once; suture (Schleich), drainage twenty-four hours. Died in five days.

4. Ibid. Syphilitic case, jaundice, ascites; tapped once; suture. Recovery; no improvement. Died in four and a half months.

5. Ibid. Syphilitic liver slightly enlarged, œdema of feet, ascites; tapped eight times; suture. tied in four days.

6. Harris. Atrophic liver, enlarged spleen, ascites, jaundice; duration one year; tapped

Summary of Cases.

1. Van der Meule, 1889. Talma operation. Death in a few hours from shock.[1]

2. Schelkly, 1891. Talma operation. Atrophic liver and ascites. Death in fourteen days from peritonitis.[1]

3. Lens, 1892. Atrophic liver and ascites. Talma operation; no improvement. Died in six months.[1]

4. Drummond and Morrison, 1894. Enlarged liver, ascites, and œdema of feet, twenty months duration; tapped forty-eight times, Morrison operation; drainage; no improvement. Died in nineteen months.[4]

5. Ibid., 1895. Atrophic liver, enlarged spleen, ascites, œdema of feet, six months duration; tapped five times, Morrison operation; drainage; recovery and improvement. Two years later died of operation for ventral hernia.[4]

6. Eiselsberg and Talma, 1896. Renal disease, enlarged spleen, atrophic liver, ascites and œdema, two months duration; tapped six times; suture of omentum and gall-bladder; second operation (Narath) for spleen. Recovery after two years.[2]

7. Morrison, 1897. Atrophic liver, enlarged spleen, ascites, eight weeks duration; not tapped; Morrison operation; drainage. Recovery; improved after two years; toxæmia from meat diet.[5]

8. Ibid., 1897. Renal disease, ovarian cyst, atrophic liver, enlarged spleen, ascites, œdema of feet, eighteen months duration; tapped once, Morrison operation; no drainage. Died in eleven days from uræmia.[5]

9. Narath and Talma, 1898. Cholæmic case, enlarged liver and spleen, ascites, and œdema of feet, several months duration; tapped three times: adhesions, suture, no drainage. Recovery with much improvement, six months; toxæmia from meat diet.[3]

10. Weir, 1898. Echinococcus of liver, enlarged spleen, ascites; no œdema, two years duration; tapped twelve times, suture, perihepatitis, drainage. Death in four days, peritonitis.[8]

11. Neumann, 1898. Enlarged liver and spleen, ascites, no œdema, short duration; not tapped, suture, no adhesions, no drainage. Recovery; improved, six months.[7]

12. Narath and Talma, 1899. Chronic peritonitis, chylous ascites, atrophic liver, œdema of feet, three months duration; tapped five times, suture, no drainage; no improvement. Died in five months.[3]

13. Folmer and Talma, 1899. Chronic peritonitis, enlarged liver, ascites, and œdema of feet; two months duration; tapped three times, suture, no drainage; no improvement. Death in six months.[3]

14. Rolleston and Turner, 1899. Syphilitic, atrophic liver, enlarged spleen, ascites, and œdema; tapped once, Turner operation, no adhesions, no drainage. Recovery; improved, five months.[6]

15. Ibid., 1899. Atrophic liver, ascites, and œdema, two months duration; tapped once, Turner operation, no drainage. Recovery; no improvement, four months.[6]

16. Grinon, 1899. Cirrhotic liver, ascites; tapped seven times, intramural operation, no drainage. Recovery; improved, two months.[13]

17. Babroff and Chervinski, 1899. Atrophic liver, enlarged spleen, ascites, four months duration; suture, no drainage. Recovery; improved, three and a half months.[11]

18. Frazier, 1900. Atrophic liver, enlarged spleen, ascites, and œdema; tapped five times; suture, no drainage, omentum thickened. Recovered; improved, three months. Tapped twice after operation.[18]

19. Packard and Le Conte, 1900. Atrophic liver, enlarged spleen, ascites, and œdema, five

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nine times; suture; omentum thickened; no drainage; no improvement; cerebral hemorrhage. Died in three weeks.

7. Ibid. Alcoholic atrophic liver, spleen enlarged, four months duration, ascites, œdema of feet, arterio-sclerosis; suture, no drainage. Recovery; no improvement. Died two months.

8. Oswald. Alcoholic atrophic liver, spleen enlarged, ascites, œdema, slight jaundice; suture, no drainage. Recovery; no improvement. Died in six weeks.

9. Lee. Duration one year, ascites, tapped once, œdema; suture, no drainage. Recovery; no improvement. Died in ten weeks.

10. McArthur (see also Annals of Surgery, 1901, vol. xxxiii. p. 653). Alcoholic cirrhosis four months duration, ascites; tapped four times; suture. Recovery; improved. No ascites thirteen months later.

The addition of these ten cases to the previous 105 makes 115. Died in thirty days 34, 46 improved, and 34 no improvement. Died 29.5 per cent., improved 40 per cent, no improvement 29.5 per cent.

years duration; tapped four times, suture, drainage, no adhesions. Recovered; no improvement; died in two months, toxæmia.[14]

20. Ibid., 1900. Renal disease, enlarged liver, spleen not enlarged, ascites, and œdema of feet, ten years duration; tapped once, suture, drainage, no adhesions. Died in four days, from uræmia.[14]

21. Muscroft and Ingalls, 1901. Jaundice, atrophic liver, ascites, and œdema; tapped once, suture, drainage. Died in thirty hours.[28]

22. Roberts, 1900. Renal discase, question of sarcoma of liver, ascites, three months duration; suture, no drainage; no improvement. Died in six weeks.[15]

23. Ibid., 1900. Renal disease, atrophic liver, ascites, and œdema, eight months duration; tapped nine times, suture, no drainage. Died in twenty-four hours from uræmia.[15]

24. Benisowitch, 1900. Enlarged liver and spleen, ascites, several months duration; tapped three times; suture, no drainage, no adhesions. Recovery; slight improvement in six months. Tapped once after operation.[17]

25. Ibid., 1900. Case of advanced cirrhosis, ascites, three years duration; tapped three times, suture, no drainage. Died in two weeks.[17]

26. F. T. Brown, 1899. Atrophic liver, enlarged spleen, ascites, and œdema, fifteen months duration; tapped nine times, suture, drainage, omentum adherent. Recovery, improved, 26 months.[10]

27. Schiassi, 1898. Pericardial adhesions, question of cirrhosis, ascites, duration two months; tapped twice, intramural operation, no drainage. Recovery, improved, two years.[19]

28. Ibid., 1899. Cirrhosis, enlarged spleen, ascites, ten years duration; tapped once or more, intramural operation, no drainage. Recovery, improved, two years; toxæmia with meat diet.[19]

29. Ibid., 1900. Malarial cirrhosis, ascites, and œdema; intramural operation, no drainage. Recovery; no improvement.[19]

30. von Ssokolow, 1901. Atrophic liver, ascites, three years duration; tapped once, suture, no drainage. Recovery, improvement, four months.[20]

31. Bucco, 1901. Cirrhosis, ascites; intramural operation. Recovery, improvement eight days later.[41]

32. Brewer, 1899. Renal disease, atrophic liver and enlarged spleen, ascites several weeks duration; tapped once, suture, drainage, no adhesions. Death in two days from uræmia.[38]

33. Ibid., 1899. Atrophic liver, enlarged spleen, ascites, two to three months duration; suture, no adhesions, drainage. Death in twenty-four hours from shock.[38]

34. Ibid., 1900. Atrophic liver, enlarged spleen, ascites; not tapped, no adhesions, suture, drainage. Death in five days from peritonitis.[38]

35. Ibid., 1901. Atrophic liver, enlarged spleen, ascites, several months duration; not tapped, suture, no adhesions, no drainage. Recovery, improved, three months. Tapped twice after operation.[38]

36. Ibid., 1901. Atrophic liver, enlarged spleen, ascites, two months duration; suture, adhesions, drainage. Death in one week from peritonitis.[38]

37. Koslowski, 1901. Cirrhotic liver and ascites; suture. Recovery; no improvement.[16]

38. Commandini and Salvolini, 1899. Atrophic liver, enlarged spleen, ascites, and œdema. several months duration; tapped three times, suture, drainage. Death in a few days.[32]

39. Annovazzi and Parma, 1900. Atrophic liver, enlarged spleen, ascites, and œdema, three months duration; not tapped, suture, no drainage. Recovery, improved, sixteen months. Tapped three times after operation.[31]

40. Torrance, 1901. Renal disease (?), atrophic liver, enlarged spleen, ascites, and œdema, six months duration; tapped three times, suture, no adhesions, no drainage. Died in four days of uræmia.[40]

41. Raffa and Dozzan, 1901. Atrophic liver and ascites; suture, no drainage. Recovery; no improvement. Died in eleven months.[31]

42. Clementi, 1900. Case recovered without improvement.[31]

43. Ibid., 1900. Case recovered from operation; no improvement.[31].

44. Jelks, 1900. Ascites, six months duration; tapped twice, suture, no drainage. Recovery, no improvement. Died in three months of toxæmia.[27]

45. Roe and Spencer, 1900. Syphilis, atrophic liver, normal spleen, ascites, two and a half years duration; tapped thirty-two times, intramural operation, thickened peritoneum, no drainage. Recovery, no improvement. Died in nine months; question of partial obstruction to colon [39]

46. Ballin, 1900. Ascites and œdema, two years duration; tapped three times, suture, no drainage. Recovery, improved, five months.[23]

47. Wyman, 1900. Cirrhosis, ascites, œdema, two months duration; tapped twice, intra-

mural operation, no drainage. Recovery, improved, over two years. Died of gastroduodenal catarrh. Tapped once after operation.[23]

48. Ibid., 1901. Enlarged liver, ascites; tapped twice, intramural operation, no drainage; Recovery, ascites did not recur. Died three months later of toxæmia.[22]

49. Ibid., 1901. Ascites, one and a half years duration; intramural operation, no drainage. Recovery; ascites did not recur, general health no better.[22]

50. Bidwell, 1900. Syphilis, cirrhosis, ascites; suture, no drainage. Recovery; ascites cured. Died in five months of hemorrhage.[24]

51. Ibid., 1901. Renal disease, ascites, and œdema, liver slightly enlarged; tapped six times, suture, no drainage. Recovery, improved, seven months.[24]

52. Ibid., 1901. Cardiac disease and ascites, œdema, liver enlarged; suture. Recovery; died "shortly" of syncope.[24]

53. Ibid., 1901. Ascites and œdema; suture, drainage. Sepsis and death in a few days.[24]

54. Ibid., 1901. Cirrhosis, ascites, umbilical hernia; suture. Died in six days from bronchopneumonia. (Operation for hernia also.)[24]

55. Fawcett, 1901. Ascites; suture, no drainage. Death in five days.[25]

56. Moullin, 1901. Ascites; suture. Death in four weeks, from pleurisy.[26]

57. Ibid., 1901. Ascites; suture. Death in one week from exhaustion.[26]

58. Ibid., 1901. Ascites; suture. Recovery, well two years later.[26]

59. Ibid., 1901. Ascites; suture. Recovery, well two years later.[26]

60. Ibid., 1901. Ascites; suture. Recovery, later condition not known.[26]

61. Doglioni, 1902. Renal disease, atrophic liver, enlarged spleen, ascites, œdema, three months duration; tapped once, intramural operation, no adhesions. Died in ten days of renal and liver toxæmia.[36]

62. Dubourg and Mongour, 1900. Enlarged liver, ascites, eight months duration; tapped thirty times, suture, no drainage. Recovery, no improvement. Died five months later.[29]

68. Ibid., 1900. Renal disease, atrophic liver, ascites, three months duration; tapped twice, intramural operation, no drainage. Died in three days of uræmia.[29]

64. Poggi and Tieschi, 1901. Atrophic liver, enlarged spleen, ascites, and œdema; tapped eight times, intramural operation. Died in five days of hemorrhage from stomach.[33]

65. Pascale (del Giudice), 1900. Atrophic liver, ascites; suture. Death in thirty days; no improvement.[35]

66. Pascale (Stigliano), 1901. "Grave case," malarial cirrhosis, ascites, atrophic liver, intramural operation. Recovery; no improvement.[35]

67. Pascale (Troncone), 1901. Ascites; intramural operation. Died in a few days.[35]

68. Pascale (Paolucci), 1901. Atrophic liver and ascites; intramural operation. Recovery; no improvement. Died in a few months.[35]

69. Pascale (Cardarelli), 1901. Ascites and œdema; intramural operation. Recovery; no improvement. Died after many days of toxæmia.[35]

70. Pascale (Paolucci), 1901. "Tuberculous" cirrhosis, liver atrophic, peritoneum thickened, ascites, two years duration; tapped every two weeks, intramural operation. Recovery; slight improvement one year after; was tapped fourteen times in first five months; not since.[35]

71. Pascale (Marciano), 1901. Ascites; intramural operation. Recovery; slight improvement three months later. Tapped twice after operation.[35]

72. Pascale (Stazio), 1901. Malarial cirrhosis, ascites, œdema; intramural operation. Recovery; slight improvement after several months.[35]

73. Pascale (Cardarelli), 1901. Ascites; intramural operation, adhesions. Recovery; improvement after fifteen days.[35]

74. Casati, 1901. Advanced cirrhosis, ascites; tapped many times, suture. Recovery; no improvement in thirty days.[34]

75. Lastaria, 1902. Cirrhosis, ascites; suture. Recovery; no improvement.[42]

76. Titovf, 1900. Cirrhosis, ascites; suture. Died in a few days from peritonitis.[12]

77. Ibid., 1900. Cirrhosis, ascites; suture. Recovery; no improvement. Died three months later.[12]

78. Peck (Brewer). Atrophic liver, ascites, enlarged spleen; suture, no adhesions, no drainage. Recovery; improvement five months later; tapped five times after operation; no return of ascites for two months.[38]

79. Markoe (Brewer). Atrophic liver, enlarged spleen, ascites; numerous taps, suture, no drainage. Recovery; no improvement.[38]

80. Ibid. Atrophic liver, enlarged spleen; suture. Recovery; no improvement.[38]

81. Kelly (Brewer). Atrophic liver, enlarged spleen, ascites, two years duration; tapped several times, suture, drainage. Recovery; improvement two years later; no ascites.[38]

82. Le Boutellier (Brewer). Enlarged liver and spleen, ascites, seven weeks duration; tapped twice; intramural operation, no drainage. Death in a few days from exhaustion.[38]

83. Syms (Brewer). Enlarged liver and spleen, ascites; tapped three times, intramural operation, no drainage. Death in seven days from uræmia.[38]

84. Ibid. Atrophic liver, enlarged spleen, ascites; intramural operation. Recovery; no improvement. Died in five weeks.[38]

85 Curtis (Brewer). Atrophic liver, enlarged spleen, ascites; intramural operation. Recovery; improvement; tapped after operation; no return of ascites.[38]

86. Ibid. Atrophic liver, enlarged spleen, ascites; numerous tappings, intramural operation, no drainage. Recovery; no improvement.[38]

87. Fisk (Brewer). Ascites, ten months duration; suture. Died in six days.[38]

88. Meyer (Brewer). Ascites; suture. Recovery; ascites did not recur. Died in four months.[38]

89. Ibid. Ascites; suture. Died in two weeks.[38]

90. Gerster (Brewer). Atrophic liver, ascites, severe hemorrhages; suture. Died in a few days.[38]

91. Lloyd (Brewer). Atrophic liver, enlarged spleen. Recovery; improved two years later.[38]

92. Tilton (Brewer). Atrophic liver, enlarged spleen, hernia, ascites. Died of shock. (Operation also on hernia.)[38]

93. Woolsey (Brewer). Ascites; not tapped. drainage. Death from peritonitis.[38]

94. Ibid. Ascites; tapped few times, drainage. Death from exhaustion.[38]

95. Ibid. Ascites; tapped few times, drainage. Death from exhaustion [38]

96. Ibid. Ascites; tapped few times, drainage. Death from exhaustion.[38]

97. Ibid. Ascites; tapped twice, drainage. Recovery; improved; tapped less often.[38]

98. Ibid. Ascites; tapped twice, drainage. Recovery; improvement. Tapped less often.[38]

99. Bradford (Brewer). Enlarged liver, ascites; tapped eight times, suture, no drainage. Recovery; no improvement. Died in two and a half months.[38]

100. Burrell (Brewer). Atrophic liver, enlarged spleen, ascites; tapped many times, suture, no drainage. Recovery; no improvement. Died in a month.[38]

101. Greenough (not previously reported). Case from wards of Dr. F. C. Shattuck, Massachusetts General Hospital, 1900. Atrophic liver, enlarged spleen, ascites, twenty-one months duration; tapped twice, no œdema, suture, no adhesions, no drainage; no improvement. Died in three weeks.

102. Harrington and Vickery (not previously reported). Massachusetts General Hospital, 1901. Enlarged liver and spleen, ascites, œdema, four months duration; tapped three times, suture, adhesions, no drainage. Recovery; tapped four times after operation in forty-five days; improvement; no return nine months later. (To be published later in more detail.)

103. Koslowski, 1901. Cirrhosis, ascites; suture. Recovery; no improvement.[16]

104. Ibid., 1901. Cirrhosis, ascites; suture. Recovery; ascites did not recur.[16]

105. Villar, 1901. Cirrhosis; suture. Recovery; improvement.[21]

106. Ibid., 1901. Cirrhosis; suture. Recovery; improvement.[21]

107. Ibid., 1901. Cirrhosis; intramural operation. Recovery; no improvement.[21]

108. Ewart, 1899. Pericardial adhesions, enlarged liver, ascites, and œdema, five years duration; tapped fifty-two times, suture; peritonitis after operation. Recovery; no improvement. Died in one year; autopsy. (Reported as a case of mistaken diagnosis and similarity to Case 4 of Morrison's pointed out.)[9]

109. J. W. Elliot (case not previously reported, to appear in detail later). Enlarged liver, spleen normal, ascites, œdema, one year duration; tapped six times, suture, no drainage. Recovery; improvement. Six weeks later, tapped once after operation.

110. C. A. Porter and E. P. Joslin, Boston, 1900. Cirrhotic liver, enlarged spleen, ascites, no œdema, one and a half years duration; never tapped, intramural operation, no adhesions, drainage. Recovery; no improvement. Died. (Seven weeks phlebitis and embolus of lung, not previously reported.)

111. Mumford, Boston, 1898. Atrophic liver, ascites; suture, drainage. Recovery; no improvement. Died in three months. (Not previously reported.)

112. Kehr, Welp, 1902. Cirrhosis; suture. Recovery; improvement.[44]

113. Franke, 1902. Cirrhosis, ascites, suture. Died in seven days. Intestinal obstruction from pressure of colon on duodenum, operation, gastroenterostomy; death from pneumonia.[43]

114. Kümmell, 1902. Enlarged liver and spleen, ascites, and œdema; suture of ileus on fourth day; operation and death in few hours.[45]

115. Ibid., 1902. Extensive cirrhosis, enlarged spleen, and ascites; mitral stenosis; suture. Death in twenty-four hours.[45]

116. Ibid., 1902. Cirrhosis, ascites; tapped six times, suture. Recovery; ascites improved. Died in five weeks of myocarditis and pleurisy.[45]

117. Ibid., 1902. Enlarged liver and spleen, ascites, one year's duration; suture. Recovery improved one year later. Died of erysipelas.[45]

118. Ibid., 1902. Enlarged liver, ascites, jaundice; suture. Recovery; improved three months later.[45]

119. Ibid., 1902. Enlarged liver and spleen, ascites, long duration; suture. Recovery; improved in six weeks. (Heart lesion.)[45]

120. Bernays, Thompson, 1900. Alcoholic cirrhosis, ascites; Talma's operation. Recovery; no improvement. Died of the disease in six months.[37]

121. Ibid., 1900. Cirrhosis and ascites; operation. Recovery; improvement; time elapsed not stated.[37]

122. Lanphear, Thompson, 1900. Alcoholic cirrhosis, ascites; Talma's operation. Recovery; improvement; time elapsed not stated.[37]

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AUTOPSY IN A CASE OF ADIPOSIS DOLOROSA.

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The following case was presented *intra vitam* before the College of Physicians by one of us (F. X. D.), February 5, 1902. The history is briefly as follows:

Charles B., aged thirty-nine years, single; American by birth; wood carver by trade.

Family History. Father and mother living and well. Has four brothers and two sisters, who are in average health, except that one brother and one sister were for a time nervous.

Personal History. Had some of the diseases of childhood, but was in average health up to fifteen years ago, when he was acutely ill with some febrile affection which confined him to bed for over two weeks. He does not remember what the disease was, but merely that his "liver and kidneys were affected." Some time after this attack he began to grow stout. After a year or two had passed the fat began to accumulate in large masses upon the side of the chest, upon the abdomen, and other portions of the trunk. These masses were exquisitely painful to

the touch. About the same time masses of fatty tissue, painful to the touch, made their appearance about the arms and upper portions of the forearms. Smaller deposits of fat took place upon the thighs and also in the upper parts of the legs. Like the fat in other situations, it was very painful to pressure. Neither spontaneous pain nor crises of pain were present in any of the fatty masses. He noticed also that as the deposit of fat grew he became excessively weak and easily fatigued. Very slight exertion either in walking or in the use of his arms would fatigue him very readily. He observed also that his flesh would bruise very easily; that slight blows would bring about black-and-blue marks. Seven years ago, after a bruise of the left leg, he developed an ulcer which was a long time in healing; a similar ulcer also developed in consequence of a bruise on the opposite leg. The ulcers were always slow in healing.

Between four and five years ago he had an epileptic seizure. The attack was preceded by an aura, which began apparently in the abdomen and ascended toward the head. Unconsciousness was complete and the convulsion general. Three months later he suffered from a similar attack, and gradually the attacks became more frequent until they occurred once a month and more recently two or three in a week. He compares the aura to a sensation of nausea and vertigo. There was not at any time any vomiting. He frequently bit his tongue, and almost always passed his urine during the attack. In addition he frequently suffered from slight attacks which he says were not always attended by loss of consciousness. Frequently when the aura comes on he can, by rubbing his hands rapidly together, prevent the attack from maturing.

Some of the black-and-blue marks which make their appearance upon his body or limbs he cannot trace to injury. He says that sometimes he cannot account for them. He had at one time, about three years ago, also an attack of severe epistaxis, in which he lost so much blood that he was completely exhausted. He does not recall any other occasions when he suffered from any form of hemorrhage.

Status Præsens. The patient is a man very much below the normal stature, his height being only four feet ten and a half inches. He presents a striking appearance because of numerous accumulations of fatty tissue over the entire trunk. The abdomen is so pendulous that the genitals are concealed as though by an apron. Huge folds of the fat also hang from the sides of the trunk. The deposits of fat in the arms are not as great in proportion as the deposits of fat in the trunk. This is also true of the deposits of fat in the thighs and legs. Everywhere these masses of fat are exquisitely painful to pressure. All of the parts appear to be equally painful, save perhaps in the upper portion of the left side of the trunk and left shoulder, where the pain appears to be more pronounced than elsewhere. The skin is dry, but otherwise presents no abnormality.

The measurements of the trunk are as follows:

The circumference of the trunk at the axilla is 42½ inches; at the level of the nipples, 47½ inches; at the umbilicus, 51¾ inches; and below the umbilicus, 57 inches. The right arm measures in its upper third 16 inches; in the middle third, 14½ inches; while the upper portion of the forearm measures 9¾ inches. The left arm measures at the upper third 15¾ inches; in the middle third, 12¾ inches; and the upper

portion of the forearm measures 9 inches. The circumference of the neck is 15 inches. The right thigh measures in the upper third 23 inches; in the middle third, 17½ inches; and in the upper third of the right leg, 14½ inches. The left thigh measures 23½ inches in its upper third; in the middle third, 16½ inches; and in the upper third of the left leg, 14¾ inches. Weight, 206 pounds.

FIG. 1.

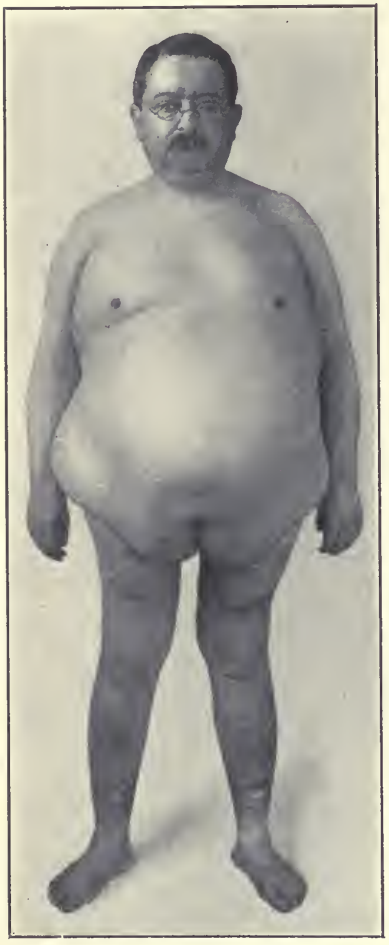


FIG. 2.

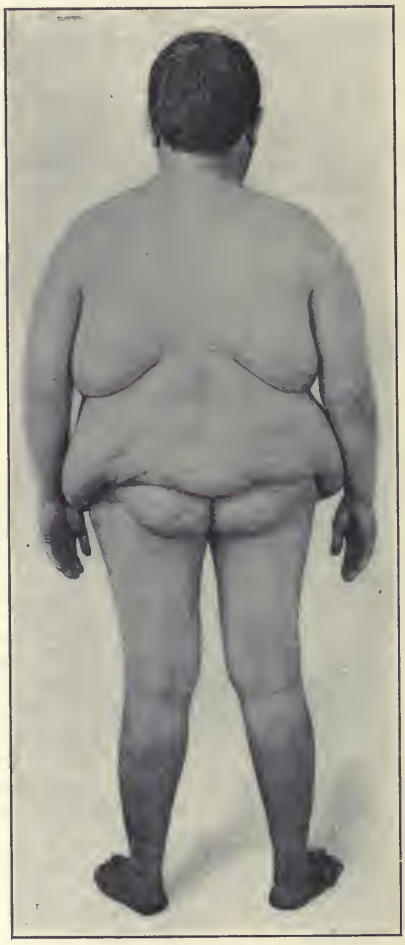


FIG. 1.—Shows the peculiar apron of fat. The small size of the hands is shown here.
FIG. 2.—Posterior view shows the arrangement of fat in folds over the hips.

It is a noteworthy fact that the lower portions of the forearms and hands and the lower portions of the legs and feet are entirely free from all fatty deposit, the skin being here, indeed, so fine in texture that the tendons can be very readily discerned beneath it.

There is some fatty deposit in the face, though this is much less in proportion than that which is observed in other portions of the body. There is also a dependent fold of fat beneath the chin. The face is somewhat flushed, with a tendency to lividity. Irregular flushing, with here and there tendency to lividity, is also observed over various parts of the body. Here and there also the veins are somewhat prominent.

Extensive scarring, due to leg ulcers, one of them still incompletely healed, are present in the legs.

The knee-jerks are normal. There is no ankle clonus. There are no areas of anæsthesia or hyperæsthesia. The viscera, as far as it is possible to examine them, are normal. The urine also reveals no abnormalities.

An examination of the eyes was made by Dr. C. A. Veasey, with the following result:

There is a very slight ptosis of the left side and some weakness of the internal rectus. The appearance of the conjunctiva is very interesting. In front of the equator of the eyeball it is so translucent that the muscle fibres and the tendinous insertions of the various muscles can be distinctly seen. Back of the equator of the eyeball the conjunctiva assumes a thickened, yellowish appearance, as if due to deposits of fat beneath. There are accumulations of fat in the orbital cavity which can be distinctly felt by the fingers. The reaction of the pupils to light is normal. The reaction to accommodation and convergence is present, but very sluggish; and if either eye be tested separately, the other eye being covered, there is a very moderate *dilatation* of the pupil in accommodation and convergence instead of contraction. This result was obtained by repeated tests and confirmed by the observation of those standing by. The fundus changes are those of very high myopia. With his glasses, the vision of the right eye equalled 6/12 and of the left 6/15. Both eyeballs are quite prominent. The media were hazy on account of many vitreous opacities.

Within one week after the presentation the patient was attacked by erysipelas. The erysipelas was diffuse, spread rapidly over the body, and the patient succumbed in a few days. Autopsy was held twenty-four hours after death.

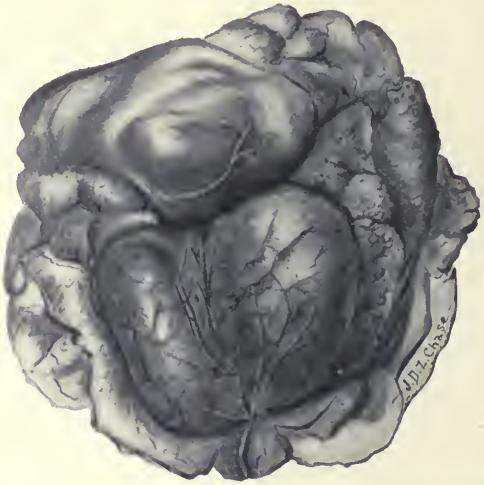
Autopsy. The body is that of a male of medium height, with tremendous deposits of fat over the trunk and extremities, hanging in folds about the abdomen and hips. The skin over the face and neck and over the right side of the trunk is reddened and covered with small miliary vesicles. The testicles are undeveloped, the penis is small, and there is a very scanty growth of hair on the pubis.

On opening the abdomen the superficial fat of the abdominal walls measures 3¾ inches in thickness. In the line of the incision—*i. e.*, from the xiphoid to the pubis—four nodular areas of congested appearance are seen. The largest of these is the size of an orange, easily separated from the surrounding fat, and inclosed in a membranous capsule of connective tissue. Over the surface of this mass of fat several small nerve fibres can be seen. On section, the fat in these capsules is firmer than the free fat surrounding it, is of a reddish color, and contains considerable blood. (See Fig. 3.)

Lying loose in the yellow fat, several small, firm bodies, the size of a split pea and of a yellowish-brown color, were found. These proved on microscopic examination to be hæmolymph glands.

On opening the abdomen the omentum was found thickened to three-quarters of an inch by a deposit of a pale yellow fat. The intestines were also surrounded by large masses of fat, and it was very difficult to locate the kidneys or suprarenal glands on account of the excessive fatty deposits. The appendix was normal. The gastro-intestinal tract was normal. The kidneys were swollen; the capsule stripped easily; on section they were bloody, the cortex swollen and injected, and the glomeruli very prominent. The right suprarenal gland was about twice the normal size; it showed no abnormality on section. The left suprarenal could not be found on account of the fat. The bladder was empty and normal. The ureters were not abnormal. The liver

FIG. 3.



A fatty nodule dissected from the subcutaneous fat, shows the encapsulation of the fat, with nerve fibres branching over it.

showed a very marked degree of fatty infiltration, but was otherwise normal. The spleen was of normal size and firmer in consistence than the normal organ.

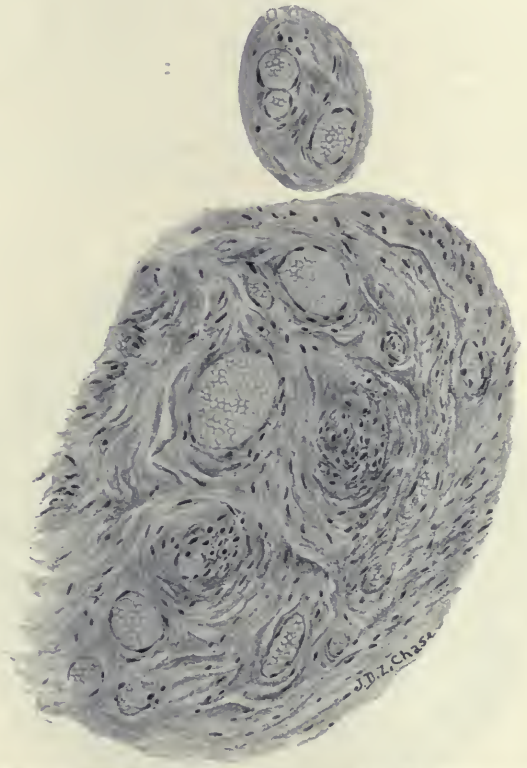
The pericardium contained about one-half fluidounce of fluid; otherwise normal. The heart was surrounded by a thick layer of fat. The valves were normal. The heart muscle was soft and fatty. The lungs were normal.

There was no enlargement of the thymus. The thyroid glands were of normal size, but of firmer consistence than is usually met with.

The brain: The calvarium was of medium thickness; the dura was firmly adherent. The pia and brain did not present anything abnormal other than a slight subpial œdema. In attempting to take out the pituitary body it was necessary to remove the sella turcica. This was easily done, because the bone was so soft that it was easily cut with the ordinary dissecting knife without effort.

The gross examination of the brain revealed a very interesting arrangement of the convolutions in the prefrontal lobe of the left side. The first and second frontal gyri followed the normal type. The posterior third of the third frontal corresponding to Broca's convolution showed a very remarkable development. Instead of the simple fold of the third frontal around the short limb of the fissure of Sylvius, a triple fold, arranged very much after the shape of a three-leaf clover, is seen. From the middle one of these folds a broad gyrus curves upward into the area occupied usually by the second frontal. The

FIG. 4.



Section of nerve in diseased subcutaneous fat nodule, showing interstitial neuritis. A distinct overgrowth of connective tissue is present between the nerve fibres. The number of bloodvessels is also increased over normal nerve tissue.

fissure of Rolando at its median end divides into three fissures. The posterior boundary of the ascending parietal convolution is formed by a deep fissure which extends from the fissure of Sylvius to the superior longitudinal fissure. An abnormal fissure corresponding to the interparietal fissure begins one-half inch behind this fissure and extends to the occipital lobe. The angular gyrus is more complex than is usually met with, and is formed by three folds of irregular shape. An external perpendicular fissure and deep Wernicke fissures are also present in the occipital lobe. The right hemisphere also shows a com-

plex arrangement of the convolutions. The first and second frontal begins at the anterior end of the brain as a single gyrus, and then divides into two distinct, nearly straight gyri of ample volume. The third frontal shows the same arrangement, although the gyri are not so large as that of the left hemisphere. The superior parietal lobe is divided by two nearly transverse fissures.

The microscopic examination of the brain and the upper cervical region of the spinal cord by the Weigert sheath stain, Marchi, carmine, Nissl, and nuclear stains revealed a perfectly normal structure.

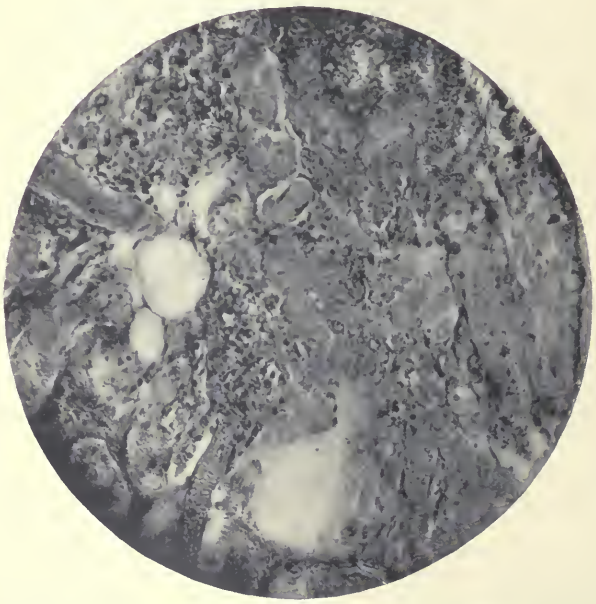
The sciatic and ulnar nerves were likewise perfectly normal.

The peripheral filaments of nerves in the nodules of subcutaneous fat showed a marked distention of the capillary vessels of the larger nerve filaments. The nerve fibres were few in number and surrounded by large numbers of connective-tissue nuclei and fibres. No such changes could be found in the intramuscular nerve fibres. (See Fig. 4.)

The muscle tissue was normal.

Microscopic examination of the subcutaneous fatty nodules: Each of the larger nodules was composed of capsules inclosing large numbers

FIG. 5.



Section of the interior of a fat nodule showing hæmolymphoid tissue. The bloodvessels are seen in the lower half of the picture; the reticular tissue and round-cell formation in the middle and upper portion of the section.

of small, oval, fatty bodies connected with each other and with the capsule by delicate fibrous bands. These delicate trabecula united and joined thick, jelly-like bands attached to the capsule. Sections made through the connective-tissue capsule and the fatty bodies *in situ* gave the following structure: The capsule was composed of several layers of well-developed connective tissue. Within this capsule a looser

areolar tissue is met. This tissue is highly vascular, and between the vessels is a reticular tissue, denser in some areas than others, and inclosing a large number of mononuclear cells, a few polynuclear cells, and large numbers of cells staining a tawny color by the Van Gieson stain. Scattered through the granular, tawny masses many of the mononuclear type of cells may be found. In other areas granules of blood pigment in clumps may be seen. Wherever the connective-tissue trabeculæ penetrate into the congested fat nodule, this same fine, reticular structure, holding in its meshes rich plexuses of bloodvessels, and between these a fine reticulum of connective tissue filled with a light yellow granular material, with nucleated yellow cells, small mononuclear cells, polynuclear cells, and numbers of degenerating red blood cells, may be seen. Some of these cells react to many of the staining reagents as do nucleated red blood corpuscles, but to the Biondi-Ehrlich triple stain they appear more as mononuclear leucocytes. This tissue is identical in structure with the hæmolymph glands found in the immediate neighborhood of the large, congested nodules of subcutaneous fat. (See Fig. 5.)

The chemistry of the free subcutaneous fat, the fat in the congested subcutaneous nodes, and the mesenteric fat was investigated by Dr. D. L. Edsall, who sent the following report:

"Portions of the tumor masses, of the subcutaneous fat, and of the omental fat were ground in a mill, warmed to almost 60 per cent. on the water-bath, and strained through a cloth. The iodine value, the melting point, and the acid value of each was determined.

"The iodine value was as follows: tumor fat, 71.53; subcutaneous free fat, 70.03; omental fat, 69.18. All these figures are about the same as those previously determined for human fat—*i. e.*, 70.

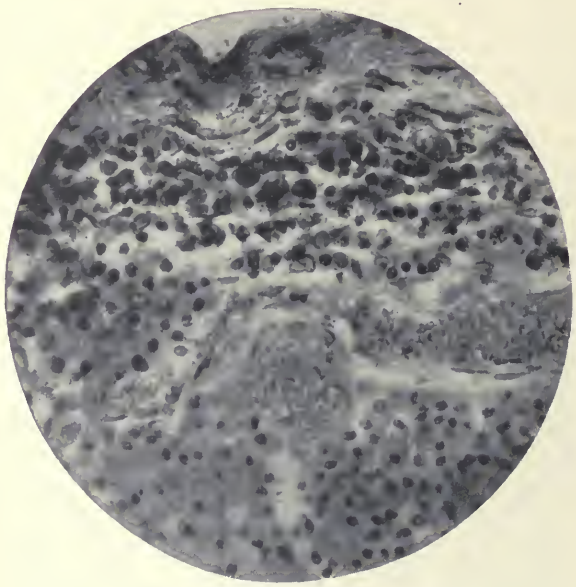
"The melting points were: tumor, 28.5° C.; free fat, 29° C.; omental fat, 31.5° C.

"The acid values per 5 grammes of fat were as follows: nodules, 4.4; free fat, 2; omental, 1.2—in each case the figures indicating the amount of decinormal sodium hydrate solution necessary to neutralize. The determination of the acid values was of special interest, as a marked increase in the free acidity would have indicated that this was connected with the pain and tenderness and perhaps with the other symptoms. The figures are, however, all rather low, and those for the tumor fat lowest of all, and decidedly below those previously found in normal fat. This is a fact of considerable interest, but the value of which is not evident. The amount of fat at my disposal was not sufficient for more elaborate investigation, and no valuable results were likely to be obtained from the determination of other factors."

The pituitary body was closely adherent to the dural lining of the sella turcica, and an attempt at removal of the gland revealed a calcareous layer material, from 1 to 3 millimetres in thickness, between the dura and the gland substance. When this was removed, what appeared to be the normal portion of the gland occupied the left quarter of the mass; the remaining three-fourths consisted of a tumor mass. It was of the same consistence as the gland structure, roughened on the surface where the calcareous plate had been removed, and attached at its farthest end to the internal carotid artery.

Microscopic Examination. The calcareous plate under the microscope showed a true bone reticulum infiltrated with the eosinophilic cells comprising the tumor mass. Sections were made transversely through the gland and tumor. The tumor mass was composed almost entirely of the eosinophilic type of cells, arranged irregularly, with a minimal amount of interstitial tissue. Around the periphery of the tumor mass the cells were arranged in parallel rows, much after the type of cell arrangement seen in endotheliomata. The tumor mass had, on account of the arrangement of the cells in rows at its periphery, an appearance as if it were encapsulated and separated from the normal gland tissue. A careful study of the cells of the tumor revealed no trace of a regular arrangement of the cells, such as is seen in the acini of the

FIG. 6.



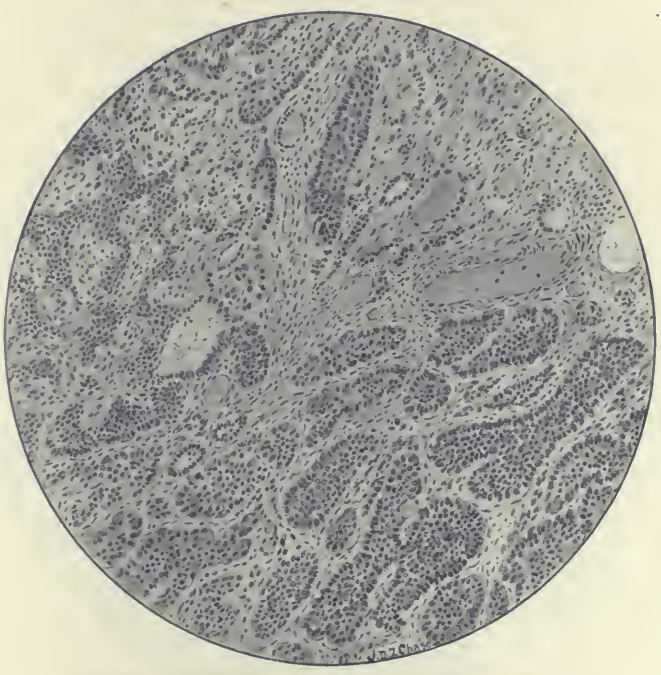
Tumor of the glandular portion of the pituitary body. The capsule of the tumor, consisting of rows of cells arranged like an endothelioma, is seen at the top of the section. The body of the tumor, consisting of the eosinophilic type of cell, is seen in the lower half of the section.

normal gland. The individual cells were round, stained a pinkish-red with eosin, and contained a small, deeply staining nucleus. The nucleus in some of the larger cells was very large and irregular in shape, such as is frequently seen in proliferating cells. The cells varied greatly in size; some were twice the size of the normal gland cells, others one-third to one-fourth that size. Between these cells, and at times in the capillary vessels of the tumor mass, small areas of colloid material were seen. (See Fig. 6.)

The area of normal gland tissue—*i. e.*, arranged according to the normal gland structure—is about one-third the size of the normal adult gland, and is situated between the tumor mass and the protuberance, consisting of cerebral tissue. The larger portion of the glandular

acini are perfectly normal. At the junction of the latter with the nerve tissue, and extending into the latter area, are large groups of cells, following an alveolar arrangement and differing from the rest of the section by the deep staining properties of the cells with nuclear stains. The posterior portion of the gland, composed of reticular nerve tissue, is permeated by the small, round, deeply staining nuclei in such a way as to give the impression that the infiltrating process followed definite lymph channels. At the periphery of the acinous portion of the gland, masses of colloid material, of sufficient size to be visible to the naked eye as minute dots, are inclosed in areas lined by rounded cells. The tumor mass, composed as it is of the same type of cells as make up the acinous portion of the gland, must neces-

FIG. 7.



Adenocarcinoma involving the protuberance of the pituitary body.

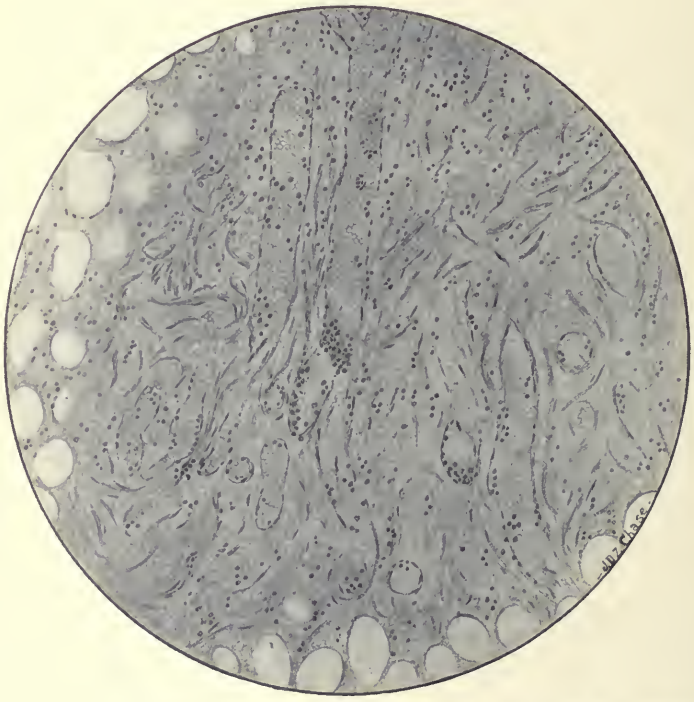
sarily belong to the carcinomata. (See Fig. 7.) The infiltrating tumor formation beginning in the acinous portion of the gland and involving the cerebral portion of the gland follows the cell arrangement of an adenocarcinoma. The arrangement of the eosinophile cells of the tumor mass around the periphery of the tumor resembles an endothelioma, but the type of cell points strongly to a diagnosis of carcinoma.

The presence of colloid matter in the small vessels of the tumor mass and between the cells of the tumor points strongly to the theory that cells of a tumor derived from a functionating tissue, such as the pituitary glandular structure, may still, even under such a pathological condition, carry on to a limited extent the function of the mother tissue. The presence of the acromegalic group of symptoms in some tumors of

the pituitary and its absence in others may be explained by such a condition as obtains in this case.

The small ovoid bodies, above referred to as hæmolymph glands, found in the subcutaneous fat, were composed of a capsule of connective tissue, from which trabeculæ of connective tissue spread in many different directions throughout the body. Within this trabecular network a rich plexus of capillaries was found. Between the capillaries the fine meshwork of fibres contains large numbers of lymphoid cells, with here and there groups of red blood corpuscles. Free blood pigment giving the iron reaction was found in small quantities free in the trabecular network. The opinion of Dr. Simon Flexner that these

FIG. 8.



Section showing the peripheral portion of a hæmolymph gland. The bloodvessels, reticular tissue, and round-cell formation are seen.

structures were new-formed hæmolymph glands was confirmed by that of Dr. A. S. Warthin, of Ann Arbor, who has recently written on the subject. (See Fig. 8.)

Spleen. The microscopic examination of the spleen showed hyperplasia of the connective-tissue elements and a very curious formation of capillary vessels throughout the spleen, which amounts in some places to an angiomatous formation.

Thyroid. A careful study of the thyroid by Dr. Flexner revealed a perfectly normal structure.

Testicles. The testicles were undeveloped and showed no evidence of functional activity, but were otherwise normal.

Kidneys. There are present all the histological changes of an acute parenchymatous nephritis. Free blood was present in the glomeruli, within and between the tubules, with cloudy swelling and degeneration of the tubular epithelium.

Adrenal. The adrenal removed was twice the size of the normal gland, but was perfectly normal under the microscope.

Liver. This organ presented the usual microscopic picture of a high degree of fatty infiltration.

The heart and lungs were normal.

A résumé of the pathological findings may be given as follows: Adenocarcinoma of the pituitary body; anomalous arrangement of the cerebral convolutions; excessive fissuration and confluence of fissures; fibroid hæmolymphoid nodules in the subcutaneous fat, in a state of acute congestion; interstitial neuritis of the nerve filaments of the superficial fat; newly formed hæmolymph glands in the subcutaneous fat; telangiectatic angioma, with slight interstitial hyperplasia of the spleen; defective development of the testicles; acute parenchymatous nephritis; cutaneous erysipelas.

The above is the fifth case of adiposis dolorosa which has come to autopsy. In the first two cases placed on record by one of us (F. X. D.) gross disease of the thyroid gland was noted macroscopically, the gland in both instances being enlarged and the seat of calcareous infiltration. Unfortunately, the specimens in both of these cases were lost and could not be examined microscopically. The third autopsy was likewise reported by one of us (F. X. D.), and was the first in which a microscopic examination was made. It revealed, as prominent features, irregular atrophy of the thyroid gland, with here and there efforts at compensatory hypertrophy; also extensive interstitial neuritis in various nerves as they passed through the fatty tissue, and, in addition, degeneration in the columns of Goll. In the fourth case—that reported by Dr. Burr—there were present in the thyroid gland changes identical with those above described, interstitial inflammation of nerves, and, in addition, enlargement and gliomatous degeneration of the pituitary body. The ovaries were small and atrophic.

In the present case changes in the thyroid gland are very slight. The changes in the pituitary body, as already stated, are those of enlargement, with new formation. An interstitial neuritis is also present. The significance of the presence of hæmolymph glands is probably that of a profound disturbance of nutrition, due, it may be, to disease of the thyroid and pituitary glands. They are probably to be regarded as efforts at compensation and probably having a compensatory function. It is exceedingly remarkable that hæmolymph glands should exist, as this is the first instance, we believe, in which they have ever been found in man as new-formed structures.

Just what is the rôle of the thyroid gland in this disease is problematical. The cases reported by Dercum and Burr would lend color to the assumption that the changes in the thyroid gland, being atrophic in character, are related to the excessive production of fat. In the present case, however, changes in the thyroid gland, though present, are not pronounced. The changes in the pituitary body, on the other hand, are very marked; and, bearing in mind the interrelation which exists between the thyroid gland and the pituitary body, the changes in the latter are, to say the least, very significant. The pituitary body is thus brought into relation, though perhaps indirectly, with a fat-producing or fat-destroying function—a relation which, up to this time, has not been considered. The fact that the thyroid gland has been found diseased in every one of the five cases coming to autopsy cannot but be of significance.

Thus far about twenty-eight cases of adiposis dolorosa have been reported. Both the clinical findings and the results of the autopsies establish the fact that adiposis dolorosa is a well-defined clinical entity. The remarkable character of the post-mortem findings should stimulate pathological studies in simple adiposis.

DIPHTHERIA WITH PERSISTENT TRISMUS AND OPISTHOTONOS. ESCHERICH'S PSEUDOTETANUS.*

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In 1897[1] Escherich described a curious symptom-complex, consisting of persistent generalized tonic contractures of the muscles of the jaw, neck, back, and legs. To this condition he gave the name of pseudotetanus, classifying it as a rare type of tetany. This pseudotetanus in its clinical history bears much resemblance to true tetanus, having in common the symptoms of trismus, opisthotonos, muscular crises, and laryngospasm. It may occur as an independent malady or associate itself with an acute infectious process, as diphtheria, scarlatina, grippe, otitis media. Nearly all of the recorded cases have at first been diagnosed as tetanus. Nevertheless, although the onset of the disease is acute, it quickly assumes a more tranquil type; and although the same group of muscles may be affected in false and true tetanus, the course and termination of the diseases are widely different. It is quite probable that many cases of so-called idiopathic tetanus ending in recovery are merely examples of this interesting phase of tetany.

* Read at the Boston session of the American Pediatric Society, 1902.

No writer upon tetany has a wider experience or greater knowledge than Escherich, of Gratz. His material, amounting to hundreds of cases, has been carefully analyzed, and a masterly treatise upon tetany was read by him in Moscow in 1897. He states that tetany is a condition with a free sensorium, no fever, and consists of tonic contracture of groups of muscles; that it is independent of rhachitis; that laryngismus is a tetany of the laryngeal muscles often associated with other signs of tetany.

Two forms of the disease are seen: (1) Intermittent muscular contractures; (2) persistent muscular contractures.

The intermittent form, observed usually in rhachitic children, is characterized by short, painful cramps, heightened mechanical and electrical excitability, and acute or subacute course, with a tendency to recurrence. Trousseau and Chvostek's signs are easily elicted. On the contrary, in what Escherich calls the persistent or tranquil type the contractures affect the trunk or extremities, run a painless and chronic course, continuing even in sleep for weeks or months. The especial nerve excitability—Trousseau, Chvostek, Erb's symptoms—may be lacking. The persistent contractures may involve single muscles, be localized in the extremities, may affect the entire body, may occur by themselves, or as a complication of various affections. When the tonic muscular spasm involves principally the masseters and dorsal muscles Escherich gives to that condition the name of pseudotetanus.

The onset of pseudotetanus is usually abrupt. A child either previously well or suffering from some acute infection or toxæmia is attacked with stiffness in the legs and rigidity of the jaws; the contracture rapidly extends until the patient lies helpless in bed with trismus, opisthotonos, and rigidity of the extremities. The arms may be spared or very lightly affected; the muscular crises (acute muscular spasms) are usually mild and few in number as compared with tetanus. The classical signs of tetany—Trousseau and the facial symptoms—may not be present. The malady lasts from one to six weeks, the patient comfortable, even cheerful, in his unnatural posture. All of the cases of pseudotetanus reported, in spite of threatening laryngismus and intercurrent disease, made complete recoveries.

In Allbutt's[2] *System of Medicine*, Rissen Russell, writing of tetany, mentions gradations in muscular contracture from carpopedal spasms to those simulating tetanus. He states that the poison of tetany acts upon the neurons of the medulla and anterior horns of the spinal cord, damaging their function and nutrition; that all neurons are not equally affected; that in different cases varying groups of muscles may be involved, and that in some cases a wide implication of nerve cells may exist, extending even to the motor neurons of the cerebral hemispheres. Russell says the masseter, cervical, and dorsal muscles may be attacked,

producing trismus, and opisthotonos suggestive of tetanus, but differing from that disease in the happy issue of the malady.

Escherich has described a pseudotetanus of the newly born, with opisthotonos and recurring arrest of breathing. Of this type I reported two cases in the *Archives of Pediatrics*, October, 1901, under the title of "Acute Recurring Respiratory Failure in the Newly Born."

My interest in pseudotetany was awakened by attending a mild case of diphtheria associated for many days with the very singular complications of trismus, opisthotonos, spasms of the muscles of the extremities, and laryngismus. This condition, which I at first called tetanus, I shall now classify as Escherich pseudotetanus.

St. Ange Roger[3] in his *Thèse de Paris*, 1902, on "Rare Forms of Infantile Tetany," has collected nine cases of pseudotetanus in children. Of the ten cases—St. Ange Roger's and my own—nine were boys, one a girl. The ages varied from four and a half to nine and a half years. All of the children had the symptoms of trismus opisthotonos—tonic spasms of the legs—and all recovered.

In four cases the disease existed by itself, two were complicated by diphtheria, one by influenza, one scarlatina, one intestinal worms, one by otitis media and rhinitis. In two cases the facialis and Trousseau symptoms were present, one absent, and one not mentioned.

My patient was a Polish boy, aged seven years, of strong, vigorous physique. About August 25, 1901, it was stated that he ran a sliver of wood into the sole of his right foot. This accident was afterward denied, and no injury was found in his foot at any time. August 31st the boy complained of sore-throat, and was seen by the family physician. The doctor discovered a diphtheritic tonsillitis and pronounced rigidity of the spine; a day later the jaws grew stiff, and the child was unable to open his mouth. The muscular contracture which was first observed in the back, then in the masseters, lastly invaded the extremities, the legs became extremely rigid, and the arms slightly so. On the sixth day of the disease there appeared frequent attacks of laryngismus. The boy would cease breathing, grow black in the face; the arms and legs would stiffen out, and the trunk would arch backward, so that the patient touched the bed only with his occiput and heels. These muscular crises were frequent and severe, so that on the sixth and seventh days of illness the physician in attendance counted four in one-half hour. The muscular contractures were painful, and were often caused by handling or efforts at treatment. Thus after a week's illness, in addition to the tonsillar diphtheria, there had developed violent generalized tonic muscular spasm of the jaws, neck, trunk, extremities, and respiratory tract. No fever. Tetanus was diagnosed, and the boy entered the Buffalo General Hospital September 7th.

The resident physician, Dr. Leonard, gave chloroform to relax the jaws, and examined the throat. He perceived a diphtheritic exudate on the tongue, tonsils, cheeks, and roof of the mouth. The tongue was enormously swollen and bulging between the teeth; its tip was literally hanging in shreds, evidently lacerated by the teeth in a spas-

modic closure of the jaws. There was a purulent nasal discharge and swollen submaxillary glands; cultures from the nasal discharge, tongue, and throat showed the diphtheria bacillus. Diphtheritic antitoxin was administered; a slight amount of fever present disappeared, and the pulse and temperature remained normal throughout the disease. After the chloroform narcosis had passed away the trismus and opisthotonos rigidity of the extremities returned. Violent muscular tetanic paroxysms, with opisthotonos and cyanosis, occurred in the morning and afternoon of September 9, 5.30 A.M. September 10, and 3.30 A.M. September 11, when these symptoms finally disappeared, and he passed into the tranquil type mentioned by Escherich.

I first saw the patient September 11th. He was well nourished; clear mentality; fairly comfortable in mind and body. He lay upon the abdomen, with the head slightly retracted, but easily movable; no ocular symptoms, jaws tightly closed, masseters hard and firmly contracted; the face wore the grin of lockjaw. Several teeth gone; tongue swollen, lacerated, and dotted with patches of grayish exudate; respiration normal; swallowing easy. The boy, although very hungry, was fed through a tube between the teeth. He at times made heroic but futile attempts to open his mouth and masticate solids. The opisthotonos was pronounced; the abdominal muscles were as hard as a board. In the arms and hands there were at times slight contractures; the thigh and leg muscles firmly contracted. By gentle manipulation, flexion, extension, and rotation of the legs could be executed; sensibility everywhere increased; knee-jerks active; Kernig's sign absent. Trousseau sign absent; facialis sign impossible to elicit on account of the contracture of the face. The contractures in the extremities varied, sometimes almost completely disappearing; the masseters were always rigid; the teeth could never be separated more than one-sixteenth of an inch; the arching of the back would slightly increase or diminish, but never disappeared, day or night. The child was not nervous or emotional, but only rough handling could accentuate the contractures. His voice was natural; urination and defecation in order; maculopapular rash present on trunk and extremities.

The idea of tetanus being paramount, ten doses of tetanus antitoxin were given September 12 to 21st. This treatment made the boy very restless, and had absolutely no effect upon the muscular rigidity.

From September 12 to 21st the child lay in the condition I have described—persistent trismus and opisthotonos and intermittent contractures of the extremities. The diphtheritic infection, proved by six positive cultures, caused no fever, prostration, or appreciable disturbance of the health.

September 21st the tetanus antitoxin was discontinued, and morphine, $\frac{1}{32}$ of a grain, was given hypodermically. A very comfortable night was the result, and, for the first time in three weeks, the opisthotonos disappeared, and the tight contracture of the masseters had somewhat relaxed. At my next visit the child was lying easily on his back, and could separate his teeth about one-quarter of an inch.

From September 21st to 27th the morphine, $\frac{1}{32}$ of a grain, was given every three hours, and the improvement was continuous. The patient slept on his back, with the muscles of the trunk and legs relaxed.

During the day there was slight arching of the back and contrac-

ture of the thigh muscles. The trismus was still present, but each day the jaws could be more widely opened.

September 24th to 27th the teeth could be separated one-half inch; there was still rigidity of the thigh and abdominal muscle; the back was normal.

27*th.* The patient sat up for the first time, and opened his mouth in a natural manner.

30*th.* The boy was able to walk and eat solids. From this date he rapidly improved, and was soon discharged from the hospital, with all muscular functions in order.

I have described a mild diphtheria associated with prolonged contracture of the masseter and dorsal muscles. From the third to the tenth day of illness, laryngismus and violent generalized muscular spasms occurred; after the tenth day the disease assumed a tranquil type, with persistent trismus and opisthotonos.

These contractures lasted twenty-one days, unaffected by tetanus antitoxin, but eventually relieved by morphine.

Trismus, opisthotonos, and muscular crises are symptoms absolutely foreign to diphtheria, and undoubtedly indicate the coexistence of another disease. The clinical picture would suggest tetanus of a most benign character. Tetanus is apt to be the result of an infected wound. The muscular crises and laryngospasms are increasingly severe, and usually end in death; while tetany is often allied with other maladies, and the motor symptoms are rather those of tonic contracture than recurring spasms.

The mixed infection of tetanus and diphtheria does not make the diphtheria milder, as was proven by the St. Louis epidemic of tetanus, in which horses immunized by diphtheria toxin afterward developed tetanus. Ten children given serum from these horses as a remedy against diphtheria, died of tetanus. The absence of Trousseau's and Chvostek's signs in my cases does not necessarily exclude tetany, as Escherich declares that in the type of tetany with persistent contractures these symptoms are seldom found, although similar groups of muscles are affected in true and false tetanus. The long-continued contracture of the jaw and dorsal muscles existing in a condition not dangerous to the patient is most suggestive of Escherich's pseudo, tetanus.

In concluding I would present some illustrative cases of pseudo-tetanus reported by Escherich and St. Ange Roger.

In three cases of Escherich's[4] the disease occurred in three boys, aged six, nine, and nine and a half years. The symptoms and course of the malady agreed in all the details. The children were previously healthy, with no hereditary taint, with no exciting cause; they first complained of stiffness in the legs, which hindered them from walking and compelled them to take to their beds. The rigidity rapidly spread

upward and attacked the muscles of the back and jaw, so that the boys lay in an extended position, motionless and stiff as a board. The muscles of the entire trunk, neck, and legs were powerfully contracted; the rigid masseters gave the patients the grin of lockjaw. If the children were asleep or quiet the contractures lessened, but never disappeared; on the contrary, noises, handling, cold, or psychical emotion caused violent muscular crises, with opisthotonos and laryngismus. At the height of the disease these respiratory and muscular spasms came on spontaneously several times a day, and were followed by profuse perspiration. In striking contrast to the woodeny appearance of the body, the arms, hands, and eye muscles remained freely movable. The disease increased in severity for a few days, remained stationary from three to six weeks, and then the contractures gradually lessened, and the boys, after considerable persuasion, were induced to use their legs again. After commencing to walk some stiffness remained for two to four weeks. Trousseau's and Erb's symptoms were absent. Escherich at first diagnosed hysteria, then idiopathic tetanus, finally deciding that the symptoms were a phase of tetany.

Baginsky[5] reports a case of tetanoid symptoms with diphtheria. The patient was a boy, aged four years and nine months. He complained of pain on chewing food, and was received into the hospital with characteristic trismus. Any efforts to open the mouth caused general convulsions, with arrest of breathing. On the edge of the tongue was a deep ulcer, covered with a grayish exudate. Considering the case one of lockjaw, Dr. Behring administered the newly discovered tetanus antitoxin for three days; no immediate effect was observed from the treatment, but the tetanic symptoms diminished in severity and disappeared in twelve days. The child afterward developed a suppurative arthritis, scarlet fever, diphtheritic ophthalmia, and diphtheritic paralysis; virulent diphtheria germs were found on the tongue, and the child infected two wards with diphtheria. No tetanus bacilli were found in the pus from the joints. The patient passed through this long series of illnesses in safety.

Question. Was there a double infection of diphtheria and traumatic tetanus from a wound in the tongue, or were the tetanoid symptoms a rare complication of diphtheria?

Behring held that a double infection existed, and ascribed the muscular contractures and crises to tetanus.

Baginsky attributed the trismus and opisthotonos to a nervous complication of diphtheria, due to the proteus bacillus. Escherich called the condition pseudotetanus. Henoch declared he had never seen a similar case.

Guinon[6] reports a case of a boy, aged four and a half years, who was suddenly attacked with trismus, opisthotonos, and muscular spasms of

the leg lasting thirteen days and subsiding with the appearance of a discharge from the ear.

Gomez[7] reports a case of a boy with grippe, complicated with trismus and painful contractures of the arms and legs, so that he lay helpless in bed. Chvostek's and Erb's signs were present. The patient was relieved by saline infusions, although the contractures lasted a month.

Guinon[8] reports a case of a boy, aged four and a half years, who in the course of scarlatina was taken with stiffness of the legs, trismus, and contractures of the extremities. Trousseau and the facialis symptoms were present. There were recurring muscular crises, with pronounced opisthotonos. The tonic muscular spasms were severe for eleven days, and had not entirely disappeared until the end of a month.

Cesare Cataneo[9] records a case of pseudotetanus in a boy, the symptoms subsiding abruptly after the evacuation of large quantities of lumbricoid worms. The child was of nervous heredity, good physique, save that he occasionally passed round worms. On May 2d, while taking a walk, he fell down, as stiff as a board, with the jaws tightly set. He was carried to the hospital, where the following conditions were noted: pronounced trismus, arms slightly contracted, legs rigid, pain in the back, recurring opisthotonos, frequent respiration, no fever.

The case was diagnosed as tetanus. Injections of carbolic acid were given. The trismus, opisthotonos, rigid leg muscles, and rapid respiration continued for eight days. The intelligence was clear, noise augmenting the muscular spasms. On the eighth day the boy was no better, and at the request of the father a large dose of castor-oil was given. A number of large, fetid stools containing masses of lumbricoid and pin worms was the result. The trismus and opisthotonos immediately disappeared, and were obviously due to tetany caused by intestinal toxæmia. A long, serious attack of bronchopneumonia followed. There was no recurrence of the tetany, and the child ultimately recovered.

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TUBERCULOSIS OF THE PAROTID GLAND; EXCISION OF THE TUMOR; RECOVERY. NO RECURRENCE ONE YEAR AND MORE AFTER THE OPERATION.

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of Boston,
Surgeon to Out-Patients, Massachusetts General Hospital; Assistant in Clinical and Operative Surgery, Harvard University.

A. M., aged fifty-seven years; *Massachusetts General Hospital Record*, vol. xxxvii., p. 248; service of Dr. A. T. Cabot.

Family History. Negative.

Personal History. Always well; married twenty-six years; has three children.

Present Illness. Five years ago a small swelling appeared just below the lobule of the right ear. Three years it grew slowly. For over

Fig. 1.

Note line of incision used in removal of tumor of parotid.

a year it increased perceptibly, but painlessly. She has had no subjective symptoms. Her hearing is good. There have been no pressure disturbances.

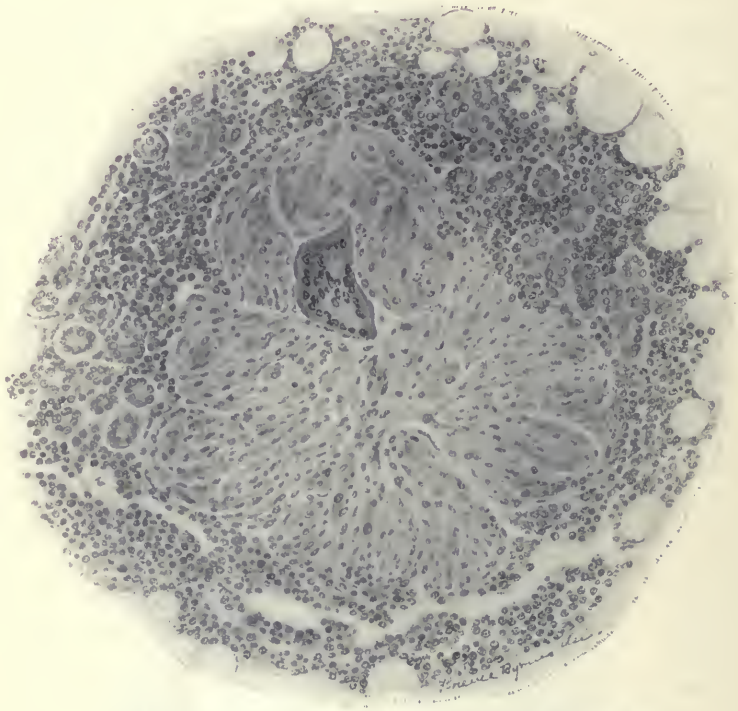
Physical Examination. A large, fleshy, and well-developed woman. In front of and below the right ear is a broad, spherical swelling, about two inches in diameter. It is hard and rounded, with irregular, indurated borders. It is slightly movable upon the parts beneath. It is not attached to the skin, nor is it tender to palpation. The chest is negative.

Operation. Mass removed through a curved incision. Capsule adherent closely to the surrounding parts. Upper part of the neck

carefully dissected. Stenson's duct and facial nerve divided, as they were involved in the disease. A few small glands were removed near the tumor. The wound healed quickly. She left the hospital one week after operation.

A year and a half following the operation examination finds no recurrence at the seat of the original disease. The cicatrix is soft and unattached to the parts beneath. There is a right facial paralysis.

FIG. 2.



Tuberculosis of the parotid gland. Parotid and tubercular tissue seen.

"*Pathological Report.* A fragmentary tumor from the parotid region. Microscopic examination showed parotid gland structure in which were numerous small foci composed of epithelioid small round and numerous giant cells, with cheesy degenerations. Tuberculosis.

"W. F. WHITNEY, M.D.,
"*Pathologist.*"

THE PRESENT STATUS OF SERUM THERAPY.

By Frederick A. Packard, M.D.,

AND

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OF PHILADELPHIA.

While the intelligent application of serum therapy—meaning by the term the prophylactic and curative use of sera obtained from artificially immunized animals—can be traced back only to Pasteur and the discovery of bacteriology, yet Pasteur and the scientific light shed by his studies formed only the full daybreak following upon a glimmering that was evident as early as the days of Mithridates and his empire.

We find numerous references in ancient historical and general literature to a partial hold upon certain facts bearing upon therapy and medical science that are even to-day far from being understood, and to principles that seem only now on the verge of perfect development. It is stated, for example, that Mithridates believed it possible to render himself proof against all forms of poison by the constant and daily use of small doses of various poisonous principles. He also compounded a general antidote by combining all forms of poisons then known. To this he added the blood of animals that had fed on poisonous adders, using the final product as an antidote and also as a preventive for poisoning from snakebite. In cultivating the blood for this remedy he used geese, reasoning that they were exceedingly resistant to the bite of the viper, which formed one of their chief articles of diet, so their blood must contain some antidotal quality or substance that would prove useful in his poison panacea.

Lambadarios, in a recent article, also reminds us that Dioscorides treated hydrophobia by administering the blood and cooked liver of the dog that had been guilty of the biting.

Without dwelling upon the announcement of Toussaint that he had produced immunity to anthrax by means of a sterilized culture, and of Pasteur that he had obtained a serum curative for the same disease, and of Behring's antidiphtheritic serum, and, later, of Marmorek's, Yersin's, Haffkine's, Sclavo's, Kitasato's, Chantemesse's, Pane's, Calmette's, and others' sera—without dwelling upon these, we can proceed immediately to the discussion of the present development of sero-therapeutics and to a consideration of the directions in which still further development is likely to take place.

There still remains the division between the two schools, represented on the one hand by Roux, Calmette, and the French investigators,

who claim that there occurs an actual tissue change (particularly a leucocytic activity) as the means by which the antitoxin causes a destruction of the toxins by the generation of neutralizing substances in the parenchyma of the cells, and, on the other hand, by many English and German students, who claim that the influence of the antitoxin upon the toxin is a purely chemical one, the tissues themselves remaining passive.

Martin and Cherry, Ehrlich, and others have demonstrated that the antitoxin unquestionably exerts a chemical action upon the toxin. It still remains to be proven, however, that there is a total absence of tissue activity; and present indications, as well as the latest experiments in the field of animal research, seem to point toward a conjoint action of leucocytic and chemical forces.

Many terms have been employed that have tended rather to obscure than to simplify the development of the problem of serum therapy.

Toxins, antitoxins, alexins, zymoses, ferments, immune bodies, end-bodies, the lateral-chain theory—all carry their special meaning to those who have followed a particular line of study from start to finish. But the main fact with which we have to deal in every infection is that bacteria are in evidence as well as their toxins; and the fact that sera do not always or even usually combine a bactericidal with the antitoxic action has frequently been overlooked, thus retarding the advance of our knowledge of the working of immune sera to no trifling degree. For example, anticholera serum seems to have both a marked bactericidal and antitoxic power, while antitetanus and other sera have little or no effect upon the micro-organisms in the human tissue. In short, a human being, like laboratory animals, may be completely immunized with large doses of such an antitoxic serum, and yet contract and die as the result of a bacterial infection, and *vice versa*.

Perhaps it will be well to explain in a few words at this point Ehrlich's lateral-chain theory, which offers, perhaps, the most satisfactory, although characterized as the most fanciful, explanation of the antitoxic action that has yet presented itself. Avoiding all unnecessary terms, it may be stated as the theory that every toxin is composed of two groups of constituents—a toxaphore group, that exert their toxic influence directly, and a haptophore group, the function of the latter being to combine the toxic element with the tissue cells of the organism attacked.

Ehrlich claims that when the cell is attacked the haptophore or combining molecules of the toxin attach themselves to a similar combining group in the cell itself, which are soon destroyed by means of the toxaphore molecules. As soon as these molecules are destroyed there is a prompt and profuse regeneration under the influence of the tissue change, just as connective tissue proliferates as the result of parenchy-

matous inflammatory processes. Ehrlich simply looks upon these regenerating molecules as reproduced in side chains, which overgrow and are carried away in the circulation. Only when they have left the mother cell do they assume a protective function and become the substance that we know as antitoxin. They still retain their attractive power for the haptophore group of the toxin, and by combining with these molecules before they reach the cells they use up, as it were, their (haptophore) entire combining power. In this way they prevent the action of the toxaphore group again by preventing their combination with the living tissue.

Antitoxic therapy, therefore, is seen to depend upon a simple contest between the affinity of the combining (haptophore) group of the poison (1) for the cells themselves, (2) for the side-chain molecules in the blood —*i. e.*, the antitoxin.

If the affinity of the haptophore group is greater for the cells than for the antitoxin, combination takes place with the cells, and infection is under way; if the affinity is equal for both, the result is good, because the antitoxin molecules are the first to come in contact with the haptophore group, and have the first opportunity of combining with the latter; if, finally, the affinity is greater for the antitoxin than for the cells, the state of affairs is ideal. Such a state of circumstances is seen, however, only when the antitoxin is present in enormous quantities.

In the case of bactericidal sera the action is entirely different. Here we do not have to consider the combination between the side chain of antitoxin molecules and the haptophore group of the toxin, but the bacteria and their destruction. Ehrlich and Morgenroth, as well as Wassermann, have shown by experiments that in the action of every hæmolytic and bactericidal serum there are involved a substance to which they have given the name of "immune body," and a second substance which they name the complement. The immune body is fixed in a fast chemical combination in those red corpuscles for which a given serum is most hæmolytic, and when the serum is not strongly hæmolytic the immune body leaves the cells and is contained in the serum. (Ehrlich and Morgenroth.) The function of the immune body is to bind the complement to the bacterium, and thus enable it (the complement) to destroy the latter. The immune body is a substance present in the blood during infections, which withstands the effect of heat at 55° C., and which has an affinity for the bactericidal substance found in normal serum.

The "complement" already mentioned corresponds very nearly with the substance called alexin by Buchner and others, and is the bactericidal agency found in every normal serum. It is probably a ferment, being destroyed by temperatures of 55° C. and over, and only

acts in co-operation with the immune body which binds it to the bacterial cell.

Wassermann calls attention to the facts learned from the experiments of Ehrlich and Morgenroth, Bordet, Buchner, Behring and Kitashima, and himself, to the effect that the influence of the hæmolytic or specific bactericidal sera depends upon the co-operation of the immune body and the complement; also, that in an immune (specific) serum one specific binding body is increased, this being its only difference from the normal serum; and, finally, that in old, immune sera there is only the binding body present, the complement soon losing its power.

As the results of his own experiments Wassermann has recently concluded that: (1) Complements are always present in the normal body; (2) they are not the only means of natural resistance, since in certain forms of congenital immunity it cannot be ascertained that there is any complement involved in the process of immunity; (3) large doses of the immune body increase the affinity between it and its complement; (4) in the action of specific sera the complement takes no part; and, finally, (5) a certain, though not the only, source of the complement is the leucocytes.

In short, we may look upon the most recent experimental teaching as showing that in every infection the tissue cells produce and give out in some quantity a substance (probably a ferment) that tends to destroy bacteria by the joining of this ferment (the end-body or complement) with and by its destructive action upon them. When an infection takes place a second substance (the immune body) is produced, which binds the destroying substance to the bacteria and enables it to act upon the latter. This second body is probably never found in the normal economy, though the ferment or bactericidal substance is present in the leucocytes and probably in some quantity in every normal cell.

A great hindrance to the development of serum treatment up to the present time has been our failure to consider the constant lack in infections of sufficient quantities of both the binding body and the complement, though Wassermann has, as stated, shown in a series of experiments that they can be supplied, and that by means of their addition results can be obtained that have heretofore seemed impossible. He has found that by injecting normal serum (thus supplying the end-body or complement) together with immune serum he can immunize animals against virulent cultures and toxins that produce early death when combated by the immune sera alone, which contain little else than the immune body or the binding substance. Ehrlich's theory that the difference in the species between the animal to be immunized and the man to be protected or cured forms a barrier to success led to

many experiments on Wassermann's part, and at last brought him to the conclusion that normal sera can always be found to act with the immune sera and add to their power. Thus he found that normal serum from cattle (beef) could be used with typhoid immune serum—*e. g.*, that guinea-pigs injected with three loops of living culture (typhoid), and in a half-hour with 0.5 c.c. of typhoid immune serum mixed with 4 c.c. of fresh normal ox serum, all survived in good health, while control animals injected with normal serum or immune serum alone all died in twenty-four hours. He suggests the monkey as the nearest animal in kin to the human being, and that its serum may be found to supply the elements that are needed to combat an infection. Metschnikoff and others have recently claimed that the serum of animals when treated with blood cells from another species has a distinctly destructive action on these same cells when it is used in large quantities, but that a small amount of this "cytotoxin" stimulates the production of new cells. Lucatello tested these claims on four anæmic children, and published results that completely confirm the statements of Metschnikoff. Dogs were injected in the peritoneum with the blood of the patient. Their serum acquired the property of stimulating the blood production when transferred to the patients again in doses of 0.3 to 2 c.c. subcutaneously. The number of red corpuscles increased nearly to normal, with a slight leucocytosis, and the improvement lasted about two weeks. The influence appeared to be cytogenic rather than hæmoglobinogenic.

Another line of experiments has been carried on by Wlaeff and Villiers, with the object in view of immunizing animals (pigeons, hens, and geese) with blastomycetes derived from malignant tumors. Injected into patients suffering from malignant growths, the serum of such animals has seemed to arrest the growth and to lead to retrogression in many cases. Wlaeff claims that the improvement is often so marked as to render an inoperable tumor operable, while the subjective symptoms are always relieved. This serum, of course, has no scientific ground or reason for success, since the causal connection of the blastomycetes with carcinoma is far from having been demonstrated. The effect, however, has undoubtedly been a satisfactory one, and enough opportunity has been afforded to prove that Wlaeff's claims are clinically well grounded. He reports at a later date the results of experiments on 510 animals with cultures of blastomycetes from the Pasteur Institute, the Prague Institute, and with a culture isolated by Plimmer from a carcinoma of the mamma. He treated forty cases of malignant neoplasm with "anticellular serum" obtained from the immunization of geese and asses over a period of a year's time, and secured appreciable results in every case. The intensity of the reaction seemed dependent upon the condition of the patient. Widal and others highly

commend the serum as the result of their experience in its use. We find, however, no record of its use in this country up to the present time.[1]

The purpose of this paper is, however, not so much to review the enormous and ever-widening field of serum experiment, even where it has been applied to therapy, but to note the clinical evidence for or against the efficacy of such sera as have become more or less known, and by presenting this casual evidence assist in bringing a new and constantly more valuable therapeutic measure into general use throughout this country and the entire world. Among those which have given promise of more or less certain value we shall consider the antibacterial sera, such as the antipneumococcic, antityphoid, and antiplague; and among the more purely antitoxic forms such sera as the antitetanus, antidiphtheritic, and perhaps the anticellular, though, as stated, the action of the latter is hardly understood.

In estimating the value of these sera it has been considered best by the writers to limit their review of the subject almost exclusively to cases treated and studies reported within the years 1900–1902, inclusive; first, because a distinct advance in serotherapy has been accomplished during this period; and, secondly, because an attempt at covering the entire literature of the subject would prove much more cumbersome and tedious than profitable. An attempt has been made, therefore, to collect reports of cases—and especially series rather than isolated instances—in order to gain both clinical and experimental evidence of the progress of this form of treatment. Certain antitoxins had thoroughly established their place and value in therapeutic medicine previous to the dates mentioned, as, for instance, Behring's antidiphtheritic serum. To these only such reference will be made as may seem of advantage from the standpoint of statistical thoroughness. Other sera have been used to a great extent in the old world and also here, and to these we shall give more attention.

Antidiphtheria Serum. At the present time little need be said of the value of antidiphtheria serum when properly prepared and preserved. A measure which has reduced the mortality in all forms of diphtheria from 40 per cent. or more (Welch) to 15 per cent. and often less, and exclusive of laryngeal and operative cases to 5 per cent. and less, needs at the present day no recommendation. There still is heard, however, an occasional voice in opposition, such as that of Lennox Browne, who states that in London the mortality

[1] Since the preparation of this article Von Leyden and Blumenthal have reported (Deutsche med. Woch., September 4, 1902) interesting results obtained from human inoculations with the serum expressed from carcinomatous tissue. In a number of cases gratifying improvement was obtained, and in no instance did metastasis or any injurious effects follow. We suspend final judgment, however, until further observation may confirm the report.

(without antitoxin) seldom passes 20 per cent.; and Bayeux (quoted by Grasset), who reports the general diphtheria mortality of the entire world as only 16 per cent. Comprehensive figures hardly bear out their statements as to the value of the antitoxin, and when the influence of the still more recently introduced preventive inoculations is considered, their objection loses its at best trifling weight.

A few of the recent statistics that carry convincing evidence of the value of the antidiphtheritic serum and its use over an everspreading area are the following:

The American Pediatric Society reported, through its committee, in 1900, a summary of 5794 cases from the practice of 615 observers, and two city boards of health, with a mortality of 12.3 per cent. Deducting 218 cases that were moribund at the time of the injection, the mortality was 9 per cent. Burrows reports 1963 cases, with 249 deaths (mortality, 12.23 per cent.); Goodno, 214 cases treated by himself, with 9 deaths (mortality, 4 per cent.); Richardiere, 1778 cases from the Hôpital Trousseau, with a gross mortality of 15 per cent. (excluding moribund cases, 11.5 per cent.; and in 1115 non-operative cases, 5.5 per cent.), and a mortality in operated laryngeal cases of only 27 per cent.

Most interesting figures are quoted from the municipality of Muhlhausen, Germany.[1]

These figures include all cases of pharyngeal and laryngeal diphtheria, those occurring during 1899 and 1900 being of an unusually severe type. Escherich reports from Germany, during 1901–1902, 115 patients treated and 54.8 per cent. cured. Since then 1147 patients and 86.92 per cent. cured, including 80.42 per cent. of recoveries in 378 cases of progressive croup, and 57.38 per cent. in 176 cases of septicotoxic type. He has had one fatality from the use of the antitoxin. Netter, Porter, Voisin, and Guinon all report favorably their results with prophylactic injections, from 1 to 6 per cent. of failures occurring in patients exposed to the disease. In this country in many city hospitals preventive injections are given to every child admitted, and in certain cities at intervals of several weeks or months as long as the child remains in the hospital. By these means diphtheria has almost been stamped out as an epidemic disease in hospitals of the larger cities. In France physicians have met with the same experience, a resolution having just been recorded (1902) by the Académie de Médecine recommending the injections as harmless and effective—

[1] Editorial in Journal of the American Medical Association, April, 1902:

Mortality in 1892 . . .	53.4 per ct.	Mortality in 1897 . . .	16.0 per ct.
" 1893 . . .	55.3 "	" 1898 . . .	20.0 "
" 1894 . . .	51.7 "	" 1899 . . .	15.1 "
" 1895 . . .	38.5 "	" 1900 . . .	18.7 "
" 1896 . . .	28.8 "		

not by way of enabling one to dispense with other measures, but by augmenting and supplementing the latter.

Geffrier and Rozet have still more recently advised care in the use of Roux's serum, and claim that as accidents may follow any dosage, small injections should be employed. In their hands the serum has appeared to aggravate renal symptoms, and in 13 cases it seemed to be the cause of anuria, 4 of these being personal cases. They do not advise the prophylactic use even in small doses.

F. Siegert publishes the statistics from five children's hospitals during the period 1886–1900. In all, 17,626 children were treated for diphtheria. In 1894, when antitoxin was first used, there was a marked fall in the mortality of the disease. During 1892–94 over 2000 died out of 4894 cases. During 1895–97 only 817 died out of 4143 cases. These figures leave no doubt as to the value of the then comparatively new measure. Very rarely has a case died as a result of the injection. Just what process takes place at such times and how and why a seemingly harmless substance now and then takes on fatal qualities remain among the mysteries that must yet be solved. Geffrier's cautions, however, seem entirely out of place and exaggerated, and the benefits have so far outweighed the slight danger that the latter has almost faded out of view.

During the last two years antidiphtheritic serum has also been applied to the treatment of other conditions than diphtheria. Talamon and Raynaud both report cases of pneumonia (double and unilateral) treated in this way. Defervescence was prompt, and recovery followed. Landrieux and Legros injected antidiphtheritic serum in 10 cases of pneumonia, of which 2 severe cases were fatal. In 8 cases, in which the injections were begun during the third to the fifth day from the beginning of the disease, a sudden fall was noted in twenty-four hours after the second injection; but the same fall was noted when cold applications were used and no serum.

Indica had, in 1900, also used the same serum in 7 cases of severe pertussis (in 10 c.c. doses), and obtained a marked effect in lessening the symptoms and abbreviating the course of the disease.

As already stated, the position of antidiphtheritic serum is already such a well-established one in the modern system of the therapeutics of diphtheria that these figures are needed simply to witness the fact that its value is an increasing one and that it has revolutionized the treatment, and with it the prognosis, of the disease; also that its applicability may yet be found to extend beyond the one condition.

Antitetanus Serum. In studying the statistics of cases treated with tetanus antitoxin during the past two years we meet with our first discouragement, and perhaps with the most decided one that has confronted us in serum therapy. Many cases have been reported treated

with the various brands of antitoxin, and from the different corners of the globe come as various reports of their efficacy. In Italy tetanus seems to be a disease that is more or less amenable to treatment of any sort. Bacelli's carbolic acid treatment, as well as Tizzoni's and Behring's antitetanus sera, all seem to control the disease in a way that is impossible to understand in the United States or Germany, where there seems to be as little success in the treatment as here. For example, Bacelli states that of 40 cases of tetanus treated with carbolic acid subcutaneously only 1 died; and Pinna notes statistics, compiled by Ascoli, of 33 cases treated by Bacelli's method, with only 1 death; of 47 cases treated by Tizzoni's antitoxin, and 36 recoveries; of 33 cases treated with Behring's serum, and 20 recoveries. Tizzoni reports 33 cases, all of which recovered under treatment by his own serum. Holsti, however, states that in Germany, Austria, and France the mortality with the same treatment varies from 41 per cent. to 64.7 per cent. The latter figures resemble closely those of our country, and a study of the cases reported in the last two years gives a percentage mortality, with the use of the various antitetanus sera, of about 42 per cent. Many factors, however, destroy the value of statistics. In many—we might say all—the serum is used far too late to accomplish its best good; in many others it is used in far too small doses and over too short a period; and no doubt in some instances the serum is of low potency, if, indeed, it retains or ever possessed any value. In contending with the tetanotoxin the problem has been one of immense difficulty in that a treatment has been required for a disease that has become uncontrollable before its symptoms are clear. To overcome such a condition forces are required that will not be and have not been secured with ease. Many cases have been handled with large doses of potent serum from the first appearance of the tetanus until death ended the treatment. The writers saw just such a case in a child —a victim of tetanus infection, in the course of vaccinia—during the past winter. Not only large (adult) doses of antitoxin, but full hypodermic doses of carbolic acid and rectal suppositories of chloral and bromides were used, and to no avail. One of the writers has recently collected 52 cases of so-called vaccine tetanus, dating from the years 1889 to 1902, inclusive, with a general mortality of 78.8 per cent.: 39 of these were treated by the ordinary method (without antitoxin), with a mortality of 82 per cent.; 13 were handled with antitoxin, with a mortality of 76.9 per cent. (10 died, 3 recovered); of the latter, 1 (an adult) was injected with an immunizing dose several days before the tetanus appeared, and thereafter throughout the course of the disease, and death resulted. The series as a whole gave a percentage mortality of about the type seen in cases formerly treated without antitoxin in time of peace. The series treated with antitoxin is too small, however,

to be of great value statistically, though it is interesting on account of its high percentage mortality, 77 per cent. instead of 30 per cent., as often claimed, or 0 per cent., as published from some of the Italian districts. So many of the foregoing cases occurred in children that the susceptibility of childhood must also have exerted its influence upon the figures.

It is interesting to note that three different methods have been used in the main for the administration of the antitetanus serum—the subcutaneous, the intracerebral, and the subarachnoid or spinal. Krokiewitz has also suggested an injection of the emulsion of brain substance, to which reference will be made at a later point. Among the experiments that have been carried out warranting these various methods brief reference may be made to the work of Roux and Borrel, who infected 45 guinea-pigs with tetanus, then trephined and injected antitoxin directly into the brain, and saved 35. Of 17 others injected subcutaneously only 2 lived, and of 17 control animals under no form of treatment, all died. Blumenthal and Jacob tetanized a series of goats, and after waiting until tetanic symptoms appeared injected antitoxin into the subdural space, not one recovering. Kitasato and Behring showed long ago that animals could be immunized against tetanus, and many instances of local tetanus infection in human beings have demonstrated that the same is possible in man. Letoux has recently experimented with animals and man with intracerebral injections, introducing early in the disease 20 c.c. of antitoxin into each hemisphere in the most prominent portion of the frontal eminence. He claims that the serum does not cure the nerve cells that are already affected, but protects those that survive; that subcutaneous injections have no effect upon the toxin except while it is *en route* from the primary wound to the nervous centres, and that once the symptoms have appeared the damage is done; that intracerebral injections are actually curative, while the subcutaneous administration of serum is only protective. Rostowtsev supports this view. Behring has shown that tetanic antitoxin can exert an active influence when applied directly to infected tissues—*i. e.*, the point of infection and its vicinity, as the vagina in puerperal tetanus, or the peritoneum in tetanus neonatorum. He has found that a dilution of 1 to 10 or 1 to 100 is sufficient for this purpose.

Wassermann and Takaki have shown that nearly all the toxin is taken up by the nervous tissue, proving this by emulsifying the brain and spinal cord and centrifugating. The nervous tissue sinks to the bottom, and the upper clear fluid is used for inoculation purposes. In their experiments this proved harmless to small and susceptible animals, while the nervous sediment promptly killed the same animals with typical tetanic contractures. Stintzing has shown that the spinal

fluid contains more of the toxin than the blood at any given time. Castronuovo has demonstrated that the antitoxin has no effect in saving the lives of tetanized animals in a fasting state. Bolton and Fisch have demonstrated within the last few months some very interesting facts with regard to the presence of the toxin in the blood of infected animals. They found that in guinea-pigs the toxin is present in the blood constantly after the injection. Two horses were inoculated with garden earth known to contain the tetanus organism from the results of tests on small animals. One horse was inoculated with earth that had produced tetanus in smaller animals; one had become accidentally inoculated. The blood from all four horses was drawn at an interval of twenty-four hours after inoculation, and the amount of toxin in the serum determined by injection into guinea-pigs and other animals. The minimum fatal dose obtained from one of the horses was 1.5 to 2 c.c. for a guinea-pig weighing 300 grammes.

The toxin appears to be present in the blood of the horse several days previous to the symptoms; it then increases in amount until symptoms appear, when it decreases, until at the time of death it has almost disappeared. From their experiments it is inferred that it is difficult to inoculate horses with earth containing the tetanus bacilli, though horses are accidentally infected with no great difficulty and are very susceptible to the disease. In the discussion of this paper Abbott said that he had examined the heart blood of a child within twenty-four hours after death from tetanus, by injecting it into white mice, but no tetanus developed.

Much in the same line were the experiments and conclusions of Zupnik, also published within the current year. He concludes that the poison leaves the wound and is distributed to the musculature of the body by the blood current. It gradually accumulates and forms chemical combinations in the muscles. Hand-in-hand with this accumulation and chemical change the contractures of the muscles increase. This naturally becomes first evident to the patient where the greatest discrepancy exists in the balance of muscular power (the jaw and back have no antagonistic set of muscles). He finds, moreover, that the toxin attacks the muscles first, and only later the central nervous tissues, especially the motor ganglia of the spinal cord; also that both tissues receive the toxin through the blood circulation. Local tetanus he believes to be caused by a direct influence of the toxin, the ascending or descending type being produced by the course of its progress through the muscular tissues. The incubation period consists, according to this view, of the time necessary for the chemical reaction between the tissues. His conclusions agree with those of Ransom in regard to the fact that small quantities of toxin reach the subarachnoid space by way of the connective tissue of the peripheral nerves, and are then

given out through the circulation to the spinal cord. Zupnik also thinks it possible that there is only one toxic principle. In this event the different sets of symptoms are caused by physiological differences in the reaction of the toxin with the various tissues; or there may be two toxic principles, of which one has a special affinity for the muscles and the other for the cells of the spinal cord. Buchner also holds the theory that certain cells are affected by the toxin, and that these cannot be relieved of the effects of the poison by the antitoxin, but that certain cells are also immunized by the antitoxin, and that these cannot be affected by the toxin. In the latter possibility rests the usefulness and need of early administration of the serum.

We have mentioned these studies—some very recent, some dating as far back as 1898—simply to introduce and explain the statistics that follow, and with a view to explaining the success and failure of the various methods used in treating the disease.

In our studies of the cases reported during 1900–1902, inclusive, we obtain the following figures: Of 1216 cases collected (including 290 cases gathered by Moschcowitz and other similar series reported by different observers) treated with antitoxin by the various methods we find that 702 recovered and 514 died, giving a mortality of 42.2 per cent. Very few cases have been reported during this time in which the antitoxin treatment was neglected, and we have been able to collect only 67 in the literature at our command. Of these 18 recovered and 49 died, giving a mortality of 73.1 per cent. This discrepancy in the percentage mortality, however, may appear greater than it actually should. The latter series is so small, and the tendency to report unfavorable cases so slight, that we have hardly adequate material for a proper comparison with a series of such dimensions as that included under the antitoxin treatment; we are therefore driven to a comparison of older records for information as to the percentage mortality of tetanus previous to its treatment by antitoxic sera. Moschcowitz states that Richter collected 717 cases, with a mortality of 88 per cent.; that Behring gives a mortality of 80 to 90 per cent.; Gower one of 90 per cent.; Raynaud of 90.5 per cent., and that Dean has obtained from a study of all the cases in the London hospitals in sixteen years a mortality of 80 per cent. Probably the latter figure is much nearer the average death-rate than the higher figures quoted above. Lambert notes 1222 cases occurring in war surroundings (mortality, 88.6 per cent.) and 280 cases in time of peace (mortality, 76 per cent.). His own experience includes 35 cases, with a mortality of 83 per cent. The general mortality of tetanus in the Civil War (505 cases) was 89.3 per cent. Lambert has also published a series of 262 cases treated with antitoxin, with 151 recoveries and 111 deaths—a mortality of 42.36 per cent. (in the acute cases of 72 per cent. and in the subacute and

chronic cases of 16 per cent.). Nearly all observers who have reckoned from a considerable number of cases agree with him in his figures, so that we shall not occupy time and space by adducing other names and statistics.

From a study of as many authorities as it was found possible to consult, we find it the general consensus of opinion that the mortality of tetanus prior to the introduction of antitoxic serum was between 70 and 90 per cent. (usually approaching the lower figure); of the acute form, between 80 and 90 per cent., and of the chronic form, 25 to 40 per cent. Lambert states the former mortality of the disease as 88 per cent., and of the chronic form as 40 per cent. In any event, statistics seem to denote a reduction in the general mortality from the conservative figure of 80 per cent. to one between 40 and 50 per cent.; of acute tetanus from 90 to 70 to 80 per cent., and of chronic tetanus from 40 per cent. to about 20 per cent.

Moschcowitz cites the mortality in cases treated with antitoxin by various observers as follows:

	Cases.	*Mortality.*		*Cases.*	*Mortality.*
Marsden	38	34.2 per ct.	Wellner	94	45.0 per ct.
Hewlitt	42	36.0 "	Weischer	98	41.8 "
Engelmann	54	29.6 "	Holsti	171	43.2 "
Kanthack	54	37.0 "			

It would seem, therefore, that we have in tetanus antitoxin not a specific, because it fails too often to have merited such a name, but a valuable remedy in the treatment of the disease, and one that cannot be neglected until a better is supplied. Unfortunately, tetanus antitoxin deteriorates rapidly, and often it seems inefficient at the start, possibly because of careless methods of production. There is also an unquestioned difference in the potency of tetanus toxin used in the immunization of animals. Tizzoni has experimented with his own and Behring's toxins, and, allowing for the deterioration to be expected from age, concludes that his own is 166 times as pathogenic for animals (such as rabbits) that are not especially susceptible to the disease, and only three-fifths as pathogenic for those (guinea-pigs) which are most susceptible. Behring in testing his own and Tizzoni's antitoxin finds that the latter is very weak (as well as Tizzoni's toxin). He also states that 700 c.c. (¾ litre) of foreign antitoxin would have to be injected to obtain 500 Behring units such as are contained in 50 to 100 c.c. of Behring's serum.

Pfeiffer, as an impartial observer, reports 22 cases, and has collected 93 others treated with the antitoxins prepared by Tizzoni and Behring. He states that the mortality of those treated by Behring's serum was 52.7 per cent., and only 36.3 per cent. in 88 cases treated with Tizzoni's antitetanus serum. He remarks, as we have stated above, that tetanus

evidently runs a milder course in Italy than elsewhere. Omitting the 21 cases reported by Italian physicians, the mortality of the series is 46.2 per cent. In 14 of his personal cases in which antitoxin was not used the mortality was 50 per cent.

We may also state that of the 338 cases collected by Moschcowitz—

76	treated with	Tizzoni's serum	53	recoveries,	23 deaths.
61	" "	Behring's "	35	"	26 "
39	" "	Pasteur's "	25	"	14 "
28	" "	Br. Inst. Pr. Med.	16	"	12 "
27	" "	Roux's	9	"	18 "
10	" "	P., D. & Co.	8	"	2 "
8	" "	New York Board of Health	2	"	6 "

With regard to the method of administration, it must be said that the subcutaneous injection has been used so greatly to the exclusion of the intracerebral and the subarachnoid, that we have only the reports of scattered individuals to witness the value of the two latter. In the series of cases collected by the writers 233 were treated by the intracerebral method, with 96 recoveries and 137 deaths, giving a mortality of 58.7 per cent. The cases treated by subarachnoid injection numbered 40, with 25 recoveries and 15 deaths—a mortality of 37.5 per cent. Seventeen cases were injected with brain emulsion, with a mortality of 23.3 per cent.

P. Jacobi (1902) reports two cases treated by injection into the spinal canal, and states that this method has been successful in two-thirds of all cases thus far treated at the Charité. Five to ten cubic centimetres of cerebrospinal fluid are withdrawn and ten to twenty cubic centimetres of antitoxin injected very slowly under weak pressure. Schultze injected Behring's serum into the spinal canal also in a case in which, immediately upon the injection, the contractures spread to other muscles than those already infected. The case ended in recovery, however, and Schultze prefers this method to that of intracerebral injection. Two cases were also successful in von Leyden's clinic. Later, von Leyden and Blumenthal reported 9 cases, of which 3 recovered and 6 died. Successful cases have come from von Jaksch's and Kast's clinics. Von Leyden reports 24 cases in which antitoxin was injected into the brain, with 6 recoveries; also 11 cases of spinal subarachnoid injection, with 5 recoveries. Parry has collected 26 cases treated with intracerebral injections, of which 17 died and 9 recovered. He states, however, that they were isolated cases, and not a series, and that there is always a tendency to report successful cases and withhold the fatal ones. Five cases are also reported by Loeper and Oppenheim, four of which recovered. The fifth was trephined and the serum injected into the brain substance, the case terminating fatally. Both writers have used the serum subcutaneously, and now suggest intravenous injection as perhaps more efficacious. Penna

reports 5 cases of subarachnoid treatment, with 3 recoveries. The other two died of pneumonia after the tetanic symptoms had subsided.

Pfandler reports 3 cases of tetanus neonatorum treated by subarachnoid injections, with marked beneficial influence in all 3 cases. McCaw also reports a recovery in an infant after the subcutaneous injection of 5 c.c. of serum from the Pasteur Institute.[1]

A number of cases have been reported in which the antitoxin has seemed to fail and in which the patient has rapidly improved under another form of treatment. Such a case was treated by Laplace, violent convulsions seeming to have been excited by the serum injection. As no improvement followed large doses of the antitoxin, it was relinquished; the cases then promptly improved and recovered under carbolic acid hypodermic injections. Whitridge also cites a case in which absolutely no result was obtained with the serum treatment. The latter was then stopped, and under large doses of morphine the case slowly recovered.

We have spent considerable time and space in considering the antitetanic serum, because small series of cases, and especially those of the past two years, would tend at first sight to discourage its use. Only by a consideration of a large number of cases is its real value discovered. Its influence appears to be appreciable mainly in cases of the subacute and chronic type, the mortality in acute cases still remaining very high. Even here, however, there has been a real reduction, and occasionally a result has been accomplished that has seemed to be entirely due to the serum, and one that must encourage the physician and the experimenter in the laboratory to new efforts at early diagnosis and thorough serum treatment. Large doses used thoroughly will influence many cases if anything will; and as the serum is harmless, it can be used without stint, only the expense standing in the way of a thorough saturation of the patient and his circulatory and nervous system. Too many cases have been treated with one or at best a few small injections, and the serum has been discarded because failure has resulted. Such cases might have occasionally been saved by proper serum treatment. It is our belief that the treatment of tetanus—at least until a more potent serum is found than any yet produced—to be uniformly successful must be a prophylactic one, and that we must take advantage of the powerful immunizing qualities of the serum. When a wound is received that suggests in any way a possible contamination with the tetanus organism or its spores the patient should be given a full immunizing dose of the serum. In most if not all such cases there will be a prevention of the disease. That this is not the invariable result is witnessed by a case that occurred in Reynier's service,[2] in which several cases of post-

[1] Cited in the Journal of the American Medical Association, September 28, 1901.
[2] Widal: Presse Med., March 13, 1901.

operative tetanus had already appeared. With a view to preventing another such mishap, Reynier injected an immunizing dose of antitoxin before the operation. Notwithstanding this, tetanus developed, though the case ran a mild course and recovered. There will also be cases that cannot be foreseen, and therefore cannot be prevented; but these will not aggregate a large total, and many a life will have been saved. In regard to this as well as to all other sera the tendency to report only favorable cases must be borne in mind; this renders it impossible to express in figures the exact value of the serum. Our object has been to present the case as accurately as possible, with inaccurate statistics for our basis of calculation.

Antityphoid Serum. The development of a typhoid antitoxic serum has proved even more disappointing than that of antitetanus serum until a very recent day. At the present time, however, it seems possible to say, and still remain within conservative limits, that we have at hand an active though by no means perfect prophylactic in the shape of the sterile cultures of the bacillus, as well as the immune horse serum, and the prospect, at least, of a positively curative serum. The difficulty with the serum treatment of typhoid fever has rested in the fact that the serum to effect a cure must be equally an antitoxin and a bactericide. Fraenkel, Pfeiffer, Levy, Chantemesse, Widal, Bokenham, Wright, and many others have produced and used sera which they believed would accomplish the cure. None succeeded with any measure or constancy of success until Bokenham and Chantemesse, at about the same time, succeeded in immunizing horses with typhoid cultures, and obtained a serum that would save guinea-pigs and other susceptible animals from typhoid infection, even when the disease was already under way. We will confine our discussion entirely to the use of the serum, omitting until its close all reference to the protective inoculations with sterilized cultures. Without question, Chantemesse and Bokenham seem to have come nearest to the production of curative sera; and Chantemesse's latest communication, in November last, would seem to indicate that he had put his product to a satisfactory clinical test. Since 1892 he has been at work upon the subject, and in 1897 he claimed to have isolated the true soluble typhoid toxin, and began at once to use it in experiments with a view to producing a serum for clinical use. He cultivated the bacillus upon a filtrate of emulsion of splenic tissue digested with pepsin, carefully avoiding the admission of air. The fluid was very toxic, but on exposure to air lost its poisonous properties. Horses seemed to be very susceptible to very minute doses for a year, then became gradually immune, while their blood serum became strongly bactericidal and both curative and protective for animals. Chantemesse reports the use of this serum in 100 cases of severe typhoid fever, and records also the results with other methods. In 371

cases treated by ordinary means in nine hospitals in Paris (January 1 to October 10, 1901) the mortality was 12.28 to 56 per cent., and averaged 29 per cent.; and of 404 cases treated at a children's hospital the mortality was 10 per cent. His 100 cases were treated with the serum, and of these all that were treated before the tenth day recovered, and all the others except 6; 2 of the latter had serum treatment only at the twenty-first day, 1 died of pneumonia, and 1 of a pre-existing extensive gangrenous sloughing. All of the 100 cases were serious clinically, and all were in hospital practice except 10, which were seen in private work. As a rule, the injection was followed in a few hours by a slight febrile reaction. In twenty-four to thirty-six hours the general condition was markedly improved. A marked defervescence occurred, and there seemed to be a decided diuretic effect. If a relapse occurred it was more severe than the first attack, but a second injection always caused a second rapid fall. Perforation occurred in 3 cases only, and in no case that was injected before the ninth to the tenth day. Chantemesse injects the serum at the elbow, because the venous plexus is so extensive here as to offer a better absorbing area than the abdomen. There were no after-effects except a slight erythema. He gave 10 to 12 c c. to adults (vigorous) as the usual dose; and if after a week the temperature was still up, 4 to 10 c.c. were again given, according to the height of the fever. If the disease is only five days old, Chantemesse recommends the use of only 6 to 8 c.c. at the start, and a repetition of the dose later. When the reaction is marked he suspends all food, and gives water alone.

E. Aimly Walker has also shown that it is possible to secure a curative serum, and in his discussion repeats Chantemesse's statement that this must be a bactericidal as well as an antitoxic serum. His conclusions, based on laboratory and clinical studies, are as follows: (1) That a serum with antimicrobal and antitoxic power can be obtained by immunizing horses against the bacillus typhosus; (2) that a high degree of immunization must be obtained, and the employment of living cultures in the later stages is desirable; (3) the serum must be made widely polyvalent by the use of as many and as widely different races of the bacillus typhosus as possible; (4) the relative value of the serum may be determined by its relative agglutinating power.

Tavel emphasizes in like manner the need of a polyvalent serum. He has experimented with the serum of horses immunized over the course of a year, and has obtained decided curative results and a most marked action in the reduction of the fever.

James Ewing states that Walker has now in preparation a two or three-year polyvalent serum. He also calls attention to the fact that the recent recognition of infections indistinguishable from typhoid fever, and yet due to bacilli that fail to agglutinate with typhoid

serum, and fail also in other ways to correspond with the typhoid bacillus, will throw new difficulties in the way of a perfect result; and yet even with this discovery of a discouraging feature, the outlook seems to be very bright for a genuinely curative measure for typhoid infection.

Jez's antityphoid extract is so closely related to the true sera that it deserves a word of mention. Since his first report of 18 cases treated with an extract derived from the spleen, marrow, brain, medulla, spinal cord, and thymus of rabbits immunized against the typhoid bacillus, later tests seem to have fully borne out his claims. Eichhorst has reported 12 cases, all of a severe type, treated successfully with the extract, all surviving and going on to perfect convalescence. The temperature reached normal in five to seven days following the injection. Two relapses also recovered under treatment by the extract. The fever seems to respond to its influence within twenty-four hours, and in forty-eight hours changes from continuous to intermittent, and by the end of the second week to apyrexia. Jez observed these results in every one of 50 cases.

With regard to preventive inoculations with sterilized cultures, it may be said that extensive experimentation has shown it to have a very decided value. An excellent opportunity has been afforded the English to test its worth in their armies in India and South Africa, and the results have been highly satisfactory when compared with cases that have lacked such protection. It has been by no means invariable in the immunity conferred; but when the inoculation has been carried out with fresh cultures, and repeated within a short time, it has exerted a marked protective influence. For a study of the subject we would refer to the writings of A. E. Wright, R. M. Cullman, Wright and Leishman, Parry, Parker, McLaughlin, Cayley, Foulerton, and Crombie. The solitary unfavorable criticism that has met our attention is that by Melville, who considers that more complications occur, the duration of the fever is longer, and the death-rate higher in the inoculated than in the uninoculated person. His assertions can hardly stand against the weight of evidence to the contrary.

Antityphoid serum, then, instead of discouraging by its gloomy outlook, as it has for so many years past, seems now to promise a signal help in the treatment of the disease. The typhoid infection is by nature a slow and gradually increasing one, and this fact, though it proved a hindrance in the discovery of a suitable and powerful antitoxin, proves to be a favorable factor now that we are in sight of a potent curative serum. We have taken little part on this side of the water in the development of the antityphoid serum, but there seems to be little doubt that the subject will now be taken up with a renewed energy and a thorough test given to claims that seem to be based upon clinical success.

Antistreptococcus Serum. Marmorek's antistreptococcus serum has been used extensively in certain directions during the period covered by the statistics of this paper, and in conditions suited to its use has met with marked success. Its proper use seems, however, to be a much more limited one than was at first supposed. Marmorek has from the first contended that streptococci, whatever their form or origin, produce the same toxin, which belongs to the group of diastases that succumb to a temperature of 70° C.; also, that the serum derived by immunizing animals against one form of streptococcus is effective against the toxin manufactured by all other varieties. The frequent failure of the serum to control the symptoms of infection by pyogenic organisms has not appeared to corroborate his finding, and it has been conclusively determined that when other micro-organisms than the streptococcus are involved in the process the specific serum exerts its influence upon the streptococcus infection alone. For these reasons very conflicting reports have been heard. Moreover, the serum has been used, as a rule, if not invariably, in critical cases; this fact alone would tend to militate against unvarying success with any remedy. With a view to surmounting one of these difficulties, Bokenham, Van de Velde, Denys, and others have endeavored to render the serum as polyvalent as possible by immunizing animals with as many different strains of streptococci as possible. Bokenham's clinical results have been most encouraging, and when the serum was fresh he obtained constant and decidedly favorable influence from the treatment. He found that the serum rapidly deteriorated, however, and that it was unfit for use after the third or fourth week.

We have found records of 117 cases treated during the last two years with antistreptococcus serum, and in 114 of these there was either a marked temporary improvement or a prompt recovery. The cases included puerperal septicæmia, erysipelas (mild and malignant), tuberculosis with pyogenic infection, general pyæmia, and local streptococcus infections, as well as a few cases of pernicious and simple anæmia that seemed decidedly improved by injections of the serum.

It will be remembered that in the report of the American Gynecological Association[1] 101 cases were reported as having been bacteriologically examined and the streptococcus found, and with a mortality under the serum treatment of 32.6 per cent. (33 deaths); also 251 cases in which no bacteriological examination was made, with a mortality of 15.85 per cent. (40 deaths), giving a total of 352 cases and 73 deaths —a mortality of 20.74 per cent. These findings resulted in the conclusion that the medical profession was not justified in proceeding further with the experimentation with the serum.

[1] American Journal of Obstetrics, May, 1898, No. 3, vol. xl.

Haberlin, however, treated 4 cases of general pyæmia (mostly puerperal) with the serum, and in the first case obtained a slight transient improvement; in the second there was no favorable result; in the third and fourth the morbid process was arrested as if by magic. Undoubtedly the difference in the strain of streptococcus involved produced the variance in results in such a series.

Harrison treated a malignant case of erysipelas with marked beneficial result and cure. Mitchell reports 1 case, seen in 1900, with symptoms that were growing steadily worse, but a prompt fall of temperature and general improvement followed the serum treatment. Shively reports a case of tuberculosis with mixed infection that showed marked improvement with Marmorek's serum; and Cahall, in the same journal, a case of gangrenous stomatitis, with immediate beneficial effect and cure.

Elder reports a case of pernicious anæmia, with an increase in the number of red corpuscles from 800,000 to 4,800,000. Injections of the serum were repeated every few days. De Witt cites a similar case, in which the number of the red corpuscles rose from less than 1,000,000 to 4,960,000, and the hæmoglobin from 30 to 90 per cent. in about three weeks' time. The latter used 8 c.c. of the serum every two to three days.

In addition to these cases, Schoull has in the last month reported three cases of smallpox greatly benefited by antistreptococcic serum.

Perhaps the most convincing series of cases is that of Tavel, also reported during the current year. Tavel takes occasion to emphasize the antibacterial influence of the serum, and states that in 76 cases of erysipelas, scleroderma, pneumonia, meningitis, streptomycosis in tuberculosis, phlegmon, perityphlitic abscess, etc., he has obtained positive improvement or recovery. In severe cases in which phagocytosis has already failed he obtained no result from the use of the serum.

All of these reports tend to convince us of the fact that antistreptococcus serum will at least do no harm, and that in cases in which the streptococcus is alone involved it will eliminate that micro-organism and control the symptoms caused by its toxin unless used too late for any remedy to be of avail. When the streptococcus infection is found in combination with those of other micro-organisms we have learned that the serum has no influence except in so far as it controls the streptococcus symptomatology. Undoubtedly the attempt to obtain a polyvalent serum is one in the right direction, and, as in typhoid fever, it presents a key to new accomplishments in the line of special serum therapy.

Antipneumococcic Serum. Although when first presented to the public in its two forms—the antitoxic serum of the Klemperer brothers and Washbourne and Pane's antibacterial sera—statistics seemed all in

favor of the new treatment of pneumonia, our estimate, after consulting the literature of two years, must be a very conservative one, and in the nature of a hopeful expectancy rather than a satisfaction over anything accomplished. De Renzi, Fanoni, and Pane have all had marked success with antipneumococcic serum, as indicated in their published case histories. All of Washbourne's published cases recovered, though without exception of a severe type. De Renzi's series included 29 recoveries and 3 deaths. A difficulty has seemed to consist in an inability to secure a highly immunized serum, and primarily in the difficulty of securing highly virulent cultures of the pneumococcus. As a result of this many reliable observers have failed to obtain the same successful results with the serum. At times, and in the hands of reliable men, we have seemed to have in our possession a serum that would answer all requirements, and again it has accomplished nothing; so that to-day no positive judgment can be registered with regard to the value of the serotherapy of pneumonia. Maragliano, Cantieri, and De Renzi appear to have had the most favorable results with the injections; but on our side of the water the experience has been often against and seldom strongly favorable.

Fanoni is one of the few who commend it highly, noting 18 cases in which the serum was used, with only one death, the latter patient being at the time of injection in the preagonal stage. He claims that in these cases the temperature was lowered and improvement was noted in the comfort of the patient; that all the symptoms were ameliorated and resolution hastened. Canby reports 3 cases of severe pneumonia in which the serum (Pane's) was used, and defervescence followed on the second day in 2 cases and on the fourth day in the third. Sears, however, publishes 12 cases treated with the serum and with other measures in conjunction, and with little benefit gained; 4 out of the 12 patients died, and the duration of the disease was about the same as in any series of cases in which the serum is not used. The patients gained greatly in bodily comfort, but the effect on the temperature was very variable. He states as his one practical objection to the treatment, our ignorance of the strength and potency of the serum at any given time, and concludes that his results warrant nothing more than a continuance of the trial.

Kelly and Musser have noted a case (an alcoholic) in whom the pneumonia followed a debauch. Large and frequent injections were made, each one producing a marked leucocytosis, though no other positive effect was observed. The serum supply gave out, and the patient went on to death, as he would in all likelihood have done in any event

De Lancey Rochester has reported a case treated with serum obtained from a blister produced upon another pneumonic patient, in which a marked beneficial result was obtained.

J. C. Wilson has published two series of cases—one of 18 and another of 17—from the study of which he simply concludes that a further trial of the serum is warranted. In the series of 17 cases there was a mortality of 35.3 per cent. He has also collected 162 cases from all sources treated with the serum, of which 27 had died (a mortality of 16.6 per cent.). His other series showed no marked favorable results. Of the 18 cases 4 died (22.2 per cent.). In 2 of the 4 no improvement followed the administration of the serum; in the other 2 there was slight improvement, but no permanent effect. At the same time in the Pennsylvania Hospital out of a series of 20 patients (all men, and 8 of these alcoholics) treated without serum only 4 died (mortality, 20 per cent.).

Elfstrom reports a series of experiments with a serum suggested by the Klemperers, which he obtained by applying two leeches to the forearm of a case of croupous pneumonia, and in 8 cases one leech. After squeezing the blood out of the leeches he diluted it with three to five parts of normal salt solution, and heated it to a temperature of 60° C. for two hours. The mixture was then decanted and injected subcutaneously; in the majority of his patients the temperature fell to nearly normal. They seemed able to leave the sick bed earlier than under ordinary treatment. In one case the patient died without any effect having been observed to follow the administration of the serum; in another there was no reaction. The quantity of blood used in the treatment seemed to have no effect upon its influence.

Perhaps the most recent report of any value is one by Eichberg, in which he cites 6 cases treated with the serum, with 1 death. His conclusions are that the serum will not precipitate the crisis, but will often diminish the severity of the disease. The fault that must be found with his series, as with so many others, is the limited number of cases on which the serum was tested. He notes, however, a fact that many others have also witnessed, and one that marks an important symptomatic effect of the serum, viz.: "In connection with the patients who recovered I would like to call attention to the almost complete cessation of cough and expectoration soon after the administration of the serum. The process of resolution in the consolidated area was accomplished apparently without any liquefaction, for no moist sounds were heard, though the consolidation was manifestly clearing."

This, then, is the most that we have been taught to expect from the use of antipneumonic serum during the past few years. Pane's series of cases, with a mortality of 9 per cent.; De Renzi's, of 32 cases, with a mortality of 9.3 per cent.; and Wiesbecker's, of 17 cases, all of which recovered, have not been duplicated with any such frequency as to warrant us in expecting such an outcome of the serum treatment of pneumonia. But we have the promise of much more positive results

as soon as we obtain more active sera and use them in large doses early in the disease, and that time does not seem to be necessarily in the distant future. The writers have known of a number of cases treated in Philadelphia with antipneumonic serum obtained from American sources, and with very varying results. In order to obtain any benefit large and frequent doses have been required, and there has always remained the question at the end whether the treatment has actually contributed to the result, if favorable, or, if adverse, has retarded the fatal process. In nearly all cases the patient experienced a very temporary relief from subjective symptoms.

Antiplague Serum. Antiplague serum seems to have yielded important and favorable results, although they have been little appreciated in this part of the world, because we have so far been so fortunate as to be spared the need of such a remedy. Following closely upon Haffkine's preventive inoculations with the vaccine, that reduced the percentage of cases to one-twentieth the number that occurred in the uninoculated, came Yersin's announcement that he had produced a curative serum. Calmette stated with regard to this, in 1899, that whereas the mortality before its use was 33 per cent., in 104 cases studied by him it was 13 per cent. as the result of the serum treatment. He repeated the injections until convalescence was thoroughly established, giving daily doses of 20 to 40 c.c. of serum, and sometimes as much as 320 c.c. in one day. In one case a drop of blood before inoculation gave thirty-two colonies of plague bacilli; after the injection it gave one to two colonies, and after the second injection the blood became sterile. In plague pneumonia he introduced the serum directly into the veins in doses of 20 c.c., and no case treated in this way was lost. In 1900 he writes again, emphasizing the value of the intravenous injection. He states that the plague bacilli multiply first in the lymph channels, but in a few hours are found in the blood and in the organs. The phagocytosis stimulated at once by the serum causes their prompt destruction. In this manner the serum has two distinct actions—curative and prophylactic. He obtains it by vaccinating small animals with virulent cultures killed by exposure for one hour to 70° C. The immunity is then increased by repeated injections of virulent cultures. In man phagocytosis begins at once upon the injection, and in a few hours the bacteria have disappeared. The temperature drops in from four to five hours, then often rises again for eight to twelve hours, and then falls finally at the beginning of an early convalescence. As a curative dose he injects 20 c.c. of the serum intravenously, and as a preventive 10 c.c. into the subcutaneous tissues.

Brownlee reports 9 cases treated with Yersin's serum, of which 5 recovered and 4 died. He admits, however, that his doses were too small, and states that at another opportunity he would employ 60 c.c

as his initial dose. Lustig and Galeotti claim for their own serum a much greater curative power than for that of others, and state that it is prepared by treating horses with a nucleoproteid obtained from dead plague bacilli. The rate of recovery in India, where the disease has been most virulent, and in an epidemic in which the general mortality was about 94 per cent., was about 53 per cent. under the serum treatment. Of 475 cases treated by themselves the mortality was only 39.36 per cent.

Choksey, a short time before, had reported 32 patients treated with Lustig's serum, in private practice, with a recovery rate of 59.37 per cent. He recommends the subcutaneous injection of 60 to 100 c.c. up to 150 to 300 c.c. or more.

Terni, who was commissioned by the Italian Government to study the plague in South America, found that Haffkine's vaccine (modified) gave the best means of immunization. He also produced a serum from cattle (beef) and monkeys, rejecting all animals that were not extremely resistant to the inoculation. This serum, he found, stimulated phagocytosis, and when combined with 0.5 per cent. sublimate solution, and injected intravenously, proved remarkably effective in the 4 cases in which it was used. The germs rapidly disappeared from the blood, and 3 patients as rapidly recovered; the fourth showed a marked improvement, and the treatment was stopped. This patient died, and at the autopsy a number of deep glands were found to have been infected from a primary bubo in the axilla.

Lucatello claims during the past year to have reduced the mortality of the plague at Florence to 46.15 per cent. of all cases treated. He also used Lustig's serum, which has been used extensively at Bombay.

Penna has recently treated 36 patients with the serum, with a mortality of 19.3 per cent., notwithstanding the fact that the supply of serum was scanty and the dose therefore small. The general mortality of cases treated at that time without the serum was 50 per cent.

Among the most recent reports are those of Jorge Pinto, from Brazil, and Proskouriakoff, from Bombay. The former reports only the results of preventive inoculations with Terni's vaccine, only 1 out of 1803 persons contracting the disease after exposure following "vaccination." In one district the only person who refused to be vaccinated took the disease. Proskouriakoff's letter from Bombay reports on the last very severe epidemic as follows: Between August, 1899, and March, 1900, 52 persons were treated with the serum, with 35 deaths (67.3 per cent.) and 17 recoveries. Of 162 cases not treated with serum 125 died (77.16 per cent.) and 37 recovered. During March, April, and May, 1901, 104 persons were treated with the serum, with 81 deaths (77.82 per cent.) and 21 recoveries. Of the foregoing the cases of a septicæmic type gave a mortality of 96.6 per cent., and those

of a non-septicæmic type one of 56.6 per cent. The septicæmic cases treated without serum gave a mortality of 98.1 per cent., and the non-septic cases one of 61.5 per cent.

These statistics give a fair idea of the influence of the serum treatment, and afford the opportunity to study the subject in a most satisfactory manner. Favorable reports have not been chosen nor unfavorable discarded; but as with the discussion of other sera, so here both favorable and adverse are cited when both are to be found. In virulent epidemics nothing seems to exert a very powerful action upon the disease, though even in severe cases the serum treatment has accomplished more than any other means. Preventive inoculations, however, have in places stamped out the scourge. In mild epidemics, on the contrary, the serum injections have had a marked influence, and their value now seems unquestioned.

A series of conflicting reports have come within the last few months from the commissions sent out from Russia, England, and Germany that leave the question in a less satisfactory position than before. The British Commission examined samples of Yersin's as well as Lustig's sera, and stated that they could find no specific antibacterial substance in them; that plague bacteria grew in them luxuriantly. On inoculating guinea-pigs with the bacillus pestis and then treating with Lustig's serum the latter seemed to hasten death. Yersin's serum seemed to delay, but not to prevent death. Yersin's serum was used in the South Camp Hospital, at Bungalore, on 49 cases, the mortality in the North Camp Hospital serving as a control. In Bombay, also, 28 cases were treated with the serum. In both Bungalore and Bombay the advantage in favor of the serum treatment was very slight, the case mortality showing a diminution of 4 to 5 per cent. Life was not prolonged, nor convalescence accelerated, nor was there any well-marked alleviation of symptoms.

Captain Mason, however, treated 100 cases with Yersin's serum, with a mortality of 59 per cent. A series of 100 control cases showed a mortality of 83 per cent.; but most of the serum cases were during a declining epidemic, while the control cases occurred in the full height of an epidemic.

Dr. Simond used Yersin's serum in 300 cases at Karad, etc., with a mortality of 58 per cent.; the mean mortality in the same hospital in cases treated without the serum was 75 per cent. Choksey tested the serum on three series of cases: (1) On 257 serum cases the mortality was 22.7 per cent. less than in 752 other hospital cases, including the untreated, moribunds, etc., which were not included in the serum count; (2) on 403 serum cases, which gave a diminution in the mortality of 18.7 per cent. as compared with 1190 patients not treated with the serum during the same period; and (3) on 968 patients (using the

alternate system), the difference in percentage mortality being 11.5 per cent. in favor of the serum group. On subtracting the convalescents and moribund from both groups this difference became 20 per cent.

These results appear to the impartial observer to indicate a value accruing to the credit of the serum treatment that ought to be apparent to anyone in spite of the isolated negative animal experiments; and it is worthy of notice that Dr. Galleotti, who made inoculation experiments at the same time as the British Commission, saved 6 out of 8 animals (infected with plague) with Lustig's serum; and yet the German Commission concludes that the only verdict that can be given is "that the injections of serum have had no perceptible, immediate, or remote harmful results."

The Russian Commission states that the serum is an "absolutely indifferent substance, with no influence either for good or evil on the course of acute plague."

And, finally, the British Commission finds that Yersin's serum as received from Paris contains "therapeutically useful substances in greater or smaller quantity"—a none too definite statement, to be sure.

The reports from individual observers certainly indicate a positive value in the serum treatment when properly employed. The question of the extent of that value is, however, still an unsettled one, and no further statement can be made from the information at hand. Study is by no means relinquished, and it is still possible that a serum will yet be obtained of greater curative powers than that which is at present in use.

Antitubercle Serum. The onus of the labor involved in the production and introduction of an antitubercle serum has been borne in great part by two men—Fisch, in this country, and Maragliano, in Italy. Both inject animals with tuberculin—the former horses and the latter asses—with a view to producing a true antitoxic serum, as in diphtheria. Courmont's and Arloing's recent papers have indicated that a serum produced in this manner has also an antimicrobic power, though this is not believed to be the case by its originators. There seems to be no doubt that in tuberculosis the subject dies more often as the result of a mixed infection than owing to the single influence of the tubercular toxin. Against such mixed infections the serum has never had any effect either in laboratory animals or in human beings; but where the case has seemed to be one of pure tuberculosis, and especially in its early stages, certain observers have apparently obtained beneficial results that at least warrant our attention.

As early as 1899 Holmes reported, after sixteen months' study of the results of serum treatment, that "it is the coming therapy for tuberculosis." He later reports 50 cases treated over a period of twenty-one months, with most encouraging results. Ambler reports

in the same year 100 cases, in treating which he used Fisch's antitubercular serum (Tr). He began with an injection of 0.2 c.c., and gradually increased the dose to 1 c.c. and even 2 c.c. His results were as follows:

Apparently cured	41 cases.	Stationary	11 cases.
Much improved	31 "	Died	2 "
Improved	14 "		

Stubbert had in 1898 reported 36 cases of incipient tuberculosis of the lungs treated with the serum in addition to general hygienic measures; 14 of these were apparently cured. In 1900 he reports that of the 14, 9 are still apparently well (no cough, no physical signs, able to work). He also reports 13 additional cases that have been out of the institution about a year, all showing constant and marked improvement. His summary states that of the patients leaving the institute three years ago 11 per cent. have remained cured ; two years ago, 14 per cent.; and one year ago, 69 per cent. He looks upon the serum treatment as a valuable aid to other measures.

Numerous tests have been made upon persons in good health by Roncagliolo that show a marked natural defensive power against the toxins of tuberculosis (averaging from 1000 to 4000 antitoxin units). He found that this quality attained its highest intensity in alcoholics, reaching 10,000 units in one man, aged fifty-two years, a chronic alcoholic, with chronic pachymeningitis. He found, however, that the antitoxic power of the individual diminished decidedly with defective nourishment and debility. Repeated injections of Maragliano's serum in small quantities raised the normal immunity in a month or two to 10,000 units per cubic centimetre—a far higher point than could be accounted for by the serum therapy. This discovery is important as showing the tendency under serum treatment, and will lend encouragement to those who are watching the clinical side of the subject.

After three years' trial Fanoni believes that the serum treatment of tuberculosis is the only scientific antituberculous treatment employed to-day. In cases in which there was no mixed infection he has seen it give valuable help in the treatment.

Mircoli publishes the statistics of 2889 tuberculous patients treated with antitubercular serum, as follows:

Cases of apyretic patients		250
Cured	95	
Improved	110	
Stationary	30	
Worse	35	
Cases of febrile patients with circumscribed lesions		938
Cured	168	
Improved	511	
Stationary	163	
Worse	96	

Cases of diffuse tuberculous bronchopulmonitis (microbic association)		332
Cured	31	
Improved	142	
Stationary	98	
Worse	61	
Cases of diffuse tuberculosis without microbic association		665
Cured	91	
Improved	301	
Stationary	166	
Worse	106	

Maragliano publishes his results for the period 1900–1901, under treatment with his own antitoxin, and obtains the following figures: In the year closing with June, 1901, 130 out-patients were treated and 36 clinically cured (including 17 with fever and destructive processes, and cavity formation in 3). Improvement was noted in 58, in 31 the condition remained stationary, and in 5 the disease progressed. He states, however, that it is impossible to cure without re-enforcing the strength of the organism.

Fraenkel and Bronstein conclude as the result of their studies (1901) that: (1) Cultures of tubercle bacilli can be made to yield a tubercular toxin, the aqueous tuberculin, the bacilli digressati (the bacilli from which all fatty substances have been removed), and other derivatives; (2) the greater number of these substances possess a marked toxic power, that can be gauged by dosage; (3) these toxins when injected cause death, with the characteristic lesions; (4) by means of small and then increasing doses (up to the maximum) it is possible to render immune the animal experimented upon; (5) the serum of immune animals possesses a strong antitoxic action against all of the toxic substances.

Finally, Cioffi, during the present year, reports his experiments upon a large number of guinea-pigs, which were first inoculated with tuberculosis and then treated with Maragliano's antitubercular serum. None of the animals thus treated died. He then reports several cases of human beings with tuberculosis, who were also treated with the serum. All had distinct tuberculous lesions, and improved so far as to appear cured. He considers that the serum treatment is contraindicated in any condition other than tuberculosis.

Clinical and experimental evidence would then appear to show that in the serum treatment we may have an adjuvant in the control of tuberculosis which, if used early, may alone result in cure, and even when used late may tend to retard the process and promote healing. As often as the test has been made the value of the serum has been witnessed, and it is to be hoped that the next few years may make still more certain its curative value, may indicate more definitely the cases that can be benefited, and may enable it to be produced at a cost that will render it available for the poorest tuberculous subject on the globe.

ANTIVENENE. The last serum of which we shall speak at any length is that which was finally secured by Calmette after numerous preliminary experiments by Wolfenden, and Physalix and Bertrand, who first demonstrated the fact that a protective principle was formed in the blood. We will simply say that the studies of Calmette, Martin, and later of McFarland (upon crotalus poison), have shown that against cobra poisoning antivenene has a very powerful action, and against other venoms a much less active one. This statement is borne out not only by the laboratory, but by actual clinical tests; and illustrative cases have been reported by Rennie and Beveridge, in both of which recovery from snakebite followed treatment by Calmette's antivenene. The former's case was a boy, aged twelve years, who was bitten in the finger. Recovery followed in five days. Hanna reports a recent case of cobra poisoning treated in the same manner. The assistant was bitten in the thumb in attempting to extract the venom from the snake. The wound was sucked at once, and within twenty to thirty minutes 18 c.c. of antivenene was injected. Symptoms of slight stupor, nausea, and vomiting followed, with slight paresis of the legs ; there was then a complete though gradual disappearance of all symptoms. Other cases have appeared scattered throughout the literature, and all tend to verify the findings of Calmette as limited by other writers. It seems settled that antivenene is of decided use in all cases of snakebite, but that its use is far less potent against the rattlesnake and similar viper poisons than against that of the cobra; in short, that its action is directed against the nervous rather than the irritative and tissue-destroying principle in the venom. Whatever the form of venom, antivenene should be used at once (20 to 40 c.c.) after the bite, and repeatedly; all possible venom should be sucked from the wound, and, as McFarland suggests, an aqueous solution of calcium chloride should be injected around the wound itself. It is hardly necessary to state that a ligature should be thrown around the limb at once, so as to shut off the poison as far as possible from the general circulation.

Dyer first, in 1897, and Woodson again, in 1899, have used Calmette's antivenene with remarkable results in cases of undoubted leprosy, and report cures after other treatment had failed completely and the case seemed to be going from bad to worse.

MISCELLANEOUS. We have now covered, at somewhat greater length than was intended when this article was planned, a sketch of the progress of serum therapy in so far as it has accomplished positive and promising results. There still remain a considerable number of antitoxins, or attempts at the cultivation of immune sera, that have not as yet established themselves as curative measures deserving of confidence. Pfeiffer's *anticholera* serum has a marked antitoxic action in the laboratory, but it has not met with the enthusiastic success clini-

cally that was promised. As a prophylactic it has been of great value, but as a curative measure it has failed; yet Tretrop studied the epidemics of 1892–94, in which the annual percentage of recoveries varied between 44 and 62 per cent., and claims that the benefits of the serum treatment were markedly evident in cases in which it was the only treatment employed.

Shiga has prepared a serum to combat the form of *dysentery* due to his bacillus. After securing a high degree of immunization in the horse or ass the serum is withdrawn three weeks after the last injection of agar cultures of the bacillus; to this serum carbolic acid is added in the proportion of 5 per cent. In mild cases he injects 5 to 10 c.c., and 15 to 20 c.c. in those of a severe type. The results of serum medication he claims to be far in advance of those of other methods of treatment. Even in the most favorable results of the ordinary treatment the death-rate is twice that obtained by serum therapy. He notes as an interesting fact that among 40 patients 15 had an eruption around the seat of inoculation (37 per cent.), 1 had an eruption over the entire body, 2 had joint pains, and in the remainder there were no symptoms attributable to the serum. Eldridge notes Shiga's results up to November 1, 1899, as follows: In the Laboratory Hospital, in 1898, 65 cases were treated, with 9 per cent. fatality; in 1899, 91 cases, with a fatality of 8 per cent. In the Hirowo Hospital, 110 cases, with 12 per cent. fatality. During the same period in 1899, and under the ordinary treatment without serum (in Tokyo) in the Hiujo Hospital, 166 cases and 37.9 per cent. mortality; in the Hirowo Hospital, 53 cases and 37.7 per cent. mortality; in the Komagoma Hospital, 398 cases and 34.7 per cent. mortality; and in private houses 1119 cases and 28.5 per cent. mortality. The expense of the treatment is a great drawback.

Terni has endeavored to use a serum obtained by immunizing dogs and rabbits to the bacillus icteroides in the treatment of *yellow fever*. Agramonte, on the other hand, has used the blood serum of convalescents from yellow fever, and of 5 cases observed 4 convalesced promptly. In none of the cases so treated was the hemorrhagic form of the disease seen. He does not believe that the bacillus icteroides is the cause of yellow fever, and mentions the fact that it neither agglutinates with any regularity with serum from yellow fever subjects nor does their serum protect guinea-pigs inoculated with the bacillus icteroides. Sanarelli's serum depends also upon the identity of the bacillus icteroides with the cause of yellow fever, and has shown little clinical value. All recent investigations seem to indicate that Sanarelli's bacillus is identical with the bacillus of hog cholera, and if this be true it is not difficult to account for the failure of its immune serum to act against the toxin of yellow fever.

Weisbecker, in 1897, claimed that treatment with the serum from *scarlatinal* patients produced an amelioration of the symptoms of the same disease. Since that time von Leyden, Huber, Blumenthal, and others have confirmed his statements by studies of their own. Von Leyden notes 16 cases treated in this way, in 3 of which the result was brilliant and in the remainder less positive. In general the course of the disease was shortened. In the beginning 10 c.c. of the serum was used, later 12 c.c., and finally 20 c.c.

Liscia reports two recent cases of *anthrax* infection in the human being, both of an unmistakably malignant variety. Both were saved by the prompt use of Sclavo's antianthrax serum. In many years' experience Liscia notes that all of the mild cases have recovered and all malignant types have died, no matter what treatment was employed, until he obtained this positive result from serotherapy. Dasso reports 130 cases treated with the serum, and as a constant result a falling temperature, disappearance of the œdema, general improvement, and resolution of the ganglionary infarct. Only 9 of the patients died, and all of these from secondary infection. The remainder of the series testified to the efficacy of Mendez's serum. Dasso used 10 c.c. subcutaneously, and states that Mendez's serum is much more powerful than Slavo's or Sabernheim's product. Mancini has reported within the last three months a case cured by injections of Sclavo's serum. He asserts that in adynamic cases the fever rises as an expression of the exertions of the organism. In dynamic subjects the fever falls at once as an immediate effect.

Carasquilla showed in 1900 that the bacillus lepra could be cultivated upon blood serum (Hermann's method), and also that by manipulation the bacillus could be rendered aerobic and motile, and that secondary cultures could be made. He then produced an immune serum, which he has since employed in the treatment of *leprosy*. After noting the good results obtained with the serum by Carasquilla and Laverde, W. A. Lee reports that he has been especially successful with it in malignant cases with fresh nodular eruptions in luxuriant growth, and in the presence of fever (102° to 104° F.). Two such cases were treated by him at the Government Hospital in Madras, each being injected with a vial of Carasquilla's serum (9 c.c.). The fever quickly abated, and the tubercular infiltration in the more severe case rapidly disappeared, leaving the skin shrunken and flabby. This patient has improved continuously since. In the milder case the changes were less notable, though the improvement was also observed. In an experiment made with Haffkine's prophylactic serum on a nodular leper child the usual reaction followed, and no fresh tubercles have appeared for nearly two years.

A few isolated cases of *glanders* have been reported as treated with

immune serum, and among them one of A. Dupuy, who notes that recovery followed a severe attack.

Jez has employed the serum of a patient with *erysipelas* upon others suffering from the same disease. He notes 10 cases in which he observed a rise of temperature after one to two hours, and a rapid improvement in all the symptoms. The number of leucocytes rose and the toxicity of the urine markedly increased. He used 5 to 10 grammes at a dose, at times increasing this amount. The serum was obtained from a blister artificially produced for the purpose.

Sylvestri drew 120 c.c. of blood from the arms of two children recovering from *whooping-cough*. This he mixed with equal parts of saline solution, and then shook it with 1 per cent. of chloroform, setting it aside for twenty-four hours. It was then filtered and 15 to 22 c.c. injected into five other children with whooping-cough. In two very severe cases the injection was repeated in five days. The effect of the serum treatment was evident at once. The general symptoms rapidly disappeared, and the cough and bronchopneumonic phenomena were completely gone in eight to eleven days.

Moore has during the last seven years been testing and experimenting with the serum from *syphilitics* as a cure for that disease. It has never failed to arrest the symptoms, and has proved in his hands a valuable differential measure for chancre. Its local application produced a marked change in a day or two, with cicatrization in a week. It had, moreover, no effect upon soft chancre. He obtains the serum by blistering syphilitics, and injects 10 to 40 c.c. of this serum every third or fourth day. He has now tested its worth on 75 cases, 30 of which he describes at length in his article. Neviorovsky has also studied the effect of serum taken from patients with tertiary lesions of syphilis, and has noted a rapid disappearance of subjective symptoms in certain cases. In control cases injected with the blood of healthy individuals no effect was produced.

No serum treatment has as yet been developed for *malaria*, and Celli goes so far as to say that it is impossible to immunize human beings against the disease by means of the blood and tissue juices of animals that are immune. Even quinine was ineffectual in protecting against experimental malaria. Experiment has not been relinquished, however, and it is hoped that malaria, too, will give way to intracellular immunization.

There remains neither time nor space to discuss Trunecek's artificial (inorganic) serum for arterio-sclerosis, so favorably commented upon by Levi and others; or Hayem's artificial syphilitic serum, commended by Augagneur and others; or Coley's tumor serum, recently revived by George, Jr. Even vaccination and rabies must be passed by on the ground that the processes involved in these conditions are not strictly

included under our title. Inspection of the report of the work of the Pasteur Institute in 1900, published in June last, will repay the student who consults it for interest and information.[1]

In closing we would simply refer to the preparation by R. Emmerich and O. Löw of a product named by them the "immunizing and curative proteidin." They have cultured bacteria on a large scale on suitable media or in the animal organism, and collected the specific bacteriolytic enzyme produced. Combinations of this enzyme with the albumins of the blood, they claim, furnish the only truly specific immunizing and curative substance. They have manufactured this on a large scale, and have used it in anthrax and hog cholera, and state that the results obtained warrant the belief that it will supplant what is now known as serum therapy. The medium used by them consisted of

Asparagin	0.8	NaCl	3
Pepton. sicc. . . .	10	Bouillon	100
Potass. biphosph. . .	2	Aq. dest.	1000
$MgSO_4$	0.15		

Cultures are sown in this (altered slightly for various forms of bacteria) and placed in large vessels for four to five weeks; it is then filtered through a Berkefeld filter. Albumin is added in the form of fresh beef blood or ground spleen, etc. The finished "immune proteidin" is then precipitated with alcohol and made into a powder. No comment can, of course, be made at this time upon the value of the product.

While the writers have included in this paper many cases and clinical data that might easily have been omitted, they have preferred to allow the individual to form his own opinion of the various divisions of serotherapy from the reports of their actual use; and this rather than from conclusions based upon our own view and interpretation of the same. It must be remembered, and we have already stated the fact at more than one point in our discussion, that statistics such as the foregoing present one never-failing source of error, viz., the tendency to report favorable cases and to withhold the unfavorable examples of a certain form of treatment. If, then, an estimate be formed of one or another branch of serum therapy that would seem at all in favor of its efficacy, it will be well if the fact be realized that statistics are of themselves poor guides to a correct conclusion. We find the outlook of serum therapy an encouraging one, but we do not wish to seem enthusiastic prior to a thorough test of figures and actual results. It is only in this way, moreover, that those who have not at their command all the facilities for experiment can learn of the work of those more fortunately situated

[1] Viala. Annales de l'Institut Pasteur, June, 1901.

for the study of methods that will perhaps lighten their own load as well as bring comfort and health at critical times to their patients; and it is with the hope that as great a development will be witnessed in serum treatment in the next few years as in the period just covered that we conclude our study of the newest therapeutic science.

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SOME OBSERVATIONS UPON DELUSIONS, IMPULSIVE INSANITY, AND MORAL IDIOCY.

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Medicine and law developed in systematic effort to preserve and benefit society without doubt accomplish much good in their respective spheres; but men who have witnessed and pondered upon the efforts of these sciences to solve together problems which arise from unlawful acts committed by the alleged insane soon note unsatisfactory procedure and result. We see, upon one hand, persons mentally alienated bespoken sane by juries within régime of the law, and, upon the other, both court and jury listening with questioning credence to

medical testimony concerning various insane states. These and other unsatisfactory conditions are largely due to lack of knowledge on the part of the court, medical witness, and counsel, respectively, of the varying viewpoints other than his own, which are occupied in reference to insanity and also to inadequate information concerning the developmental phases of legal and medical science which have led up to these positions. Obviously, complete co-operation among all the factors engaged in administration of justice is desirable, for it may be said, for instance, that a jury without medical exposition, will perhaps never see the necessity for immediate detention of the author of those facetious and seemingly shrewd tricks, frequently perpetrated by incipient progressive paralytics or those to be noted in the maniacal state of circular insanity. But as against this we may also hope that greater weight will be accorded testimony that recommends restraint in such cases when the medical expert who deposes will not advocate, or seem to, entire criminal immunity for every person in the least degree mentally alienated. With the intent to contribute something toward a better understanding that is needful between court, counsel, and testifying physician, and, through the harmonious efforts of these judicial elements, toward acquirement of greater confidence on the part of the lay public, in our profession upon the stand, this essay will consider some facts pertaining to mental conditions which are frequently propounded as the cause of homicide or other grave unlawful act.

"*A delusion* is a false perception accepted as a fact. It may be based upon an illusion or an hallucination. It may also result from reasoning in regard to real occurrences, or be evolved out of the intellect spontaneously as a result of imperfect information, or be an inability to weigh evidence or to discriminate between the true and the false. A delusion to be an indication of the existence of insanity must relate to a matter of fact; must be a belief that would not be entertained in the ordinary normal condition of the individual; must have been formed without such evidence as would have been necessary to convince in health, and must be held against such positive testimony as would in health have sufficed for its eradication."[1]

Because judgment for or against commitment for insanity is pronounced by laymen, a fact known to students of psychiatry should be more commonly understood, viz., that delusions, although the frequent manifestation of lunacy, are not always evidence of it. For a clear comprehension of this statement let us take note of some frequent and ordinary delusions and also some historical false ideas.

First, as regards classification. It is convenient to follow Esquirol,

[1] William A. Hammond. "A Treatise on Insanity."

and set down as Class A delusions which are based upon an illusion, namely, an actual sensory perception falsely interpreted; as Class B hallucinatory delusions—that is, such as are not based upon an immediate sensory perception of the outer world. Convenience dictates the use of this classification, because, although of great practical service in the many instances in which it is applicable, this differentiation is nevertheless established in some cases with great difficulty or is altogether impossible. An illusion refers to individual experience; hence our ability to decide upon it as the basis of a delusion in another depends upon the knowledge gained from our own senses. Thus a person who, under ordinary conditions, mistakes the identity of one person for another, or who hears spoken messages in the sound of bells, possesses a delusion clearly based upon an illusion; but if this same spoken message—claimed to be heard at a time when to others there was no audible sound, and therefore to be regarded as an hallucination—in reality originated in certain very common head noises which are alone audible to the person experiencing them, as for instance, rhythmical sounds arising in the cranial circulation or the tinnitus aurium due to middle-ear catarrh, we would after all, in such a case, have to do with a misinterpreted sense-perception—an illusion appearing as an hallucination to all others than the subject of it.

Nevertheless, despite possible difficulty in assigning the exact origin of false ideas in exceptional cases, many at once betray their true character. For example, we pronounce without difficulty as insane a belief wherein a man declares that he is some renowned character in history whom we know to be dead, or that he is the Supreme Ruler of the universe. He may thus express in one idea or another this same kind of false belief, viz., that which exhibits an insanely exaggerated self-importance. Another class of insane delusions typify persecution. A person may entertain the belief that, although innocent of crime, he is being tracked by the police, or is being slowly poisoned for his wealth, or because he is looked upon as an obstacle in a supposed love affair, etc. Insanity is also often betrayed by somatic delusions, such as the belief that the body is made of glass, necessitating the greatest care in moving about; that only the talking head lives, and that all the rest of the body is dead; that moving machinery is in the abdomen, etc. These corporeal beliefs are usually illusions depending upon some pathological body function. Paraplegia or mere skin anæsthesia may easily suggest death of a body-part to the insane mind; an increased and perceptible peristalsis of the bowel as easily machinery in the abdomen.

If we reflect upon the means which enable us to deny the truth of these ideas we find (1) that the refuting testimony is furnished by our senses employed at close range, and that the evidence is probably

corroborated by several of them ; (2) that our decisions refer to a combination of facts concerning which we ourselves and others have deliberated upon and reached similar conclusions many times previously to each particular instance—*i. e.*, they refer to common experience. All insane delusions, whatever their origin, involve " inability to discriminate between the true and the false," and are therefore not corrected. Hence an uncorrected delusion is usually deemed equivalent to an insane one. This test is applicable in many cases, but cannot be invariably relied upon. To illustrate, we shall designate as Class 1 all insane delusions, and some already cited may serve as examples. Class 2 shall include delusions of sane persons, and in reference to these we shall now speak.

The story in the school books relating how the guide-post in an imperfect light assumed a human shape—a delusion dispelled by closer inspection—portrays a false belief of sanity based upon an illusion. But sane persons also at times experience and correct hallucinations. Well known is Goethe's approaching vision of himself. He relates concerning this adventure upon the road to Sesenheim : " I saw, not with the eyes of the body, but of the spirit, myself upon a horse, approaching on the way, and, in fact, in a garb which I have never worn ; it was light gray and gold. As soon as I shook myself out of this dream the figure disappeared." Dornbluth[1] regards this vision as identical with the imaginative faculty of great artists to vividly reproduce pictorial or acoustic impressions. The connection is scarcely apparent at once, but becomes plainer in the light of Goethe's claim that he could give form to images passing in his mind and the possibility that he had pictured such a scene to himself. The idea of a man meeting himself is not novel. It has more than once been employed in romantic fiction. Medical history records many other well-authenticated hallucinations of persons whom society would hold accountable for their acts. Nicolai, a German bookseller, in 1790, for many weeks, during which he attended to his affairs, saw during day and night numerous figures of persons—some on horseback—also forms of dogs and birds, that he knew existed only as hallucinations. After four weeks he could hear some of the phantasms talk. His hallucinations disappeared after the application of leeches to the arms.[2]

[1] Compendium der Psychiatrie.

[2] Hammond. Loc. cit. As proven by experience, the correction of persisting and oft-repeated hallucinations cannot be continued indefinitely. Gradually the intellect will accept them as realities. This the experience of the painter Blake demonstrates. The latter required but a single sitting to afterward see at will the material figure of his sitter as the latter had appeared, which was accomplished by looking at the chair which the subject of his work had occupied. This faculty was a great help to the artist in the dispatch of his work, but gradually the painter lost the distinction between the imaginary and the real figure, and later mental confusion, loss of memory, and insanity followed.

In recent times the London Society of Psychical Research has recorded numerous instances wherein persons deemed mentally responsible recounted the appearance of apparitions as within their experience. According to present common knowledge, we cannot do otherwise than classify such occurrences with ocular hallucinations, and, as in the instances of delusions of sane persons previously cited, demand (1) that interpretation must place such visions outside a normal manifestation of the physical world; (2) the person to whom the hallucination appears must not be so influenced thereby that his actions be other than the possible outcome of common world experiences.

Thus far we have briefly considered some uncorrected insane delusions and also some examples of corrected false ideas of sane persons. We may next examine some uncorrected delusions of the sane.

It is readily seen that a mistake, in its limited sense of a misconception, and a delusion (previously defined as acceptance of a false belief as a fact) have a common origin; both are misinterpretations of or a false conclusion deduced from sense perception. But while human fallibility is an axiom, and looked upon with indulgence because universal, an individual may not leave his delusions uncorrected with impunity, because concerning them there exists a different unanimous opinion. The latter is the result of more exact knowledge (in fact or so supposed) than is the basis of a mistake, inasmuch as the source of information is furnished by common experience or is the product of science as interpreted by a comparatively limited number of persons, whose opinion concerning a given subject is accepted as a demonstrated fact by the majority of people, although unproven by the latter.

This condition obtains because the designated minority is believed to be more conversant with all the facts established in relation to a given subject. It is no arraignment of science, but mere testimony to its striving upon planes higher than are those of common experience, to recognize that its dicta from time to time must be corrected, and to comprehend that supposed facts accepted as truth up to a certain time are eventually proven to be delusions. Of the latter, one often cited was the belief in witchcraft. Perhaps at first glance it may seem unreasonable to categorize the demonology of a previous age with twentieth century science, yet both stand in their time for the most advanced explanation by learned men of physical phenomena. Maudsley,[1] himself quoting, says: "The most learned physicians only put the devil a step farther back, acknowledging 'such a preparation and disposition of the body through distempers of humors which giveth great advantage to the devil to work upon, which distemper

[1] Responsibility in Mental Disease, foot-note, p. 10.

being cured by physical drugs and potions, the devil is driven away and hath no more power over the same bodies.' "[1]

About two hundred years ago Lord Hale, instructing a jury, stated that he made no doubt at all there were such creatures as witches: "For, first, the Scriptures have affirmed as much; secondly, the wisdom of all nations had provided laws against such persons, which is an argument of their confidence of such crime (*i. e.*, witchcraft)."[2] This utterance of an eminent jurist unquestionably emanated from a sane man—a circumstance of special interest to us, as it was pronounced at a time when the belief in witchcraft was no longer universal; therefore, delusion concerning power to bewitch, being at that period corrected by some and uncorrected by other sane persons, it is clear that at the close of the seventeenth century this false belief could not properly have been looked upon as an insane one. In our time, however, to pronounce the death penalty because of a faculty to bewitch evilly would no doubt lead to inquiry as to the court's sanity; and, moreover, particularly in view of the many judicial errors of like nature at a later date in our own country, we note how recent is the necessity to correct a delusion the belief in which may not to-day be reflected in the actions of sane persons. But if we recognize in the error of belief just considered one which is always evolved at some period of a people's mental development in the effort to explain unknown causes of world phenomena—one, also, which thrives best upon the very absence of accurate testimony, except in so far as the marvel of co-ordinated muscle spasm and catalepsy had arbitrarily been adduced as proof—how was it in regard to the belief that the earth and not the sun was the centre of our solar system? Galileo had proclaimed the truth of the Copernican system, yet in his old age and under humiliating circumstances was made to recant and to publicly announce his adherence to the older theory. In this one may perhaps see mere evidence of Church power which scented danger in the rejection of any established doctrine. But also important is the fact that the delusion concerning movements of the earth and heavenly bodies was seemingly proven by calculations accepted as correct by learned men of that day. True, some phases of our solar system were not in exact accordance; but in this day, with immeasurably more exact data, a like condition prevails in so far as known astronomical laws do not explain all celestial phenomena. Referring to the explanation of physical laws by modern science, the writer knows of an obscure,

[1] The modern physician will not fail to recognize in the above correct clinical observation of disease, if he only substitute the present day theory of locus minoris resistentiæ for "distempers and humors" and pathological bacteria or any morbid process of disease for Satan himself.

[2] Maudsley. Loc. cit.

mistaken, but in any case sane philosopher who rests satisfied that Newton's theories concerning gravitation contain egregious error, and that they do not take cognizance of certain existing conditions. This person's ideas are fallacious; nevertheless, we have a sane man who fails to correct his delusion, and in this his position is the same as Galileo's appeared to opposing scientists of his day. And in our own day who will question the sanity of ex-President Kruger, who, on good authority, is said to declare his belief that, barring slight inequalities, the surface of the earth is flat? We remember, too, that child-life is filled with delusions. The babe reaches for the moon; night-terrors of children are peopled with ocular hallucinations; the young arrive at most unreasonable conclusions as to the acts and motives of persons about them. Such false beliefs are in general not viewed with alarm, because, in respect to the child, a normal judgment is usually attained with added experience; and in respect to society we recognize in childhood a receptive age, and not one that, as a rule, acts upon its own judgment to avenge fancied wrongs. So, also, with the adult who does not act in accordance with peculiar beliefs. For him much latitude of individual opinion is countenanced, and, therefore, so long as an individual's delusions appear harmless—that is, effect no relaxation upon his part of his obligations to society and to himself as a part of it—we are content to regard him as an eccentric, meanwhile suspending judgment as to actual mental status.

With this brief résumé of mind-conditions relating to delusions we pass on to succeeding topics, enough having probably been said to have made clear why this variety of false idea and the state of insanity are by no means equivalent to one another; and no less patent will appear the reason for the alienist's desire to base his pronouncement as to sanity in a given case upon the individual's demeanor and conduct in its entirety, or, in other words, upon the latter's *collective reaction to life's stimuli* rather than upon expression of any single delusion, however bizarre.

Impulsive insanity shall include those forms of degeneration insanity wherein the subject is possessed of morbid propensities and impulses, and wherein, if the latter be consummated by action, the same is undertaken without a clear motive, but because an irresistible impulse so to act is experienced.

Moral insanity, a form of imbecility characterized by the absence or enfeeblement of those emotions which combat the inconsiderate gratification of egotism.[1]

[1] These definitions are practically identical to those laid down by Kraepelin. Psychiatrie, Emil Kraepelin, 1896.

When and where both the law and medical science, emerging from mediæval intellectual darkness, threw off the incubus of demoniacal possession as the explanation of mental alienation, these recognized but two kinds of acquired insanity, viz., *mania*, in the sense of maniacal fury, and *melancholia*, including under this head all lunacy not congenital and not characterized by raving paroxysms. Because of frequently associated mental depression in cases of chronic insanity, melancholia came to have its present significance; but, as pointed out by Prichard, this term, from the Greek, was originally synonymous with insanity, literally meaning to be out of one's mind. Experience demonstrated, however, that some deranged persons exhibited a mood the reverse of melancholy, these being eager in the enunciation of certain delusional opinions, and yet, far from being actuated by blind frenzy, were collected and apparently rational upon some or most subjects. Such conditions first received extended and formal recognition in psychiatric classifications so late as the early years of the nineteenth century under the title *monomanie* (Esquirol, 1772–1840), although the literature records clinical descriptions of like cases by earlier observers (Plater, Ettmuller, Pinel). Long before Esquirol's time, however, Lord Hale (1609–1676), by differentiating between a partial and a total insanity, practical established legal recognition of mental disease marked by conduct influenced by delusions to greater irrationality in some respects than in others.[1]

The foregoing types of mental alienation—viz., mania, melancholia, and monomania—served as a basis upon which were constructed many classifications of insanity, as, for instance, one *according to cause* (Morel), which, however, to some extent, merely represented a clinical picture instead of etiology, viz., climacteric insanity, phthisical insanity, mania of pregnancy, of lactation, etc.; *according to functions interfered with* (Bucknil), *faculties affected* (Maudsley), *by symptoms* (Griessinger), *upon clinical history* (Clouston), etc. The foregoing and all other classifications of abnormal mental conditions remain very imperfect to this day, because as yet we lack that knowledge of minute pathology

[1] He said: "There is a partial insanity and a total insanity. The former is either in respect to things *quoad hoc vel illud insanire*—some persons that have a competent use of reason in respect of some subjects are yet under a particular dementia in respect of some particular discourses, subjects, applications, or else it is partial in respect of degrees, and this is the condition of very many, especially melancholy persons, who for the most part discern this defect in excessive fears and griefs and yet are not wholly destitute of the use of reason." (Maudsley, loc. cit.) Lord Hale apparently speaks with special reference to melancholia wherein this partial insanity was most patent. At the same time, we need remember that the term *melancholia* as used two hundred years ago conveyed a somewhat different meaning than it does to the alienist of to-day. Modern knowledge of insanity breaks down in many instances the old rigid limits which separated melancholic from maniacal states, since it is known that both conditions are often comprehended within a single disease—witness such transitions of mood in periodic and circular insanity, or again in melancholia agitata, where the listless demeanor common to depressed mental conditions is replaced by a desperate restlessness born of fear that recalls the excitement and incessant movements of mania.

in brain disease upon which an exact classification of insanity according to cause could be formulated. Kraepelin's arrangement is to-day probably the most satisfactory, being based *upon causes so far as known, upon symptom-groups,* and *upon similarity of course and termination of cases.* It is the intention to consider at this time impulsive and moral insanity only; but so much as has been said concerning general classification had as its object (1) to recall that until the early part of the nineteenth century recognized insane conditions comprehended in all a few pregnant types which, in cases not utterly frenzied or incoherent, would exhibit with great constancy some forms of delusion, viz., maniacal and melancholic conditions and that of so-called monomania;[1] and (2) to point out that since that time complexity of insanity classification has been due on the one hand to ignorance of cause, in respect to which some progress has now been made (*i. e.*, recognition of causal toxins), and on the other to the tardy acknowledgment of instinctive insanities unassociated with delusions. Such false beliefs having from time immemorial been looked upon as evidence of insanity, the acceptance of any form of mental alienation without delusion, aside from the congenital defect of idiocy, became difficult. Witness in this respect Casper's definition, so late as 1857, as it appears in his *Handbook of Forensic Medicine,* translated from the German for the London New Syndenham Society: "Insanity is a disturbance of self-consciousness based upon delusions." According to this, insanity without delusions does not exist.

French alienists, beginning with Pinel (1745–1826), under the title *manie sine delire,* gave publicity to cases of mania in which it was stated no delusions were exhibited. Approximate observations had at an earlier date been made by Ettmuller under the name *melancholie sine delire.* We have already gained some insight as to how cases of the same class could receive such seemingly opposed designations (see note, p. 1058); also, since all recognized forms of insanity which were compatible with a somewhat collected demeanor—*i. e.*, partial insanity, monomania—betrayed themselves by delusions, many or few, mania or melancholia without delusions became equivalent to mania or melancholia without insanity. Not only Casper, but Griessinger, Henke Moreau, Baillarger, and in America Gray and Winslow, wrote against the unreason which assumed the possession of an intellect normal in all respects other than that which related to the commission of a crime and at all times but at the moment of its commitment. Owing, however, to Pinel's reputation and influence, we find to this day lengthy

[1] It may be here stated that although courts sometimes still use the terms monomania and partial insanity in the discussion of insane states, most alienists do not, because it is recognized that a delusion in reference to a few lines of thought or even to one, must affect judgment, a collective attribute of the mind.

arguments to combat this claim where writers discuss irresistible impulse and moral insanity from a legal point of view; but modern psychiatry and the law are as one as regards the repudiation of the doctrine that an isolated insane act may be committed by a person in complete mental health just previous to and immediately subsequent to it. Meantime, the clinical recognition of insane states by Pinel and his school, wherein, without delusion, occur the commission of immoral acts—viz., to kill, to destroy, to wound, to steal, etc.—which are crimes when committed by responsible persons, involved a broader conception of insanity than had existed up to their time.[1]

Pinel's cases of *manie sine delire* and those of his school resolve themselves chiefly into three classes, namely:

1. Certain forms of degenerative insane states (Kraepelin), meaning *impulsive insanity and moral idiocy.* Moral idiocy always, and impulsive insanity usually, is unassociated with false beliefs; but where delusions are experienced it is in the form of hallucinations often occurring at the moment the act is accomplished. Like the aura of epilepsy, the hallucination has no causal relation to the reflex movement. Without doubt, delusions which develop action may be harbored by persons who are subject to an irresistible impulse; but in this case delusional insanity is associated in the same subject with the degeneration type.

[1] However, Casper's viewpoint that insanity is a disturbance of self-consciousness based upon delusions is still the one usually taken by American and English courts. The former have frequently recognized an irresistible impulse as a valid defence, but either this term has been misapprehended in that it has been applied to some act evidencing the usual ill-considered and impulsive action of the insane, often indeed responsive to delusion, or, true uncontrollable impulse being recognized, we may yet find upon exposition that at least phraseological concession has been made to long teaching of the omnipresent delusion as cause of violence, as witness the charge of Chief Justice Shaw, of Mass. (Wharton, Mental Unsoundness and Psychological Law, § 156), who, in reference to monomania stated: "1. Either the delusion is such that a person under its influence has a real or firm belief of some fact not true in itself but which if it were true would excuse his act, etc. 2. Or this *state of delusion* (italics mine) indicates to an experienced person that the mind is in a diseased state, that the known tendency of that diseased state of mind is to break out into sudden paroxysms of violence, venting itself in homicide or other violent acts toward friend or foe indiscriminately; so that although there are no previous indications of violence, yet the subsequent act connecting itself with the previous symptoms and indications, will enable an experienced person to say that the outbreak was of such a character, and for the time being, it must have overborne memory and reason, that the act was the result of the disease and not of a mind capable of choosing; in short, that it was the result of uncontrollable impulse and not of a person acted on by will." If in this instance *delusion* was used in the broad sense of *error* and "state of delusion" is equivalent to mental alienation, then the phrase becomes misleading where used in connection with impulsive insanity. Certain it is, that in forensic discussion of specific cases of insanity the term delusion had best be employed in its more limited medical sense. English courts have usually looked with less favor upon the doctrine of irresistible impulse than those of America. Wharton (§ 152, vol. i.) says in reference to their rejection of this state as a defence for crimes: "No person however insane can by the law as now (1882) expounded by those courts be acquitted of a crime if it appears to the satisfaction of the jury that he knew the nature and quality of the act he was doing or if he did not know it, if he knew the act was wrong." Some English views concerning knowledge of right and wrong in cases of impulsive insanity will be quoted later on.

2. Instances in which the subject is possessed by delusions, but these are exhibited in so slight a degree and are associated with reasoning power so closely approximating that which is normal that they were ignored by earlier clinicians (*folie raissonante, mania mitisima, hypomanie*).

3. Cases of *melancholia activa,* in which the constant dread of something unknown, but fearful, which hangs upon the patient like a pall of doom, is translated into a violent act, in which delusion as an hallucination or in the sense of a deprivation of reason probably does exist, but whose connection with the patient's act could not be or failed to be established.

Casper[1] contended that all of Pinel's cases of *manie sine delire* really belonged to Class 3 of the above. This is not true. Casper's error is best demonstrated by a perusal of his own cases, which he details clinically, and wherein characteristic data of degenerative types are classed with forms of insanity dependent upon delusions. Three brief reports by Pinel on as many cases are reproduced in Casper's *Handbook of Forensic Medicine,* and are substantially as follows:

Case I.—A man, indulged by his mother in his youth, was perfectly rational when quiet, managed his large property with propriety, fulfilled social duties, and was beneficent; but he was constantly quarrelling, opposition increasing his anger. If a horse, sheep, or dog annoyed him he killed it at once. In society he gave and received blows. Wounds, litigation, and fines had been hitherto the sole result of his quarrelsomeness, but one day he got incensed against a woman who had offended him and threw her in a well. Casper complains "that this account resembles a horrible newspaper anecdote more than a medical observation." We must agree that the story is as unsatisfactory as a clinical history, as it is lacking in data to determine the presence or absence of criminal motive. Casper asks: "What was his conduct during the time just preceding the act? what was it subsequently? what was his relation to the murdered woman, or was he really a man of violent passions who could not, because he would not, command himself? On these and many other points Pinel is silent." And yet we may be sure that some degree of imbecility as typically displayed in certain degenerative states existed in this case. Gauged by the common standard of his society, the exhibition at mature age of a lack of mental equipoise and restraint which so continually resulted in violence, the immediate product of a first emotion, side by side with developed talents in special directions, can be explained in no other way. Such a conclusion, however, is by no means equivalent to the withdrawal of entire responsibility for this person's acts.

[1] It may appear to some that discussion of opinion advanced by some of the older authorities in reference to forms of mental alienation that are now included under the degeneration insanities is reviewed without good reason, because of the better classification and fuller knowledge already acquired by modern psychiatry. While it is true that a physician may view much that is adduced as of mere historic interest, he would find that authorities who discuss moral insanity and irresistible impulse from the legal side still quote the earlier writers of the subject in hand, and base their judgment largely upon their opinions.

CASE II.—A man who periodically experienced a burning sensation in the bowels, intense thirst, obstinate constipation, the face becoming flushed, the temporal arteries pulsating violently, was also seized at these times with an irresistible desire for blood. If cutting implements were at hand he was ready to sacrifice, in a kind of fury, the first person he came across. Even during the attack he was in possession of his reason, answered questions correctly, betrayed no incoherence of ideas; indeed, felt the horror of his situation. At one time he warned his beloved wife to flee in order to avoid a violent deed; at another time, while in the hospital, he stabbed himself in the breast and arm. The paroxysmal desire to commit sanguinary violence, with realization of the evil character of the deed—at least during the time of sufficient consciousness to permit conscience to inspire repulsion—and also the absence of ordinary motive, in that his fury is vented upon the first person at hand, at one time even upon himself, present characteristic marks of true impulsive insanity. Had it been looked for, a sexual element would probably have been found associated with the paroxysm. It is significant that Casper refers the discussion of this case to a chapter on *homicidal monomania*, concerning which he says: "The observation that men occasionally commit murder without any of the usual motives—indeed, under the most remarkable circumstances and apparently on the most sudden impulse, and that, frequently, on persons most dearly beloved by them—is not of recent date," etc.; and this from an authority who even contended against the existence of an irresistible impulse!

CASE III.—A man whom the mob, during the French revolution, freed from Pinel's asylum. This person declared his confinement in fetters with lunatics to be the most horrible injustice. He was set free with shouts of "Vive la Republique!" But the sight of so many armed men, their furious shouts, their countenances flushed with wine, aroused the fury of the lunatic. He forcibly wrested a sabre from one near him, hewed right and left around him, and had to be taken back to the asylum. One agrees with Casper that the selection of this case to demonstrate "mania without delirium" is most unfortunate. The fact that the patient had to be returned to the asylum proves he was not unjustly confined with lunatics. If a paranoiac, a delusion of persecution may have incited him to "hew about" for revenge; but, what is more likely, he probably aped the violent actions of those about him from sheer weakness of intellect, and for this reason also failed to distinguish friend from foe.

And yet Casper, who quoted Pinel to better prove, as he thought, the absurdity of insane irresistible impulse, and who as the much-sought forensic physician was greatly concerned in the embarrassment of the practical administration of justice which recognition of novel forms of insanity entailed, had not failed to observe instances of impulsive insanity, as yet another quotation from his chapter on homicidal mania[1]

[1] Casper urged that homicidal mania be stricken from the classification of insanity. Disregarding errors which arose from failure to recognize insanity unassociated with delusions, modern psychiatry must nevertheless appreciate his efforts to correct the fashion of his day to formulate long lists of insane types often theoretically constructed by metaphysicians, or again, as in the above instance, merely based upon the name of the morbid act.

demonstrates. He says: "There are still other cases whose actual existence I am all the less anxious to deny, as I myself have had occasion to make similar observations. These pure cases—that is, those in which without the individual having labored under any form whatever of insanity, or having been, from any bodily cause, suddenly and transitorily affected by mental disturbance; those cases, therefore, in which there coexisted with otherwise mental integrity an inexplicable able something, an instinctive desire to kill (Esquirol, Mark, Georget, etc.)—are extremely rare, or, rather, there are extremely few cases published, for I am convinced that such pure cases actually occur far more frequently than their literary history would seem to show." We demur from this opinion, as from that of Pinel, that impulsive insanity coexists with mental integrity; and we marvel, in view of the similarity of this statement to that of Pinel's, which follows, that Casper denied the existence of a *manie sine delire.* Pinel had stated "that there are madmen in whom there is no perceptible alteration of the intellectual process, of the perceptions, judging faculty, imagination, or memory, and yet a perversion of the manifestation of the will, in a blind impulse to the commission of violence or even bloodthirsty rage, without any assignable dominant idea, any delusion of the imagination which could cause such propensity."[1] We gather from statements by Maudsley[2] that Esquirol, Pinel's greatest pupil, at first believed, as did Casper, that all of Pinel's cases of *manie sine delire* were really examples of melancholia. This was his opinion at the time he published his article on "Mania" in the *Dictionnaire des Sciences Médicales*, in 1818; but subsequent observation compelled Esquirol to abandon it and to declare that although some insane persons committed homicide in consequence of delusions, hallucinations, or illusions, there were unquestionably others who were driven by an instinctive impulse—a blind, instantaneous impulse, independent of the will—and who acted without passion, without delusion, without motive. To this condition—the *manie sine delire* of Pinel—he gave the name *monomanie instinctive*, distinguishing it, in the first place, from true monomania—*i. e.*, *monomanie intellectuel*—in which there was delusion, and, secondly, from *monomanie affective*, or *moral insanity.* Moreover, Esquirol withdrew from the untenable position of Pinel (one taken later, as we have seen, by Casper as well), and regarded as psychologically impossible an insanity of any kind in which the understanding is not 'more or less affected'[3]—an opinion which placed this authority in line with the views of modern alienists.

Also, the eminent German alienist Griessinger, as a perusal of his

[1] Wharton, § 541, Mental Unsoundness and Psychological Law.
[2] Responsibility in Mental Disease, p. 153.
[3] Translation by Dr. Chipley. Quoted by Wharton, § 542.

work[1] easily establishes, seems to have occupied the anomalous position of inveighing against and yet recognizing the existence of insane irresistible impulse; but we find upon examination that his objections are aimed against what in reference to that doctrine has not stood the test of time—*i. e.*, errors arising from the blending of true and false characteristics of this form of mental alienation. For instance, the term *monomania*—used after Esquirol by the medical profession for so many years, and to this day by the judiciary—encompassed both delusional insanity following markedly one or two lines of thought and the clinically observed insane uncontrollable impulse; hence, the latter shared in Griessinger's contention that the mind as a whole must be influenced by any cause which evidenced insanity in any one direction. Again, Griessinger, like Casper, objected to the custom, in vogue in his day and our own, of making "the deed itself the distinctive mark of an abnormal mental state (homicidal mania, kleptomania, etc.) as alike dangerous to science and to practice." But this opinion, to which modern psychiatry also subscribes, was with him no more equivalent to non-belief in an irresistible impulse to kill, to destroy, to steal, etc., than is the same opinion of present-day science, for he adds: "But, finally, are there not cases in which in criminal deeds a morbid mental state exists and has influence, and yet presents no external manifestations? I believe it possible. Who would dare to trust himself to separate his mental mechanism as one would lay open the leaves of a book? Who would deny the possibility of an active organic influence of a morbid nature, not exactly noticeable, when disturbed and disordered at the moment of action, turning the scale to crime? In this sense I was compelled to express myself at the bar in the case of a murderer who suffered from well-constituted vertigo epileptica. I was constrained to say that neither before, nor at, nor after the deed did we find certain signs of mental disturbance, yet, notwithstanding, *it was possible that this disease allowed influences to act in the phenomena of volition which obscured reflection and weakened freedom of will, without, however, manifesting themselves by any external symptom*" (italics mine). But, it may be suggested, this is epilepsy. The precipitate convulsive muscular spasm of epilepsy, and the approximately voluntary, although perhaps long and consciously resisted, act of impulsive insanity, appear to be widely diverse morbid phenomena. Not so, however, when, as in the case cited by Griessinger, the *vicarious equivalent* of the spasm is recognized. The unstable neural response to external stimuli in both instances has a common origin.[2] Another time

[1] Mental Pathology and Therapeutics. W. Griessinger, trans., 2d edition.

[2] E. D. Fisher (Medical Jurisprudence, Becker and Witthause, vol. ii. p. 275), quoting Simon, tells of a case of pyromania: "A young quarryman had set fire to thirteen quarries, barns, and buildings. The multiplicity of the crimes, the identity of the circumstances attending the

Griessinger says: "Almost as obscure—*i. e.*, as those fits of spurious violence which arise from melancholic anxiety—in so far as the motives which dictate them are concerned, yet of the greatest importance in a medico-legal point of view, are those cases where individuals, hitherto perfectly sane and in full possession of their intellects, are suddenly and without assignable cause seized with the most anxious and painful emotions and with a homicidal impulse as inexplicable to themselves as to others." Following this are detailed a number of cases of impulsive insanity. Griessinger, like Casper, has been regarded a bulwark among the opponents of the doctrine of irresistible impulse. However, examination of his writings prove that, like all alienists of considerable clinical experience, he had observed cases exemplifying this condition; but he was alive as were the conservative authorities of his time to the danger of a formal recognition of this mental state because of the easy generalization and laxity of application by its earliest advocates. That paragraph in Griessinger's work which is a favorite quotation to prove this author opposed to a belief in uncontrollable impulse is as follows: "Whether and to what extent certain directions of the will and impulses of the insane—particularly such as lead to criminal acts—are irresistible, is a question which can scarcely ever be answered with certainty. Few of the acts of the insane have the character of forced, purely automatic movements. In mania, also, according to the testimony of individuals who have recovered, many of the wild desires could often be restrained. The criminal deeds of the insane are not generally instinctive." Here are general statements, found in the chapter on "Anomalies of the Will," from none of which advocates of insane irresistible impulse will dissent. The sane judges the insane mind and the actions growing out of the latter as best it can. It could never follow all the crochets of abnormal reasoning, even if suppressed causes and motives were known. And, again, who will doubt that, viewed not in relation to acts of degeneration insanity without delusion, but in regard to those of all varieties of lunacy, few insane acts are forced and purely automatic? What Griessinger observed and thought concerning the special cases which

accomplishment, and the doubt of the existence of a motive, led the authorities to ask for an examination of the mental condition of the accused by Tardieu and Lasigue. These declared the accused impulsive and irresponsible, and recommended his commitment to an asylum. An epileptic seizure soon after explained unmistakably the cause and nature of his impulse." Savage says (Epilepsy and Insanity, Dict. Psychological Medicine, p. 453): "There are certain cases of moral insanity (impulsive insanity as employed in this article) in which there are no very clear evidences of convulsive seizures at first, though these may develop later, and with these occur certain impulsive destructive acts which in many particulars resemble in character the purposeless yet energetic muscular acts which form part of an epileptic fit, and in the two classes of cases similar discharges of nerve force along paths of the least resistance take place and may become habitual by recurrence." Clouston (Clinical Lectures on Medical Diseases) makes a class of the epileptoid manifestations of irresistible impulse in his excellent chapter upon the subject.

came under his notice we have seen. And so it will be found that a review of the clinical observance and recognition among alienists of an overmastering and at times pleasurable impulse proves that authorities who opposed moral insanity (including in this term both impulsive insanity and moral idiocy) were really mere protestants against Pinel's and later Prichard's conception of a mental state which coupled reason and unreason—against what Wharton terms "the compartment theory" of moral insanity, which assumes that one may be insane morally and not intellectually. Prichard, the father of the universally adopted term moral insanity, added not a little confusion to medico-legal discussion of our theme, and in this way: Pinel had said—and this quotation is cited by Prichard himself—"We may justly admire the writings of this philosopher (Mr. Locke) without admitting his authority upon subjects not necessarily connected with his inquiries. On resuming at Bicetre my researches into this disorder—*i. e.*, insanity—I thought, with the above author, that it was inseparable from delirium or delusion, and I was not a little surprised to find many maniacs who at no period gave evidence of any lesion of the understanding, but who were under the dominion of instinctive and abstract fury, as if the active faculties alone had sustained injury."[1] Again, the novel insane type wherein insane action was associated apparently with normal understanding, this conclusion being derived from an absence of delusion and retention of considerable power to reason coherently. With the correction advanced by Griessinger and others, who urged the necessity of recognizing the human mind's unity of function, Pinel's conception could at once have been translated to that of the present day concerning impulsive and moral insanity. Unfortunately, however, Prichard extended Pinel's idea so as *to encompass that frequent state of mind in chronic maniacal conditions wherein are associated a degraded ethical standard for conduct and ability to reason plausibly.* This moral insanity, or "morbid perversion of the natural feelings, affections, inclinations, temper, habits, moral disposition, and natural impulses, without any remarkable disorder or defect of the intellect or knowing and reasoning faculties, and *particularly without any insane illusion or hallucination*" (italics mine), Prichard discovered not only in the degeneration states without delusion that we are at present considering, but also in the various maniacal forms of delusional insanity—*i. e.*, the monomanias, or, as expressed in modern nomenclature, in cases of paranoia, circular insanity, senile dementia, etc. It is therefore obvious that Prichard, who defined Pinel's conception accurately, erred in the application of his definition. Thirty years since the alienist Maudsley used the term moral insanity in the modified sense, viz., as an expres-

[1] J. C. Prichard. A Treatise on Insanity.

sion of that general letting down of a moral ethical nature often noticeably coincident to a developing acquired insanity; while within recent years Clouston has found it advantageous to designate this condition as *Prichard's moral insanity.* Medically, then, the term in this sense is obsolete, and its use should be avoided, that it may finally be discarded by legal writers also.

And we may finally ask, in the interest of a more specific nomenclature, that irresistible impulse in the sense of impulsive insanity as distinguished from that of moral insanity (moral idiocy) be no longer used synonomously by medical men and the courts.[1] To-day alienists such as Clouston, Krafft Ebing, and Kraepelin may differ as to the expediency of classification, but each looks upon the mental types which are encompassed by the definitions of impulsive insanity and moral idiocy as degenerative forms of mental alienation. But palpable differences exist in typical cases. The motive of the morbid impulse in the former possesses no moral alignment to those of the subject's acts in general; also, unless mental obscurity and desire have been developed with equal suddenness, the impulse has to a more or less extent been resisted by the subject who has been able to review objectively his intention. Afterward, if the act be accomplished, this person, who can scarcely be said to experience true remorse, may in some cases possess a semblance of this feeling subsequent to the mental ease following immediate completion of desire. Examples most important to forensic practice are impulses to steal, to kill, to commit lustful acts, to set fire to or otherwise destroy property, and to commit suicide.[2] On the other hand, the moral idiot, always completely conscious, continuously or as opportunity offers, likewise administers to his sense-pleasure, but merely in this case obeying the first dictates of self-interest, and, having no thought beyond his wish, acts without the least mental resistance. This insane type is most frequently exemplified by those unnatural children who find delight in torturing animals, maliciously tormenting weaker playmates, persecuting some old or helpless relative—children who will steal, sometimes murder, or plan a considerable destruction of property to satisfy a childish whim or accomplish a childish revenge, and whose

[1] J. Robertson, of Kentucky. Quoted by Wharton, § 175.

[2] Kraepelin classes separately as constraint insanity (Zwangsirresein) those instances of fearsome and unseemly impulse without delusion which we know as *imperative conceptions.* When analyzed we find these impulses to consist of resisted repellant acts: 1, whose remote sexual germ generally passes unrecognized, viz., an idea of this nature, "what if I should plunge a knife in that soft flesh;" or 2, when the thought is fearsome because it has its origin in an effort toward self-preservation. According to their nature one may trace a talismanic idea of protection or one of direct material danger, viz., fear to jump from a high, open space, or to be alone in a dark wide area, fear to refrain from reassuring one's self that a door is locked, that a certain paper is within the sealed envelope, fear to refrain from counting up a certain number, from touching certain objects, etc.

demeanor proves an inability to duly appreciate the character of their acts despite all instruction. Viewed objectively and alone, scarcely a single characteristic has been mentioned but may be duplicated by criminal propensity. Because of this, facts elicted in reference to these insane types are viewed by the public with misgiving, the latter to a great extent believing that the enthusiasm of physicians has resulted in false conclusions which, if accepted, would dissolve society's safeguards against the deeds of the evil-minded. However, upon examination it will be found that the accumulation of clinical evidence in favor of the existence of insane morbid impulse has, willy-nilly, forced itself upon all who have given the matter study, and is a conviction which has by no means been confined to the medical profession. Where physicians have attempted to deny clinical evidence in this matter their own experience, if published, is apt to prove their contention unreasonable. This has already been shown in our review of the conception and development of the irresistible impulse idea as an explanation of unlawful acts; yet as distinctly bearing upon this false position we may yet adduce the following from that fountain-head of forensic knowledge, Casper's *Forensic Medicine*. He who says that "the unscientific and untenable doctrine of morbid impulses and their constraining power in the causation of crime has been sought to be introduced into forensic medicine and practice for the benefit and advantage of frail mortality," nevertheless records in his chapter on homicidal monomania two "pure cases" which he personally observed—one homicidal in character, the other an impulse toward self-mutilation. These morbid impulses were resisted. Not so, however, was that of a subaltern (also a clinical observation from Casper's own practice) who "had from his youthful years labored under the extraordinary 'monomania' that whenever he saw whips hanging out at a belt maker's he was immediately seized with sexual desire which had at once to be gratified." The relation of such imperative desire to possible crime if gratification were difficult is manifest.

This typical example of masochism Casper calls "a fixed idea" having "the actual strength of a true insane delusion—not merely a caprice—and yet the integrity of the mind still continues." We have nothing to do here with the extended interpretation of an insane delusion, but we need take note of that incongruity that admits an impulse morbid to insanity and yet demands complete control of action by the sane part of the same mind—an idea familiar to legal conceptions of partial insanity since Lord Hale's time. But, strangest of all, is Casper's contention against the position of Heinroth and Ideler and in favor of the verity of paroxysmal dipsomania ("periodic intoxication insanity"), which no one to-day would think of differentiating in kind

from other periodic morbid impulses. Two cases personally observed are detailed.

For reasons already given we are not surprised that the legal view of this important question has developed opposition to the theory of an irresistible impulse. So much as is born of a reasonable conservatism in the desire to protect society can only be lauded; but, as we shall see, courts of law, which in general have viewed the theory of an uncontrollable impulse with the greatest disfavor, have at times been compelled to recognize it as a real causal factor of crime. For a better appreciation of this point, recognized amidst great legal conservatism, some landmarks in the history of English law in reference to the criminal responsibility of the lunatic will be first recorded. Lord Hale (1609–1676), who had recognized a complete and a partial insanity (approximating in our time an acute and furious mania or utter incoherence as differentiated from various forms of delusional insanity associated with some power of sequential reasoning) ascribed legal irresponsibility to the former, but entire responsibility to the latter form. Justice Tracy, in 1723, following the same rule, stated that to be exempted from punishment "it must be that a man is totally deprived of his understanding and memory, and doth not know what he is doing, no more than an infant, than a brute, or wild beast; such a one is never the object of punishment." The same rule was advanced by the attorney-general in the prosecution of Hadfield, in the year 1800, for shooting at the King; but was now discredited by the principle advanced by Erskine, for the defense, that "delusions where there is no frenzy or raving madness is the true character of insanity." The effect of the rule laid down by Erskine, whose client was acquitted, was far-reaching; but the principle was not formally sanctioned. In 1812, in the course of a trial for homicide committed by one Perceval under the influence of an insane delusion, the attorney-general prosecuting stated (the presiding judge concurring therein) "that, although a man might be incapable of conducting his own affairs, he may still be answerable for his criminal acts if he possess a mind capable of distinguishing right from wrong." Maudsley[1] calls attention to the fact that it was the power to distinguish right from wrong generally, and not in relation to the particular act in question, which was made the criterion of responsibility in this case, for it was said: "If such a person were capable in other respects of distinguishing right from wrong there was no excuse for any act of atrocity which he might commit under this description of derangement. It must be proved beyond all doubt that at the time he committed the atrocious act he did not consider that murder was a crime against the

[1] Loc. cit., p. 99.

laws of God and nature." The insane Perceval was executed. In 1843 occurred the murder of Drummond by McNaughton, who shot the former under the insane delusion that he was being followed, his character blasted, etc., while at the same time it was shown that the homicide " had transacted business a short time before the deed, and had shown no obvious symptom of insanity in his ordinary discourse and conduct." The defendant was acquitted on the ground of insanity. Maudsley says: " Thereupon the House of Lords, participating in the public alarm and indignation which were occasioned by the acquittal, propounded to the judges certain questions with regard to the law on the subject of insanity when it was alleged as a defence in criminal actions, the object being to obtain from them an authoritative exposition of the law for the future guidance of the courts. The answers of the judges to the questions thus put to them constitute the law of England as it has been applied since to the defence of insanity in criminal trials." In these answers it was stated that " to establish a defence on the ground of insanity it must be clearly proved that at the time of committing the act the party accused was laboring under such a defect of reason from disease of the mind as not to know the nature and quality of the act he was doing, or, if he knew it, that he did not know he was doing wrong." This was a great advance upon the position assumed by the court in the Perceval case, for henceforth criminal responsibility in the alleged insane was to be dependent upon the mental condition at the time of committing a specific act, and not upon a knowledge of right and wrong in reference to various episodes of life-conduct abstractly contemplated ; also, the latter rule, by its more comprehensive " defect of reason," with benefit superseded the principle laid down by Erskine, for as well need delusion, in the absence of frenzy, not typify insanity as it is possible that madness exist without false beliefs.

And now as regards some knowledge of right and wrong in the insane. We have seen that in 1812, if possessed by them even as regards matters remote from the offence in question, responsibility was established. The insane often possess such knowledge, although its development is not logical. It is vague, indistinct, even as Lubbock says of the inherited knowledge of children, that they know there is a wrong and a right, and yet they cannot properly categorize occurrences ; or ethical perception of the insane may be reasonably clear along one line and absent concerning another. To illustrate this point we may borrow another leaf from the authoritative Casper's vast clinical experience, and incidentally it may be noted how the opponent of impulsive insanity records in Case II. a morbid, pleasurable impulse without delusion.

Case I.—A deaf-mute twice forced his way into the house of a sexton and demanded the latter's daughter for his pleasure. Being threat-

ened, the mute attacked the girl's father. Upon precognition he smilingly confessed these deeds; also that he might have killed the sexton, and that this would have cost him his head. After long consideration he also remembered the ten commandments. His general demeanor led Casper to pronounce this man irresponsible.[1] Casper also says: "It is well known that lunatics, though they no longer possess actual 'power of discrimination,' yet have a certain instinctive foreboding of what is allowed and what forbidden. From this never distinct knowledge such lunatics are observed to conceal stolen goods, deny the deed, and exculpate themselves until they are palpably convicted."

Case II.—Herein is recorded of a sensible, educated woman of pure morals that she had gone deranged fifteen years previously, had remained so many years, had been declared judicially "imbecile," but had now regained full and free use of her understanding. "With the greatest composure she communicated to me many particulars in regard to her derangement and its excesses, describing with the utmost distinctness her then powers of ratiocination. For a time she was impelled to break panes of glass with stones; but she knew how improper this was, *therefore she threw the stones carefully, so as not to break the glass, but if this happened, then she rejoiced at it.* . . . I relate this case here, however, because it gives a most instructive peep into the interior of a mind under the trammels of disease; gives from a credible witness a confirmation of a well-known psychological experience, that those mentally diseased may not only have a clear cognizance of the difference between good and evil, but also that even in respect to their obscure consciousness they can command themselves up to a certain point. The discipline of every lunatic asylum is based upon the very proper recognition of this fact."[2]

From all of the foregoing, therefore, we may declare that the position of modern alienists, viewed so frequently with disfavor by the courts, only differs from oft-quoted opponents within their own camp, in that the

[1] Casper. Loc. cit., vol. iv. p. 344.

[2] Casper. Loc. cit., p. 147. Observations by Maudsley (loc. cit., p. 3) very similar to these are brought out in a discussion of a subject closely related to knowledge of right and wrong, viz., the fact that insane persons sometimes act from motives which also actuate the sane. He says: "Were the observer, whether casual or skilled, to reside for some length of time in an asylum, and thus make himself practically acquainted with the ways, thoughts, and feelings of its inmates, he would certainly discover how great a mistake it is to suppose, as is often done, that they are always alienated from themselves and from their kind as not to be influenced by the same motives as sane persons in what they do or forbear to do. When an insane person is on trial for some criminal offence, it is commonly taken for granted by the lawyers that if an ordinary motive for the act, such as anger, revenge, jealousy, or any other passion can be discovered, there is no ground to allege insanity or at any rate no ground to allege exemption from responsibility by reason of insanity. The ideal madman whom the law creates is supposed to act without motives, or such motives as it enters not into the mind of a sane person to conceive, and if some one who is plainly mad to all the world acts from an ordinary motive in the perpetration of an offence, he is presumed to have acted sanely and with full capacity of responsibility. No greater mistake could be made. Much of the success of modern humane treatment of insanity rests upon the recognition of two principles: first, that the insane have like passions with those who are not insane and are restrained from doing wrong and constrained to do right by the same motives which have the same effects in sane persons: that these motives are only effective within limits, and that beyond those limits they become powerless, the hope of reward being of no avail, and the expectation or infliction of punishment actually provoking more unreason and violence."

attempt is now made to classify generically insanity which chiefly involves perception, assimilation, and application of ethical principles.

Not otherwise than the experience of clinicians has also been that of many courts, whose study of criminal action and its motives in the degenerative insane has convinced them of the genuineness of the morbid phenomena presented. In these instances courts which apparently concede to the conditions named the right to plead insanity as a defence have usually framed a charge based upon the English rule as expounded to the Lords, yet referring more directly to existing special conditions. Such a charge by an American court has already been referred to (see note, page 1060). As has already been mentioned, English courts have, as a rule, been more rigid in dealing with alleged irresistible impulse than have those of our country. Nevertheless, British courts, too, have at times expressed the usual dictum concerning responsibility so modified as to permit the jury to decide whether the conditions of irresistible impulse or moral idiocy was established by the evidence, and to state the degree of criminal responsibility possessed by the accused. Thus Ogsten quotes a charge of the Lord Justice Clerk, of Edinburgh, delivered in 1863: "If a man knows what he is doing—that is to say, if he knows the act that he is committing; if he knows also the true nature and quality of the act and apprehends and appreciates its consequences and effects—that man is responsible for what he does. If from the operation of mental disease he does not know what he is doing, or if, although he know what is the act he is performing, *he cannot appreciate it or understand* (italics mine) either its nature or quality, its consequences, or effects, then he is not responsible." In a charge of Lord Deas, at Aberdeen, it was said: "If the jury believed the prisoner, when he committed the act, had sufficient mental capacity to know, and did know, that the act was contrary to the law and punishable by the law, it would be their duty to convict him."[1] Here not alone are all special tests for insanity put aside. With due recognition of the oft-remarked obscure sense of right and wrong in the insane, the charge in both instances makes paramount the question whether the accused had *sufficient knowledge and appreciation* of the quality of the act to make him responsible therefor.

Something, however, must be said in reference to another side. The scope of ethical conceptions necessarily varies among the insane as it does in the mental make-up of various normal persons, and so it happens that in some cases of undoubted mental defect appreciation of wrong-doing sufficiently approximates the normal to recognize in it a diminished responsibility instead of complete absence thereof.

[1] Francis Ogsten. Lectures on Medical Jurisprudence.

Cognizance of this condition, which is more especially noted in persons who are mentally deficient, yet possess no delusions, has long been taken in forensic cases concerning ordinary imbecile offenders. It is an equally important factor, however, in degeneration insanities. From all of which arises the necessity of disassociating insanity and criminal irresponsibility as equivalents. It is, indeed, difficult, to understand how this idea may be entertained by students of psychiatry, and yet so well-known an alienist as McDonald has said not long since: "The plea of insanity as an excuse for crime rests on the supposition or allegation that the accused is the victim of a form of disorder the existence of which, if established, renders him irresponsible for his acts. This being true, we may properly assume that, medically speaking, insanity and irresponsibility are so closely allied that they are essentially convertible terms, and that whenever the existence of insanity is clearly established the question of responsibility is practically determined. Hence this question of responsibility for criminal acts is, strictly speaking, a medical one, and it can be determined—especially in complex and obscure cases—only by those who are practically familiar with the symptoms of mental derangement."[1] Certain it is that the question of criminal responsibility is never a purely medical one any more than it is a legal one at first hand. Through the medium of the law medical evidence contributes its knowledge to elucidate conditions of mental alienation; but both sciences are employed for the one purpose, to better enable the lay jury, as the representative of the accused's fellows, to say whether the offender shall in some way be set apart from other men because unable or unwilling to be guided in conduct by established general rules; and as regards the doctrine which holds insanity and irresponsibility as convertible terms, this might easily have been developed in the course of opposition to unjust legal rulings whose position (1) denied to well-defined insane types the least immunity for illegal acts, as witness Lord Hale's utterance in reference to partial insanity, or (2) where this position refuses to allow as a mitigating circumstance to crime abnormal mental conditions, whether or not these be recognized as evidence of insanity, as Wharton has said is true of English law in regard to insane irresistible impulse. Nevertheless, McDonald's proposition is not only in itself incorrect, but also by asking, in this day, complete criminal immunity for every degree of mental alienation, it really effects the bad result of taking from some cases of insanity the mitigation of responsibility which is their due.

The layman's idea, which discovers in madness and criminal irresponsibility invariable equivalents, is more easily understood. To him

[1] Carlos McDonald, M.D. The Legal *versus* Scientific Test of Insanity in Criminal Cases. Medical Record, September 23, 1899.

the term insanity brings the picture of very patent manifestations of a diseased mind, viz., violent mania, unmistakable delusions, pronounced dementia, etc.—all conditions wherein only exceedingly inadequate notions of crime could be entertained. And here the importance of the medical expert's testimony and the need that he be properly supported by the court becomes apparent. Very frequently, indeed, the testifying physician is sometimes misapprehended when, in answer to questions of counsel, he pronounces insane this or that condition. The term alike describes a slight deviation from a normal condition of mind and the mental manifestation of grossest mental disease, while it is obvious enough that the same degree of responsibility for conduct does not exist for these extremes of mental capacity. Just in these types of mental aberration which are unassociated with delusion, incoherence, or frenzy at any time (or, perhaps, the last solely at the moment marking the acme of a paroxysmal seizure) is it sometimes necessary to convey to the minds of the jury a conception of insanity which the latter will feel they may not entirely absolve from criminal capacity. We may remember, as somewhat analogous, that the law recognizes in reference to the effect of alcoholic intoxication several conditions which modify responsibility for crime. The immediate cause of the abnormal passions and impulses of alcoholic drunkenness is comprehended and its effects recognized as evanescent. In impulsive insanity and moral idiocy the intoxicating cause, being developed within the organism, is less apparent, but its effect in ebb and flow is more lasting. Altogether, however, from what has been said, develops *the apparent need for sufficient exposition on the part of the medical witness to aquaint the jury with special conditions which apply in these and other forms of degenerate alienation, and as distinctly to be avoided, in the present knowledge of the public concerning these cases, the mere pronouncement of the mental state of the accused as one of insanity.* We find another reason for properly conserved freedom of speech on the part of the testifying physician in the character of his testimony. His opinion is asked in the light of his entire experience, and not only in reference to the facts elicited concerning the case in hand. But even where the question in actual dispute is solely considered, the doctor's diagnosis often rests, perforce, upon other conditions than those perceived in the course of his own examination of the patient, viz., upon the clinical history previous to a certain attack or symptoms noted between the times of the doctor's visits. These are often of material importance, and from them diagnosis, prognosis, and treatment each takes its cue. By experience the practitioner utilizes what is relevant in the testimony of these facts, because such are daily elicited at second hand in the course of his work. Nevertheless, evidence concerning a diagnosis

based upon this hearsay evidence, even when weighed in the balance of professional judgment, must of necessity be of a different nature than the testimony given by an ordinary witness, which must always be personally perceived of sense to be relevant. It is easy to see why a direct affirmation or negative answer may be properly demanded in the latter case, but it is no less plain that a demand of simply a "no" or "yes" from the medical witness, without modification or explanation, by its misleading directness may easily produce a subversion of the truth. One would, therefore, deduct also from this circumstance that a better understanding between the jury and the physician testifying before them would be established *if the court would hold the medical witness under special protection, permitting him to frame all his replies to questions of counsel as he thinks best, provided his testimony is relevant, tends to elucidate the points at issue, and is not extended at too great length.*

Herewith this paper is brought to a close. The writer trusts that to its object, previously set forth, some material facts have been brought to bear, and of these he would regard as of particular importance such as have added testimony concerning the absolute reality of insane irresistible impulse through the pens of medical authority so frequently quoted in opposition to this morbid phenomenon.

REVIEWS.

Und der Nervenzelle und der zelle im Allgemeinen. By Paul Kronthal. Jena: Gustav Fischer, Verlagsbuchandlung.

This volume departs considerably from the usual road followed by writers upon the histology of the nerve cells. The author has selected a topic with which he is not only familiar, but which affords a rich opportunity to his genius to ramble among the devious and highly speculative paths of general cytology. The nerve cell, indeed, has scarcely afforded more than a text from which at the first chance the author has proceeded to diverge. The work is not the less interesting because of that feature; rather it gains in interest because of the perspective which a wide and critical excursion yields.

The author loses no time in stating the method of work, which is to treat parts of the central nervous system with hardening agents in such manner as to preserve relations of cells and intercellular substances. At once, after describing the relatively simple procedures employed to accomplish this end, he dips into a consideration of the theory of the fixation of tissues in which the newer conceptions of physics and chemistry play an important part. This section of the work is, however, no more interestingly dealt with than the next, in which the theory of staining is discussed; and in both sections you are led to feel that the author possesses a keen appreciation of the bearing of modern physico-chemical studies upon histology and physiology.

The descriptions of the figures, which form the strictly original portions of the contents, are given immediately after the methods of study have been discussed, and they furnish the backbone of the work in that the author's original conception of the origin of the nerve cells follows upon their interpretation. This conception appears the stranger since all advances in our knowledge have tended more and more to emphasize the specificity of cells, a specificity, moreover, that applies not only to general morphology, but intimate inner constitution, with which, indeed, function must be closely linked.

In view of these facts and the data which the finer anatomy has given us in such abundance in the past decade, it is somewhat startling to be told that the nerve cells arise through fusion of leucocytes. The absence of mitotic figures and other evidences of regeneration in nerve cells afford, therefore, no obstacle to a belief in their post-embryonic generation, the denial of which the author finds it impossible to accept. He says: "If the conclusion—drawn upon the basis of the histological picture—that the nerve cells rise through fusion of leucocytes is correct, there will be found during the period of growth of the individual many more leucocytes in the central nervous system than in later periods. In that the central nervous system grows rapidly at first, and then progressively slower, so must we find the greatest number of migrating cells

in it soon after birth. From the examination of histological preparations it should, therefore, be possible to state if the tissue were obtained from a young, growing, or fully grown individual. The studies upon rabbits confirms this expectation to the extent of finding the spinal cord of the embryo crowded with cells, while in the adult they are much fewer. The nerve cells are constantly being consumed and as constantly restored through the fusion of leucocytes. Since the appearance of Apáthy and Bethe's publications there is no longer any doubt that the nerve cells are traversed by fibres which come from and hasten to the periphery."

This conception of the origin of the nerve cells will not have many supporters among histologists; but notwithstanding this fact the results of the author's work need not be lost. The methods employed may have advantages, and if the illustrations, which are excellent, can be taken as sufficient guides, they are to be recommended for preserving unimpaired the structure of protoplasm and nuclei and the relation between cells and intercellular substance. Moreover, the second part of the volume, which deals with the general as well as the special histology of cells, will be found highly interesting as well as critically presented. S. F.

Saunders' Hand Atlas Series. Atlas and Epitome of Abdominal Hernia. By Privatdocent Dr. George Sultan, of Göttingen. Edited, with additions, by William B. Coley, M.D., Clinical Lecturer on Surgery, Columbia University (College of Physicians and Surgeons). With 119 illustrations, 36 of them in colors, and 277 pages of text. Philadelphia and London: W. B. Saunders & Co., 1902.

This volume is a useful addition to Saunders' *Hand Atlases*, fulfilling in the most satisfactory manner the purpose of its author, that of supplying the general practitioner and the occasional operator with a reliable and concise book of reference. The publishers have been fortunate in the choice of their American editor, whose views when differing from the author's are definitely stated, thus giving to the book a distinct additional value. The translation is particularly readable and comprehensive.

The first portion of the book deals with hernia in general, including its definition, diagnosis, accidents, and treatment. The second portion has to do with special herniæ, and here are found excellent illustrations serving as reliable guides to the most approved operations of the day.

The editor has anticipated the reviewer in criticising the statement that 70 per cent. of alcohol, when properly employed as an injection for the cure of inguinal hernia in the young, is free from danger. Experience has demonstrated to many operators that although this method may, when properly used, be free from immediate danger, yet the tissues thus treated lend themselves badly to a later operation for radical cure, which in all likelihood will be found necessary. In justice, however, it should be said that the method is not recommended. The author's demonstration of strangulated hernia, and the illustrations of this condition are very comprehensive. He who undertakes to treat a strangulated hernia will do well to read closely what is said regarding taxis. If Sul-

tan's advice upon this subject were generally followed there would be fewer cases of bowel resection, of perforation, and of reduction of gangrenous bowel. J. H. G.

Eczema and Its Congeners: Their Pathology and Bacteriology, with Some Improvements in Their Treatment. By Edward Blake, M.D., Member of the Royal College of Surgeons, etc. London: Henry J. Glaisher, 1902. Philadelphia: P. Blakiston's Son & Co.

The title of this little book would naturally lead one to expect a treatise upon eczema and kindred affections, but an examination of its contents shows it to be made up of rather disjointed remarks upon a great variety of subjects not always very nearly related. Eczema, urticaria, herpes, gout, chorea, the teeth, and worms are some of the subjects discussed. Some of the author's statements would be very interesting if true; as, for example, it is stated in the preface that dental bacteria are among the commonest causes of eczema.

Buckley's investigations concerning the urine in eczema are referred to as supporting the view that this malady is a constitutional one. As we interpret this investigator's results, they prove, if they prove anything, that there is absolutely no constant relation between the composition of the renal excretion and this disease.

Minute doses of croton oil or dulcamara are said to be very valuable in the treatment of impetigo contagiosa. Even if these remedies were as useful as claimed, which we doubt very much, it seems a rather roundabout way to treat a strictly local affection which is usually curable in a few days by local treatment.

The author introduces a new remedy for the treatment of eczema, viz.: formalin, which he has used with benefit in one case—a rather limited experience.

The book is not a very illuminating contribution to our knowledge of eczema; it is difficult to consider it as a serious attempt to discuss an important subject. M. B. H.

Therapeutics, Preventive Medicine, Climatology, and Forensic Medicine. By George F. Butler, M.D., Henry B. Favill, M.D., Norman Bridge, M.D., and Harold N. Moyer, M.D. Practical Medicine Series of the Year Book. Vol. VII. Edited by Gustavus P. Head, M.D. Chicago: The Year Book Publishers.

We cannot recommend too highly this collection of short abstracts from the most recent literature upon the above-named subjects. The section devoted to Materia Medica and Therapeutics, occupying more than half of the total number of pages comprising the volume, is most interesting and instructive. In this collection the investigator may find an abundance of suggestions for further original work, and the busy practitioner valuable hints as to treatment. The chapter upon Climatology we would consider of great general value, giving, as it does, the temperature range, general climate, altitude, etc., of the regions most often

resorted to by those suffering from tuberculosis. It contains just the information with which every physician should familiarize himself before advising an invalid to attempt a journey for the benefit of his health. The other subjects, though necessarily occupying less space, are also well handled. T. A. C.

THE STUDENTS' MEDICAL DICTIONARY. Including all the Words and Phrases Generally Used in Medicine, with Their Proper Pronunciations and Definitions. Based on Recent Medical Literature. By GEORGE M. GOULD, A.M., M.D. Eleventh edition, enlarged, with many illustrations. Philadelphia: P. Blakiston's Son & Co.

THE fact that his book is now in its eleventh edition is sufficient proof of its worth. It is necessary to add, however, that in this enlargement of over a hundred pages it has not reached the size which renders it too large for ready reference. There has been no change in the general style of spelling and pronunciation which has always characterized the book. It is probably the most satisfactory of all small medical dictionaries.

The paper, type, and binding are to be commended for their durability, which in a book of its nature is very essential. J. H. G.

DISEASES OF THE NOSE, PHARYNX, AND EAR. By HENRY GRADLE, M.D., Professor of Ophthalmology and Otology, Northwestern University Medical School, Chicago. Handsome octavo of 547 pages, profusely illustrated, including 2 full-page plates in colors. Philadelphia and London: W. B. Saunders & Co., 1902.

DR. GRADLE, in his preface, states that in matters of treatment he "details only the procedures which have stood the test of critical experience, and omits those that have failed under this test, even though sanctioned by the tradition of text-books." At first appearance this seems to be rational and wise; but when we come to look through this volume, and find page after page devoted to etiology, symptomatology, and diagnosis, and the treatment often dismissed with a scant paragraph, this method seems open to question at the least. The majority of physicians who will read and study a work of this size and character will be those interested more or less in general work rather than specialists, and for this class of readers the treatment of the various conditions of ear, nose, and throat disease is of at least equal importance, in most cases, to the diagnosis. One cannot help feeling, after the perusal of this work, that after throwing out all the so-called unsatisfactory methods very few are left that the author considers efficient, and that he therefore considers most diseases of the upper respiratory tract and allied regions in a not too hopeful manner.

A fair amount of the work is taken up with anatomy and pathology. Unlike many text-books on this subject, this is not all massed at the beginning of the volume to which the student must turn back for refer-

ence, but is placed in small articles at the head of each chapter or section, treating of a different locality, and in such a manner as to be of distinct advantage.

The book is well and clearly written, and Professor Gradle, in repeating the dictum that "a specialist can never afford to lose his interest in general pathology," emphasizes a fact too often overlooked. At the end of various sections are paragraphs devoted to the history and literature of the subject under discussion, which will be of great interest and usefulness. The illustrations are fairly numerous and well drawn, though there is nothing strikingly new or original in most of them. There are far too few in the latter part of the book, in which otology is taken up. G. M. C.

A Manual of Bacteriology, Clinical and Applied, with an Appendix on Bacterial Remedies, etc. By Richard T. Hewlett, M.D., M.R.C.P., D.P.H. (Lond.). Second edition. Philadelphia: P. Blakiston's Son & Co.

Since, at the present day, a practical working knowledge of bacteriology is almost indispensable in routine clinical examinations, a textbook dealing with bacteriology, especially in regard to its clinical adaptation, is really of great value. The present book is written to cover exactly this ground. The book is not only confined to a consideration of bacteria and bacterial processes, but likewise includes a chapter on Blastomycetes, a most useful article considering the present importance attached to the pathogenic members of this group; a chapter on hyphomycetes, and a short description of the protozoa, with special reference to malaria. Some space is also devoted to the practical examination of water and milk, and to disinfectants and antiseptics.

The first few chapters deal with the ordinary methods of bacteriological investigation, the technique of stains, and the fixing and staining of tissues. A good, concise account is given of the fundamental principles concerned in the subject of immunity and the protective substances of the body fluids, together with a short discussion of hæmolysis, cytotoxins, agglutinins, precipitins, and the anti-bodies.

Practically all the bacteria pathogenic to man are described, but the descriptions of a few of the less important organisms are entirely too short. The classification of some of the bacteria is useful perhaps from a practical standpoint, but certainly not scientific. Again, although the latest work on the etiology of dysentery is quoted, this affection is classed, for some unaccountable reason, among the diseases of uncertain origin. Such errors are all the more astonishing since the book, on the whole, is thoroughly modern.

The descriptions of the saprophytic bacteria most commonly found in the body excretions are most fortunate. But perhaps the best feature of the book is the page or two of notes placed after the description of each group of organisms, which treats of the special methods of examination for that particular group of bacteria, and appends a list of the lesions where they are most apt to occur. It is this guide for the practical application of bacteriology which gives the book its principal value.

The photomicrographs are excellent, but some of the wood-cuts, especially those in the chapter on malaria, are decidedly poor. The manual contains 520 pages, and is well printed on good paper.

W. T. L.

A Manual of Minor Surgery and Bandaging. By Henry R. Wharton, M.D., Professor of Clinical Surgery in the Woman's Medical College, Surgeon to the Presbyterian Hospital, Philadelphia, etc. New (5th) edition, thoroughly revised. In one 12mo. volume of 612 pages, with 509 illustrations, many of which are photographic. Philadelphia and New York: Lea Brothers & Co.

That there should be a call for the fifth edition of Dr. Wharton's book is evidence of the high esteem in which it is held and a gracious tribute to its usefulness. Surgery has made rapid advances during late years, and a text-book on the subject very soon becomes antiquated if not kept constantly revised. This the author has been enabled to do by the successive exhaustion of previous editions, so that student and practitioner alike will find a mine of information there that cannot very often be obtained from larger works, and which represents the latest advances made, not only in minor surgery, but in the technique of major operations as well. For in addition to complete and lucid descriptions of all so-called minor surgical procedures, the volume has sections on all the major operations, and, although not very extensively, explains them in the concise way that impresses the mind of a student. Wharton's *Minor Surgery* is the standard work of its kind, and justly so. The text is accompanied by numerous illustrations, many of them being photographic, and arranged in an admirable manner. Particularly is this so in the section on bandaging, where almost every known variety of bandage or dressing is explained in detail, and with such clearness that a novice could scarcely fail in the application of one. It is praise enough to say that the volume is fully up to the high standard of previous editions, and abreast of the times.

G. M. C.

The Etiology of Acute Articular Rheumatism, with Critical Observations upon Its Therapy. By A. Menzer, Staff Physician and Assistant of the Illinois Medical University; Clinic of the Royal Charité. With a preface by Professor Senator. Gen. Med. Rath.; 5 plates Berlin: August Hirschwald, 1902.

This book is practically a monograph upon the etiology of acute articular rheumatism, in which the author thoroughly reviews the recent work upon the subject, and adds, besides, many original observations. The greater portion of the work is, of necessity, allotted to a discussion of the various bacteriological findings in acute rheumatism and their relative importance as the causative factor of this affection; the results obtained from cultures of the joint exudation, the blood, the heart valves, vegetations, etc., are all considered under separate headings. In

the critical review of the subject the work of certain investigators is, perhaps, given undue prominence, while a few more important observations are not sufficiently emphasized. Much stress is laid upon the results of animal experiments, and many interesting and new observations are recorded in which animals have been inoculated with streptococci obtained from sources other than the lesions of rheumatism. The relationship between rheumatic fever and acute tonsillitis is dwelt on, and the recent bacteriological work upon this side of the subject is thoroughly reviewed. Here, again, personal observations are added, and some new experiments described. The chapter upon the treatment of the disease offers nothing especially new, but there are some suggestions as to the future rational treatment based upon the author's conclusions as to the mode of infection and the part played by tonsillitis in the origin of the joint involvement. W. T. L.

International Clinics. Edited by Henry W. Cattell, A.M., M.D., of Philadelphia. Vol. II. Twelfth series, 1902. Pp. viii., 292. Philadelphia: J. B. Lippincott Co., 1902.

This volume opens with an excellent paper by Lépine on the treatment of diabetes mellitus; but the opinions therein contained should be compared with those of Douglas, who has recorded his investigations on the presence and significance of beta-oxybutyric acid in the urine of diabetics, and its relation to the coma (p. 128). Romme takes up the now thoroughly-known subject of Gersung's method, and commends it. Leguere records two instances of immediate death caused by spinal injection of cocaine, and emphasizes the warnings which have been expressed in other places in this series. Robino covers rather exhaustively, even if somewhat academic, the treatment of simple ulcer of the stomach—not so simple in his treatment as other than the French school may suggest. Eight pages of selected prescriptions are of value therapeutically, but not thorough as to nomenclature. Hepatic cirrhosis is presented by Edwards, although we prefer the term sclerosis used by Benedict in his excellent paper which follows. Then comes a carefully observed and concisely reported instance of pseudoleukæmia, with chronic relapsing fever, by Vickery. May he continue his important contribution! Hemmeter has a further word on gastro-intestinal auto-intoxication, and Patton contributes to the always interesting and somewhat ill-defined subject of bradycardia. Surgery, obstetrics, and gynecology are well represented by Tonnesco, who presents some rather astonishing statements about resection of the cervical sympathetic, by Coley, Gibbs, Senn, and Kelly on various topics. Walker traverses well-filled territory in the treatment of acute appendicitis, and takes cognizance of the fulminating forms so often the cause of unpleasant surprises. We are inclined, even from the medical viewpoint, to agree with him, suggesting, however, that if not so frequent as he implies, these cases are of immediate urgency. Of the special articles but one—that of Borissof—on the functions of the digestive glands, based upon the researches of Pavlof and his pupils, rather appeals as of especial importance. This is really to be studied by all advanced thinkers on digestive physiology and pathology. But one "eminent

living physician" is honored with a portrait and sketch in this volume. There is much which is satisfactory in this volume, and while the editorial blue pencil has been spared there is little that should be relegated to the limbo of the hopelessly bad. R. W. W.

A Text-book of Practical Therapeutics: With Especial Reference to the Application of Remedial Measures to Disease, and Their Employment upon a Rational Basis. By Hobart Amory Hare, M.D., Professor of Therapeutics and Materia Medica in the Jefferson Medical College of Philadelphia. With special chapters by Drs. G. E. de Schweinitz, Edward Martin, and Barton C. Hirst. New (9th) edition. Pp. xv., 857. Philadelphia and New York: Lea Brothers & Co., 1902.

For this edition the author states that he has carefully revised the text, included new and useful measures, added nearly one hundred illustrations, and claims it is almost a new work on the subject. We can vouch for the correctness of these statements. The matters which in former editions called for our disapproval, and which are found in the present, are the alphabetical arrangements and the failure to adhere strictly to pharmacopœial nomenclature. The objection to the alphabetical arrangement is somewhat diminished by the classification which is found on pages 43 to 47, inclusive. As for pharmacopœial terminology, each succeeding edition shows a change for the better. No doubt the author will in the future closely follow the nomenclature of the next revision of the Pharmacopœia, in whose production he is taking an active part. Much as we have in other places commended the material found in Part. II., devoted to Drugs, we believe that the most potent reason for the long-continued and deserved popularity of the book is to be found in Part. III., Remedial Measures Other than Drugs, Foods for the Sick, and in Part IV., Diseases. It is in these two parts that the author gives especial proof of the usefulness of the work and the reason for the addition of the qualifying adjective "practical" to the title "therapeutics." Here the student and the practitioner find their interest acute, and here one recognizes the steady progression of the author's opportunity for observation, the faithful use which he had made of it, and the forcible presentation of his conclusions for the use of his fellow man. This edition shows great advance over its predecessors, not only in text but in illustrations. Of methods and medicines but little *ex parte* argument obscures the clean-cut decisions reached after philosophical reasoning and aggregation of collected experiences. This book will not place in abeyance the divorce between laboratory and bedside, because of the simple fact that the author has studied both phases of drug action, and speaks *ex cathedra*, but because the clinician, from his laboratory experience, can reach more accurate conclusions based on a broader foundation than one who has not enjoyed similar advantages. And, further, the practical physician thus trained can translate in the language of practical therapeutics the findings of the

laboratory as no mere laboratory worker can do. We congratulate both author and reader on the improvements which we have noted, and rejoice in the unmistakable evidences of appreciated exertions.

R. W. W.

The Practical Medicine Series of Year Books. Under the general editorial charge of Gustavus P. Head, M.D., Professor of Laryngology and Rhinology, Chicago Post-Graduate Medical School. Vol. VIII., Pediatrics and Orthopedic Surgery. Edited by W. S. Christopher, M.D., John Ridlon, A.M., M.D., and Samuel J. Walker, A.B., M.D. Chicago: The Year Book Publishers, July, 1902,

The present volume of this series is fully up to the standard of those which have preceded it. The editors have ably selected abstracts from the best literature which has appeared on the subject of pediatrics and orthopedic surgery. The small size of the book makes it convenient for reference, and the very cheap price at which the entire series is sold places these valuable epitomes of literature at the disposal of every physician. The arrangement of the volumes is commendable, the amount of space devoted to each subject being fully equal to its importance or to the value of the literature which has appeared upon it in recent times.

The typography of the present volume shows an improvement over that of past numbers.

J. H. G.

Essentials of Histology. By E. A. Schäfer, LL.D., F.R.S. Sixth edition, revised and enlarged. 8vo., 416 pages, with 463 illustrations. Philadelphia: Lea Brothers & Co.

The title of this admirable text-book of histology should not mislead one to regard it in the nature of a "Quiz Compend." On the contrary, it is a most complete and painstaking guide for the beginner, as well as a not unworthy book of reference for the more advanced. The work in its previous editions is so well and favorably known in this country that a brief consideration of its revised scope is all that need be made. The volume is arranged as a series of lessons considering in turn the structure of animal cells in general and particular, and followed by studies of the tissues and organs of the animal body. Each lesson is preceded by directions for study which deal with the selection and preparation of material to illustrate the subject at hand. The work is profusely illustrated, not only with the more customary cuts from recognized sources of authority, but also by numerous new drawings by Muir made for this edition. Although many of the illustrations are extremely diagrammatic, the teaching purpose is perhaps better served by them than by the more indefinite lines of the real picture. The more familiar organs are treated adequately and with due regard to later researches on these lines. In addition, it is pleasing to note with what fulness the blood, the nerve cell, and the central nervous system are described.

The organs of the special senses have been considered in detail sufficient for a general treatise. An appendix descriptive of a few of the simpler technical methods of preservation, fixation, and staining of tissues ends the book. The paper, type, and binding are fully worthy of the most excellent text. F. P. G.

A Treatise on Cellular Toxins, or the Chemical Factors in the Causation of Disease. By Victor C. Vaughan and Frederick G. Novy. New (4th) edition, revised and enlarged. 8vo., 480 pages, with 6 illustrations. Philadelphia: Lea Brothers & Co.

No one who has an interest, practical or experimental, in the problems of scientific medicine can afford to pass by this most recent and comprehensive treatise. The field which the authors have chosen is a large one, covering, as it does, all the known toxic products produced by bacterial and animal cells, whether in a state of activity or after death.

The work is of chief value as presenting full, well grouped, and impartial summaries of the original investigations on each subject treated. The importance of a work such as this, which brings into so admirable an order researches undoubtedly interrelated, but confused to all but those especially conversant with the subject, can scarcely be overestimated.

That the conclusions drawn from the original sources are in many places incomplete is due to the unsettled nature of the problems.

The work may be divided conveniently into four different parts, which considered in turn are: first, toxins formed by bacteria; second, toxins (specific substances) present normally in the blood or found in the process of immunization; third, toxins from food substances formed before or after entrance into the animal body by the action of bacteria; and, fourth, methods of detecting ptomaines and leucomaines in foods. Bacteria produce toxins of two sorts—directly, they produce intracellular or extracellular toxins, and indirectly by their action on nitrogenous substances they produce ptomaines. In this connection have been considered the bacterial poisons of certain infectious diseases. On some of them, such as diphtheria, tetanus, and anthrax, we may consider ourselves relatively well informed. On others, such as tuberculosis and pneumonia, nothing very definite has been revealed to us. A consideration of the properties of the blood serum follows. The germicidal properties of the blood, precipitins, agglutinins, and lysins are taken up in turn, and in conclusion the theories of the immunity of Metschnikoff, Bordet Emmerich, and particularly of Ehrlich, are quoted and discussed.

Food-poisoning comprising poisoning by mussels, fish, meat, cheese, milk, and grain is considered in respect to epidemics and to general endemic diseases supposed to be dependent on the use of such improper food. An exhaustive chemical consideration of such bases as have been isolated from these ptomaines, and also of the leucomaine bases—that is, preformed bases of the proteids irrespective of the action of bacteria—follows. F. P. G.

ESSENTIALS OF THE DISEASES OF THE EAR. Saunders' Question Compends, No. 24. Arranged in the form of Questions and Answers. Prepared especially for Students of Medicine and Post-Graduate Students. By E. B. GLEASON, S.B., M.D. Third edition, thoroughly revised. Philadelphia and London: W. B. Saunders & Co., 1902.

THE third edition of this little book is thoroughly up-to-date with the recent progress made in the subject of otology. Although the arrangement in the form of the questions and answers may savor too much of didactic teaching, it is to be remembered that the books in this series are intended to teach the rudiments of the subjects with which they deal, and that their authors are men qualified by their standing in the profession to speak with positiveness upon what they teach.

For the purpose of the student, under-graduate or post-graduate, this book may be recommended as a very reliable guide to the subject. Within its limits Dr. Gleason has succeeded in comprising the essential points which must be learned by those who would seek a knowledge of aural surgery. The illustrations are excellent, and the book amply fulfils the purposes for which it is written. F. R. P.

MEDICAL LECTURES AND APHORISMS. By SAMUEL GEE, M.D. London: Smith, Elder & Co.

THIS admirable little book consists of 13 lectures upon medical subjects and 271 clinical aphorisms. A number of the lectures are illustrated by histories of cases which serve to make them more interesting. Among the more valuable may be mentioned that upon Tubercular Peritonitis in Children and that upon the Signs of Acute Peritoneal Disease. The clinical aphorisms from Dr. Gee's wards, collected by Dr. Thomas J. Horder, contain a fund of useful information concisely and conveniently arranged, adding greatly to the value of the publication. In fact, there is not a page of Dr. Gee's book which is not pregnant with useful and interesting matter gleaned from his vast experience. T. A. C.

PRACTICAL MEDICINE SERIES OF YEAR BOOKS. GENERAL MEDICINE. By FRANK BILLINGS, M.S., M.D. Chicago: The Year Book Publishers.

THE sixth volume of this series, which is under the general editorial charge of Gustavus P. Head, M.D., fully comes up to the standard of excellence established by the previous issues. It is, of course, impossible in a volume of its size to quote from every article upon the numerous subjects treated, but, on the whole, the selections have been good, and the ground of recent medical advances well covered. The chapters upon Typhoid Fever, Malaria, and Yellow Fever are especially full.

T. A. C.

PROGRESS

OF

MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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On the Pathogenesis of Typhoid Fever.—SCHOTTMÜLLER (*Muenchener med. Wochenschr.*, 1902, xlix. 1561) in the clinic of Lehnhartz, in Hamburg, has, as is well known, made during the last three years a number of valuable observations concerning the culture of typhoid bacilli in the circulating blood during the course of the disease. His observations during the last year have wholly confirmed his earlier results in that out of 101 patients the bacilli have been cultivated 84 times. Positive results were obtained in a large proportion—39 out of 50—of cases on the day of their entry into the hospital. From a very large number of individual culture experiments the author reaches the conclusion that the number of bacilli in the blood bears a more or less direct relation to the clinical symptoms. They were, for instance, appreciably more numerous during the fastigium than in the earlier stages or during the periods of more intermittent temperature. Where the bacteria had already disappeared with the fall of temperature, a reappearance was noted with the onset of a relapse. Of special interest is the fact that in a certain number of cases bacilli were found during the brief post-typhoid elevations of temperature of twenty-four or forty-eight hours' duration. As a general rule, the bacilli were more numerous in the severer cases.

The author concludes that blood cultures constitute our most important diagnostic method in typhoid fever. Positive results may be obtained much earlier than by the Widal test, while a negative bacteriological blood examination in very ill patients with high fever where the clinical symptoms do not allow of a positive diagnosis practically excludes the diagnosis of typhoid.

The estimation of the number of the colonies is of a certain prognostic value.

In conclusion the author insists upon the fact that typhoid fever must be regarded as a general infection, pointing out the fact that the frequency with

which the bacilli are found in the circulation is really greater than in other conditions (puerperal sepsis, ulcerative endocarditis, etc.) which are generally so recognized.

While the usual portal of infection is probably the gastro-intestinal tract, the local lesions produced at the point of entry may, in some instances, be slight. In other cases it is possible that, as in some streptococcus infections, the processes may remain local, being arrested by the lymphatic apparatus of the intestine and the retroperitoneal glands. In most cases, however, the parasites pass "the protecting wall of the mesenteric glands," causing a general infection of the lymphatic system and the blood just in the same manner as a general infection occurs after wound infection. By the blood the bacilli are distributed throughout the organism, producing more or less characteristic manifestations. The author is inclined to even believe that the tendency toward involvement of the intestinal lymphatic apparatus is not necessarily the result of the fact that the intestine is the ordinary portal of entry, citing in support of this view the involvement of this system in relapses where it is much more reasonable to believe that the renewed infection springs from depots within the organism and from the intestinal tract as well as the fact that many areas far apart are so often simultaneously affected. He is inclined rather to assume that the intestinal follicles have a special predisposition toward infection with the typhoid organisms even when present in the general circulation.

[These latter theories have much in their support. If the general medical public only realized the fact that typhoid fever is clinically a general septicæmia, of which the intestinal changes form the more marked local manifestations, and not an intestinal disease, the senselessness of attempts at aborting or influencing this malady by so-called intestinal antisepsis would be more readily appreciated.—W. S. T.]

A Case of Typhoid Fever without Intestinal Lesions.—Blumenthal (*Deutsche med. Wochenschr.*, 1902, xxviii. 626) from Stadlemann's clinic, in Berlin, reports the case of a woman, aged twenty-three years, who entered the hospital on the tenth day of typhoid fever. She was at that time five months' pregnant. The symptoms were characteristic; well-marked roseola and Diazo reaction were present, while the Widal reaction was positive at a dilution of 1/150. On the fourteenth day the patient aborted, and on the twentieth, died. At autopsy there was a hemorrhagic enteritis of moderate degree in the jejunum. In the lower part of the ileum the follicles were a little prominent; no affection of Peyer's patches. The ileocæcal glands were enlarged, on section, soft and grayish red, with prominent follicles; the spleen was large and soft. Cultures from the spleen and glands showed numerous bacilli answering to all the characteristics of the typhoid organism.

[This case emphasizes again the fact that the essential symptoms of typhoid fever are not dependent upon the intestinal lesions, but rather those of a general septicæmia with certain special characteristics.—W. S. T.]

Further Observations on the Relation of Changes in the Pancreas to Diabetes.—Weichselbaum and Stengel (*Wiener klin. Wochenschr.*, 1902, xv. 969) contribute an interesting discussion to this important question.

After considering the important contributions of Opie, Herzog, Wright and Joslin, Schmidt, von Hansemann, Ssobolew and Schultze, they discuss seventeen observations which they are able to add to their eighteen previously reported. Two of these cases were instances in which, clinically, the condition was regarded not as pancreatic diabetes, but as glycosuria of other origin. In the other fifteen cases the islands of Langerhans were found on necropsy to be diminished in number in every instance; sometimes so markedly that in large sections none could be found, while those islands which remained showed not only diminution in size, but "constant, definite, unmistakable changes." These were of three types: (*a*) Simple atrophy; (*b*) vacuolization or liquefaction; (*c*) an increase in connective tissue. In three cases hemorrhage into several of the islands was found, while twice marked deposition of fat granules, especially limited to the islands, was made out. These changes in the islands cannot, in all instances, be secondary to sclerotic changes elsewhere in the pancreas.

The proper interpretation of these observations and those of the authors previously noted is discussed at some length. v. Hansemann, an opponent of the theory that disease of the islands of Langerhans stands in direct causal relation to diabetes, noted that in 34 cases they were never wholly absent, while in only 6 was a sclerosis to be made out. But this argument is hardly sufficient in view of the mass of observations which have been accumulated; for the absence or disease of the majority of islands might well seriously injure their function, while, if one were to suppose that a total destruction alone resulted in diabetes, it would be difficult to explain the frequent improvements or recoveries which are seen. v. Hansemann himself observes that he has never seen a sclerosis of the islands without diabetes. It must be remembered, too, that sclerosis is by no means the only or even the commonest change which is found in the pancreas of diabetics. The authors conclude that there is much in favor of the theory that on the one hand Langerhans' islands play a most important rôle in the metabolism of the carbohydrates, while, on the other hand, pancreatic diabetes may result from a disease of these islands. Their conclusions are as follows:

1. In all cases of pancreatic diabetes, excepting those which they have clinically ruled out as not belonging to this class, they have found constant definite changes in the islands, changes sufficient to impair or destroy their function. These changes are not present in non-diabetics. In the non-diabetic atrophy of the pancreas in general marasmus they were able to make out a marked thinning of the epithelium, but neither liquefaction, destruction, nor diminution in the number of the islands.

2. The authors quoted above have found in all or in a considerable majority of their cases similar or like changes.

3. In these cases of pancreatic diabetes the remaining pancreatic tissue shows no changes or, at all events, alterations which are appreciably less marked than those of the islands, and are of a nature which from the experimental investigations of von Mehring and Minkowsky would have been insufficient to cause diabetes.

4. Those cases of glycosuria in which no changes in the islands have been found, admit always of an explanation which is reconcilable with the above-mentioned theory.

5. The histogenesis and structure of the islands make it probable that they have a wholly different function from that of the true gland parenchyma of the pancreas.

6. The experimental observations of Ssobolew, Schultze, as well as one of their own cases, show that the islands behave in an entirely different manner toward the agent producing pancreatic diabetes than toward those poisons which produce the other forms of pancreatic atrophy.

[These observations wholly confirm those of Opie demonstrating the remarkable—very probably causal—relation between disease of the islands of Langerhans and diabetes. It must, however, be remembered that, as Opie has pointed out, there are instances of diabetes in which no changes in the pancreas are demonstrable –and it must be acknowledged that we have as yet no methods for recognizing these two classes of cases clinically.—W. S. T.]

Eosinophilia in Filariasis.—Calvert (*Johns Hopkins Hospital Bulletin*, June, 1902, p. 133), in studying the blood in four cases of filariasis in natives of the Island of Luzon, P. I., found that there was a quite marked eosinophilia in all cases. His attention was drawn to the possibility of an eosinophilia occurring in filariasis by the finding of enormous numbers of eosinophiles in the tissues surrounding the lymph vessels and in the bloodvessels of a patient who died of plague, but who was found at autopsy to have filariasis. Subsequently three cases were studied clinically, and an increase of the eosinophiles found in all. The highest eosinophile count was 22 per cent. In all the cases there was also a leucocytosis. An interesting point brought out was that the eosinophilia was most marked at the time of the day when the peripheral circulation was free from embryo filariæ. The leucocytosis and eosinophilia are apparently present only in the early stages of the disease, both disappearing in chronic cases.

The Etiology of the Summer Diarrhœa of Infants; A Preliminary Report.—A short time ago it was noted in this department that Vedder and Duval had investigated isolated cases of dysentery in the Philadelphia hospitals, as well as epidemics occurring in institutions in Lancaster County, Pennsylvania, and at New Haven, Connecticut. They had found, as a result of their study, that the dysentery was produced by *bacillus dysenteriæ*, the same organism that had been isolated from cases of acute dysentery in adults by Shiga in Japan, Flexner and Strong in the Philippines, Kruse in Germany. They seemed justified in concluding that this organism was the cause of acute dysentery the world over.

Duval and Bassett (*American Medicine*, September 13, 1902, p. 417) have just made a preliminary report on their bacteriological studies of the cases of summer diarrhœas of infants admitted to the Thomas Wilson Sanitarium, near Baltimore, Maryland. They isolated *bacillus dysenteriæ* Shiga from the stools of forty-two of these cases. The organism was also found in the scrapings of the intestinal mucosa, and in one case from the mesenteric glands and liver. From an etiological and therapeutical standpoint this important discovery places the summer diarrhœa of infants on the same basis with the acute dysenteries of adults.

SURGERY.

UNDER THE CHARGE OF

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The Treatment of Prolapsus Ani of Children by Injections of Paraffin.—KAREWSKI (*Centralblatt für Chir.*, 1902, No. 28) states that the best results are to be obtained by injections of hard paraffin with a melting point of from 56° to 58°. The technique is as follows: For two days before the operation the bowels are to be well moved by artificial means, and on the afternoon previous to the operation 2 gr. of bismuth are given to induce constipation. The region of the anus is rendered as aseptic as possible and then the prolapse is reduced. A ring of the paraffin is then placed in the rectum above the anus between the skin and the mucous membrane. By means of diet and additional doses of bismuth the bowels are prevented from moving for the next twenty-four hours. Eight children (varying in age from two to eight years) were treated by this method and with success in every case but one, which came to the table not properly prepared. In no case was there infection, and the results are thoroughly satisfactory.

Twenty-one Cases of Gastro-enterostomy for Intrinsic Stenosis of the Pylorus.—CAIRD (abstract in *Medical Press and Circular*, May 28, 1902), in a paper read before the Edinburgh Medico-Chirurgical Society, says:

In dealing with the indications for gastro-enterostomy it was pointed out that they were in the main similar to those for gastrostomy, namely, difficulty in the onward passage of food, vomiting, progressive emaciation, and subnormal temperature. When these were present operation could not be delayed without serious risk. He held that it was erroneous to say that gastro-enterostomy was in itself an operation of great danger and of doubtful value in so far as prolonging life was concerned. Even if life were not prolonged by it, the patient at least did not die of starvation, his discomfort was lessened, and pain might be completely removed. Even in undoubtedly malignant cases there was sometimes so great a gain in weight after the operation as to call the diagnosis in question, for a time at least. Moreover, in some cases the tumor entirely disappeared after gastro-enterostomy. Of his twenty-one cases only one was said to be simple—a stricture due to gastric ulcer, and at the operation the diagnosis was confirmed. In only one case was no tumor to be felt. The principal symptoms were vomiting, emaciation, and absence or diminution of free hydrochloric acid after a test-meal. On the whole, the speaker preferred a posterior gastro-jejunostomy as close

to the duodenum as convenient, or in the complicated cases an anterior operation. The choice of a method was largely determined by what was found on opening the abdomen and to what extent the stomach remained mobile. He did not think that it made much difference whether the food current was isoperistaltic or antiperistaltic. No special preparation of the patient was required; unless the patient was accustomed to it, lavage was not practised. If the general condition was poor, teaspoonfuls of warm milk and water were given on the evening of the operation, and a small dose of morphine if there were pain or restlessness. On the morning succeeding operation, if there were eructations, vomiting, or quickened pulse, the stomach was washed out, a procedure from which Mr. Caird had seen nothing but good, although one must be prepared for, and guard against, syncope. If the pulse still remained rapid after lavage, then thirty ounces of saline solution should be transfused; this often gave markedly good results. Of his twenty-one cases four proved fatal; one patient died of bronchopneumonia and congestion of the kidneys, the abdominal wound remaining healthy; a second patient died from exhaustion, and a third from leakage through the wound in the stomach; in a fourth case fatal peritonitis ensued, probably from aërial infection.

Of the seventeen patients who survived the operation three had been lost sight of, and were probably dead, six were certainly dead, three from extension of the disease, two from cardiac failure, and one from phthisis; while eight patients were alive at periods extending up to six years after operation. A second laparotomy had been performed on two—in one for ventral hernia, and at the operation no trace of the old tumor could be found; in a second for nodules in the cicatrix, and here again the abdomen appeared free from disease. It might be asked whether cases which survived for six months were really malignant, but while the difficulty of differentiating simple hyperplasia from carcinoma might be extreme, it was hardly possible that experienced physicians could be so frequently in error about cases which showed all the clinical features of cancer. It was impossible to ascribe the great improvement in the patients to laparotomy alone, though Strüdel and others had reported improvement in abdominal cancer after simply opening the abdomen.

Lumbar Puncture as a Method of Treatment for the Sequelæ to Fractures of the Skull.—Rochard (*La Presse Méd.*, April 30, 1902), states that the constant presence of blood in the cerebro-spinal fluid shows that a fracture of the skull is present, but it is to be remembered that blood is also found just after a severe cerebral contusion. The diagnostic value of lumbar puncture is slight in comparison to its value as a therapeutic agent. It has been found to be particularly valuable in those cases of cerebral concussion where the resulting hemorrhage has not only caused mechanical pressure, but where, in addition, it has acted as a foreign body and caused a leucocytosis which markedly increased the tension of the cerebro-spinal fluid. Its value has also been well shown in those cases of chronic meningo-encephalitis in which, in addition to the trouble with the mentality, there is marked headache which is so severe as to render life almost intolerable. This headache is not relieved by any other method of treatment, but quickly disappears after the withdrawal of a varying quantity of the fluid.

Spinal Anæsthesia.—Racoviceano-Pitesci (*Bull. et Mem. de la Soc. de Chir. de Bucarest*, December, 1901) reports briefly 406 cases operated on under this method of anæsthesia without a death. A solution of from 1 to 2 cg. of cocaine, made up with cerebro-spinal fluid which had previously been withdrawn by puncture, was used in all the cases. Although there have been no fatal cases the author has observed nearly all the unpleasant sequelæ, such as headache, etc. The method has proved satisfactory, but should not be used in the presence of contraindications. Sequen in his last series of cases reports two deaths. In one there was an incarcerated hernia with the phenomena of septicæmia, while in the other arterio-sclerosis was present.

In the discussion which followed Jonnesco stated that he has used the method in only eight cases, and in one of these with a fatal result; no arterio-sclerosis nor organic lesions were present, and death was attributed directly to the cocaine. The author has abandoned this method, for the reason that its mortality is higher than ether or chloroform, and the after-effects, as a rule, are severe.

Sevrieana stated that he had used the method in thirty cases with one death, and in his hands it had proven in every way unsatisfactory.

Cicatricial Stenosis of the Pylorus.—Quenu and Petit (*Revue de Chir.*, No. 2, 1902), after reporting in detail the results obtained in thirty-five cases operated on by different methods, state that the mortality in this series was 22.8 per cent. Considering this result more in detail, they show that three cases were treated by dilatation of the pylorus, with one death and two failures. In four cases resection of the pylorus was performed, and each time the operation was a success. Twenty-three cases were treated by pyloroplasty, with five deaths, or a mortality of 21.7 per cent. In seven cases gastro-enterostomy was performed, with two deaths, or a mortality of 28.8 per cent. In view of these immediate results, it would seem that the operation of resection is the best one, as having the least mortality; but it should be remembered that this method was used in the very small number of four cases. Closer examination of the five fatal cases of pyloroplasty shows that death in four cases was caused by shock, and in one case by gangrene of the lungs. The two fatal cases of gastro-enterostomy died of infection, but it should be remembered that these cases were operated on in the years 1884 and 1885, at which time the technique of this operation was not as perfect as it is at the present day. In looking at the subsequent history of all the operative cases one finds that all the cases of resection remained cured, but in no case were they under observation for more than five months after the date of operation. Of the cases operated on by pyloroplasty three died subsequently of pulmonary tuberculosis. The autopsy in each case showed that the new pylorus had maintained its normal dimensions. This observation is of the utmost importance, as it shows that the operation of pyloroplasty is sufficient to maintain the normal gastro-intestinal circulation. One case was in perfect health two years after the operation, but in all the other cases except three the patients had had some gastric trouble subsequently. Of the five cases of gastro-enterostomy four were under observation for a period of five months from the day of operation. Each of these cases was absolutely well during this time, and there was an entire absence of gastric phenomena. The

other successful case died two years and a half after the operation of tuberculosis, but during this time he was free from all intestinal symptoms. In view of all the facts the authors draw the conclusion that gastro-enterostomy is the best operation for the relief of stenosis of the pylorus. The posterior operation, with sutures, is the operation of choice. In a small number of cases gastro-enterostomy is contraindicated. These cases are where the stomach itself has been much altered by the swallowing of a caustic fluid and is small and shrivelled up. In one such case Hartman performed duodenostomy.

THERAPEUTICS.

UNDER THE CHARGE OF

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Suprarenal Extract in Eye Diseases.—DR. G. E. DE SCHWEINITZ states that suprarenal preparations are valuable: 1. To relieve hyperæmia of the conjunctiva when this is caused, for example, by local irritation, nasal catarrh, hay fever, eyestrain, etc. Under these circumstances adrenalin is particularly valuable and may be employed in very dilute solution; for example, 1 drachm of the 1 : 1000 solution in 2 ounces of distilled water, with 10 grains of boric acid. 2. To relieve the congestion, irritation, and lacrymation of ordinary conjunctivitis and to combat blepharospasm. 3. To relieve Fruehjahrs' catarrh, on which these substances have a marked curative effect. 4. To relieve trachomatous pannus and various types of vascular keratitis and scleritis, repeated instillations under these circumstances reducing the vascularization and allowing the tissues a chance to recover. 5. To enhance the action of cocaine, eserine, and pilocarpine by promoting their absorption. The adrenalin preparations are first used and followed, during the period of blanching, by the drugs named. 6. To reduce the tension of glaucoma. 7. To facilitate the introduction of lacrymal sounds, the preparation being first injected through the canaliculus. 8. To relieve ciliary pain in all forms of keratitis, iritis, and cyclitis with glaucoma. 9. To modify and even clear up certain opacities of the cornea, for example, those which follow contusions and even the opacities in syphilitic iritis. 10. To produce a cosmetic effect.—*Therapeutic Gazette*, 1902, vol. xxvi. p. 433.

Adrenalin in Genito-urinary Diseases.—DR. A. VON FRISCH has employed adrenalin in the form of three to five ounces of a 1 : 10,000 solution in the bladder for cystoscopic cases where there is liability of hemor-

rhage, and in most cases clear pictures were obtained. For operations for the removal of vesical tumors through suprapubic incision the bladder was treated with a 1:1000 solution, and the entire tumor with its base could generally be removed without the slightest hemorrhage; but, since a dilatation follows the constriction, the raw areas must be carefully cauterized if they are not approximated by suture. Adrenalin is also of great value in urethral stricture and prostatic hypertrophy where sounding and catheterizing are difficult, since a shrinkage of the mucous membrane will follow and the canal will materially widen.—*Wiener klinische Wochenschrift*, 1902, No. 31, S. 787.

Therapeutical Properties of Lachnanthes Tinctoria.—Dr. J. A. Gardner has investigated the properties of the lachnanthes herb, which has been lauded as a specific for consumption. He finds it to consist largely of a resinous principle and some body which is precipitated by lead subacetate and is soluble in water. Further, so small a dose as a drachm of an aqueous solution of the material obtained by alcoholic extraction of the plant is sufficiently powerful to kill guinea-pigs, while doses varying from 12 to 35 minims of the same solution do not exert any inhibitory action upon the progress of tuberculosis, but rather seem to hasten it.—*Lancet*, 1902, No. 4115, p. 72.

Therapeutic Application of Sodium Cinnamate.—Dr. Gilbert Morgan says that the therapeutic application of the sodium cinnamate has been rendered practicable by the discovery that this salt dissolves in glycerin to form a clear solution which can be easily manipulated in the hypodermic syringe. This preparation is more reliable than the emulsions usually advocated, inasmuch as no alteration of the salt occurs. The solution is prepared by heating dry, powdered sodium cinnamate with the pure solvent at a temperature of 356° F., and in this way from 10 to 11 per cent. solutions are readily obtained. It is important that the salt should be finely subdivided in order to shorten the heating process, which might otherwise lead to decomposition of the glycerin. The glycerin is otherwise admirably adapted for subcutaneous use.—*Lancet*, 1902, No. 4115, p. 66.

Treatment of Tuberculous Laryngitis.—Dr. L. Réthi says that despite the apparently hopeless condition of patients suffering from tuberculous laryngitis there is much that can be done for them to alleviate their suffering. The remedies generally employed for tuberculosis are in place, especially since the affection of the larynx is, in by far the most cases, secondary to pulmonary disease. As a broad statement it may be said that the prognosis is fair if the patients still are robust and without fever, if the process in the lungs is not far advanced, and if the changes in the larynx are circumscribed and without tendency to spread along the surface or into the depths. In small ulcers, cicatrization may result after the use of 60 to 80 per cent. of lactic acid, with or without previous scarification. The use of the single or double curette is often followed by success, the reaction being, as a rule, but slight. Galvanocautery also has its advantages, the sharp point being introduced into the infiltrated areas during intervals of ten days. This

may be supplemented by the application of trichloracetic acid. It is important to individualize and not to use radical measures in advanced cases, but, exceptionally, severe cases will heal and mild cases will advance. Where a cure cannot be hoped for, the treatment must be limited to the inhalation of disinfectants and the application of cocaine for pain. Where swallowing is difficult, food must be taken in the horizontal position with hanging head, and asphyxia may make a tracheotomy necessary.—*Centralblatt für gesamte Therapie*, 1902, Heft viii. S. 449.

Camphor in Morphine Habit.—Dr. J. Hofmann states that in many respects the physiological actions of morphine and camphor are diametrically opposed, and this has led him to try the latter in chronic morphine poisoning, with the astonishing result that the usual severe symptoms on withdrawing the drug were almost entirely missed. Not only was there a decided antagonistic action, but sedatives, such as trional and dormiol, were found to act much better with camphor than when given alone. The treatment is supplemented by the use of validol and electric baths, and there is no danger of causing either camphor or validol habit.—*Therapeutische Monatshefte*, 1902, Heft vii. S. 331.

Treatment of Early Mental Cases.—Dr. F. S. Toogood states that many, especially functional, mental diseases are made worse by improper management in the early stages, especially when one considers that temporary insanity may disappear after a few days of proper treatment, such as by the removal of abdominal tumors, or by the cure of various bodily affections, or alcoholism. The latter is the most frequent single cause of this type of insanity, and its most familiar forms are delirium tremens and dementia, which may be completely cured in from one to six months. Mania may have its origin directly in alcoholism or may develop subsequently to delirium tremens or dementia. Many sensory disturbances are also common. The author's confidence in the curability of most of these cases has led him to request the authorities to permit hospital rather than asylum treatment, since the stigma of having been in an insane asylum reacts upon all by preventing permanent and lucrative employment in man and marriage in woman.—*Lancet*, 1902, No. 4115, p. 76.

Persistent Hiccough.—Dr. William McDonald says the essential feature of persistent hiccough is sudden, involuntary contraction of the diaphragm. Simultaneously there is closure of the glottis, producing the characteristic sound. As to the predisposing condition, it can be said that any case in which there is increased general nervous irritability might be easily complicated by more or less persistent hiccough; that any local disorder which might extend to or become contingent upon any portion of the phrenic, its centres, or immediately related afferent nerves, such as the gastric branches of the vagus, may be said to offer special liability; that abnormal conditions in certain distant parts may constitute a predisposition; finally that, inasmuch as every reflex act prepares the way for its own repetition and that nerve force expends its energy along paths of least resistance, each attack intensifies the predisposition. Of the general conditions, hysteria and

neurasthenia are the most common; of the local, pre-existing inflammations of the pleura or peritoneum are the most frequent; of those acting reflexly, diseases of the organs of digestion and generation make up a large number. Alcoholism also constitutes a large proportion. The attacks vary very much; they may be continuous or intermittent and in some considerable exhaustion follows. The outcome of any given attack depends upon the gravity of the exciting cause. The list of remedies proposed is legion, but in all cases rational treatment must be directed to the cause, and if this cannot be discovered, measures which have an improving effect upon the whole economy are to be advised.—*Albany Medical Annals*, 1902, No. 9, p. 471.

Xeroform in Gastric Ulcer.—Dr. Dieninger has noted the rapid healing which is seen in all wounds of the skin when treated with xeroform. This has led him to try the drug in a marked case of gastric ulcer presenting all the typical symptoms, especially since it is known to rapidly and effectively coat all surfaces deprived of their epithelium. Four times daily seven grains were given in a wafer, and at the same time an ice-bag placed over the epigastrium and nutrition kept up by means of enemata. Very soon the tenderness disappeared, vomiting ceased, and the general condition improved from day to day, so that the author makes use of the highest words of praise.—*Allg. medicinische Central Zeitung*, 1902, No. 61, S. 719.

Anusol in the Treatment of Hemorrhoids.—Dr. John Moir remarks that in the case of patients suffering from piles, whether newly formed or chronic in character, whether small or large, even up to large venous knots hanging from the rectum and at times bleeding profusely, the medical man has found himself, as a rule, much handicapped in their treatment, owing to the want of any thoroughly reliable method to satisfy the exigencies of the patient The entire question of the treatment of hemorrhoids can now, however, be summed up in one sentence: Procure regular passage from the bowels. This object can be thoroughly obtained by the regular, systematic use of anusol suppositories. In the event of a threatened relapse, the further use of two or three suppositories will be indicated.—*The Therapist*, 1902, vol. xii. p. 104.

Value of Sulphur Baths.—Dr. Karl Ullmann emphasizes the value of sulphur baths in two conditions: Superficial diseases of the skin, and deeper, chronic affections of the fasciæ, joints, and muscles. Plain baths, no doubt, have an equally sedative action; yet experience has shown that syphilitics improve more rapidly if they take their inunctions at a watering-place where sulphur baths abound than at home or in localities where the water is indifferent or contains iodine. It seems as if the suspended sulphur or the sulphuretted hydrogen creates a tolerance in the skin which increases absorption and prevents the development of furunculosis. At all events it is a well-known fact that baths can be kept up much longer in sulphur than in other waters. It has been urged from many sides that sulphur and mercury are really incompatible since leading to the formation of insoluble sulphide of mercury, but it has since then been shown that if this were to be rubbed into the skin, it could produce ptyalism as well as the ordinary ointment.

Much has been said in favor of sulphur waters taken internally, and they could here be well dispensed with.—*Centralblatt für die gesamte Therapie*, 1902, Heft. vii. S. 385.

Yeast as a Remedy.—Dr. Heinrich Paschkis has carefully examined the action of yeast in fermentation, and states that it is hard to understand how it acts deleteriously upon the cocci which underlie the disease. There is certainly no direct action of the plant cells, nor can the minute quantities of alcohol formed be held responsible, and it seems as if by the presence of yeast abnormal processes in the alimentary canal are corrected and a cure thus brought about. Other conditions for which yeast is employed are anthrax, axillary adenitis, phlegmonous acne, and certain cases of sycosis. After-effects are acid eructations and diarrhœa. Certain writers have seen good effects in diabetes and diseases of the pancreas. The proper dose is seventy-five to one hundred and fifty grains daily in one to three doses with the chief meals. The different preparations vary considerably in strength.—*Wiener klinische Wochenschrift*, 1902, No. 31, S. 791.

PEDIATRICS.

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The Management of Infectious Diseases in Paris.—Ruhrah (*Pediatrics*, June 15, 1902, p. 449) reviews briefly the interesting investigations of Graucher concerning the transmission of infectious diseases as observed in his wards at the Hôpital des Enfants Malades.

Reasoning that antisepsis with isolation of the patient should give the best results in preventing the transmission of infectious diseases, Graucher began experimenting about 1888, and has finally evolved a system of hospital control that should be carefully studied by all those concerned in the management of hospitals for infectious diseases.

The leading principles of Graucher's system are contained in this dictum: Air infection does not exist where the patient does not expectorate and where dust is suppressed; on the contrary, infection is by infected objects—that is to say, by contact, direct and indirect. In order to avoid infections it is necessary to purify immediately the hands and objects soiled by contact necessary in the examination and care of the patient, and, secondly, to diminish contact with children with infectious diseases and with those supposed to be infected.

In the management of the ward the first care is the suppression of dust. To maintain this the floors are paraffined and are washed twice daily with a solution of sublimate. The walls are painted and are washed twice a week with sublimate solution. The second care is the isolation of the patient. A metal screen, 1.25 metres high, surrounds the bed. One end is left open, so that it may be entered. On entering the screen both physicians are gowned, and on leaving the hands are disinfected by washing with soap and brush, followed by the use of a 1:1000 sublimate solution. The gowns for each patient are hung on the screens of the respective beds. All mattresses and bedding are sterilized by steam, and all the linen and articles used for feeding are boiled in water. The food is served on wire trays. After the meal the napkin and feeding utensils, with the tray, are placed in a pot of water with a little carbonate of sodium and boiled for five minutes. The beds are of iron, and are disinfected by scrubbing with an acid solution of sublimate.

Infectious cases developing in the ward are not removed, but are treated in the same room with the other cases, and the same nurses handle both the infectious and non-infectious cases. All of them are obliged to take the same rigid precautions. A number of infections could be directly traced to importation by visitors. In order to avoid the introduction of contagion by new cases, all new cases and newly admitted patients are regarded as suspects, and are isolated behind screens just like the contagious ones. If at the expiration of twenty days they have not developed any infection they are released.

The results of this system of caring for contagious cases are very significant. Previous to the change an average of 36 cases of measles developed in the wards; during the decade following, under the special precautions, the annual average was reduced to 11. With varicella, about the same result was shown. With diphtheria the results were very remarkable. Previously there had been an average of 12 infections yearly in each of two wards. Afterward, during the next ten years, in one ward there was not a single case of infection, and in the other there were only 6 cases, 5 of which were imported by visitors. Cases occurred in the wards during this period, but they came in either as developed cases or during the stage of incubation. Of the other infections, scarlet fever was practically controlled, and whooping-cough, mumps, and bronchopneumonia were practically entirely suppressed.

Tetany and its Relation to Cow's-milk Feeding.—Finkelstein (*Bulletin Médicale*, 1902, p. 683) presents some interesting features in connection with latent tetany, a condition characterized only by electrical hyperexcitability of the nerves and muscles (Erb's sign). He has observed that this hyperexcitability, with or without other symptoms of tetany (laryngospasm, Trousseau and Chvostek phenomena), exists in 30 per cent. of all infants fed on cow's milk, but is never found in breast-fed infants nor in those fed upon farinaceæ, broths, and eggs. In the latter class Erb's sign may be obtained if the serum of cow's milk is administered. From this he concludes that the substance which produces tetany is not in the casein or in the fat, but in the serum. On the other hand, the author has been able to convince himself that with an infant affected with latent tetany the neuromuscular

hyperexcitability disappears or notably diminishes when the cow's milk is replaced by breast feeding or by farinaceæ and eggs.

From these facts Finkelstein concludes that under the influence of cow's-milk feeding one frequently sees develop, by a mechanism yet to be elucidated, a disturbance of metabolism manifested by a more or less active neuromuscular hyperexcitability, with or without the phenomena of a frank tetany. These symptoms are due to a defective assimilation or transformation of an unknown principle, found in the milk of the cow, which is also, perhaps, formed at the expense of a regressive metamorphosis of the infant's own tissues. The variability of the relation between these two pathogenic factors of tetany is the reason for the variable effect produced by substituting another kind of alimentation for cow's milk—whether it suppresses completely the neuromuscular hyperexcitability or reduces it partially, or not at all. This substance appears not to exist in vegetables, eggs, or meat broths.

A New Sign of Tetany.—Solovieff (*Rousski Vratch*, 1902, No. 26) has observed two adolescents suffering from tetany, who, in addition to the Trousseau and Chvostek phenomena, presented quite violent rhythmic contractions of the diaphragm. These were perceptible to both inspection and palpation, synchronous with the cardiac systole. At the same time a feebly-whistling sound is heard, which is produced by the penetration of a certain quantity of air into the left lung, sharply inflated at each contraction of the diaphragm. These spasmodic contractions, which can be verified by radiographic examination, are produced, in the author's opinion, by a direct irritation of the phrenic nerve (in a state of hyperexcitability) by the movements of the heart. They cease only during effort and deep inspiration. This new sign of tetany Solovieff proposes to designate by the term "the phenomenon of the phrenics."

The Supposed Infectivity of Desquamation in Scarlet Fever.—C. Killick Millard (*Lancet*, April 5, 1902) discusses the subject of the infectivity of desquamation in scarlet fever, and believes that there is not sufficient evidence at hand to justify the general opinion that the desquamated cuticle of scarlet fever is infectious *per se*. After consultation with numerous physicians connected with fever hospitals throughout England, he finds them quite uniformly agreed that (1) they can adduce no evidence that the desquamating epithelium is *per se* a source of infection; (2) they consider that too much importance has been attached in the past to desquamation as a source of infection; (3) their experience does not support the popular view that desquamation after scarlet fever is necessarily an indication that a patient is still infectious; (4) they believe that a patient may continue to desquamate for some time after he has ceased to be infectious; and (5) they do not believe that it is necessary, in order to prevent the spread of infection, that patients who otherwise are quite ready to leave the hospital shou'd be detained until every visible trace of desquamating epithelium has disappeared.

The writer questions the supposition that the flakes of epithelium from scarlet fever contain the germs of the disease in the same way that the pustules and scabs of smallpox are believed to do. The eruption, being an

erythema, is a process characteristic of chemical poisoning or of poisoning by the chemical products of microbic action rather than of the direct action of microbes themselves. Thus it is quite analogous to the erythematous rashes caused by the use of certain drugs and by septic absorption, these erythemata being often followed by desquamation. Desquamation much more profuse than that seen in scarlet fever follows the eruption of erythema scarlatiniforme desquamativum, yet there is no reason to think that the process in any of these cases is a microbic one.

The writer has endeavored in a small way to collect statistics by observing whether patients discharged from hospitals while still desquamating, though otherwise apparently free from infection, were more frequently followed by "return cases." Of 2500 cases discharged, 8 per cent. showed some trace of desquamation; but of the cases which carried out infection (by giving rise to "return cases") only 6.5 per cent. had been noted as showing traces of desquamation. In the absence of bacteriological evidence, it appears that the only way in which this question can be settled is by specially collected statistics.

GYNECOLOGY.

UNDER THE CHARGE OF

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Vesicovaginal Fistula.—Drew (*British Medical Journal*, No. 2159) devised an ingenious method for closing a vesicovaginal fistula, one-half inch in diameter, due to the ulceration caused by a Zwanck pessary, and situated at the junction of the cervix with the anterior vaginal wall. An incision was made in the median line of the anterior vaginal wall from close to the urethral orifice to the margin of the fistulous opening; this incision was prolonged around the margin of the fistula. The vagina was then carefully separated from the bladder, and the two flaps thus made were drawn aside. A U-shaped flap of mucous membrane was dissected from the anterior lip of the cervix and accurately sutured, by Lembert's method, to the margins of the fistula. The vaginal flaps were united in the middle line and their upper margins sutured to the raw surface on the cervix. The fistula was permanently closed, and the vaginal wound healed well.

Vaginal Shortening of the Uterosacral Ligaments.—Bovée (*American Gynecology*, vol. i., No. 1) gives the following technique for shortening the uterosacral ligaments to correct retrodisplacements of the uterus: The patient is placed in the extreme lithotomy position, the perineum well retracted, and the cervix grasped with a volsellum forceps and drawn forward. A longitudinal incision, starting at the cervicovaginal junction, is made

through the structures of the posterior vaginal fornix down to the perineum. By careful dissection the ligaments are brought into view. The amount of shortening needed is decided upon, and one of the ligaments is grasped with forceps midway between the points to be united; the traction on the cervix is lessened and the ligament brought into the vagina. A curved needle armed with kangaroo tendon is then passed through the extreme points of shortening; another is passed through the loop thus formed and through the posterior portion of the cervix below the insertion of the ligament. The opposite ligament is similarly treated. The sutures are tied after they are all in place. The vaginal wound is spread well open, and the two ends of the longitudinal incision are approximated by suture, the remainder of the wound being closed as though originally a transverse incision.

Gonococcal Peritonitis.—FRANK and KOEHLER (*American Journal of Obstetrics*, vol. xlv., No. 3) report a case of septic peritonitis following operation for acute gonorrhœal salpingitis. The right tube was easily removed, but the left broad ligament was infiltrated and friable, so that the ligatures cut through the tissues, and a small amount of pus escaped during the removal of the left tube. The abdominal cavity was irrigated and drainage used. Peritonitis developed within twenty-four hours; death occurred seventy-two hours later. Bacteriological examination of the pus found in the pelvic and abdominal cavities showed on human blood serum a pure culture of the micrococcus of Neisser, this being the only organism found. This finding is in contradiction to the opinion of Bumm and Treves, that the gonococcus is only pathogenic when implanted on mucous membrane, and is soon destroyed in serous cavities unless there is a mixed infection.

[The report affords a strong argument for postponing radical operative interference in this class of cases until the acute symptoms have subsided and the organisms have become less virulent, unless the tubes become so distended that rupture is threatened, or a large pelvic abscess forms, when vaginal puncture and drainage is, as a rule, preferable to an abdominal operation.—W. E. S.]

Deciduoma Malignum.—LADINSKI (*American Journal of Obstetrics*, vol. xlv., No. 4) reports a case of deciduoma malignum, and reviews 132 cases collected from the literature on the subject. The clinical features which should aid in the diagnosis of the disease are summarized as follows:

A history of recent parturition or abortion, especially if a hydatid mole has been discharged or placental tissue retained; profuse hemorrhage occurring at irregular intervals without apparent cause and not amenable to the ordinary means of treatment, and which recurs in spite of repeated curettages; the presence of a constant sanguineous discharge during the interval of hemorrhage; a persistently large and hyperplastic uterus and cervix, with patulous os; pain in the pelvis; anæmia, rapid loss of flesh, and strength, and cachexia; characteristic nodules in the interior of the uterus in the early stage; the presence of metastatic deposits, especially in the vagina and lungs, the latter producing cough and bloody expectoration.

Owing to the rapid progress of the disease, the only treatment is complete

extirpation of the uterus, and vaginal metastasis, if present, as soon as the diagnosis is made from the clinical signs or the histological examination. This should be resorted to, even though metastatic deposits are found or suspected in other parts of the body, for in a few cases secondary deposits disappeared after the primary tumor was removed.

The author agrees with Newmann that the uterus should be extirpated whenever the microscopic examination of the cysts in a hydatid mole shows an atypical proliferation of the cells or the scrapings from the uterus show the slightest indication of malignant degeneration.

The Endometrium during Menstruation.—FINDLEY (*American Journal of Obstetrics*, vol. xlv., No. 4) confirms the observations of Gebhard regarding the changes occurring in the endometrium in menstruating uteri. Sections were made from uteri removed during the menstrual period for conditions other than disease of the endometrium. In one specimen removed twenty-six hours after the onset of the menstrual flow the capillaries, which are rarely visible in the intermenstrual period of the normal uterus, were found to be widely dilated; a serosanguineous exudate permeated the stroma, widening the intercellular spaces. These changes were more marked near the surface. The glands were not affected, and the surface epithelium was intact and apparently normal.

A second specimen removed on the third day of menstruation showed the "subepithelial hæmatoma" well marked. The surface epithelium was lifted from its bed by underlying blood; here and there the blood had burst through the epithelial covering and carried with it small bits of epithelium. Fatty degeneration of the mucosa was not in evidence.

In a specimen removed the day following the cessation of the menstrual flow the bloodvessels were less engorged than in the preceding specimens; the blood extravasated into the stroma was less in amount and did not have the appearance of fresh blood. The surface epithelium was intact and adherent to the stroma.

In none of the specimens were changes found in the tubes.

The Changes Occurring in Uteri in which Fibromyomatous Tumors Are Present.—E. S. BISHOP (*British Gynecological Journal*, Part lxviii.), after a careful study of microscopical sections from uteri in which fibromyoma were present, seems justified in drawing the following conclusions:

The presence of a fibromyomatous growth in the uterine tissue has an effect on the endometrium lining the uterus. In the early stages, and while still intramural, it tends to produce hyperplasia of the endometrium. When it becomes sufficiently submucous to exert some pressure upon the membrane it produces compression of the glands, with subsequent disintegration of both them and the interglandular substance. When actually polypoid into the uterine canal the endometrium over the tumor and the opposing uterine wall is reduced to a single layer of cells, which becomes progressively thinner in proportion to the pressure exerted, and approximates the squamous type. In many of the specimens examined bloodvessels and lymphatics were seen immediately below or within a very short distance of the protecting line of epithelium.

A further study of the sections seems to add weight to the theory that these tumors originate from the muscular coats of the smaller uterine arteries. The author states that the arteries in a uterus that has been the site of a fibromyomatous neoplasm do show changes in their structure differing from the normal; that these changes consist mainly of more or less hypertrophy of the muscular coat, and that it is perfectly possible that such hypertrophy, carried to a sufficient extent, might produce the masses or neoplasms known as fibromyomatous tumors.

Ultimate Results of Operations for Retroflexion and Prolapsus.—ANDERSCH (*Archiv für Gynäkologie*, Band lxv., Heft 2) tabulates 344 cases from the Breslau clinic, representing the results obtained in four and one-half years. He notes that while Pfannenstiel operated upon 28.6 per cent. of his hospital cases of uterine displacement, only 2.4 per cent. of his private patients were treated surgically.

The first series included cases of anterior and posterior colporrhaphy. Among 60 patients who were examined 50 were cured. In 37 cases vaginal shortening of the round ligaments was combined with colpoperineorrhaphy. Of 29 patients, 48.2 per cent. had a recurrence of the displacement.

Seventy-three cases of vaginofixation by Dührssen's method are included in the third series, but it was confined to women who had passed the age of childbearing. Fifty-four patients were examined, in only 7.4 per cent. of whom was the uterus retroverted.

In 44 cases of younger women the modified Dührssen's method was adopted —*i. e.*, the vesico-uterine fold alone was sutured; 12.5 per cent. of 32 patients examined subsequently had a recurrence.

Sixty-three cases of adherent retroflexion, with diseased or adherent adnexa, were treated by ventrofixation, a permanent cure being noted in 94 per cent. of the 50 patients examined afterward.

Commenting on these statistics, the writer notes that the results as regards the cure of prolapsus, as well as of retrodisplacement, were quite satisfactory, even in the first series, where the prolapsus was the main indication for operation. Although a recurrence of the cystocele was noted in only three cases, he admits that it must be expected to occur eventually in all working women unless the uterus has been fixed in a position of anteflexion. He believes that most cases of simple retroversion in nulliparæ and in a few women who have borne children are usually best treated by pessaries, or, if non-surgical treatment is unsuccessful, by Alexander's operation. That the latter has a limited field, in his opinion, is shown by the fact that he records only 9 cases, with 4 failures.

Although Pfannensteil adopts Dührssen's method in selected cases of movable retroflexion, he does not approve of the latter's practice of separating adhesions and removing diseased adnexa or neoplasms through the vaginal incision, but prefers the abdominal route.

Torsion of the Pedicle.—BÉRARD (*Gaz. des Hôpitaux*, 1901, No. 55) reports three cases. In the first he found a dermoid cyst, with purulent contents, which compressed the ureter, the patient succumbing twenty-four hours after operation. In the second case torsion of the pedicle of a cystic ovary

produced symptoms causing the writer to diagnose appendicitis. The usual lateral incision was made when the true condition was recognized. A median incision was then made, and the ovary was removed successfully.

In the third case a solid tumor of the ovary (cancerous) was removed with the uterus.

OBSTETRICS.

UNDER THE CHARGE OF

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Rapid Dilatation of the Cervix with Rossi's Dilator.—In the *Centralblatt für Gynäkologie*, 1902, No. 35, KNAPP adds his testimony to that of Leopold in favor of the use of Rossi's dilator. It will be remembered that this instrument consists of several arms over which are placed corrugated tips to secure a firm grasp of the tissue. These arms are separated by a screw turned by a small wheel at the outer extremity of the instrument. It is inserted within the cervix, closed, and its blades gradually separated until dilatation is complete.

Knapp's case is that of a patient, aged thirty-eight years, in a critical condition from extensive pulmonary tuberculosis. She was seven months pregnant, and the cervix admitted three fingers with difficulty. It was desired to empty the uterus as rapidly as possible in the interests of the child and with the hope of somewhat relieving the mother. In a little over ten minutes it was possible to completely dilate the cervix and extract the child with forceps. The fœtus had recently perished before extraction.

It must be remembered in judging of this case that in phthisical patients the tissues are often anæmic and relaxed, and hence dilatation would not be difficult. In spite of this, however, the action of this instrument is certainly remarkably efficient.

Two Vaginal Cæsarean Sections for Eclampsia.—JAHREISS (*Centralblatt für Gynäkologie*, 1902, No. 35) reports two cases in which vaginal Cæsarean section was practised, with version and extraction of the child, for eclampsia. The first of these was that of a primipara who had had twenty-three convulsions before she was seen. She had marked œdema, the pupils were very small, and the pulse full, hard, and rapid. The cervix was undilated, the head movable, and the membranes had ruptured. Vaginal Cæsarean section followed by version and extraction of the child were performed. Mother and child made a good recovery. In Case II. the patient had not been so long in eclampsia, but seemed much more prostrated and with much less power of resistance. The child was dead when the patient was admitted to the hospital. She was delivered by a vaginal Cæsarean section, with

version and extraction and separation of the placenta. The mother did not recover consciousness, and died of heart failure nine hours after delivery.

From the standpoint of those who believe that rapid delivery is imperative in eclampsia, the method of Cæsarean section by vaginal incision deserves careful attention. It has the advantage over abdominal section that the abdomen remains unopened, while version gives a ready method for the extraction of the child.

Myoma of the Uterus Complicating Pregnancy.—Backer (*Centralblatt für Gynäkologie*, 1902, No. 38) reports six cases of myoma of the uterus complicating pregnancy.

The first case was that of a primipara who was delivered of a child at full term, labor being complicated by the presence of a myomatous tumor as large as a child's head. The tumor was fixed, immovable, its lower portion lying in the hollow of the sacrum and its upper border extending above the promontory. It was impossible to remove the tumor through the vagina or to so displace it that labor could proceed, and accordingly the abdomen was opened and the child extracted by incision of the uterus. The tumor was left. The patient's recovery was complicated by phlegmasia of the lower extremity, from which the patient made a gradual recovery. Nine months afterward the tumor had decreased one-half in size.

In two of these cases the presence of the tumor caused such dyspnœa that operative interference was undertaken during the second half of pregnancy. In the first of these the tumor was an intraligamentous growth upon the left side, and was successfully removed, pregnancy continuing. The second of these cases had the tumor behind the uterus, and the uterus and tumor were removed and the stump treated with the thermocautery. This patient died from purulent peritonitis.

Two other cases were those of pregnancy in the early months complicated by the presence of myomatous tumors. In each of these cases the uterus was emptied, and in each the patient made a good recovery from the operation. One of the tumors was a polyp which protruded from the uterus and became gangrenous.

His last case was that of a patient seen in consultation and found dying of septic infection. Upon examination it was found that a gangrenous myoma retained within the abdomen after the birth of the child was the cause of the infection.

Abdominal Section for Retroflexion and Fixation of the Pregnant Uterus.—At a recent meeting of the Obstetrical Society of Dresden, Marschner (*Centralblatt für Gynäkologie*, 1902, No. 38) reports the case of a patient, aged thirty years, suffering from loss of appetite, vomiting, and pain in the back and abdomen. It was thought that she had tubal gestation. The uterus seemed to be small, the left ovary swollen, and the right could not be felt. A tumor was developing in the right side of the pelvis which was thought to be a tubal gestation. This tumor could not be moved under anæsthesia, and was possibly a retroflexed and incarcerated pregnant uterus. The patient was treated by abdominal section. It was found that the tumor was the retroflexed pregnant womb, which was fixed beneath the promontory of the

sacrum by numerous adhesions. The uterus was dislodged and restored to its normal position, and the patient's pregnancy continued to term.

Hebotomy.—Ven de Velde (*Centralblatt für Gynäkologie*, 1902, No. 37) has collected three cases by Italian operators in which the pubes have been severed at one side of the symphysis to enlarge the pelvis during labor. He adds to these three cases two of his own as follows:

Case I. was that of a patient in her second labor, aged twenty-eight years. She had had one child in spontaneous labor which was small and ill-developed, and which died shortly afterward. The patient had been in labor twenty-four hours without the engagement of the head. The contraction ring could be plainly distinguished between the umbilicus and the symphysis. The child was living, the membranes had ruptured, and the cervix was considerably dilated. The internal antero-posterior diameter was 8.5 cm., and the distance between the tuberosities of the ischia 10.5 cm. The patient was transported to a hospital, and under anæsthesia the cervix was dilated and version was attempted. This was abandoned because of the danger of the lower uterine segment. The patient was then put in Walcher's position and the operator endeavored to force the head into the pelvis, but this also failed. The child's heart sounds remained good.

Cæsarean section was declined because the discharge from the uterus had a distinct odor, and the patient's temperature was slightly above normal. The pelvis was opened by an incision upon the patient's left side at the spine of the pubes, extending slightly inward and beneath. Under the guidance of the finger, the chain saw was passed around the bone, which was very easily severed. There was slight bleeding, which was controlled by a tampon of iodoform gauze. The child was readily delivered by forceps, and proved to be above the average size and weight. It was slightly asphyxiated, but readily recovered. A slight rupture of the perineum occurred. The periosteum was brought together by buried sutures of silk, and the lower portion of the wound was drained by small pledgets of iodoform gauze. The pelvis was compressed by a firm bandage, and sand bags were laid upon each side of the pelvis after the patient had been put in bed. The patient recovered, with fever for a few days and with slight phlegmasia of the left side, which readily subsided. The stitches were removed on the seventh day, and a slight serous discharge persisted from the point of drainage for a short time afterward. When the patient got up the ends of the bones could be felt to rub together slightly, although a distinct callus could be appreciated on the anterior surface of the wound. The patient ultimately made a complete recovery.

Case II. was that of a patient, aged thirty-three years, who had been pregnant three times previously. Her pregnancies had ended in premature labor in two cases, with version and extraction of a dead child. In one instance she gave birth to a small child which did not survive. The patient had a strongly rhachitic pelvis, which also was much flattened. The internal antero-posterior diameter was 7.5 cm. On examination, the head was found above the pelvic brim, freely movable, and with the back directed toward the right side. Pains were becoming strong, the lower uterine segment was much distended and thin, and the uterus was painful to palpation. The patient was operated upon by the same method, and after the pelvis had been opened

the child was delivered by version and extraction. The pelvis was allowed to separate widely until the head had come into the pelvic cavity, when firm pressure was made upon both sides of the pelvis, and the lower extremities were strongly flexed. The child was delivered without difficulty. The uterus did not contract vigorously, and the placenta was immediately removed and the uterus tamponed with vioform gauze. The vagina was also tamponed. The wound was closed as in the previous case, and a permanent catheter placed in the bladder. The bowels were prevented from moving for several days after the operation in order that the patient should be kept as quiet as possible. The bladder was douched with boric acid solution. The gauze was allowed to remain within the uterus and vagina for five days. The patient made an excellent recovery.

Van de Valde believes that this operation furnishes a safe and most rational method of dealing with cases of moderate contraction of the pelvis. He believes that it is safer to sever the pubes at one side of the symphysis than to cut directly through the joint. He believes that a better union is obtained through bone than when joint surfaces are opened. While the number of his cases is too small to justify a positive conclusion, his experience and that of others is sufficient to draw attention to this method.

The Medical Indications for the Induction of Labor.—PINARD (*Annales de Gynécologie et d'Obstétrique*, September, 1902), in a paper under the above title, states that in his clinic during the ten years from 1890 to 1900 he has induced labor for cases other than pelvic contraction twenty times. The number of patients under observation during this time was 22,708. Fifteen of the twenty patients recovered and five died. When these cases are examined to determine for what conditions he would induce labor, we find that severe albuminuria, cardiac disease, hemorrhage with low attachment of the placenta, pernicious nausea, polyhydramnios, molar pregnancy, and eclampsia were the causes which justified the interruption of pregnancy. His method is that usually employed, consisting in the introduction of an aseptic bougie within the uterus.

The First Stage of Labor.—TWEEDY (*Journal of Obstetrics of the British Empire*, October, 1902) has studied the dilatation of the cervix during the first stage of labor, with special reference to rupture of the uterus. His conclusions, which are of practical interest, are as follows:

The first stage of labor begins when the polarity of the uterus is established. This condition results from overstretching of the nerves which pass through the lower uterine segment, distributed to the circular muscular fibres of the cervix. The painless uterine contractions of pregnancy thin out the segment and bring about this condition. The cervix may be fully dilated without being sufficiently open to permit the passage of the fœtus. The most usual cause of the elongation of the anterior lip of the cervix is a retraction of the posterior cervical lip and the dragging upward of the os. In these cases there is danger of rupture to permit an expansion sufficiently large to give exit to the child. Such a laceration cannot be sutured because of the unfavorable condition of the parts and the retraction of the posterior lip. In multiparous women tears of the cervix most often involve the vagina as well

PATHOLOGY AND BACTERIOLOGY.

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A Contribution to the Normal Histology and Pathology of the Hæmolymph Glands.—A. S. WARTHIN (*Journal of Medical Research*, July, 1902) discusses the histology and pathology of the hæmolymph glands. The essential feature of the glands is that they contain blood sinuses instead of lymph sinuses. The blood sinuses may entirely replace the lymph sinuses, or may occur with the lymph sinuses, in which case they belong to a mixed type. The hæmolymph glands are found most commonly in the prevertebral retroperitoneal region, usually near the great vessels, and less commonly in the mediastinal tissues. Very frequently they lie near the parathyroids. Microscopically, two distinct types are distinguishable: First, the splenolymph gland; and, second, the marrowlymph gland. The first form is the more usual, and may be mistaken for an accessory spleen. In this variety the sinuses, which besides red blood cells contain leucocytes, are lined by endothelium and reticulum, but the endothelium may be absent. The cells which make up the lymphadenoid tissue are small lymphocytes, large mononuclear cells, transitional and polymorphonuclear leucocytes, and rarely mononuclear eosinophiles and mast cells. Although the lymphadenoid tissue is often present in fair amount, it may be so much reduced in comparison to the blood spaces that the gland closely resembles the spleen. In the blood sinuses numerous large mononuclear phagocytes packed full of red blood corpuscles are seen, and pigment is present in large amounts. Warthin believes the chief function of these glands is of a hæmolytic nature, and that secondarily they are leucocyte forming organs.

In the marrow lymph glands the blood sinuses are filled with a coarse reticulum, through which the red blood corpuscles filter. Between the sinuses masses of lymphoid tissue are arranged in cords, in the pure type, there being no true follicles. Fat cells are scattered throughout the glands. Many varieties of cells are found in the lymphadenoid tissue; mononuclear eosinophiles and multinucleated cells as well as large mononuclear forms with knobbed nuclei are numerous; giant cells of the bone-marrow type are occasionally seen, and red blood corpuscles are common—none of them, however, being nucleated under normal conditions. Besides these various types of cells deposits of hyaline material occur frequently. In the blood sinuses, also, the cell forms are very varied and in much greater numbers

than in the splenolymph glands. Normally these glands are leucocyte forming, and play but a small part in hæmolysis.

Different pathological conditions may affect these glands, such as inflammation, congestion, carcinomatous metastases, and tuberculosis. The marrow lymph glands in pyæmia showed actively proliferating lymphocytes and many nucleated red blood corpuscles. In both secondary and pernicious anæmia hæmolysis is increased, but there is no new formation of red cells. The glands, however, from a case of anæmia gravis with hemorrhages showed both hyperplasia of the lymphoid tissue and actively segmenting red blood corpuscles and lymphocytes, thus suggesting that the tissue had assumed a portion of the bone-marrow function. Still more marked were the changes in a fatal case of anæmia following epistaxis, for not only were nucleated red cells present, but every type of bone-marrow cell was found. The same picture was again present in a case of splenomyelogenous leukæmia. After splenectomy in a case of splenic anæmia the microscopic appearance of the glands was practically that of the spleen. Finally, from his studies Warthin concludes that these glands are to be considered as compensatory structures assuming the function either of the spleen or bone-marrow should these organs be destroyed or become incapable of carrying on their own functions.—W. T. L.

The Influence of Alcoholic Intoxications upon Certain Factors Concerned in the Phenomena of Hæmolysis.—A. C. Abbott and D. H. Bergey (*University of Pennsylvania Medical Bulletin*, August and September, 1902). The main problems dealt with in this series of experiments were:

1. The influence of alcohol administered per os upon the complement content of the blood of rabbits.

2. The influence of alcohol similarly administered upon the specific blood reactions of rabbits already artificially immunized against an alien blood.

3. The influence of alcoholization upon the process of artificial immunization by an alien blood.

In the first series of experiments the serum of rabbits immunized against bovine blood was used as a basis. After heating this serum varying amounts of fresh normal rabbit's serum and alcoholized rabbit's serum were added in order to ascertain the amount of each of these sera necessary to reactivate the heated immune serum. Much more of the alcoholized rabbit's serum than of the normal rabbit's serum was required to obtain hæmolysis—that is to say, the complement of the blood was definitely reduced in the case of the alcoholized rabbits, their serum containing roughly only about 50 per cent. as much complement as normal rabbit's serum. Control experiments showed that the reduction was not due to small amounts of alcohol in the serum or to a diminished alkalinity of the blood.

In the second series of experiments it became apparent that when alcohol was fed to animals previously immunized there resulted not only a reduction in the complement content, but also a reduction in the immune body of that serum. This was demonstrated by reactivating the heated serum of alcoholized artificially immunized rabbits with normal serum. Much more normal serum was needed to obtain hæmolysis with this serum than with the serum of control animals which had not received alcohol.

Finally all attempts failed to immunize rabbits, which had previously received alcohol, against alien blood. Some of the animals died after the first inoculation, others died after the second or third inoculation, but artificial immunity was not established in any case. This result agrees with the findings of Deléarde, Lactinier, and others. The authors explain it by the great diminution in the complement content of the blood brought about by the injection of alcohol. They conclude that:

1. The daily administration of alcohol per os to rabbits brings about a reduction in the circulating blood of hæmolytic complement.

2. Slight alterations in the normal alkalinity of the blood serum has no demonstrable influence upon the complement (hæmolytic) of the blood of alcoholized rabbits.

3. The diminished reactivating power of the blood of alcoholized rabbits is not due to the presence of small amounts of alcohol as such in the blood.

4. The administration of alcohol to rabbits induces not only a marked reduction in the complement content of their blood, but may cause at the same time a reduction in the specific hæmolytic receptor in the blood of rabbits artificially immunized against alien blood.

5. The diminished complement content of the blood of alcoholized rabbits renders the animal more susceptible to the toxic action by an alien blood.—W. T. L.

Guarnieri's Vaccine Bodies.—R. Romme (*La Presse Médicale*, May 3, 1902) in his review of the subject of vaccine bodies bases his belief in their specificity chiefly on the work of Wassielewski. Since 1894, when these refractile oval corpuscles were first described by Guarnieri, various explanations have been given of their meaning. Many have regarded them as products of degeneration either of leucocytes (Salmon) or cell protoplasm (Hückel), but the work of Wassielewski seems to have determined rather definitely certain points which tend to a belief that these corpuscles are parasitic and of a specific nature. In brief, this author has shown that these bodies are of constant occurrence in the epithelial cells in cases of variola and vaccinia, and occur in no other cutaneous infection; they can be reproduced by inoculating calf vaccine in the cornea of rabbits, and can be transmitted for many successive inoculations; and, finally, that no other pathological product or traumatic lesion will produce the bodies in the cornea.—F. P. G.

Researches on the Hæmolytic Properties of Human Blood Serum.—Carmus and Paguiez (*La Presse Médicale*, May 21, 1902, No. 41) reported, at a recent meeting of the Société de Biologie, interesting observations on the variations in the hæmolytic properties of human sera on rabbits' red blood corpuscles. In eleven out of fourteen cases they have found a direct parallelism between the degree of leucocytosis and the intensity of hæmolysis; in the other three cases the polymorphonuclear leucocytes alone were increased, with practically no change in the mononuclear leucocytes, which is of interest in its relation to Metschnikoff's idea that these latter cells alone produce the "macrocytase" or alexin capable of causing hæmolysis.

In twenty-four observations on the effect of human sera in various chronic

diseases on normal human corpuscles, in thirteen the blood was found hæmolytic—a property which, however, had no relation to the degree of leucocytosis, and apparently is not dependent on a specific "isosensibilisatrice" (isointermediate body), but to toxins derived from the diseased conditions.—F. P. G.

Experimental Coccidial Carcinosis.—BRUANDET (*La Presse Médicale*, April 26, 1902, No. 34), in working with two forms of rabbit coccidia, namely, the coccidia oviforme of the liver and another coccidia which occurs in cysticerci—probably coccidia perforans—has found several interesting points in regard to their reproduction. Shattock and Ballance had tried in vain to reproduce coccidia oviforme in both the dog and the rabbit by subcutaneous, intrapleural, and intravenous inoculations. According to Bruandet, the failure was due to the fact that the coccidia are dependent on an epithelial nidus for their growth. The simultaneous injection of epithelial cells will not accomplish this purpose, but the author has found that they may be readily reproduced by inoculating them in the rabbit's ureter in a direction toward the bladder, with a ligature above to prevent expulsion. A few days later the kidney may be inoculated. In both kidney and bladder small masses of epithelial cells which contain coccidia are found after twenty or thirty days. Similar lesions may be produced in the testicle.

The deduction which the author draws is that epithelial parasites are dependent on an epithelial surface in order to reproduce. The experiments with coccidia he regards as of great importance on account of their relation to the cause of carcinoma.—F. P. G.

On the Extension of Tumor Metastases in the Lung.—ADOLPH TRENTLEIN (*Cent. f. Allg. Path. u. Path. Anat.*, 1902, Band xiii., No. 13, p. 520). A demonstration of the so called "Kohnische Porenkanälchen" through the alveolar septa of the lung was well given in the present case by the extension of a metastatic sarcoma from the lumen of one alveolus into another. In the gross examination a section through the lung showed numerous tumor nodules varying from the size of a hazelnut to that of a walnut. Microscopically the tumor proved to be a spindle-celled sarcoma which invaded the lung, not through the vessels, but through the perivascular and peribronchial lymph-channels. From the lymphatics the growth spread into the alveolar spaces, completely filling them, but at the same time leaving the alveolar walls intact, so that the author likens the process to a "sarcomatous pneumonia." In thin sections single sarcoma cells could be traced through the septa from one alveolus into another, thus explaining the peculiar intra-alveolar growth of the tumor, and demonstrating, so the author believes, pre-existing openings through the alveolar walls.—W. T. L.

Leucocytosis after the Use of Digitalis in Pneumonia.—A. BORINI (*Central. f. Bakt. u. Par.*, 1902, Band xxxii., No. 3, p. 207). Attracted by the favorable results obtained with digitalis in the treatment of pneumonia, Borini made experiments to determine the protective property of digitalis and aleuron, both hyperleucocytosis producers, when given to rabbits inoculated with virulent cultures of pneumococcus. It was found that the animal

which had received injections of digitalis lived several hours or even days longer than either the control rabbits or those given aleuron. Definite quantities of the drugs and of pneumococcus cultures were injected according to the weight of the animals. Both aleuron and digitalis, harmless in themselves to animals, produced a marked leucocytosis, but they differed essentially in the fact that after the injection of aleuron the hyperleucocytosis was quickly followed by a leukolysis and finally a hypoleucocytosis, while with digitalis the hyperleucocytosis was sustained for a comparatively long period. To these facts was attributed the favorable action of digitalis and the failure of aleuron to prolong the life of the animals.—W. T. L.

HYGIENE AND PUBLIC HEALTH.

UNDER THE CHARGE OF

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Is Typhoid Fever Sometimes Air-borne?—In support of the theory that typhoid fever may be air-borne, QUILL (*British Medical Journal*, February 15, 1902) gives an account of the circumstances which obtained in a military camp in the hills of Ceylon, where large numbers of Boer prisoners were confined. An epidemic of typhoid fever developed, and no less than six hundred cases occurred. The water-supply was analyzed chemically once a week, and was examined bacteriologically with frequency. No fresh milk was allowed in camp. All carbonated water used was from the same source as that supplied to a neighboring sanitarium, in which no typhoid fever occurred. No uncooked food of any description was used, and peddlers of all kinds were rigidly excluded from the camp. All persons leaving the grounds, for any purpose whatever, were required to carry with them a bottle of filtered water. Since these sanitary regulations were enforced thoroughly, Quill believes that the infection was air-borne from an adjoining camp of prisoners, where the disease prevailed, although the possibility of transmission through the agency of flies after visiting specifically infected latrines must be borne in mind.

VAUGHAN (*Journal of the American Medical Association*, April 19, 1902) also believes that dissemination of the typhoid fever bacillus in dust through the air has been clearly demonstrated, but he believes that the most important means of dissemination of the disease is specifically polluted drinking-water. Frequently the infective agent is carried on the hands and clothing of nurses and other attendants. It is his belief that the disease is never spread by exhaled air, although the organism may exist in the sputum.

JEHLE (*Wiener klinische Wochenschrift*, February 27, 1902) has found the bacillus in the sputum of cases of bronchitis with no lesions of the intestine, which suggests the possibility of inhalation with dust.

In the opinion of TURNER (*British Medical Journal*, February 15, 1902) it is a mistake to attach very great importance to wind and flies in the

causation of epidemics of typhoid fever. His experience of six years in South Africa has led him to believe that, in the great majority of cases, the cause is to be found in a polluted water-supply. He does not deny the possibility of air-borne typhoid, but points out that if dust infection were a predominating or even an important cause of typhoid fever, one would expect to find the disease most prevalent from shortly after the beginning of the dusty season until shortly after its close; but he notes, as a matter of fact, that it is during this very period that typhoid fever is least prevalent. On the other hand, it is during the wet season, when, on account of heavy rain, there is no dust, that the disease is most prevalent. Although conceding the possibility of the transmission of typhoid fever by flies, he points out that, in South Africa, flies begin to be troublesome long before typhoid fever prevails, and continue to be so long after its subsidence. In answer to the criticism that typhoid fever prevailed among the British troops in spite of the fact that filters were provided, he asserts, of his own knowledge, that the filters were not generally used, and that where the commanding officer of a regiment enforced the use of filters the number of cases in that particular body was insignificant.

Schüder (*Zeitschrift für Hygiene und Infectionskrankheiten*, Band xxxviii., p. 343) has collected reports of 650 epidemics of typhoid fever in all parts of the world, of which 377 occurred in Germany, 140 in England, and 66 in France. It appears that 70.8 per cent. of these were due to contaminated water, 17 per cent. to contaminated milk, and 3.5 per cent. to other foods. In reality, water as a cause preponderated even more than is here shown, since even among those attributed to milk and other foods, as oysters, etc., it is probable that in some instances a polluted water may have been a contributing if not the main cause. Speaking also of the transmission of the disease from person to person, he takes as a measure of the danger the relation between the whole number of cases in certain hospitals and clinics and the number of cases occurring among the nursing staff and among other patients. Of 35,647 cases of the disease, 1179—that is to say, 3.3 per cent. —occurred among the nursing staff and other patients; of 23,554 cases in the Prussian military hospitals during the period 1881–1897, 1012, or 4.3 per cent., were among the personnel of the hospital; and 478—that is to say, 2 per cent.—among patients who were present on account of other sickness. The vehicle of infection is chiefly the discharges, and particularly the urine, of those sick and convalescent. He recommends the protection of the nursing body by antityphoid inoculations, according to the method of Marsden and Wright.

Preservation of Meat by Means of Borax.—Vaughan and Veenboer (*American Medicine*, March 15, 1902, p. 421), experimenting with borax on meat, found that meat not treated with borax, and kept at ordinary temperatures, becomes slimy within a few days. From the surfaces of specimens so kept they isolated twenty different species of micro-organisms, fourteen of which were peptonizing bacteria. Inasmuch as it is the usual practice to wash meats so treated as soon as they arrive at their destination, they see no objection to this use of borax; and it would appear reasonable and proper to allow the practice, provided the preservatives do not pene-

trate the meat to any considerable extent. Since the announcement of the German Government of its intention to enforce, on and after October 1, 1902, the law prohibiting the importation of meats to which borax or any other of a number of preservative salts has been applied, Virchow, who is very strongly opposed to such action, has made known that for years he has taken a daily dose of borax with apparent benefit, and that since reaching his eightieth birthday he has doubled the dose.

The law goes much further than merely to prohibit preserved meats. It deals most minutely with the whole subject of slaughtering and meat-inspection. One of the sections regarding the importation of dressed meats requires that they shall be in the form of whole carcasses. Carcasses of hogs and beeves may be split, but the halves must be left together, and must be accompanied by the head, lungs, heart, and kidneys. Cow beef must be accompanied also by the udder, and the carcasses of hogs must include the tongue. No piece of meat preserved by any of the permitted processes shall be allowed entrance if it weighs less than 4 kilogrammes (8.8 pounds), except hams, bacon, and intestines.

Tuberculosis, Human and Bovine.—Koch's denial of the identity of human and bovine tuberculosis has not passed unchallenged in Berlin. MAX WOLFF has induced the *grapes* or *perlsucht* in a calf by inoculation with materials taken at the autopsy of a patient in the wards of Professor von Leyden, suffering from primary ulcerative intestinal tuberculosis, with miliary granulations on the peritoneum and in the spleen, but without any lesions in the lungs or bronchial glands. In another experiment, in which he used the sputa of a tuberculous patient, the results were somewhat equivocal; and Möller failed altogether in his attempts—whether by inhalation, injection, inoculation into a wound, or injection of human tubercle in the form of living cultures—to excite general tuberculosis in the ox, the infection remaining localized when it occurred at all.

[But no number of negative results can disprove well-established positive cases so clear as to present all the conditions of experiments proving the communicability of tuberculosis through the milk of diseased cows. Such was the case of the thirteen previously healthy girls in the school of Les Dames lanches, at Chartres, reported by Dr. Ollivier; and Dr. Nocard's, of the daughter of a medical man at Berne—a remarkably fine girl, who died of extensive primary intestinal tuberculosis. In both these instances the infection was clearly traced to the consumption of milk from cows with tubercle of the udders. Dr. Koch has found that bovine tuberculosis is more virulent than human to rodents and monkeys, and why not to man also? The bacillus acquires greater virulence in the bodies of some animals and loses it in others, and all that Koch has proved is that the cow has little to fear from man, while man has much to fear from her—more, indeed, than from his own kind. This phenomenon may be connected with difference of body temperature, that of the cow being normally 101° to 102° F.; and in the one recorded instance of tuberculosis in fish it was found that the bacilli had lost all virulence to warm-blooded animals, though originally derived from a human source.—E. F. W.]

Benzine-poisoning.—Dorendorf (*Zeitschrift f. klin. Med.*, Band xliii.) reports two cases of poisoning by benzine among the men in cable and india-rubber works. One suffered from violent pains in the muscles and joints, especially on the right side, which he had ascribed to chronic articular rheumatism. Improving during his stay in the hospital, he returned to the works, where he was employed in the process of vulcanizing; but the symptoms soon reappeared in an aggravated form, with headache and anorexia, compelling him to seek readmission to the hospital. In addition to the former symptoms he now complained of loss of memory, difficulty in speaking, and a sensation of extreme cold in the limbs of the right side, while the pains were exacerbated from time to time in violent crises having their seat in the bones. Careful examination showed loss of muscular power, markedly greater on the right side than on the left, and an appreciably lower temperature on that side. On the same side the brachial plexus, median, radial, ulnar, tibial, and peroneal nerves were painful on pressure, but on the left the ulnar only was so. There was no wasting of the muscles, and no change in the electric reactions of muscles or nerves or in the sensibility of the skin. The reflexes of the knee-joint were exaggerated. There were tremors of the hands, tongue, and eyelids, and nystagmus. After two months he left the hospital, cured.

The other patient was a turner, but working in a room where vulcanization was carried on. Very shortly after entering the factory he began to complain of loss of appetite, vomiting, headache, sleeplessness, and alternations of constipation and diarrhœa, which he ascribed to the vapors given off in the moist vulcanizing process. Admitted to the hospital as a case of gastro-enteritis, he was found to exhibit the same symptoms, with the like unilateral distribution, as the other. A close examination of the several departments and rooms in the factory led Dr. Dorendorf to the conclusion that the inhalation of the vapors of pure benzine, in such proportions as were present there, did not give rise to toxic symptoms, but that these were caused by the use of an impure article containing an admixture of carbon sulphide.

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