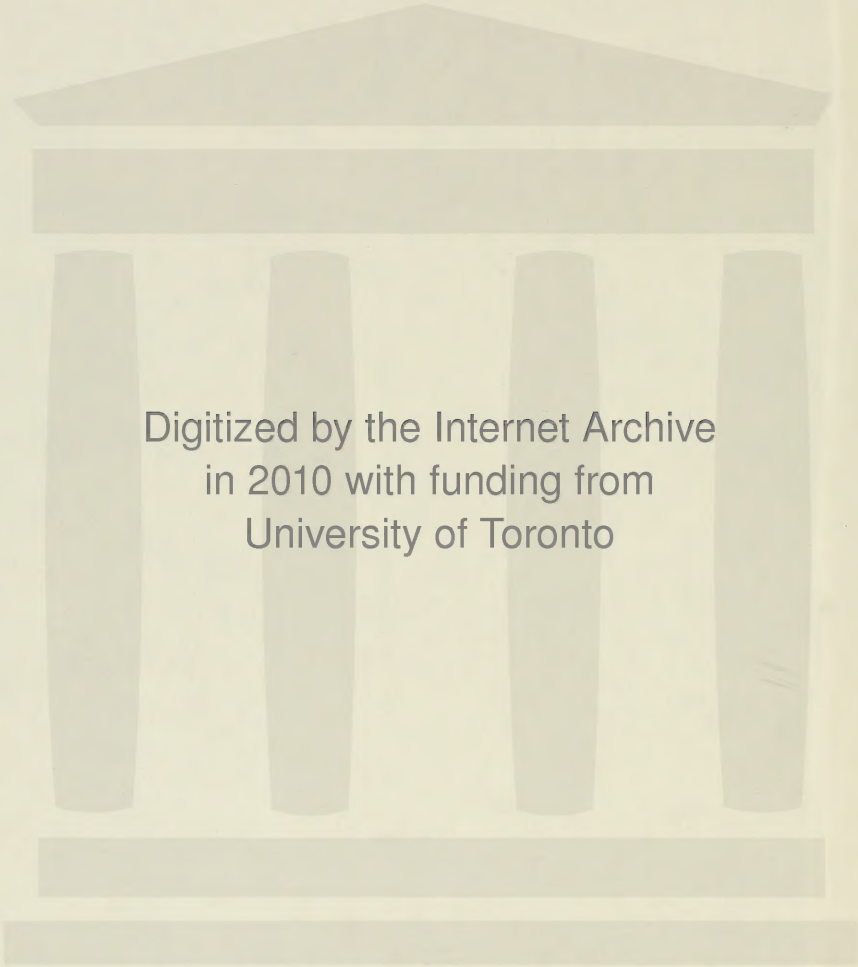

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CONTENTS.

PRESENTATION OF THORWALDSEN'S STATUE OF CHRIST TO THE HOSPITAL.

On Wednesday afternoon, October 14, 1896, at 3 o'clock, there was unveiled in the rotunda of the Administration Building of the Johns Hopkins Hospital, in the presence of the trustees and officers and a large audience of invited guests, Stein's reproduction of Thorwaldsen's statue of Christ, a gift from William Wallace Spence, of Baltimore. Mr. Spence, in presenting the statue, spoke as follows:

"I have but a few words to say on this occasion; merely to state how it happens that this statue stands here.

"On a visit to Copenhagen I saw the great work of Thorwaldsen, his ideal conception in marble, of 'Christ, the Divine Healer.' It impressed me more than did any statue I had ever seen, and I think this is the general experience of those who have the good fortune to see it. It was stated that Thorwaldsen himself said, 'I never was satisfied with any work of my own until I executed the Christ; now I am satisfied.' He felt that his genius had reached the zenith of its powers and that he could go no higher. Well might he be satisfied, for the grace, dignity and majesty of this figure have never been surpassed.

"Later on the thought came into my heart how eminently appropriate it would be to have this ideal statue placed where it now stands, in the centre of this hall, under the lofty dome of this great hospital. To every weary sufferer entering these doors, the first object presented to him is this benign, gracious figure, looking down upon him with pitying eyes and outstretched arms, and as if it were saying to him, 'Come unto Me and I will give you rest.' I thought it might help to comfort some sad and weary one, and lead his heart and thoughts up to the ever-living Divine Healer, who alone could give that rest. With this feeling I asked permission of the trustees to present this statue to the hospital. It was cordially given, and at once I placed an order with Professor Stein, the eminent sculptor and Director of the Royal Academy of Art in Copenhagen, and there it stands. How well he has executed it you will judge.

"A few years ago, at the formal opening of the Hospital, President Gilman expressed the hope that some day it might stand there. To-day his hope is realized. And now, Mr. President, I beg to present this statue to the Johns Hopkins Hospital."

The statue was then unveiled by little Emily Riggs, an infant great-granddaughter of Mr. Spence.

Mr. W. T. Dixon, the President, in behalf of the Board of Trustees of the Hospital, accepted the gift in the following words:

"Mr. Spence—It gives me very great pleasure to accept, in behalf of the Board of Trustees of the Johns Hopkins Hospital, your generous gift, this beautiful and impressive statue, and to assure you of our appreciation of your motives and munificence.

"These grateful feelings of the trustees, I am confident, will be cordially shared by all the workers in every department of the Hospital, by our many friends throughout the country, as well as by the sick and suffering who may come under our care.

"You have most appropriately placed this 'Divine Healer' just where it can be seen by all who may enter the doors of the Hospital, thus affording them the opportunity to derive comfort, courage and hope from its contemplation. And not only are the outstretched hands of this Christus Consolator

held out to this company, this community and the people of this age, but they will remain extended to tens of thousands of the generations yet to come.

"There are grave responsibilities and many discouragements in maintaining and conducting a hospital, especially a hospital with the high aims and beneficent purposes of the one you are honoring to-day, and we cannot too earnestly assure you that such evidences of interest in our efforts to comfort the sick, relieve the suffering and advance knowledge, as come with your gift, are most encouraging and inspiring to us all."

The following hymn by Whittier was sung by a male quartet:

"So stood of old the holy Christ
Amidst the suffering throng;
With whom his lightest touch sufficed
To make the weakest strong.

That healing gift he lends to them
Who use it in his name;
The power that filled his garments' hem
Is evermore the same.

For lo! in human hearts unseen
The Healer dwelleth still,
And they who make his temples clean
The best subserve his will.

That Good Physician liveth yet
Thy friend and guide to be;
The Healer by Gennesaret
Shall walk the rounds with thee."

President Gilman of the Johns Hopkins University, upon a special invitation from the trustees of the Hospital, afterwards made the following address:

We are assembled in the presence of one of the best works of modern Christian sculpture,—a transcendent theme, treated by an illustrious artist, in his noblest manner; a work, too, that has stood the test of more than seventy-five years without a word of censorious criticism. Canova saw it in Rome, while it was modeling by the artist, and praised it. The people of Copenhagen determined to have it. It was reproduced at Potsdam (Berlin) in front of the Church of Peace, near which the Emperor Frederic lies buried. A copy, in plaster, surrounded by the twelve apostles, from the same artist, was brought to New York at least forty years ago and exhibited in what was known as the Crystal Palace or the World's Fair.

But we have here, not the original cast in clay, nor a plaster reproduction, nor one in galvano-plastic; but we have a marble like that which Thorwaldsen himself touched with his chisel. The pose, the drapery, the figure, the outstretched arms, the head, the face, are reproduced for us with exactness by a living artist of Copenhagen.

We are greatly indebted to that honored citizen of Baltimore who has brought here a work which from so many points of view delights and inspires us.

This is not the first time that a hospital has been decorated by a great work of art. If I remember rightly, Benjamin West painted the picture of "Christ Healing the Sick," for the Pennsylvania Hospital in Philadelphia; and, if I am not mistaken, in St. Luke's Hospital, New York, there is still a famous picture by Daniel Huntington, "The Dream of Mercy," based upon an incident in Bunyan's Pilgrim's Progress.

Nor is this the first gift that this hospital has received. Its munificent endowment by Johns Hopkins has been strengthened by funds provided for the foundation of a school of medicine and surgery, which supplements the work of the Hospital. And minor gifts have come in. Not long ago we had a very small but noteworthy present, a likeness of Florence Nightingale. At another time a friend gave us models and pictures of various public institutions throughout the country. Again, one who loves medical biography and history has hung upon these walls a fine collection of the portraits of illustrious physicians and surgeons who in many countries and in many generations have adorned their profession. Recently a large gift has enabled the trustees to provide better facilities for the instruction of those who are here engaged in preparing themselves for the profession of medicine or for nursing. And now we have this work of art which, perhaps, appeals to more of us than any of the other gifts, unless it be that touching memento of a departed child, the "White Rose Fund," which enables the Superintendent every year to distribute flowers to, and to provide for the entertainment of those who are convalescing in the Children's Ward.

Baltimore is fortunate in many ways in the gifts that are coming to it. We seem to have reached a period in the history of this city when its citizens are ready to adorn and decorate the place of their residence. Mr. Spence has presented a noble statue of William Wallace that stands in Druid Hill Park. Around the Washington Monument are the works of Barye, of Dubois, and of Story, and also the grand figure of Chief Justice Taney, perhaps the best portrait statue, with one or two exceptions, that has ever been produced in this country, the work of our own Rinehart. But pleasant as these tokens are, I must not dwell upon them, but must rather speak of the circumstances under which this work of Thorwaldsen was produced, and tell you some things regarding the sculptor.

The city of Copenhagen, at the entrance to the "Sound," is not a very large place; I should say not more than one-half or two-thirds the size of Baltimore (if size is measured by population); but it has a port, a university, a citadel, a harbor, and an academy of fine arts, the latter holding high rank among the academies of Europe. The city suffered greatly by the bombardment of 1807 during the Napoleonic wars, and it was not till some twelve or thirteen years afterward that an historic edifice, which had thus been destroyed, was reconstructed. This was the old church which bears the name of the "Frue Kirke." The sound would be more familiar to us if I called it Notre Dame, or the Church of Our Lady. Denmark, as you know, is a Protestant country, and this is a Lutheran church. I have heard it called a Presbyterian church, and I do not know that Mr. Spence will object to that. While in the process of reconstruction, the commissioners had a conference with Thorwaldsen, a native of Copenhagen, and arrangements were made by which he should model a statue of Christ. It was also agreed that the approach to the altar from the main portal should be lined with statues of the apostles, beginning with Peter and Paul. This arrangement was carried

out by the artist, then living in Rome; and such is the origin of the Christus Consolator upon which we are looking.

Not far away from this church stands the Thorwaldsen Museum, constructed by the people of Copenhagen for the reception of the casts of all or nearly all the works that Thorwaldsen made. This museum was subsequently endowed by him with a very considerable sum of money, and now constitutes his monument. In the interior court his body lies buried.

Now perhaps you would like me to tell you regarding the artist himself. Perhaps I may mention two or three things that will connect him with this country. Those of us who have watched the ships coming in and going out of a great harbor, as I did in my boyhood in New York, remember how common it was to see ships with carved beaks, often quite well wrought. Now Thorwaldsen commenced his sculpture by carving beaks for great ships. It is not unlikely that in some such place as the Naval Museum in Brooklyn some of those images which Thorwaldsen and his father carved are still preserved.

When Thorwaldsen was beginning to acquire a reputation, about the year 1807, the United States Consul at Leghorn negotiated with him to model a statue of Liberty to be placed in Washington. Whether it was for the summit of the capitol or to stand upon the ground, I do not know, but the life of Thorwaldsen records the fact that negotiations went forward for the statue, and also that a proposal was made to him to make a monument to commemorate the American victories over the pirates of Tripoli and Tunis.

I have come upon another incident perhaps more curious. You know that when a man becomes famous all the world begins to ask "Who was his grandfather?" and to trace his heredity as far as possible. As soon as this Danish sculptor became famous, people found out that he was descended from an old Icelandic sculptor. But they did not stop there; they thought they found that he was a descendant of Thor Finn. Thor Finn is the name of one of the Norsemen who is said to have crossed the Atlantic, not far from the year A. D. 1000, and is said to have skirted along the New England coast and to have established himself in the southern part of that peninsula. A son was born to Thor Finn in what is now Rhode Island (so at least it is said), and to that man they have traced the genealogy of Thor-wald-sen, and thus they claim that Thorwaldsen is descended from the first person born of European descent in the new world.

The enterprising secretary of the Rhode Island Historical Society took occasion to address a letter to Thorwaldsen congratulating him not only on his honors but on his origin, and Thorwaldsen replied, with a fine touch of courteous humor, "Let us admire those savants, for if it were not for them, we should not know where we came from or whither we are going."

It is just one hundred years this very month, and I may say this very week, since Thorwaldsen, in a note dated October 16, 1796, states that he is on his way from his northern home, like the Norsemen of old, to establish himself in the south. He was a passenger upon a government frigate which stopped leisurely at one point and then another, so that his journey grew tiresome. At last he abandoned the man-of-war and found other conveyances to carry him from Malta to Palermo, to Naples, and so on to Rome. There he went to work.

But how could this boy maintain himself in Rome? It was by the aid of a scholarship provided for him by the Royal Academy of Copenhagen. He had not been a very bright boy in his ordinary school instruction. His teacher could not make anything out of him, and the pastor who was engaged in giving him lessons for confirmation shook his head many a time at the dulness of the artist. One day in the course of these lessons he said, "Thorwaldsen, was that your brother that took the prize in the Academy of Fine Arts the other day?" "No," said the young sculptor, "it was I." "You!" said the teacher; "Mr. Thorwaldsen [with the emphasis on the title], go up to the front seat." It is not a bad thing for those of us engaged in instruction to remember that sometimes boys who are dull at books, who do not like to receive knowledge through the printed page, may yet have talents that are worth developing. This should never be forgotten.

Now I want to remind you that scholarships just like that which enabled Thorwaldsen to go forward, have been established within a short time in Baltimore. Rinehart, as you know, left a considerable sum of money, which was carefully invested by Mr. Newcomer and Mr. Walters, until it reached the sum of $100,000, and it was then given to the Peabody Institute. This very week the Maryland Institute, by the aid of that fund, has instituted a school of sculpture, to bear the name of Rinehart, and besides this, Rinehart scholarships have been bestowed upon two young men, selected with great care by distinguished artists, and they are now engaged in the prosecution of their art-studies, one in Paris and the other in Rome. I think it is not unreasonable to hope and believe that as the years roll by we shall hear something proceeding from these influences worthy to stand beside the Danish artist whom we this day commemorate, worthy likewise of Rinehart's bounty.

At Rome, Thorwaldsen instantly came under the modern influences of that day. Winckelmann, the well-known critic, had already called attention to the great value of the Greek art in distinction from that of the Renaissance, and sculptors began to work in the Hellenic spirit. You get an illustration of this movement in the Flaxman designs, as produced in England. You get another illustration in the work of Canova, and you get an especially good illustration in the early work of Thorwaldsen.

A great many illustrious people came to Rome. An amusing story is told of Sir Walter Scott. He was very desirous of meeting and talking with Thorwaldsen, and they were introduced to one another; but Thorwaldsen could not speak a word of English, and Sir Walter was not at his ease in French. All that any one could hear was "plaisir," "plaisir," "connaissance," and similar nouns, expressing gratification that they had met.

The sculptor soon came into church circles. He was a particular friend of Cardinal Consalvi, and made his monument. It was through his influence, undoubtedly, that Thorwaldsen was selected to make for the Church of St. Peter the famous monument of Pius the Seventh. Some one objected that a Protestant had been selected. The Pope inquired, "Is not he the

best artist in Rome?" "Undoubtedly," was the answer. "Then let him hold the place."

Thorwaldsen after a time went home, and, as I have said, received the commission for a statue of Christ. He returned to Rome, and with his helpers, it took him eight or nine years to complete the group of Christ and the Apostles.

You must be familiar with many of the works which he produced meanwhile. The little medallions of Night and Day which hang in so many parlors were his. Almost every one who goes to Europe knows the Sleeping Lion of Lucerne and the statue of Lord Byron at Cambridge. He made many portrait busts. He worked long on mythological subjects, till finally "he turned from Jove and Mars to nobler themes."

The story goes that he made six models of the Christ before he was satisfied with the one which is here reproduced. At first he thought of giving to the figure an uplifted hand, in the attitude of benediction. Afterwards he uplifted both arms as if in prayer. The artist was standing before his statue one day, when he said to a friend, "I am not satisfied with that." His friend replied, "What was your motive in giving that posture; what were you thinking about?" Thorwaldsen paused, and in a moment turned down the arms to the position in which you now see them, and then said, "I am satisfied now."

It is worth while for me to add that between five and six hundred works by this artist have been catalogued—a large part of which may be seen (in the cast, if not in the original) at the Thorwaldsen Museum in Copenhagen.

Now, ladies and gentlemen, it is not for me to draw the lesson of the statue. I suppose (to use a phrase of Coleridge) that this statue "will find each one" of us in his own mood. To some it will be a reminiscence of travel,—of a delightful day in Copenhagen. To others it will be a work that is famous in the history of modern art. To many of the anxious and suffering it will be suggestive of hope and faith and love. To each, according to the inward eye that he brings to bear upon it, will the lesson be given. I do not propose to read a homily; but I may remind you that throughout modern literature and art this figure appears. From the Divine Comedy of Dante to the Paradise Lost of Milton, in the Saul of Browning and Tennyson's Crossing the Bar, one name is repeated. So it is in painting, from Raphael and Leonardo to those gifted men who are now decorating the churches in this country with the illustrations of the life of Christ. So it is in sculpture, from Michael Angelo to St. Gaudens. So it is in religious meditation, from Thomas à Kempis to Phillips Brooks. Everywhere there is one note prevalent, one name pre-eminent. Whatever else the founder of Christianity may have been, we cannot read the narratives of his life without a certainty that he was the Great Physician. Whatever else may be found in this statue, however we may look at it, we must be mindful that it represents to us one who lived and walked upon this earth, and wrought more cures and more wonderful cures than any physician or surgeon that had ever lived. Thorwaldsen, better than any artist that I know, has produced this thought in marble. In "Ecce Homo" attention is called to a fact which you will allow me to repeat —that the founder of Christianity was not only the Great Healer, but when he first organized his followers into a definite society, for the purpose of bearing glad tidings throughout the world, he sent them on their mission as physicians. "Go," he said, "and heal the sick"; and the narratives of the Evangelists and of the Book of the Acts bring out most clearly this distinctive character. Among its other lessons we shall remember that this "House of Mercy," this "Hotel-Dieu," is pervaded by the spirit which appeared upon the earth almost nineteen hundred years ago.

In the presence of Mr. Spence it will not do for me to recount the many good deeds which he has done for the city, the many great services, political, financial, mercantile, philanthropic, educational and religious, which he has rendered to Baltimore; but I must be allowed to say that twice when the finances of the Johns Hopkins University have been in a critical condition, he has been the one citizen to come forward and by his example to inspire the liberality of others. He was kind enough to tell you that I had on a "wishing cap," or words to that effect, seven years ago. I am going to put on my "wishing cap" now, and I am going "to wish" that as long as Baltimore lives and flourishes it may have the presence and influence and co-operation of such men as William Wallace Spence.

THE BACILLUS PROTEUS ZENKERI IN AN OVARIAN ABSCESS.

By Hunter Robb, M. D., *Professor of Gynecology, Western Reserve University, Cleveland, O.*, and Albert A. Ghriskey, M. D., *former Assistant Gynecologist to the Johns Hopkins Hospital.*

Mrs. T. G. was admitted to the gynecological ward of the Johns Hopkins Hospital, August 8, 1891, with the following history:

The patient was a Bohemian, 26 years of age, and had been married seven years. She had had three children, and said that she had never miscarried. The oldest child is six and the second four years old; the third child, born in Jan., 1890, died of "summer complaint" at the age of six months. Her labors had been easy; she remained in bed for two days after each, being attended only by a midwife. Her menses first appeared at 16 years of age. They were irregular, lasting usually seven days, and were often profuse and painful; since marriage her menses have been regular, lasting five or six days, being profuse but not painful. In May, 1890, she ceased to menstruate for two months, but in July her menses reappeared and lasted six days. At this time they were profuse and accompanied with a great deal of backache and pain in both ovarian regions. She had never had leucorrhœa; she suffered from constipation. There was no urinary difficulty. The patient remained well until April, 1891, when a hemorrhage from the vagina occurred suddenly and continued for six days. Two hours after the hemorrhage ceased she passed foul-

smelling black clots of blood and experienced labor-like pains. During May, June and July she was free from these labor-like pains, but complained during these months of weakness, of occasional chills and fever, of pains in the lower zone of the abdomen, and backache. On admission to the hospital she was too weak to walk. The slightest touch over the region of the left ovary provoked intense pain. The temperature on admission was normal; the patient weighed 123 pounds.

At the examination made August 8, 1891, under chloroform narcosis, the following note was made:

Vaginal outlet moderately relaxed; vagina bathed with bloody fluid; cervix small, bilaterally lacerated, pointing upwards; uterus anteflexed, sagging in the pelvis, enlarged, soft and movable. Right broad ligament thickened. Fallopian tube and ovary not definitely palpated.

On the left side a fluctuating tumor is outlined, about the size of an orange, adherent to the uterus.

Diagnosis. Abscess of the left ovary. Treatment advised, cœliotomy.

Urinary analysis. A voided specimen examined on August 9th was turbid, straw-colored, specific gravity 1.020, reaction acid. On standing it deposited a heavy bloody and mucous sediment. On boiling, albumen was found to be present. A large number of red blood corpuscles were revealed by the microscopical examination, as well as numerous epithelial cells both large and small.

A catheterized specimen was cloudy, amber-colored, specific gravity 1.035, reaction acid. Albumen as in voided specimen; mucous sediment not so deeply stained with blood. The microscopical examination gave much the same results as those shown by the previous specimen.

Operation August 12, 1891, under chloroform narcosis.

Incision 7 cm. long through thin abdominal walls. On exploration of the pelvis, the mass previously palpated on the left side was brought into view. It was bound down to the broad ligament, uterus and pelvic walls by dense connective tissue adhesions. The tumor mass was successfully enucleated, but during its delivery a small rupture occurred at the point at which it was adherent to the fimbriated extremity of the Fallopian tube, and a small quantity of purulent fluid, having a strong fœtid odor, escaped. A ligature was immediately tied about the rent, thus preventing the escape of more fluid. The remaining portion of the Fallopian tube, although not adherent, was enlarged and thickened. The tumor mass was transfixed and ligated below the round ligament, after which it was excised and the pedicle cauterized.

The Fallopian tube and ovary of the right side being bound down by only a few adhesions, were enucleated without difficulty. The fimbriated extremity of the tube was occluded, enlarged and thickened. The ovary appeared inflamed, but was not enlarged. The tube and ovary were removed by transfixion and the pedicle was cauterized. The pelvic cavity was irrigated with three litres of a sterilized salt solution at a temperature of 112° F. and sponged dry.

A drainage tube was inserted in the lower angle of the wound and the usual dressings applied. Time of operation, 40 minutes.

The specimens removed consist of the tube and ovary of the right side, which are covered with villamentous adhesions, and the tube and ovary of the left side, which are encapsulated in connective tissue-like adhesions.

VIII-13-91. First dressing. The gauze plug in the drainage tube is thoroughly saturated with a dark bloody discharge, and streaked with a fluid resembling pus. Tube cleansed with 20 pledgets of cotton, the last three pledgets being but faintly stained. The discharge had a decided odor of decomposition.

The cotton immediately over the drainage tube was slightly moistened with the same character of secretion as that seen upon the plug and upon the cotton pledgets.

Abdomen flat, no distension, general condition good, usual cultures taken.

VIII-14-91. Second dressing. Slight amount of fluid on cotton over the drainage tube; plug in tube moistened by a clear fluid holding a clot of blood at the lower end. On the gauze plug there are white opaque points of lymph, corresponding in position to the perforation in the drainage tube. The fluid has the same odor of decomposition. Tube cleansed with twelve pledgets of cotton, which when withdrawn were stained with a serum-like fluid, the two last being hardly soiled at all. Drainage tube removed and a plug of iodoformized gauze inserted down the track of the tube. Abdomen flat, general condition good; usual cultures taken.

VIII-15-91. Third dressing. Gauze removed from the tube track; moistened; not as much odor. Track of tube cleansed with peroxide of hydrogen. Abdomen flat, general condition good. Gauze reapplied to wound, but not down the track; abdomen sensitive. Gauze impregnated with permanganate of potassium and oxalic acid applied over the protective dressing and track of the tube.

VIII-19-91. Fourth dressing. Stitches removed. Line of union good; some suppuration about the track of the tube. General condition good.

VIII-26-91. Fifth dressing. Small amount of creamy fluid escaped from the track of the tube. Line of incision in good apposition and well united.

Analysis of temperature chart.—The temperature was taken for ten days after the operation by the mouth, rectum and vagina. The highest point registered was that on the fourth day, when it was 102° F. by the rectum, 101.8° F. by the vagina, and 101.2° F. by the mouth. After this it was never above 101° F. and on the 9th day registered 100.5° F.

Bacteriological examination.—The following cultures were made from the left Fallopian tube and abscess cavity: Two sets of Esmarch's roll plates on agar-agar, one smear and one stab culture in the same medium; a blood-serum tube (bullock's blood) and a litmus milk tube. From the right Fallopian tube, which was distended by a muco-purulent, rather viscid looking fluid, we only made gelatine Esmarch's roll plates.

Microscopical examination.—Cover-slips stained with gentian violet show numerous polynuclear leucocytes, with compound granular bodies, and a few cells with large round nuclei resembling epithelial cells. Many bacilli were observed; they were rather faintly stained, and were seen only occasionally within the leucocytes. These bacteria were stained best with carbolic gentian violet.

Numerous rod-shaped bacilli were found in the preparation

from the Fallopian tube on the right side. Though less intensely stained, they resemble tubercle bacilli somewhat morphologically. They are, however, completely decolorized when treated after the method of staining for the latter organisms. It is to be noted that the organisms were very numerous in the specimen from the point at which the cultures were made.

After 48 hours in the thermostat all tubes were sterile, except the blood serum slants, which showed an opaque, very faintly granular growth, apparently due to closely set colonies. Only the growths from the two inoculations from the abscess contents were considered reliable for study. Inoculations were made from these on the agar-agar, blood serum, potato and gelatine. Examined microscopically they proved to be pure cultures of a bacillus.

All these tubes showed growth after 24 hours on agar; very faintly after 48 hours on gelatine, on account of the lower temperature, but more distinctly on the latter on succeeding days. The appearance of the colonies in gelatine corresponded to that presented by the bacillus proteus, a fact suggested by Dr. Booker and confirmed by Dr. Welch. These colonies showed the typical twisted wandering offshoots (schwärmende Colonien) characteristic of the proteus group. The gelatine was not liquefied.

Cultures from the Drainage Tube.—First dressing 24 hours after operation. Roll plate, agar-agar, Esmarch's tubes. The colonies on the tubes from the gauze plug were composed of the skin-coccus. Microscopical examination of stained cover-glass preparations from the secretion showed a few diplococci, and numerous bacilli identical with those found in the abscess cavity. The coccus grew on potato and in bouillon with the characters of the streptococcus pyogenes albus, but liquefied gelatine, though less rapidly than this organism.

The inoculation of a guinea-pig subcutaneously in the flank with the serum-like secretion from the gauze plug was without result.

Further inoculations from the drainage tube on bullock serum were not made, as the supply of culture medium was exhausted.

The case is of unusual interest on account of the results of the bacteriological examination. The bacillus proteus vulgaris (variety Zenkeri?) was found in cultures from the abscess cavity in the left ovary, and on cover-slips in the right Fallopian tube. In all our previous examinations of abscess cavities, cysts and Fallopian tubes, we have never met with another instance in which it was present.

Macroscopical and microscopical description of specimens from the Pathological Laboratory of the Johns Hopkins Hospital, by Dr. J. Whitridge Williams.

Appendages on both sides. Left side: Tube 6 by 0.7 by 1 cm. Fimbriated end thickened and adherent to ovary, but not occluded; some portions are still bound down to the ovary, but at other places the adhesions have evidently been torn loose during the operation. On section it is seen that the mucosa is much thickened and resembles a pyogenic membrane. The characteristic folding has disappeared. Scattered through it here and there are areas which appear decidedly caseous.

The ovary is converted into a pus sac 5.5 cm. in diameter. The greater part of its exterior is smooth, though signs of several dense adhesions are observed. On the surface are a few dilated follicles. The abscess wall varies from 0.5 to 1 cm. in thickness, its interior being lined by a characteristic pyogenic membrane 2 to 3 mm. thick. Externally it is glistening and presents many circular elevations, 1 to 5 mm. in diameter, which are raised only a few mm. above the general surface. These are found to be movable and to represent tags of tissue. On section, the pyogenic membrane is readily divided into two layers; the one nearer to the pus cavity being opaque, thicker, of a yellow color, and having a tuberculous aspect (?); the other, lying next the ovarian stroma, is lighter in color, more translucent, and considerably thinner than the inner coating.

Cover-slips from the pus show many thick bacilli, but no tubercle bacilli.

Right side: Tube 5 by 0.4 by 1.2 cm.; fimbriated end occluded; many adhesions. Ovary 3 by 3 by 1.5 cm. Many adhesions on surface. On section, the ovary is succulent and contains an oldish corpus luteum and a small corpus luteum cyst, 5 mm. in diameter, with white opaque walls 1 mm. thick and with a glistening interior. There are also several follicles with hemorrhagic contents.

Microscopical examination. The left tube presents a marked purulent salpingitis, the folds of its mucosa being infiltrated with leucocytes and round cells. In places the epithelium is swollen and breaking down, and in others has entirely disappeared, affording a picture which beautifully illustrates the liquefaction of tissue.

There is also a marked endarteritis.

Sections through the wall of the ovarian abscess show that the portion adjacent to the cavity contains many newly formed blood-vessels; it is filled with leucocytes and most beautiful fibroblasts, which are rapidly proliferating, nuclear figures and cell division being well seen.

In this portion the connective tissue bands are hardly visible. As we recede from the abscess cavity we find fewer leucocytes, more fibroblasts and connective tissue, until we gradually approach characteristic ovarian tissue.

The bacillus corresponds morphologically to the bacillus proteus Zenkeri, and stains well with methylene blue, and does not entirely decolorize with the Gram or Weigert stain. It may be observed in the abscess walls as a bacillus of varying lengths and in forms simulating cocci. The fibroblasts are strikingly like the large cells of the corpus luteum.

In a contribution to the subject of the proteus vulgaris in abscesses, Hauser[1], besides the report of his own case, gives a résumé of the instances previously reported by other writers. Hauser's case is that of an adult who had a series of abscesses in the hand, following an injury from one of the autopsy instruments. The pus, which was of an ichorous and stinking character, contained both the streptococcus and proteus. The suppuration was regarded as induced by the streptococci, and the peculiar character of the contents of the abscesses was attributed to the presence of the proteus.

Beck[2] reports several cases of puerperal endometritis in which the proteus vulgaris was found, and one case of puru-

lent peritonitis, following total extirpation of the uterus for carcinoma, in which the presence of the same organism was demonstrated.

Finally, Döderlein[3] reports that in the lochia of puerperal women he has often found bacilli which cause a rapid liquefaction of gelatine; but from his brief description one is not able to say whether or not he was dealing with the proteus.

It seems fair to assume that our patient had a puerperal endometritis following the abortion which occurred last April, and that the infection subsequently involved the Fallopian tube and ovary.

The proteus Zenkeri, which he classifies among the anaërobes of putrefaction, is described by Hauser[1] as follows: The organisms 0.4 in breadth, and of an average length of 1.65; in some instances the forms are rounder, at other times longer. After inoculation on gelatine, a layer which towards the periphery becomes thinner and has the appearance of the steps of stairs, is formed around the point of inoculation, and from the margin of this layer numerous threads and rods begin to pass out; after 24 hours we find large numbers of moving islands, composed of rods and threads presenting exactly the same appearance as in the case of proteus mirabilis. The deposit becomes gradually thicker and opaque, but no liquefaction of the gelatine occurs except sometimes quite at the surface. The formation of spirilla is seldom observed. Cultures in gelatine and blood serum do not show any marked odor; meat infusion, on the other hand, is decomposed by the organism with the production of a strong smell. In its other effects the proteus Zenkeri resembles the proteus mirabilis and the proteus vulgaris, and as Hauser[1] has pointed out, there is probably only one species of proteus, the vulgaris, of which the other forms are to be regarded as simple physiological variations.

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THE PHRENOLOGY OF GALL AND FLECHSIG'S DOCTRINE OF ASSOCIATION CENTRES IN THE CEREBRUM.

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[*Remarks made before the Clinical Society of Maryland, November* 20, 1896.]

In the history of medicine the 18th century stands out prominently as a period in which flourished a whole host of so-called medical systems and theories. The *animismus* of Stahl and the nerve-ether theory of Hoffman had been displaced by the system of Boerhaave; the last, in turn, being gradually supplanted by the doctrine of irritability advanced by Albrecht von Haller, who had formulated a new theory based upon his experiments in physiology. William Cullen, again, combining Hoffman's system with the doctrine of irritability of Haller, sought the cause for all pathological processes in the nervous system. Each individual attempted to subordinate the most varied phenomena met with in disease to his own particular principle, and as yet the newer studies in anatomy and physiology were not wide-reaching enough in their influence to prevent the development of the most diverse and contradictory medical theories. The "excitation theory" introduced by John Brown met with an enthusiastic reception not only in England but also on the Continent, although it was gradually undermined by the vigorous opposition of Stieglitz and of Hufeland. It was only toward the end of the 18th century and the beginning of the 19th that the investigations in the field of natural science began to affect medical ideas to any very considerable degree. The natural philosophy of Schelling, which was accepted widely by physicians, especially in Germany, benefited medicine very little, if at all. Indeed, the statement has been made that the general tendency of the time to favor Schelling's philosophy did more than anything else, except the curiosity of the public, to spread the three false doctrines, animal magnetism, phrenology, and homœopathy. Animal magnetism, fathered by the shrewd Anton Mesmer, had a brilliant career until the French commission with Franklin at its head successfully demolished it. Homœopathy, founded by Christian Friedr. Samuel Hahnemann, which attempted to subordinate the whole of the healing art to an arbitrary dictum, *Similia similibus curantur*, still has many adherents, especially in America. Phrenology or cranioscopy, connected closely with the name of Franz Josef Gall, has now but few disciples, and an avowal of belief in phrenological doctrines is usually received, even by the layman, with a suppressed smile.

Gall was born at Tiefenbrunn, in Germany, in 1758. The history of his life affords entertaining reading. He studied medicine in Strassburg and Vienna, and practiced his profession in the latter city, where he became very well known. He tells us in his books how at a very early age he noticed among his playmates the existence of definite relations between the external appearance of the head and face and certain mental characteristics. His lectures delivered in Vienna, in which his phrenological doctrines were chiefly set forth, were very popular and largely attended until 1802, when at the instance of

the ecclesiastical authorities he was commanded by the Austrian government to discontinue his public teaching. On leaving Vienna he went to Paris, where he gathered around him many supporters and continued to lecture, investigate and publish. He died at Montrouge, near Paris, in 1828.

It has been thought by many that Gall's statement concerning his early observations of his schoolfellows was made late in his life with the object of bolstering up his claims to originality. Macallister, in his excellent and comprehensive article on Phrenology in the Encyclopedia Britannica, points out that Prochaska, of Vienna, who had published a work on the nervous system in 1784, is really to be looked upon as the father of phrenology, inasmuch as in his volume are to be found the germs of the views propounded by Gall in the same city a few years later. Prochaska in turn was preceded, at any rate as far as the idea of connecting the anatomical diversities of the brain with intellectual peculiarities is concerned, by Metzger, who 20 years before had proposed the inauguration of a series of observations bearing upon this point. Moreover, the doctrines of localization of function in the brain are of still older date, though it must be admitted that very little positive knowledge upon this point existed before the beginning of the 19th century.

After leaving Vienna, Gall attached to himself Spurzheim, who seems to have been for some time an enthusiastic pupil, and, along with his preceptor, to have made many investigations upon the structure of the brain and the shape of the skull. Spurzheim rendered great service to the phrenological doctrines in England and America, where he lectured to large audiences and attracted many pupils, the most important one in America being perhaps George Combe. Gall and Spurzheim did not, however, remain throughout life in harmony. They separated in 1813, in the subsequent years, each preaching his own doctrine and disparaging to a certain extent, at least, the philosophical views of the other.

The doctrines of the phrenologists may be briefly summed up as follows: They believed that the brain, as a whole, is the organ of the mind, and that it is made up of multiple organs, each mental capacity displayed by an individual depending upon the development of its corresponding organ in the brain. The form of the skull was thought to depend upon its relations to the brain within it, though Gall in one of his publications vigorously opposes the appellation "cranioscopy" as descriptive of his doctrines, stating that he had always maintained that his work was directed toward the anatomy and physiology of the brain, the contributions concerning the relations of the form of the skull to the morphology of the brain being merely an appendage of the bulk of his studies.

It is not my purpose in this brief communication to describe the whole list of faculties and the portion of the brain assigned to each by Gall, Spurzheim and others; phrenological diagrams are familiar to all of us, and, moreover, an account of the views of the various adherents and modifiers of the system is to be found in almost any encyclopedia. A glance at the loose manner in which some of the so-called organs of the mind were localized in the brain by bumps upon the skull will suffice to show the unscientific nature of the whole system. Whereas Gall believed that there were only some 26 or 27 organs of the brain, with some of his followers the number was increased considerably, Fowler, for example, describing as many as 43 different faculties. Spurzheim divided the different capacities of the human mind into (1) the *feelings*, including the propensities and sentiments, and (2) the *intellectual faculties*, including the perceptive and reflective activities. As examples of the propensities may be mentioned concentrativeness, amativeness, philoprogenitiveness, combativeness and acquisitiveness; of the lower sentiments, self-esteem, vanity and cautiousness may be mentioned; and of the *higher sentiments*, benevolence, veneration and firmness. Among the *perceptive faculties* he included the appreciation of form, size, weight, color, locality, number, order, time and language; while the power to study causality and the ability to compare one thing with another were described as *reflective faculties*. Having gained an idea as to the localization of a certain faculty, Gall and his friends would examine the heads of their acquaintances and the casts of the skulls of persons who had possessed the particular mental characteristic under examination, and would seek for a distinctive feature corresponding to this particular trait. The following examples are excerpted from Macallister's article. *Amativeness* was located by Gall in the lower part of the posterior surface of the head because he found this area to be hot in an hysterical widow. He referred the faculty to the underlying cerebellum. It is amusing to learn that the adherents of phrenology explained the presence of a rudimentary cerebellum in the girl Labrosse, who had during life exhibited very marked amative tendencies, by assuming its obliteration from over-use. *Destructiveness* was located above the external auditory meatus, inasmuch as this is the widest part of the skulls in carnivorous animals. A marked prominence had been found in this situation on the head of a student, "so fond of torturing animals that he afterwards became a surgeon," and it was also well developed in the head of an apothecary who subsequently became an executioner. *Acquisitiveness*, located upon the upper edge of the anterior half of the squamous suture, was attributed to this region because Gall had noticed it to be prominent among the pickpockets of his acquaintance. The bump of *constructiveness* was easily found, since it was large on the head of a milliner of very good taste and upon a skull said to have been that of Raphael. *Self-esteem* was located over the obelion because Gall found this region prominent in a beggar who had excused his poverty on account of his pride. The *love of approbation* was supposed to be situated outside the obelion, inasmuch as this part of the head was especially protuberant in a lunatic who thought herself the queen of France. *Cautiousness* was assigned its proper situation from the observation of the large size of the parietal eminences in an ecclesiastic of hesitating disposition. *Veneration*, located in the middle line at the bregma, was determined by Gall after visiting churches, where he found that those who prayed with the greatest fervor had distinct prominences in this region. The bump of *ideality* was found especially developed in the busts of poets, and was said to be the part touched by the hand when composing poetry. Since the frontal eminence was prominent in Rabe-

lais and Swift, it was believed to be the organ of the sense of the ludicrous. The capacity for recognizing faces was supposed to depend upon the width of the interval between the eyes, inasmuch as Gall found in a squinting girl a good memory for faces. The murderer Thurtell, who had a large organ of benevolence, is said by devotees to phrenology to have been in reality generous, since it was discovered that he once gave half a guinea to a friend. Many other laughable instances might be given of these crude methods of localization and of the futile attempts of the adherents of the doctrine to bolster up their tumbling edifices.

It is easy to understand how a shrewd man like Gall,—and any one who reads his books will be very ready to grant his shrewdness and intelligence,—developing with great rapidity a system full of interest for the public and stimulating their curiosity by providing them with an infallible clue to the determination of character and fitness for occupation in life, should have attained wide-spread and lucrative popularity. He soon made large amounts of money, lived in state, and numbered among his personal friends some of the first names in France. Nor was he a charlatan pure and simple; he undoubtedly had a brilliant mind, and made elaborate and careful studies of the brain and skull which resulted in discoveries of permanent value concerning the anatomy and physiology of the brain. No better proof of this statement can be obtained than by perusing the volumes which I place before you, kindly loaned by the Provost of the Peabody Library. This atlas, with its well-executed copper-plates, in particular, shows the care with which much of his work must have been done. The edition, including the atlas, sold in Paris at 1000 francs.

It is curious how nearly a man starting with false premises may often approach to actual conditions. The newer investigations bearing upon the architecture of the brain have thrown much unexpected light upon the origin of the phenomena of the mind; the significance of the brain for the psychic phenomena has been established upon the basis of exact scientific investigations, and we are now justified perhaps in speaking in a certain sense of a "new phrenology." It may be interesting to refer briefly to the series of investigations which have led up to our present knowledge upon this subject.

In so far as his doctrine maintained that the convolutions represented the most important substratum of the mental activity, and that the single convolutions of the cerebral cortex are not of equal significance for intellectual life, Gall most certainly approached the modern theory of cerebral localization. The investigations of Flourens led him to very different conclusions, and in 1842 he published his well-known "Examen de la Phrenologie," which was thought to have demolished the phrenological doctrines. It was Flourens' idea that every portion of the substance of the cerebral cortex had precisely the same significance. He believed that the removal of any given mass of the grey matter affected all the mental functions in exactly the same way, so that visual or olfactory perceptions would not be diminished in different proportions, no matter what area was extirpated. The facts which have been discovered by pathologists and clinicians concerning aphasia were, however, in entire opposition to these ideas of Flourens. Gall and Bouillaud had recognized that circumscribed lesions in the cerebrum, especially in the frontal region, could give rise to definite disturbances in speech. Later, Marc Dax pointed out that aphasia occurred practically only when the left half of the cerebrum was diseased, and in 1863 Broca established the fact that in right-handed people the third left frontal convolution is the portion of the grey matter of the cerebral cortex which is important for articular speech. Subsequent studies upon aphasia have shown that there are several different kinds of the affection, only one variety of which depends upon disease of Broca's convolution, *i. e.* the one in which the capacity to speak out the word which the individual has in his consciousness is lost; the inability to understand spoken words, and the incapacity to call into consciousness the names of objects which are visible to the individual, being associated with disease of other parts. These facts alone prove that different regions of the brain are of different significance for the intellectual functions.

In addition to the studies on aphasia there have been recorded a whole series of pathological lesions which clinically were associated with definite disturbances of sensation; thus, lesions of the occipital cortex have a tendency to affect visual sensations; lesions of certain portions of the temporal cortex interfere with hearing; the sense of smell has been shown to be connected with the under surface of the cerebrum, and the sense of touch with the upper frontal and anterior parietal regions. Physiologists by means of experiments upon animals have added most satisfactory support to these clinical and pathological observations.

In 1870 Fritsch and Hitzig reported the results of their investigations concerning galvanic excitation of the surface of the brain of animals, in which it was shown that stimulation of definite regions calls forth movements of certain only of the parts of the body. Three years later Ferrier used faradic stimulation of the cortex and was able to elicit quite complicated movements of different parts of the body, movements which seemed to be purposeful, inasmuch as they correspond to those employed by the animal when utilizing its sense organs, that is to say, movements such as are employed in listening, touching, looking at, or smelling external objects. Munk proved further that by the removal of certain convolutions it was possible to produce in animals disturbances of sensory activity quite analogous to those which had been observed in the clinical and pathological study of diseased human beings.

The studies of Goltz upon dogs supply an exceedingly interesting link in the chain of experimentation. This investigator demonstrated the possibility of keeping a dog alive for a considerable length of time in the entire absence of a cerebral cortex, and in this way was able to ascertain what faculties the animal possesses when only the lower parts of the brain are functioning uncontrolled by the cerebrum. He found that an animal without a cerebrum still possesses a very complex nerve life, a fact which is not so very surprising when one recollects the observations of comparative anatomy. While the dog of Goltz's experiment appeared to be devoid of memory and judgment and incapable of finding out for himself among the objects outside of the body those necessary for the satisfaction of his needs, he showed himself to be by no

means an involuntary machine. Goltz states that he could stand upright, could run, could be set in motion by external stimuli of various kinds, that he could show evidences of emotion, becoming angry and biting and howling under provocation. When hungry the whole body entered into lively motion, and after food had been taken the animal again became restful and showed evident signs of satisfaction. As Flechsig points out, these experiments do not permit any conclusion regarding the condition of consciousness after the loss of the cerebrum, but they do show distinctly the power and the independence of the bodily instincts, and teach us that no small part of the acts concerned in these can be set free simply through bodily influences, entirely independent of the higher mental faculties.

The studies of His and Flechsig, which have done so much in recent years to give us an insight into the finer organization of the nervous system, have been especially devoted to the development of the nervous system. It is to the work of Flechsig to which I wish on this occasion to especially direct your attention.* His method of outlining tracts by the observation of successive periods of myelinization is not new. His larger work, published many years ago and entitled "Die Leitungsbahnen im Gehirn und Rückenmark," is based almost entirely upon studies made after this fashion. The tracts which function first, receive their myelin sheaths before the others, and a tolerably definite idea of the physiological capacities of a developing animal at a given moment, up to a certain period at least, can be gained by ascertaining the number of tracts which have already been medullated. Thus the spinal cord, medulla, pons and corpora quadrigemina are almost entirely medullated at a time when the parts higher up show very little or no myelin. Even in the new-born child, Flechsig has shown that the cerebrum is almost entirely unripe, inasmuch as extremely few of the myriads of nerve fibres which it contains are at this period medullated. Man, therefore, at the beginning of his earthly experience, resembles very closely the dog of Goltz's experiments; he is practically a being without a cerebrum, and yet, as in Goltz's dog, even with the drawing of the first breath, the bodily instincts in the child demand satisfaction. The new-born infant, with satisfied impulses and unaffected by external stimuli of a disagreeable nature, shows no evidence of consciousness. If it become hungry or be exposed to cold, or if painful stimuli be applied to it, active movements of the body result.

Flechsig has shown, in his study of the embryonal cerebrum, that it is the sensory paths which first become medullated. Gradually the individual fibres of one sensory path after another, beginning with that concerned in the sense of smell and ending with that by which are carried auditory impulses, passing from the sense organs of the body toward the cerebral cortex, gain their myelin sheaths. Each sensory path includes a very large number of nerve fibres containing the axones of neurones whose cell bodies are situated lower down. Following the different sensory paths to their cortical termination, it is easy to show in these early stages, in which very little of the brain is medullated, that the individual sensory paths terminate in tolerably sharply circumscribed cortical regions, for the most part widely removed from one another, being separated by masses of cortical substance which remain for a considerable period entirely unripe. Indeed, the cortical terminations of the individual sense paths correspond entirely to those regions of the surface of the brain which pathological observation has shown to stand in relation to the different qualities of sensation. It is the destruction of these internal sense organs which results in cortical blindness, cortical deafness, etc.

After these sensory paths in the child's brain have become medullated, new paths begin to develop from the points where the sense fibres terminate—paths which go in the opposite direction. These fibres as they become medullated can be traced passing downwards to the medulla and the spinal cord, to the nuclei of origin of the motor nerves, and connecting in this way the sensory regions on the surface of the cerebrum with the motor apparatus. The area of the cortex concerned in the sense of touch has an especially well developed bundle of these motor fibres, the fasciculus cerebro-spinalis or so-called pyramidal tract, which consists of more than 100,000 fibres on each side, an arrangement which permits the carrying out of very delicate movements, especially of the parts of the body concerned in the sense of touch. Connections between the cortical sensory areas and the lower centres which appear to be concerned more directly with the bodily instincts, have already been made out. It is clear, therefore, that bodily instincts and external sense impressions may reciprocally influence one another. According to Flechsig, the sense of smell is most intimately connected, the sense of hearing least associated with the centres concerned in the exercise of the lower instincts, a fact which, if confirmed, might account for the more ideal character of auditory impressions.

In the diagram before you, the localization of these various sense areas in the brain, according to the newest investigations of Flechsig, has been pictured. It will be seen that they are very sharply circumscribed, although at the peripheries of the areas the fibres do not terminate so close together as in the central parts. The large region, the somæsthetic area, occupying the whole domain between the fossa sylvii up to the corpus callosum, including the gyri centrales and the feet of the frontal convolutions, together with the lobulus paracentralis and the middle third of the gyrus fornicatus, represents the cortical field in which terminate on either side those of the 200,000 fibres of the medial lemniscus which do not stop at the basal ganglia. These fibres, together with those relaid in the thalamus, it is believed, carry to the cortex the impulses which are concerned in the projection

*I have thought it best at this time to present, in as clear and brief a manner as possible and without discussion, the main tenets of Flechsig with regard to the structure and function of the brain. While in such a short communication it is impossible to do justice to so broad a subject, it is to be hoped that it may be possible to show at least the trend of his views. The anatomical basis for his studies is given at some length in the voluminous notes appended to his "Gehirn und Seele" (Leipzig, Veit. Co., 1896). An idea of some of the criticisms which may be made of his doctrines can be gained by a perusal of the discussion of the address delivered by Flechsig at the Versammlung deutscher Naturforscher und Aerzte, Frankfurt, September, 1896 (cf. Centralbl. f. Nervenheilkunde und Psychiatrie, October, 1896).

Fig. 1.

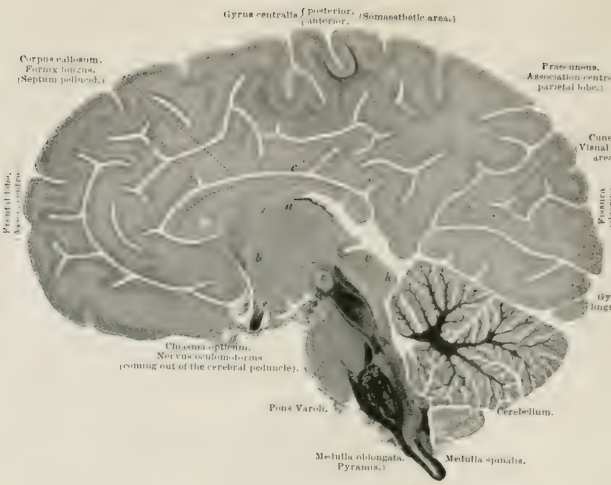


Fig. 2

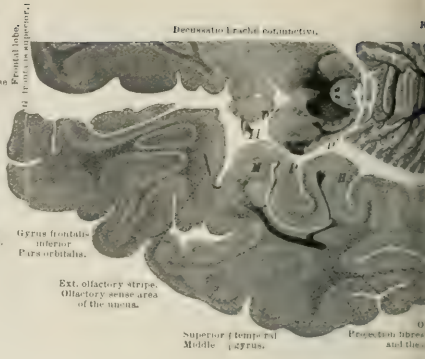


Fig. 3

Fig. 5.

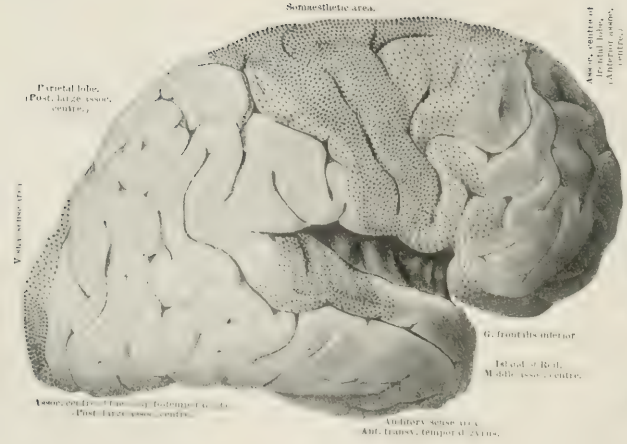
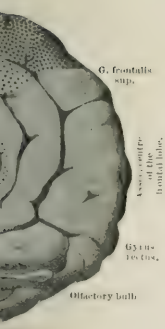
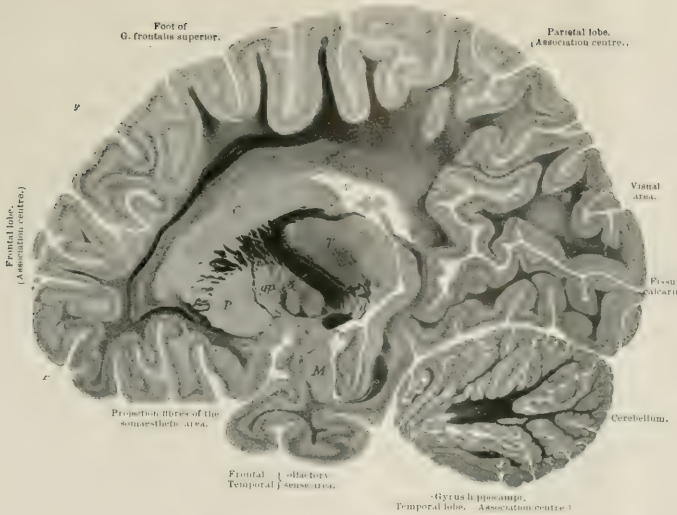


Fig. 6.





LEGENDS.

FIG. 1. Sagittal section through brain of a child one month old stained by the Weigert-Pal method. (*After Flechsig.*)

a. Taenia thalami optici (reflex path for the transference of olfactory impressions to the centres governing the movements of the head ?).
b. White matter of septum pellucidum (in part running between the olfactory area and the gyrus hippocampi).
c. Corpus callosum corresponding to the somæsthetic area.
v. Superior } colliculus of corpora quadrigemina, cut near the middle
h. Inferior } line; here very few medullated fibres are present; sections lateral to this show many.
r. Red nucleus of the tegmentum; below this is seen the decussatio brachii conjunctivi.

(In this and succeeding plates I have translated Flechsig's terms as far as possible into the nomenclature of the Anatomical Society. For his sense-centres and association-centres English terms which seemed most suitable have been employed. For the suggestion of the name "somæsthetic area" as a translation of the German *Körperfühlsphäre* I am indebted to Prof. B. L. Gildersleeve.—L. F. B.)

FIG. 2. Horizontal section through the brain of a child aged 3 months. (*After Flechsig.*)

II. Tractus opticus.
H. Association system (cross-section) in the g. hippocampi, connecting the olfactory cortex of the uncus with Ammon's horn, going over into the alveus.
M. Nucleus amygdalæ.
P. Pyramidal tract in cross-section.
p'. Temporal cerebro-pontal path.
p''. Frontal cerebro-pontal path.

The decussation of the nervus trochlearis is shown. The projection fibres of the olfactory sense area and of the g. hippocampi are completely medullated. At the tip of the frontal lobe and at the junction of the superior and middle temporal gyri myelin is as yet entirely absent. In many other parts (darker in tint) corresponding to the advanced age, association fibres are already medullated.

FIG. 3. Horizontal section from the brain of a child a little over a week old. (*After Flechsig.*)

C. Nucleus caudatus.
P. Putamen of the nucleus lenticularis.
gp. Globus pallidus of the nucleus lenticularis.

The optic radiation is well medullated; the auditory path is not yet medullated as far as the cortex.

FIG. 4. Sagittal section through the brain of a child said to have died in the fifth month of life. (The child was probably some months older.) (*After Flechsig.*)

All parts of the white substance medullated, only in places still mixed with non-medullated fibres.

C, P, gp, as in Fig. 3.
T. Thalamus (lateral nucleus).
H. External geniculate body.
X. Substantia innominata *Reil* (gray substance between the n. lenticularis and the n. amygdalæ).
M. Nucleus amygdalæ.
x–y. Projection fibres of the anterior upper and inner part of the somæsthetic area (Körperfühlsphäre); these run from the internal capsule (between *P* and *C*) forwards and bend around at an acute angle at *x* to pass upwards and inwards.
V. Lateral ventricle.

FIG. 5. External view of right cerebral hemisphere, showing sense-centres and association-centres. (*After Flechsig.*) The more closely dotted areas show the regions in which the majority of the sensory projection fibres terminate. The large areas between the dotted areas represent the association centres.

FIG. 6. Internal view of left cerebral hemisphere. (*After Flechsig.*)

1. Corpus mammillare.
2. Median section of optic chiasm.
3. Cross-section of anterior commissure.
4. Superior colliculus of corpora quadrigemina.
5. Corpus callosum (cross-section).
6. Fornix.
7. Septum pellucidum.
8. Pineal gland.

HS. Tegmentum.
T. Basis pedunculi.

into consciousness of sensations of touch, pain, temperature, muscle and tendon sense, thirst, hunger and equilibrium, as well as sexual sensations, that is to say, the sensations which tell us of the condition of our bodies rather than that of external objects. It is obvious that this area must represent a complex mass of sense centres rather than a single sensory area; indeed, we already have evidence from the pathological side indicating very different functions to the several parts of the somæsthetic area, although the localization here, as might be expected, concerns that of groups of elementary rather than of single sensations. This is the area in which the body in its whole extent can be reflected in consciousness. It is possible that a similar mirroring of somatic sensations occurs in the cerebellar cortex.

Besides being a sensory field, the somæsthetic area is also the great motor region whence nearly all the movements serving for the voluntary satisfaction of the bodily instincts appear to start. When a man voluntarily swallows, chews, breathes or seizes an external object, it is this area which is active.

The nerve fibres conducting the impulses concerned in olfactory sensations terminate, according to Flechsig, mainly in the gyrus uncinatus where it touches the island of Reil, although many of them end in the frontal lobe.

The fibres concerned in visual sensation, passing from the lateral geniculate body, the thalamus and the superior colliculus of the corpora quadrigemina, follow a direct course to terminate in the immediate neighborhood of the calcarine fissure, although subsequently fibres run out from this tract into adjacent areas, ending, however, only in that part of the cortex of the occipital lobe which shows the well known macroscopic stripe of Vicq d'Azyr. It is interesting to note that fibres from the fovea centralis are believed to go to the cortex of both cerebral hemispheres. Such a distribution would help to account for the incomplete blindness from unilateral cortical lesions.

The fibres communicating auditory impulses to the cerebral cortex form the lateral lemniscus in the pons and are connected particularly with the median geniculate body; they run out into the temporal lobe to terminate mainly in the transverse temporal gyri, especially in the anterior one. It is obvious, therefore, that the main portion of the auditory area of the cortex is hidden in the wall of the fossa sylvii, appearing on the external surface of the hemisphere only in the middle third of the superior temporal gyrus, *i. e.* in that part of it which is in contact with the transverse gyri.

When all these sense centres have become ripe, that is, when the fibres going to them and the motor fibres passing from them to become connected with the lower motor centres, are medullated, only about one-third of the whole area of the cortical surface has been concerned. This means that approximately only one-third of the human cerebral cortex is directly connected with the paths which bring sensory impressions from the periphery into consciousness, or carry motor impressions to the periphery causing muscular contractions. Two-thirds of the whole cortex appears to have nothing directly to do with the periphery, but to be reserved for another and apparently a higher work. These other areas which are left uncolored in the diagram are the so-called association centres of Flechsig. They make up the main portion of the frontal lobe, a large part of the temporal and occipital lobes, the island of Reil, and occupy a large area in the posterior parietal region of the brain. For a whole month after birth these portions of the cortex remain unripe and are entirely devoid of myelin. But after the development of the sense areas of the cortex, Flechsig has been able to follow band after band of nerve fibres passing from the different sense areas into these other immature portions of the cerebral cortex, and ending there close beside one another, thus forming true centres of association between the different sense centres. And it is his belief that these association centres represent arrangements which unite the activities of the central internal sense organs and build them up to higher units. Sensory impressions of different qualities, visual, auditory, tactile, olfactory and gustatory, are united, or at any rate the anatomical mechanism is afforded for their union. The association centres have an entirely different microscopic structure from that to be made out in the sense centres, a topic into which, however, I cannot now enter.

Flechsig believes, therefore, that these association centres are the portions of the cerebral cortex which above all others are concerned in the higher intellectual manifestations, in memory, judgment and reflection. If his theory be right, the study of the association centres should be the especial object of research for the neurologist and psychologist. That they really are of definite importance for the intellectual activities has been shown by these anatomical studies, which might of themselves be deemed conclusive. But it must be conceded that clinical experience has also afforded a large mass of evidence in favor of the view. In certain of the diseases of the mind marked disorganization of the association centres has been noted, the microscope permitting the recognition in them of the destruction of many cells and fibres. In such cases, during life, instead of a connected train of thought, the mental processes may be confused and tangled. New mental pictures entirely foreign to the normal intelligence may appear, the capacity for using past experiences may be lost and the knowledge of the results of certain acts be gone. It is in the study of general paresis that the most convincing clinical proof of Flechsig's doctrine of association centres is to be found, and from a consideration of the varying symptomatology of this disease, taken together with the pathological lesions which have been proven to exist in such cases, some clues have already been gained towards the explanation of differences in function in the different parts of the association areas in the cortex. Flechsig in the first edition of his "Gehirn und Seele" stated that the anatomically demonstrable alterations of the brain-substance in general paresis were often limited to the intellectual domains. He refers in the second edition particularly to the monograph of Tuczek upon dementia paralytica published in 1884, and recommends strongly the study of this paper in connection with his own classification of the different regions of the cortex.

It seems likely from Flechsig's studies of the brain lesions in general paresis, that this disease more than any other will afford the key for the deduction of psychic disturbances from

alterations in the cerebral substance. In cases of the disease in which the lesions are widely diffused over very many different areas of the cortex, no reliable conclusions can be drawn regarding the significance of the association centres; but occasionally the disappearance of nerve fibres is limited almost entirely to the association centres, and in some instances especially favorable for the study of function, the frontal association centre alone or the large posterior parietal association centre alone is chiefly diseased.

The study of such lesions and of the symptoms manifested by the patients during life, has not yet gone far enough to justify many positive assertions regarding the specific function of the different association centres; but enough has been done to warrant the consideration of certain statements which possess some degree of probability. Thus, where there has been bilateral disease of the frontal lobes, that is, of the anterior association centre, there has been observed in the individual during life an alteration or loss of ideas regarding his own personality and his relations to what is taking place inside and outside his body—symptoms which are quite in accord with those observed in higher apes by Bianchi after extirpation of the frontal lobes. The phenomena vary of course according to the irritative or destructive nature of the lesion. The individual may in his mind connect his personality with mental pictures which have in reality nothing to do with himself; thus he may think himself of enormous dignity, or that he is possessed of great wealth or that he is a genius. In other cases he fails to connect his own person in any way by means of association with external perceptions, so that he may forget himself or may fail altogether to observe his surroundings. Still in possession of numerous ideas, he may speak in an orderly fashion, although he appears unable to distinguish the true from the false and the imagined from the experienced. Besides these logical defects he may show a diminution of his capacity for ethical and æsthetic judgment, so that he will perform acts entirely irreconcilable with his character as manifested earlier in his life. Even in the absence of emotion he may appear to be devoid of his normal self-command; but when subjected to unaccustomed stimuli, especially to sexual excitement, anger or vexation, he may lose all control of his movements and acts, so that some simple influence may lead him to try to satisfy his desires without any regard to custom or good taste. In late stages of the disease imbecility may appear, with entire loss of the mental pictures regarding his personality.

The mental phenomena displayed in connection with disease of the posterior parietal association centres appear to stand in marked contrast to those just outlined. They have been studied in cases of general paresis, but better opportunities for the observation of such phenomena are often afforded where there has been focal softening of the cortex due to vascular disease. Here the individual may be incapable of naming correctly objects outside his body which he can touch and see; and if this centre on both sides be widely diseased, he may not recognize at all the nature of these objects, so that he loses the power of forming intelligent conceptions of the external world. On the contrary, he may be entirely clear as regards his own personality; he may appear to possess his self-control, and may show deep perversity of feeling or of the will, the specific character of the disease-picture consisting in his inability to recognize external objects, that is, to associate external sensory impressions with the memories of those of his previous experiences. On this account he may use external objects falsely; he may confuse persons; he has no certain ideas as regards space and time. His mental conceptions of the external world, the knowledge of these which he can put into words, and the power of interpretation of external impressions as the result of experience, are lost to him. He is in severe cases almost bankrupt in ideas, although his regard for himself and for those who are dear to him may be unaffected.

If one of the sense areas of the cortex alone be diseased, the clinical picture is entirely different from that presented by these purely intellectual disturbances. Here again we may have to do either with phenomena of absence or phenomena of irritation. A tumor pressing upon the auditory area may give rise to noises and other subjective perceptions of sound. Pressure upon the posterior central gyrus may lead the individual to believe that he experiences movements of his thumb, although his eyes convince him that it remains stationary. Again, a tumor pressing upon the uncinate gyrus has been known to give rise to subjective odors; while a cysticercus cyst pressing upon the visual area of the occipital lobe has caused the arrival into consciousness of mental pictures of colored figures and the like. Destructive lesions of the sense centres may prevent the external sense impressions from entering into consciousness at all. There may be entire absence of mental confusion in such instances; the patient recognizes the subjective character of the hallucinations, and so is not actually mentally diseased in the ordinary sense, but if focal disease affect along with one sense centre several of the others, or the posterior large association centre, the picture of hallucinatory confusion is prominent.

Time will not permit me to discuss the so-called functional disturbances ascribable to conditions of exhaustion of different cortical areas dependent upon prolonged and violent emotion, various intoxications, impoverishment of the blood, and other causes. Suffice it to say that, on theoretical grounds at least, more or less sharp criteria can be mentioned for the participation in the process of the different centres, especially the somæsthetic area, the frontal lobes and the posterior large association centres. In many instances, however, the phenomena presented show, what we *a priori* might expect, that several of the sense areas and association centres are diseased at once. The various permutations and combinations possible will doubtless account for the manifold symptomatology of the great group of nervous and mental diseases, a symptomatology which as yet is in almost hopeless confusion and which calls urgently for an ordering hand. It will be the task of psychology and neurology in the future to analyse the specific activities of the various regions of the cortex, and to correlate these with the mental phenomena of human beings in health and disease.

Flechsig's researches have established the fact that the human cerebral cortex is made up of at least seven anatomically more or less well separated areas. As the phrenologists

thought, the brain is the organ of the mind, and the whole is in reality made up of multiple organs. But instead of calling these, as did the old phrenology, after certain qualities, friendship, good-nature, wit, firmness, and the like, thanks to Flechsig's studies we can now adopt a more rational nomenclature. We can now speak of sense centres and of association centres in the cerebral cortex. The sense centres may be roughly grouped as the somæsthetic area, the visual sense area, the olfactory sense area and the auditory sense area; the association centres for the present have to be designated according to their position as frontal or anterior, insular or middle, and parieto-occipital or posterior. Thus a distinct advance has already been made, and it is hardly too much to expect that further study will permit of much more complete differentiation and more definite localization of both kinds of areas.

It is not stating too much to affirm that advances in true psychology are to be mainly hoped for from strictly scientific investigations into the structure and function of the nervous system. Pure philosophical psychology has advanced but little beyond the concepts of Aristotle and the other ancients, and as Flechsig says, "Medicine at all periods has been nearer the ideas believed in to-day mainly on account of the fact that the physician has had ever before him as the special object of his observations the human individual, presenting healthy or diseased conditions, in life and in death."

It would take too long to give even a brief *résumé* at this time of the insight into psychological processes which are afforded by Flechsig's work. His recent publications speak for themselves, and his treatment of the subject cannot fail to prove interesting to the reader. Doubtless many of the theories which he has advanced as a result of his anatomical studies will not stand the test of time. But we owe to him a deep debt of gratitude for supplying us with a large mass of entirely new knowledge, from which further investigations may start.* The relative positions of the individual sense centres to the association centres are, as can be seen from the diagram, very peculiar. The posterior association centre is situated among the visual, auditory and somæsthetic areas of the cortex; while the anterior association centre is related, in gross at least, only to the somæsthetic area and to the olfactory sense area. The middle association centre has adjacent to it the auditory, olfactory and somæsthetic areas. When one remembers that the association centres receive bands of fibres which run into them from the adjacent sense areas, the remarks made before concerning the specific functions of the different association centres will perhaps be more easily appreciated.

Flechsig in his "Rectoratsrede," as well as in his later address upon the "Border-lands of mental health and disease," has laid especial emphasis upon the significance of the somæsthetic area. Assuming it to be the portion of the cerebral cortex where impressions regarding the body enter into consciousness, the centre which appears to have to do with the bodily emotions and bodily needs, and upon the excitability of which the crudity or delicacy of the instincts which enter into consciousness depends, as well as the centre whence start nearly all motor impulses which are concerned in conduct, be they those leading to the closure of the fist, the pressure of the hand, or the most delicate embrace, Flechsig believes that this somæsthetic area is to be looked upon as the main organ of character. This cortical area, connected as it is on the one side directly with the peripheral sensory and motor apparatus of the body, and on the other with the higher association centres in the cortex, stands, as it were, like a buffer intercalated between the organs of the body and the organs of the intellect. The character of the activities manifested by these complex cortical centres of which the somæsthetic area is made up, may thus be influenced from either of the two sides. As Flechsig says, it represents a sort of arena in which, at least in the more nobly endowed natures, the lower impulses struggle for the mastery with the higher feelings and ideas. To follow this struggle between the reciprocal influences of the body and the intellect will form one of the most stimulating problems of brain investigation, especially when it is remembered that the subject is of eminently practical significance. In the investigation of the brain it will be necessary to study the conditions which lead to an ennobling of the sensual instincts, whether it come immediately through bodily influences or from the other side through the intellect. Since, further, in these studies the presumptive existence of an ennobling of the intellect through refinement of the sensual instincts must be kept in view, the new brain anatomy and physiology is brought into contact with the fundamental problems of all scientific pedagogy and the aims of all true culture. The old *a priori* ideas concerning the antitheses of sensuality and reason, and of the "heart" and the "brain," would seem to find some actual confirmation in recent anatomical discoveries.

Furthermore, Flechsig sees in these newer studies the essential preparation for a physiological basis of ethics, so much desired by some of the writers of the last century. Inasmuch as the health of the cerebrum is essential for the control of the lower centres concerned with the instincts and emotions, as is proven by the cessation of the struggle between the instincts and the ethical feelings where the intellectual centres are paralyzed, and inasmuch as we now know some of the causes of the diseases of the sense centres and of the association centres, and are convinced that many of these causes are removable or avoidable, the ethical significance of these studies becomes manifest.

It must be the aim of educators to enlighten the people concerning the hygiene of the body and especially of the brain. We must not fear to teach the intimate interdependence of bodily conditions and mental phenomena, or hesitate to let the masses know that the abuse of alcohol, the over-indulgence of the passions, and mental and physical excesses of all descrip-

* We should be particularly grateful for the definitiveness of the concepts of brain structure which Flechsig has afforded us. In this embryological self-analysis of the cerebral tracts, the bands of medullated fibres, stained by the method of Weigert, stand out as clear-cut on the yellow background of non-medullated nervous tissue as the lines of a diagram. The illustrations of sections in Flechsig's book are by no means fanciful. In his regular lectures during the spring semester of 1895, Flechsig showed us a large number of his preparations which bear out fully his anatomical statements and illustrations.

tions, can lead to results of a most serious nature. Only by increasing knowledge, general and special, can we hope in coming generations to strengthen and make solid the foundations of the higher ethical feelings. All will agree that for the advancement of the race we must presuppose a social arrangement which will subordinate the blind instincts of the morally and intellectually deficient to the control of the deeper insight and the better will of an intellectual ethical aristocracy. If it is in the main the remarkable development of his association centres which has raised man so far above the level of all other living creatures, it is also by virtue of the function of these same association centres that man is to be elevated in the future beyond his present status. Flechsig at the close of his "Rectoratsrede" makes brief reference to the aims other than practical of these newer studies. "Just as by means of one of the noblest faculties of our natures, namely, the thirst for knowledge, an instinct conferred upon human beings with the development of their association centres, we are forced to study the natural laws involved even in the domain of the mind, so the actual advances of our knowledge, even in this field of investigation, lead with the forcible necessity of a natural law to an ideal philosophy. The more the enormous potencies embodied in an intelligent individual become unveiled to our questioning reason, the more clearly must we feel that behind the world of phenomena there are controlling forces with which human knowledge scarcely dare lay claim to be compared."

NOTES ON NEW BOOKS.

Practical Points in Nursing, for Nurses in Private Practice, with an Appendix. By Emily A. M. Stoney, Superintendent of Training School for Nurses, Carney Hospital, Boston. Illustrated with 73 engravings and 9 colored and half-tone plates. (*Philadelphia: W. B. Saunders*, 1896.)

This little book is primarily designed for the instruction of private nurses, and as such it will undoubtedly serve a useful purpose. It is to be regretted, however, that it is also intended to be used for the instruction of classes, and for the home nurse, for which purposes it seems very inadequate. It may help those who are already instructed and who require a book of reference, but it presupposes a degree of previous knowledge on the part of the student which pupil nurses and home nurses do not possess.

The chapters on physiology and descriptive anatomy are of the most elementary character and are couched in such terms as to convey no adequate idea of the subjects treated. Witness the following: "The parotid gland is situated below and toward the front of the ear. It secretes saliva, *and it is inflammation of this gland that causes mumps.*"—or "*The skull is a box of bone containing the brain, which is a soft pulpy substance*, and is the chief organ of the nervous system." Could the modicum of technical knowledge be made any smaller? The book ought to be very popular for the instruction of nurses among those who are apprehensive of the over-education of nurses and are fearful that they will make third-class physicians.

The definitions are very imperfect and are evidently written by one who is not accustomed to use language accurately. "A lotion is a medicinal application, and may be evaporating or non-evaporating." "Worms, which are of three kinds—tapeworm, thread worms and round worms—are caused by impure drinking water and food, and *also by feeding food that is not properly cooked.*" "Ophthalmia neonatorum is inflammation of the conjunctiva, which is one of the coats of the eyeball. Its causes are numerous, *but in the newborn* it is generally caused by infection during birth from the urethral or vaginal discharges of the mother."

The chapter in which directions are given to nurses as to their conduct is clearly and judiciously written. Some nurses would doubtless take exceptions to the author's declaration that "it is not degrading to the nurse to assist in the kitchen when emergencies arise; it shows the true spirit of a nurse, and the kindness is not lost." The chapters also on the Sick Room, of the Patient, and Accidents and Emergencies, are to be commended. The book is well printed and illustrated, and has a good index.

Practical Notes on Urinary Analysis. By W. B. Canfield, M. D. (*Published by George S. Davis, Detroit*, 1896.)

The second edition of this little work has recently appeared as one of the numbers of The Physician's Leisure Library. It is essentially practical, as most of the tests given are such as can be used at the bedside by the general practitioner. Although the subject is treated as briefly as possible, yet we think that if practitioners were fully conversant with the various tests described, and with the precautions to be observed in performing them, many errors in diagnosis would be prevented and much valuable assistance in the treatment of diseases afforded. Many of the higher organic compounds found normally in the urine are, however, not even mentioned. In fact, no constituents of the urine, normal or abnormal, are treated of that cannot be tested for with the simplest apparatus and reagents. Thus, the use of the polariscope in diabetes and the influence of diabetic urine on polarized light, one of the most reliable tests, is entirely overlooked. Such statements as "the diagnosis of typhoid fever is now made almost certain by the diazo-reaction of Ehrlich" should certainly be qualified, as it is well known that this reaction is very frequently obtained in tuberculosis and not infrequently in other febrile conditions: the test is merely an aid to diagnosis. One can hardly see how the practitioner is to be aided in recognizing leucin and tyrosin in the urine, by the author's statement that "leucin and tyrosin are found in the urine in certain abnormal conditions of the liver. They are easily recognized in the sediment, or may be found on evaporating the urine." It is only justice to say that a diagram of the leucin spherules and tyrosin crystals is given in the plate of urinary sediments, from which alone it would be unsafe to make a diagnosis, however. While the author's book serves a useful purpose, no general practitioner should be without a larger work on urinary analysis, for purposes of reference.

Diseases of the Eye. A Hand-book of Ophthalmic Practice for Students and Practitioners. By G. E. de Schweinitz, A. M., M. D., Professor of Ophthalmology in Jefferson Medical College, etc. With 256 illustrations and 2 chromo-lithographic plates. Second edition, thoroughly revised. (*Philadelphia: W. B. Saunders*, 1896.)

This admirable text-book of ophthalmology is so well and so favorably known, and so short a time has elapsed since the appearance of the first edition (1892), that an extended notice seems scarcely called for at this time. In the preface to the present edition the author states that the entire book has been thoroughly revised, and that in addition to this general revision, new paragraphs have been added upon Filamentous Keratitis, Blood-staining of the Cornea, Essential Phthisis Bulbi, Foreign Bodies in the Lens, Circinate Retinitis, Symmetrical Changes at the Macula Lutea in Infancy, Hyaline Bodies (Drusen) in the Papilla, Monocular Diplopia, Subconjunctival Injection of Germicides, Infiltration-Anæsthesia, and Sterilization of Collyria.

For the bibliography of the first edition an appendix containing a description of the method of using the ophthalmometer of Javal & Schiötz and the tropometer of Stevens has been substituted. The

chapter on operations has been enlarged and rewritten, and those on General Optical Principles and on Abnormal Refraction, which were contributed to the first edition by Dr. James Wallace, have been revised by Dr. Edward Jackson, who has also recast the section written by himself upon Retinoscopy.

Dr. Jackson's revision of these chapters has evidently been carefully done, and we note a number of instances, as, for example, in the definition of emmetropia and of ametropia (p. 140), and in the description of the refraction of light by an astigmatic eye (p. 163), in which it has resulted in the elimination of errors, some of which had previously arrested our attention in the perusal of the first edition. It is perhaps not to be wondered at that he has not, in every instance, succeeded in noting and correcting these faults. The description of the "seat of astigmatism" on p. 161, which, in the new edition as in the old, seems to warrant the inference that lenticular astigmatism is due always to an *oblique position* of the lens, it would appear, might easily have been improved upon. So, too, as to the description given of the well-known illustration (p. 163) of the refraction of a pencil of light in regular astigmatism. It is certainly not correct to speak of the different sections of the pencil there shown, as representing the "retinal images of a point" in compound hypermetropic astigmatism, simple hypermetropic astigmatism, mixed astigmatism, etc., unless absence of accommodative power in the eye be presupposed.

The author tells us in his preface that the book has been enriched with forty additional illustrations, but he does not tell us how much more effective many of the illustrations have been made by the substitution of well-executed photo-engravings for the woodcuts of the first edition. The illustrations of congenital ptosis and of epicanthus and congenital ptosis on p. 200, and of rodent ulcer of the orbit (p. 203), are striking examples of the effectiveness of this method of representation. Having said this much in praise of the illustrations, perhaps we shall be pardoned for finding fault with the legend descriptive of Fig. 90, on p. 254—"lipomatous dermoid of the conjunctiva."

The publisher has performed his part of the work in a manner worthy of especial commendation. S. T.

A Manual of Obstetrics. By W. A. NEWMAN DORLAND, A. M., M. D. With 163 illustrations in the text and 6 full-page plates. (*Philadelphia: W. B. Saunders*, 1896.)

This well-printed and fully illustrated volume seems a happy mean between the more ambitious and encyclopedic works upon obstetrics and the quiz-compends, and is clearly and systematically arranged for the use of students. Although lacking the details and references of larger works, it is clearly and carefully written and will be a safe guide. There is really little to criticise.

The directions given for the disinfection of the accoucheur and of the patient are admirable and explicit. The recommendation to use a creolin douche after the expulsion of the placenta, as a matter of routine, cannot be endorsed, because it would do harm rather than good in the majority of cases. Vaginal douches should not be given after the second stage of labor, unless they are clearly and definitely indicated. The employment of a pad above the fundus uteri and the use of an abdominal binder tightened daily for six weeks or three months are recommendations which do not seem free from danger.

Water and Water Supplies. By JOHN C. THRUSH, Medical Officer of Health to the Essex Co. Council, etc. (*London: The Rebman Publishing Co., L't'd. Philadelphia: W. B. Saunders*, 1896.)

This excellent little book can be commended unreservedly as probably the best short treatise on Water and Water Supplies in the English language. The information contained in it is concise and the whole book is thoroughly modern. It is gratifying to observe that the author shares the opinion of Koch that the best of all water supplies for a city is that obtained from deep wells. The sources of water pollution are clearly described and well illustrated. We are pleased to see that careful directions are given for the filtration of water, and the dangers which lurk in improper filtration are distinctly stated. If the book could be in the hands of every householder, the preventable causes of water-borne disease would unquestionably be much better understood. The book is well printed and sensibly illustrated, and deserves a large sale.

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Transactions of the Association of American Physicians. Eleventh Session held at Washington, D. C., April 30 and May 1 and 2, 1896. Vol. XI. 8vo. 1896. 453 pages. Printed for the Association. Philadelphia.

Transactions of the Medical Society of the State of Pennsylvania. Forty-sixth Annual Session, held at Harrisburg, 1896. Vol. XXVII. 8vo, 499 pages. Published by the Society. The Edwards & Docker Co., printers, Philadelphia.

An American Text-Book of Applied Therapeutics. For the use of practitioners and students. Edited by J. C. Wilson, M. D., assisted by Augustus A. Eshner, M. D. 1896. 4to, 1326 pages. W. B. Saunders, Philadelphia.

An American Text-book of Physiology. Edited by William H. Howell, Ph. D., M. D. 1896. 4to, 1052 pages. W. B. Saunders, Philadelphia.

A Text-book of Histology, Descriptive and Practical. For the use of students. By Arthur Clarkson, M. B., C. M. Edin. 1896. 8vo, 554 pages. W. B. Saunders, Philadelphia.

Diseases of the Eye. A hand-book of ophthalmic practice for students and practitioners. By G. E. de Schweinitz, A. M., M. D. Second edition, thoroughly revised. 1896. 8vo, 679 pages. W. B. Saunders, Philadelphia.

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A Text-Book of Materia Medica, Therapeutics and Pharmacology. By George Frank Butler, Ph. G., M. D. 1896. 8vo, 858 pages. W. B. Saunders, Philadelphia.

Twentieth Century Practice. An international encyclopedia of modern medical science by leading authorities of Europe and America. Edited by Thomas L. Stedman, M. D. Vol. VII. Diseases of the respiratory organs and blood, and functional sexual disorders. 1896. 8vo, 796 pages. William Wood & Co., New York.

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Index-Catalogue of the Library of the Surgeon-General's Office, U. S. A. Authors and subjects. Second series. Vol. I. A–Azzurri. 1896. 4to, 828 pages. Government Printing Office. Washington.

Transactions of the Texas State Medical Association. 28th annual session held at Fort Worth, Texas, April 28th–30th and May 1st, 1896. 8vo, 458 pages. Eugene von Boeckmann, printer, Austin, Texas.

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Twenty-seventh Annual Report of the State Board of Health of Massachusetts, 1895. 8vo, 807 pages. Wright & Potter Printing Co., Boston. 1896.

Essentials of Physical Diagnosis of the Thorax. By Arthur M. Corwin, A. M., M. D. 2d ed. 1896. 12mo, 199 pages. W. B. Saunders, Philadelphia.

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PUBLICATIONS OF THE JOHNS HOPKINS HOSPITAL

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Report in Pathology.

The Vessels and Walls of the Dog's Stomach; A Study of the Intestinal Contraction; Healing of Intestinal Sutures; Reversal of the Intestine; The Contraction of the Vena Portae and its Influence upon the Circulation. By F. P. MALL, M. D.

A Contribution to the Pathology of the Gelatinous Type of Cerebellar Sclerosis (Atrophy). By HENRY J. BERKLEY, M. D.

Reticulated Tissue and its Relation to the Connective Tissue Fibrils. By F. P. MALL, M. D.

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Two Cases of Protozoan (Coccidioidal) Infection of the Skin and other Organs. By T. C. GILCHRIST, M. D., and EMMET RIXFORD, M. D.

A Case of Blastomycetic Dermatitis in Man; Comparisons of the Two Varieties of Protozoa, and the Blastomyces found in the preceding Cases, with the so-called Parasites found in Various Lesions of the Skin, etc.; Two Cases of Molluscum Fibrosum; The Pathology of a Case of Dermatitis Herpetiformis (Duhring). By T. C. GILCHRIST, M. D.

Report in Pathology.

An Experimental Study of the Thyroid Gland of Dogs, with especial consideration of Hypertrophy of this Gland. By W. S. HALSTED, M. D.

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Report in Medicine.

On Fever of Hepatic Origin, particularly the Intermittent Pyrexia associated with Gallstones. By WILLIAM OSLER, M. D.

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Report in Gynecology.

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BULLETIN

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A CASE OF DERMATITIS DUE TO THE x RAYS.

By T. C. Gilchrist, M. R. C. S., L. S. A., *Associate in Dermatology, Johns Hopkins University and Hospital.*

Since the discovery of the x rays by Röntgen, thousands of observations and experiments have been made with them both in Europe and in this country, and hundreds of investigators have exposed various portions of the body, particularly the hands, frequently, and for long periods of time, yet, after searching the literature, records of only twenty-three cases (including the present one) have been given where injurious results have followed their use, and in these, lesions of the skin only have been described. Of these twenty-three cases, twelve occurred in this country, one in Canada, four in England and six in Germany.

The first report which I have been able to find was a communication in the *Deutsche Medicinische Wochenschrift*, No. 28, 1896 (July 9th), from O. Leppin, an engineer, who had used his left hand a great deal in experimenting with the x rays. He remarked that the rays had the power of producing cutaneous lesions like sunburn. The hand presented a peculiar redness, was swollen, and a vesicular eruption appeared later on the middle and ring fingers. Where the skin was hidden by a ring it was white and quite normal. Even five weeks after discontinuing the use of the rays the altered skin gave the hand an older look than the normal one.

Professor Daniel, of Vanderbilt University, reported a case of alopecia as the result of exposure to the x rays three months previous to Leppin's communication.

After examining the other reports (the references are given at the end of the article) it was found that the eruptions of the skin presented many points of similarity, and differed chiefly in severity, according to either the length of time and frequency of exposure to the rays or to idiosyncrasy of the patient.

In Dr. Sehrwald's case, which was described fully, the lesion occurred after one exposure of forty-five minutes to the x rays, and Dr. Crocker's patient had also experienced only one exposure of one hour when an eruption appeared. In Dr. Kolle's case, the patient, a boy, was exposed once, for forty minutes, when a pronounced alopecia followed, and a similar result is recorded by Professor Daniel in a man after one sitting; but the most interesting case of all was Professor Thomson's, of Harvard, who, being skeptical as to the deleterious results of the rays, made the only experiment which has so far been recorded, by exposing his finger to the x rays for half an hour and at one and a quarter inches from the tube, with a definite purpose of producing lesions if possible. The cutaneous trouble followed in nine days after the exposure. In two cases the patients had two sittings; in Dr. Dunn's case the first exposure was one hour, and the second, seven days later, lasted one hour and a half; and in Dr. White's case the patient had two exposures of thirty and forty-five minutes each on successive days.

In Drs. Stern's and Richardson's cases the lesions appeared after three sittings, and Dr. Skinner experienced cutaneous lesions after three or four exposures of short duration. In eleven cases the results had only followed after prolonged and constant use, the duration varying.

I append a table of the cases which I have been able to find in the literature.

Recorder.	Duration.	Distribution.	Character of the Lesions.	Subjective Symptoms.	Remarks.
O. Leppin (personal experience)..	Used very frequently for many days.	Left hand and fingers.	Peculiar redness, swollen, vesicles on middle and ring fingers.	No mention.	After five weeks hand still looks "older" than the other.
Dr. Marcuse.....	Young man, 17, exposed 5-10 minutes once or twice a day for four weeks.	Left half of face, back and chest.	Brownish redness on face, followed by desquamation; later, patch of alopecia above right ear; on back, large raw patch, exposing the corium with hemorrhagic points and exudation and a number of bullæ; on chest slighter changes.	No pain in face; on back much tenderness, but no pain was felt until just previous to the eruption.	Three months later, hair returning on the bald spot. Chest and back healed, but numerous fine cicatricial lines on the back and brown pigmentation.
Dr. Feilchenfeld	exhibited a somewhat similar case (no details given) to the Berlin Medical Society.				
Dr. Conrad.	A photographer had used the x rays very frequently and for some time.	1st and 2d fingers, left hand.	Swelling and stiffness of the joints; 1st and 2d fingers swollen and of a livid brown color on the dorsal surface from the tips to the carpo-metacarpal joints. Sense of touch greatly diminished. Mustache falling out and color was changed.	Fingers extremely sensitive and pain was of a burning and scalding character.	No mention.
Dr. Paul Fuchs (personal experience).	After prolonged use of the x rays.	Left hand and fingers.	Much swollen; skin was wrinkled, cracked and stained quite brown; condition of skin like a frozen hand; later, on further exposure, a vesicular eruption appeared.	None given.	
Dr. Sehrwald.	In a boy 13 years old. Only one exposure of 45 minutes duration. Two weeks later eruption appeared.	Abdomen.	At first hyperæmia, then a vesicular eruption. Four weeks later central portion healed, but peripheral portion covered whole abdomen. Brown color. Exfoliation soon followed.	Itching when the vesicles appeared.	Cured in 9 or 10 weeks.
S. J. R. (personal experience).	Used the rays several hours daily and eruption appeared three weeks after.	Right hand and fingers. Later left hand.	Numerous dark little blisters appeared on right fingers; then marked redness and inflammation of the skin, which later became hard, very dry and yellow like parchment. Exfoliation followed. On further exposure tips of fingers became much swollen and nails affected. A colorless, bad smelling discharge came from beneath the nails, which were gradually thrown off. Left hand was substituted and similar symptoms followed.	After inflammation hand smarted very much. Skin became insensible to the touch. After second exposure serious discomfort and pain followed.	Results similar to those of sunburn but much more acute.
Dr. H. C. Dunn.	Man aged 35 years. Exposed first for one hour and afterwards for an hour and a half, the second with interval of seven days. Two days later eruption appeared.	Abdomen.	Three hours after first exposure some nausea. After second exposure, nausea, and on second day abdomen slightly red, like sunburn; redness increased in intensity until fourth day, vesicles appeared, which developed into bullæ. Eighteen days later the patch was 7½x8¼ inches between umbilicus and chest, and was smooth, glazed and weeping for some days, notwithstanding treatment.	No subjective symptoms; neither itching nor pain; the raw surface painless and almost insensitive.	Eruption healed after 28 days, but skin was like boiled fish skin. After cauterization of surface a slough separated and a tough yellow opaque membrane formed.
Dr. G. C. Skinner (personal experience).	Exposed the wrist 10–15 minutes for 3 or 4 days in succession. Ten days later eruption followed.	Wrist.	Reddening of the skin appeared first; this increased until it was almost purple; considerable swelling followed. Desquamation followed.	Great pain and excessive tenderness.	Process of repair was very slow.
J. Macintyre (personal experience).	Worked for months with the x rays before cutaneous lesions were produced.	Hand.	Appearance of a sunburn. Skin red and swollen, followed by exfoliation of the "epidermis" and loss of hair.		Author thinks condition due to heat and electricity; the latter the chief cause of injury to the tissues.
Dr. Freund.	10 days, child who had hypertrichosis.	Neck, back, upper arm and scalp.	x rays used as a depilatory for 10 days, when the hair began to fall out.	None given.	

Recorder.	Duration.	Distribution.	Character of Lesions.	Subjective Symptoms.	Remarks.
Dr. E. E. King.	Patient used the x rays for two and a half months from two to six hours daily before cutaneous lesion appeared.	Hand, left.	Hand felt stiff, then became swollen and large "blisters" formed; after five weeks rest he exposed the hand again 7–8 hours daily. In two weeks left hand became swollen, tender, discolored; vesicles followed, and the finger-nails began to fall off. The hairs disappeared. Left side of the face was also affected. The skin was swollen and erythematous, and the hair over the temple disappeared. Eyebrows were almost gone and left side of the mustache had almost disappeared.	Great pain followed the appearance of the blisters. Second eruption followed by aching. Face became tender and painful.	The case has been carefully and continuously watched.
Dr. M. J. Stern.	Patient was exposed at three sittings of 40–50 minutes duration. Eruption appeared two days afterward.	Extended from the side of the face down to the umbilicus.	Erythematous blush first appeared, which a few days later appeared like a severe burn, followed by a large slough.		Examination of the chest after a gun-shot wound.
Dr. F. Kolle.	A boy 12 years old. Whole body exposed 40 minutes. Sixteen days later alopecia appeared.	Right side of head.	Large area of alopecia over the region exposed to the rays. Hair fell out all at once the night previous. Skin slightly œdematous.	No symptoms.	Later, lanugo hairs began to appear.
Dr. J. C. White.	Young lady exposed to the rays 30 minutes on one day and 45 minutes on the next day. Eruption appeared the following day.	Sternal region.	Skin was first reddened, then blistered. Three months later the patch showed angry-looking granulations which had refused to heal.	Granulation surface very sensitive and the seat of severe neuralgic pain.	At the time of writing there were still two open spots.
Prof. E. Thomson.	Exposed half an hour at a distance of one and one-half inches from the tube. Eruption appeared nine days after.	Little finger of left hand.	Finger became hypersensitive, then dark red, swollen, stiff, and soon after vesiculation occurred. Pus formed and the epidermis became detached, but pustules remained over 3 weeks.	Pain.	
Dr. H. R. Crocker.	Boy aged 16. One exposure of one hour. Eruption appeared next day.	Epigastrium.	A Crookes tube placed five inches distant—flanelette shirt intervened. Next day, skin deep red in color. Nine days later vesicles appeared. Palm-sized patch, well-defined, purplish red. Vesicles increased in number; 9 days later the epidermis had separated. Healing very slow. Alopecia very slight.	Stiffness felt at first and soreness when the vesicles appeared.	
Prof. John Daniel.	Man; exposure 1 hour. Alopecia 21 days later.	One side of scalp.	Tube was 1½ inches distant from head. Bald spot was 2 inches in diameter; skin healthy.	None.	
Dr. M. H. Richardson.	Woman. Exposed three times to the rays, 20, 30 and 35 minutes. Eruption appeared two days later.	Abdominal region, particularly over liver area.	Bulb was 18 inches distant. First appearance was that of sunburn, gradually became brown, and ulcer, 8 inches in diameter, formed; slough thrown off; very slow in healing.	Pain accompanied the first appearance of the lesion.	Four months later, even after curetting, granulating surface 4 inches in diameter still remained.
Dr. W. E. Parker.	Man. Exposed five times, from 20 minutes to 80 minutes.	Jaw and neck.	After two exposures face and neck became swollen and red. The later sittings were also followed by eruption.		16 days afterwards skin discolored and exfoliated.
University of Minnesota.	Man whose ear was exmined for several hours.	Ear and surrounding scalp.	The parts presented later a frozen appearance. All the hair from this side of scalp was lost.	No pain or sensation at the time.	
Dr. Banister, U. S. Army.	Man. Numerous exposures.	Abdomen, chest and beard.	At first a patch, red, inflamed, hyperæsthetic, about half the size of a man's hand. The lesion increased in size until a denuded surface 8x15 inches was formed. Exudation profuse and uncontrollable. Beard turned white in places and growth stopped.	Raw surface, very painful and hyperæsthetic. Pain agonizing even six weeks after.	Patient confined to bed for one month, and will probably be in bed another month.
Dr. T. C. Gilchrist.	x ray operator. Eruption began after frequent and continued exposures.	Right hand, wrist, and lower portion of forearm dorsal surface.	Hyperæmia and swelling of back of hand; afterwards inflammation of fingers and hand. Skin became dark brown in color and gradually exfoliated.	No pain at first, but afterwards severe aching and shooting pains, which lasted about 2 weeks.*	

* February 5, 1897, patient writes, "My hand is much about the same. I cannot use those (first) three fingers much better; and my nails are coming off, that is, the old nail is like a shingle on top of the new one."

As far as the cutaneous lesions were concerned, the skin of the trunk appeared to suffer the most severely, although when the hand was attacked the pain was the most prominent feature.

As to the character of the lesions produced, the majority of observers describe a peculiar redness or erythema at first, then swelling of the derma, followed by a deep discoloration of the skin until it became quite a dark brown color. Exfoliation of the pigmented skin followed later. In a number of cases vesiculation occurred after the hyperæmia, and quite a serious eruption resulted in two cases after only two exposures. The most severe effects followed after exposing the same region again to the rays when the lesion had only partially or wholly healed.

The cases of Dr. Dunn, Dr. Banister and S. J. R. showed perhaps the most severe results. Other lesions produced were alopecia, loss of the finger-nails, and obstinate ulceration. In connection with the subjective symptoms, severe pain and aching were present in the majority of the cases, especially with the eruptions on the hands. The lesions on the abdomen and back were, rather curiously enough, unaccompanied by pain.

Many theories have been advanced to explain the injurious lesions produced by the *x* rays. Some have supposed them to be entirely due to frequent and long exposures; but that is not tenable, because in five cases (Dr. Sehrwald's, Dr. Kolle's, Dr. Crocker's, Professor Daniel's and Professor Thomson's) marked results followed a single exposure, and in two cases two sittings only preceded the eruptive phenomena, and finally three other cases experienced deleterious results after only three exposures. Others again have compared all the phenomena to severe sunburn, but it can be demonstrated that more severe results have followed the use of the rays than have ever been known from exposure to the sun. Tesla believes that the hurtful action of the *x* rays is not due to the rays but to the ozone generated in contact with the skin. Ozone, he says, when abundantly produced, attacks the cutaneous surface, its action being no doubt heightened by the heat and moisture of the skin. In his discussion of the rays themselves he speaks of the disintegration of the electrodes, especially if they are of aluminum, but this is so slow that no appreciable diminution of the weight results, even after long use; it follows, he says, that the matter conveyed by the Röntgen stream is so minute as to escape detection. Some bulbs which he has used for a number of months showed that the bombarded spot of the glass was entirely permeated with particles of the aluminum electrode, but it would probably require years of constant use to accumulate any appreciable amount of matter outside. He further remarks "that no experimenter need be deterred from carrying on an investigation of the rays for fear of poisonous or generally deleterious action, for it seems reasonable to conclude that it would take centuries to accumulate enough of such matter to interfere seriously with the process of life of a person." His last remark is certainly incorrect. His ozone theory is also incorrect, as I shall show later.

Professor Thomson, with the definite idea of producing cutaneous lesions, exposed his finger to a bulb of low potential and used a small 24-plate static machine. "The rays came from a bombarded spot, and were limited to the area which the Röntgen rays could reach. The tube was of blue glass, with a clear German glass window from 1½ to 1¾ inches in diameter opposite the bombarded spot." One striking feature was the fact that the fingers opposite the blue glass were not affected, as this was so dense as to absorb the rays. Only where the little finger was opposite the clear glass was it affected with a sharp line of demarcation. He says the blue glass would have been transparent to the ultra-violet rays. He also thinks that brush discharges have nothing to do with the cutaneous phenomena. His theory is that the deleterious effects are due to the *x* rays themselves or something that goes with them.

The case which I will now report presents a sufficient number of interesting points to make it worthy of record.

The patient is a healthy-looking man, 32 years of age, who came to me November 18, 1896, with the following history: During the first week in September he exposed his right hand, wrist and lower portion of the forearm to the *x* rays while exhibiting an apparatus, each exposure lasting two or three minutes. No bad results followed, but on October 1st he came to Baltimore and resumed the use of the *x* rays for the same purposes. After he had exposed his hand for three weeks for four hours daily he noticed that the skin of the back of the hand, wrist and forearm began to turn very red and became "puffed up," although he suffered no pain. The swelling first occurred on the back of the hand from the knuckles to the wrist, then "inflammation set in" and he was compelled to stop his demonstrations. From about October 21st the hand, wrist and lower fourth of the forearm gradually became more inflamed and swollen, and the lesions spread to the fingers. The affected area ached and throbbed so much that he frequently could not sleep at night; there were also shooting pains which gradually increased in intensity and extended up the forearm along the ulnar side. These symptoms continued for a week when the patient consulted Professor Chambers, of Baltimore, who advised him to bathe the hand frequently in hot water and ordered bromides internally with benefit. The symptoms were much relieved and the swelling had gone down considerably in two weeks time. Three weeks after he had first sought medical advice he consulted me about the diseased condition of the skin.

Condition at the time of the first examination. The right hand on its dorsal surface presented a deeply pigmented condition. The skin over the dorsal surface of the fingers, hand and wrist was of a very dark brown color, and part of it was already exfoliating. The skin was dry, infiltrated and wrinkled. The patient says the skin was more of a greenish hue at the end of the first week after it became affected. In places near the lateral margins of the hand a slightly vesicular appearance was presented. They were not true vesicles, but were due to the loosening of the surface of the epidermis, and contained only air. The pigmented skin could very easily be peeled off from the hand without any pain, leaving a dull, dry, reddish surface beneath.

On comparing the two hands they were found to be practically of the same temperature. The fingers of both were of about the same calibre. A photograph, which is represented here (Fig. 1), was taken of the hand the first time I saw him,

and it shows very well the exfoliation of the epidermis. It also represents the position of the hand which was most restful and least painful to the patient. The palmar surface was dry and paler than that of the normal hand, but the palmar surface of the fingers appeared swollen.

I saw the patient ten days later, and the exfoliating epidermis had all been removed; the skin now presented a glossy appearance, and over the fingers it appeared to be tighter than on the corresponding fingers of the healthy hand. The palmar surface was still a little drier.

On careful examination the patient complained of rather severe pain when the first phalanx of his right index finger was grasped, and it was then noticed that this bone was distinctly thickened, especially as compared with the corresponding phalanx of the other hand. The first and second phalanges of all the fingers were found to be thickened, but the increase in size was most marked in the first phalanges of the index and second fingers. Further careful examination of the other bones of the hand revealed a very painful spot over the wrist joint. The metacarpals were also tender on pressure, and the head of the second metacarpal was enlarged. The hairs were found to be less numerous on the affected hand, but they may have been removed in tearing off the exfoliating epidermis.

Movements of the hands. All movements were found to be quite difficult of accomplishment and very painful. When the patient first consulted me, voluntary movements of both fingers and hand were abolished, except of the little finger, which could be slightly flexed. Wrist movements were also very limited in extent and caused much pain. The thumb and fingers could scarcely be apposed. The patient could not pick up a lead pencil or penholder, and could grasp with but slight force; if he could get his finger or thumb beneath an object he could pick it up. He complained of the joints being very stiff.

Sensation was very much impaired before exfoliation occurred, and even after that it was much diminished as compared with the normal hand. The sense of touch on the palmar surface was also markedly decreased.

When the distinct thickening of the phalanges was detected I requested him to obtain careful *x* ray photographs of both hands under similar conditions at the same distance from the bulb. The accompanying photographs show the bones of the two hands clearly, and I am particularly indebted to Professor W. C. A. Hammel, of Baltimore, for such excellent pictures.

The hands were placed exactly twelve and a half inches from the *x* ray tube, the distance being carefully measured from a plane passing through the long diameter of the tube to the fixed support on which the hand rested. The time of exposure was exactly three minutes for each hand.

It will at once be noticed from the photographs how much thicker all the first phalanges of the right hand (Fig. 3) are than those of the left normal hand (Fig. 2). The increase in size is particularly marked in the first phalanges of the index and second finger; that of the little finger is less marked The second row of phalanges is also thicker than normal, but less thick than those of the first row. The heads of the second and third metacarpal bones are enlarged, and their shafts are also slightly thickened. It cannot be said, from the photographs alone, that any of the carpal bones of the affected hand were at all increased in size.

A number of other points were discovered from these photographs. The spaces between the bones at the joints, particularly at the metacarpo-phalangeal and the interphalangeal joints, were much less marked and narrower than in those of the normal hand. The outline of the affected bones was also more irregular and rougher than that of the left hand. On looking at the hand as a whole, it is also, I think, noticed that all the bones are denser in appearance in the affected hand.*

Two portions of skin were excised for histological purposes on the first day. One portion was taken from dorsal surface of the phalangeal region of the third finger, and the other from the lateral margin of the hand over the base of the metacarpal of the little finger. Neither stained nor unstained sections demonstrated the presence of any foreign particles, and only showed chronic inflammatory changes. The horny layer was thickened and half of it was partially detached. A large number of brown pigment granules were found in the exfoliating portion. The mucous layer was not thickened, but it was more pigmented than normal. In the corium the vessels were dilated, and the pigment cells of the papillæ were almost as numerous as are usually found in a section of negro skin. It was suggested that particles of platinum might have passed from the tube through the glass bulb deep into the tissues.

Portions of the exfoliating skin were accordingly submitted to Professor Abel for chemical analysis, and he has very kindly furnished me with the following brief report: "I could find no platinum in the pieces of epidermis that you left with me for analysis. These pieces weighed, just as you sent them, 640 milligrams, or about ten grains."

Summary. In reviewing this case, there is here an example of a disease of the skin which was brought about by frequent and prolonged exposure to the *x* rays. The lesions, as I have already described, were first those of hyperæmia, then œdema, without the accompaniment of pain. Subjective symptoms were felt later, and continued to increase in severity (he was still using his hand for exhibition purposes) until, on account of the severe pain, he was compelled to stop his work. These subjective symptoms consisted of aching, throbbing and shooting pains. The color of the skin gradually changed to a deep brown, and the epidermis began to exfoliate. The bones of the hand were very tender on pressure, particularly the first phalanges of the index and second finger and the carpal bones. The movements of the hand became so limited that it was practically useless for some weeks. Sensation was also much impaired, but after exfoliation occurred it recovered again, but only gradually. Recovery of all the lesions has been very gradual indeed.

The photographs have revealed what has never been observed before, viz. a distinct osteoplastic periostitis, and probably an osteitis, particularly of the first and second rows of phalanges of the index and second fingers, also of the heads of meta-

*As an interesting point the photographs show the outlines even of the finger-nails and the interossei muscles.

carpal bones of the same fingers, and judging from the symptoms, even of some of the carpal bones.

This then accounts for the severe symptoms, the aching, throbbing and shooting pain which prevented sleep. The density of these bones has also been increased, showing that even bone tissue has been affected.

A complete demonstration is thus afforded of the powerful, piercing character of the *x* rays, and the severe, painful symptoms which have been described by other observers are probably due to the inflammation of the periosteum, and possibly the bone, besides the softer tissues.

This inflammation has also extended into the joints, which would explain the loss of movements, and pain, when they could be used later.

As the result of these observations, it proves that the *x* rays are even more powerful than have been generally thought, that the deleterious effects can in some cases be quite serious, and that the cutaneous manifestations are not the most severe of the lesions, but those of the deeper tissues, and particularly of periosteum and bones, being more severe.

The discovery of this deeper and more profound effect at once overthrows many of the explanations which have been advanced to account for the cutaneous lesions. Tesla's theory of the ozone generated in contact with the skin will not explain these deeper effects. Prof. Thomson has demonstrated that they are not due to the ultra-violet rays. They cannot be compared to sunburn, since no case, as far as is at present known, has been published where sunburn has produced periostitis and even osteitis. Nor can such serious results be produced by brush discharges, and Thomson has also proved that these cannot be the causes. His further explanation that the effects (he was not aware of the deeper injuries to the soft tissues and bone) are due to the *x* rays themselves or something which accompanies them, is rather indefinite. It was suggested to me, as I have already mentioned, that it might be due to the platinum particles piercing the bulb and then attacking the tissues, but this almost appears impossible, since serious cutaneous effects have even followed only one exposure of half an hour (*vide* Thomson's case).

I consulted with Professor Ames, Associate Professor of Physics in the Johns Hopkins University, who, after reviewing all the facts of the case, kindly wrote as follows concerning the present theory of the *x* rays:

"The radiation in an '*x* ray tube' may be divided provisionally into three classes: ether-waves, which may have wave-lengths from 150 to 800 $\mu\mu$, approximately; kathode rays, which undoubtedly are streams of matter, electrically charged; *x* rays, about whose nature there is no conclusive evidence at the present time. If the walls of the tube are thin enough and of suitable material, all these radiations will emerge and pass into the surrounding air. It is a matter of doubt if the kathode rays observed outside the vacuum-tube are the same as those inside; but the inner ones undoubtedly cause the outer ones. There is no evidence that *x* rays carry with them particles of matter, or that they directly cause a stream of particles; in fact, all known facts seem to point to the belief that they are ether-waves of extreme shortness."

It will thus be seen that the opinion expressed here does not make it possible for the *x* rays themselves to produce such deleterious effects as have already been described, but Dr. Ames mentions the fact that the kathode rays are undoubtedly streams of matter electrically charged. Here then we have some possible grounds for the theory that the lesions may be due to the entrance of particles (platinum in our case) into the injured tissues, and that the kathode rays which accompany the *x* rays may be the cause of the trouble, and not the *x* rays themselves.

On clinical grounds there is considerable support for this, at first sight, improbable theory. If the lesion extends at all deeply, it leads to the formation of ulcers, which are extremely intractable, and they may be due to irritating particles still present in the tissues.

I do not think that the possibility of injury ought to deter one from using these wonderful rays in surgical work, because only a few have been affected out of thousands who have been exposed to them. By keeping, as Thomson says, some distance away from the rays, injurious effects will hardly follow their use, and when the exposure is for a short time, unless, as may happen in all other diseases, idiosyncrasy plays a prominent part.

When I viewed my own hand two or three times near a new Edison bulb, through a tungstate of calcium screen, after four or five minutes I distinctly felt a tingling sensation throughout the dorsum of the hand; this symptom lasted for ten or fifteen minutes and passed away without any further results. It occurred to me that *x* ray operators and experimenters should expose to the rays the palmar surface of the hand, which is protected by a much thicker horny layer, rather than the back of the hand, which is much less protected.

In conclusion I would strongly advise all *x* ray operators and experimenters who develop any special idiosyncrasy, to abstain from their use if they find that the slightest deleterious results follow an exposure to them.

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FIG. 1.

Case of *x* ray dermatitis. Photograph showing exfoliation of the epidermis.

FIG. 2.

x ray photograph of left hand (normal).

FIG. 3.

x ray photograph of the right hand showing thickening of some of the bones.

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LESIONS INDUCED BY THE ACTION OF CERTAIN POISONS ON THE NERVE CELL.

Study VI.—DIPHTHERIA.

By Henry J. Berkley, M. D.

During the course of this investigation, an article by Ceni* on the same subject came into my hands, and the results determined by both investigations are so entirely similar that it seems hardly necessary to repeat in full the details of the study.

Ceni's work was done on rabbits and horses, with an acute and a chronic series. The first, after the inoculations with diphtheria cultures, lived from three to four days, and showed, in exquisite form, the beginning of the moniliform swellings of the dendrites of the cortical and hippocampal cells common to the action of all the toxins of the infectious series. The chronic series lived from 36 to 41 days after the inoculation with the toxin, during which period they lost full half their weight. Ceni also utilized the cerebra of horses which had been used in the Milan Bacteriological Laboratory to produce diphtheria serum. In these, after three or four months of the treatment, he found the cortical cells far degenerated, and to a degree not seen with the rabbits, the stouter dendrites and corpora of the cells being extensively involved in the destructive process.

Interesting to note, he also finds distinct lesions of the vascular neuroglia, principally tumefaction of the bodies and branches, the one attached to the blood-vessels' walls showing the alterations most distinctly, all being identical with those described and recorded in the III. study of this series (Art. Ricin Poisoning).

Our present series consisted of five diphtheria guinea-pigs, whose brains had been sent me by Dr. Flexner for the purposes of the study. The first two brains, after hardening and examination of the sections, were rejected on account of the possible presence of post-mortem changes. The other three cerebra were carefully hardened in Müller's fluid and treated afterwards by the silver phospho-molybdate formula.

Guinea-pig No. 3 received an injection of the toxin at 2.30 P. M. and died about 3 A. M. the following morning. No. 4 was inoculated at 2 P. M., was re-inoculated two days later at 10.30 A. M., and died two days afterwards at noon. No. 5 went through the same course of treatment as No. 4 and died approximately at the same hour.

The local manifestations at the site of the inoculation were experimental membranes, œdema, and slight central necrosis. The lymph glands throughout the body were enlarged, there were small hemorrhages in the mucous membranes, and ecchymoses and necroses of the abdominal organs, with considerable fluid in both the thoracic and abdominal cavities.

With Case 3 the dendrites only show beginning changes. There are numerous small moniliform swellings scattered over their branches, not focally but uniformly throughout the cortex, and over the sites of these tumefactions the gemmules are either lost or are very sparingly present, while on those that have normal dendrites they are undiminished in numbers. On the stretch of dendrite between the swellings, which either appears normal or slightly below the natural calibre, the lateral buds are beginning to disappear, as shown by the paucity of their numbers and lessened tendency to assume a deep black tint. The bodies of the cells do not appear to be in any way changed in staining properties, or to have lost in any degree the angularity of their contours.

The vascular neuroglia cells are uniformly stained throughout the outer layers of the cortex, and have their tentacles, particularly the vascular foot, somewhat swollen, the degree being considerably less than in some specimens we have noted after the injection of other toxins. The axis-cylinders are distinct, and show no alterations. The terminal apparatus of the cortical fibres were so infrequently stained that it is hardly possible to determine with certainty whether they were pathologically altered or no, but those found appeared to be normal.

The larger vessels showed neither thickenings nor ruptures of their coats.

With cases Nos. 4 and 5 the pathological alteration is similar to that in No. 3, only increased in intensity, from the longer duration of the poisoning, and, perhaps, also from the repetition of the inoculations. The moniliform nodules are well marked over long stretches of cells in the pyramidal region of the sections, and are uniformly larger than in the more acute case. Also the denudation of the gemmules is

* Carlo Ceni: Riforma Medica, vol. I, 1896.

marked by the greater absence of these pin-like projections from the dendrites.

Some of the psychical cells are beginning to show alterations of their outlines, appearing now rounded in contrast to the third case.

The vascular neuroglia also shows signs of more advanced swelling, the tentacles being thicker and the pseudopodia more prominent.

The axôns and collaterals are well stained, but show no unusual varicosity or other departure from the normal. A few of the cells having upturned axôns are well stained, but the morbid changes are of less intensity than with the pyramidal variety.

The cerebellar cells, as in the previous studies, showed less damage than those of the cerebrum. The Purkinje variety was the only one recognisably involved. The peculiar axôns of the basket cells were natural, and the various nerve fibres throughout the outer lamina of the cortex retained their histological appearance.

From the studies conducted on the cerebra of hydrophobic and diphtheritic guinea-pigs it would appear that all severe infections were followed by brain-cell degeneration of an order not dissimilar to that found in the cells of the abdominal viscera under similar conditions, a degenerative process unaccompanied by inflammatory reaction and a tendency to atrophy and necrosis.

PUERPERAL SEPSIS DUE TO INFECTION WITH THE BACILLUS AEROGENES CAPSULATUS.

By George W. Dobbin, M. D., *Resident Obstetrician, The Johns Hopkins Hospital.*

The following case, which occurred in the Out-patient Obstetrical Department of the Johns Hopkins Hospital, is interesting from the fact that we have been able to find reports of only a few similar cases in the literature.

We were called to see the patient, Paulina A., about eleven o'clock on the evening of March second, the messenger saying that she had been in labor about two days and the midwife was unable to deliver the child.

As the patient and midwife were Polish it was exceedingly difficult to obtain an accurate subjective history of the case, but after considerable difficulty it was found that she had had an abdominal operation done a year ago in Germany, the nature of which we were unable to ascertain. She was at the end of her third pregnancy, and had been in labor two days.

Examination showed her to be a person of medium size, of an exceedingly pinched and pale appearance about the face, with weak and rapid pulse, running from 130 to 140 beats per minute.

The abdomen was enlarged to about the size of a full-term pregnancy. Just above the symphysis was the pigmented cicatrix of the abdominal operation referred to. The fundus of the uterus presents the bullet-shaped appearance suggestive of pelvic contraction; it reaches to a point midway between the umbilicus and xyphoid cartilage, and was in a condition of tetanic contraction. Palpation showed a large child in the left-occipito-iliac-anterior position, with the head impacted in the pelvis. The fœtal heart could not be heard, and the patient was not having regular labor pains.

Measurements of the pelvis showed that she had a generally contracted pelvis, with a *conjugata vera* of approximately 8 cm.; the other measurements were as follows: distance between iliac spines 22.5 cm., between iliac crests 25 cm., between trochanters 28 cm., Baudeloque diameter 17 cm., and a diagonal conjugate of 10.5 cm.

By vaginal examination we found that the vaginal outlet was much relaxed. There was a very large caput succedaneum presenting in the vagina. The head was very firmly impacted in the pelvis and could not be pushed up. The sagittal suture was in the transverse diameter of the pelvis, with the small fontanelle to the left. The impaction of the head was so great that the cranial bones overlapped one another to the extent of one centimeter.

On approaching the bed a very sweetish, offensive odor became noticeable, and a distinct bubbling, crackling sound could be heard. This was thought at first to be due to the escape of gas from the rectum, but on turning down the bedclothes it was seen to come from the vulva, which was bathed in a dirty reddish-brown fluid containing many gas-bubbles. The bubbling, crackling sound was continuous, and was much more apparent when the patient's genitals were exposed.

Diagnosis. Generally contracted pelvis, with *conjugata vera* of about 8 cm.; large child in left occipito-iliac anterior position, with head impacted in the pelvis; arrest of labor.

Owing to the mother's condition, and as the child was already dead, immediate delivery was indicated. She was given chloroform, placed across the bed in the lithotomy position, and a Tarnier axis-traction forceps was applied by Dr. Williams. The head was brought down to the outlet with great difficulty, and as it became more and more crushed out of shape with each traction it allowed the forceps blades to slip several times. The lateral blades of the Tarnier basiotribe were then applied, screwed tightly together, and the crushed head delivered.

Tractions now made on the delivered head showed that the shoulders were so firmly impacted in the pelvis that they could not be delivered without tearing the head from the body. The blunt hook was then put into the posterior axilla and that shoulder brought down; this manipulation caused the separation of the epiphysis from the shaft of the humerus, and in order to effect delivery of the trunk it was necessary to put the blunt hook between the ribs beneath the substernal notch and literally drag the child from the mother.

Just as the child was delivered there was an escape of gas from the uterine cavity accompanied by an explosive sound. The gas possessed a most sickening fœtid odor, which was so intense that Dr. Williams was obliged to leave the patient and seek the outside air.

The third stage of labor also gave considerable difficulty, for

the uterus having been for so long in a tetanic condition, refused to retract, and it was finally necessary to deliver the placenta manually.

Retraction still being very slow, a hot intra-uterine douche of boiled water was given, which had, however, little effect; but there being no excessive hemorrhage, the patient was put back to bed. Her condition, while very bad, was not much worse than at the beginning of the operation. She was given strychnia, brandy, etc., and left for the night.

March 3rd, 9 A. M. The patient was seen by the nurse, who reported her condition in no way improved. She had repeated attacks of vomiting during the night. Temperature 98.4°, pulse 144, irregular, weak and intermittent.

5 P. M. The patient was decidedly worse than in the morning. Temperature 101.2°, pulse 144, weak, irregular and intermittent, her face presented an anxious expression, and the respirations were rapid and irregular.

During the morning "gas bacilli" had been found in the tissues of the fœtus and placenta, so a fatal prognosis was given to her husband. At this time in no part of the body could we detect the presence of emphysema. Slips and cultures were made from the lochia, which showed staphylococci, streptococci and large numbers of gas bacilli.

As well as we have been able to find this is the first instance in which a diagnosis of this form of puerperal infection has been made before death.

10 P. M. The patient is decidedly worse, no gas detected in the tissues. The patient died three hours later, and soon afterwards the body began to swell.

March 4th, 10 A. M. Seven hours after death. The body was enormously swollen, being almost twice its original size, the face was swollen entirely beyond recognition, from the mouth and nose there exuded a frothy, bloody serum, and from time to time large bubbles of gas could be seen to escape. The abdomen was enormously distended and gave a deep drum-like note on percussion. Over the entire body we could obtain the characteristic crackling of gas in the subcutaneous tissues.

The husband unfortunately allowed no autopsy.

Pathological report. The fœtus and placenta were brought back to the laboratory and the following is a copy of the pathological report:

The child weighs 2900 grammes, without the brain; its length is 55 cm. The head is entirely crushed, the right arm almost completely torn from the body, and there is a large jagged wound in the chest, all of which were caused by the craniotomy instruments and blunt hook.

The fœtus is very offensive, being much decomposed and macerated. The entire body is emphysematous, and everywhere, on making pressure, we obtain the characteristic "feel" of gas in the subcutaneous tissue. By making pressure on the chest, large bubbles of gas are seen to escape from the wound in the neck. The body was then put under water, and on puncturing the abdomen there was marked escape of gas, which when ignited shot up in a flame six inches high.

Cover-slips made from the blood and subcutaneous tissues show large numbers of bacilli morphologically similar to the "gas bacillus" of Welch and Nuttall. Cultures on sugar media gave the characteristic growth.

The placenta is of a distinctly bilobed shape, dimensions being 18x14x1.5 cm. and 10x9x1.5 cm. for the greater and lesser lobes respectively. Its weight is 420 grammes. The entire placenta is of a dull brownish color, and a distinct vascular trunk runs from the insertion of the cord, in the larger lobe, to the lesser lobe. On the maternal surface, the cotyledons are poorly marked, and here and there are seen a few minute areas of calcification. There is a large white infarct, 3 cm. in diameter, at one margin of the lesser lobe. The entire surface is crepitant, and in places small bubbles of gas escape on pressure. The fœtal surface shows numerous blebs and bullæ beneath the amnion, which contain gas. The larger placental vessels are distended with gas, which can be pressed into the smaller ramifications.

The umbilical cord is 36 cm. long, it is thin and flabby, and its vessels have considerable gas within them. Cover-slips made from the placental blood show large numbers of typical bacilli.

Microscopic examination of hardened portions of the placenta. The decidua presents for the most part a normal appearance. In the serotina the cells are often necrotic and have become converted into canalized fibrin, which in places is seen to be continuous with the canalized fibrin of typical infarct areas of the chorion. Infiltration with small round cells is noted to a slight degree. The decidua is poor in gland and vessel spaces, and when present they seem to have lost their epithelium and endothelium.

In that part of the chorion situated near the decidua serotina the villi present a typical appearance, they are closely packed together, rich in vessels, and their cellular elements take the stain well. Many small infarct areas are seen, particularly at the margins of the placenta, which present the usual structure. As we go deeper into the chorionic substance (*i. e.* toward the amniotic surface), we see that the villi do not lie in so close relationship with one another, but are widely separated.

The larger vessels of the chorion are seen to be plugged with bacilli, identical with those seen in cover-slip preparations mentioned in the macroscopic description. In some of these vessels the bacilli form a solid plug, completely filling the lumen, while in others a "gas cyst" has been formed, and the bacilli lie in a zone around its margin. As we go from the vessels into the chorionic substance we find a few bacilli; these do not lie in the villous capillaries, but in the stroma of the villi, thus it is seen that while the larger vessels are filled with organisms the capillaries are free from them. The "gas cysts" mentioned above are found to lie in the placental vessels and not in the intervillous spaces.

The tissue surrounding one of these foci of bacilli presents the following characteristics: Centrally we find the mass of bacilli, which may lie either closely packed together in a clump, completely filling the vessel lumen, or surrounding the margin of a "gas cyst" in a zone. Going outward we first find a zone of necrotic material, the remains of the vessel wall; this is entirely necrotic and shows no trace of nuclei. We next get a zone of necrotic villi, which take a pink stain with eosin, and show no cell structure. That portion of the villus which formerly represented its syncytial covering takes

the stain somewhat deeper than the stroma. Continuing outward, we next find a zone of partly necrotic villi, in which each villus has retained a portion of its cell structure.

Which portion of the villus (syncytium or stroma) first succumbs to the toxic action of the organism cannot be said, for in this zone of partly necrotic villi we sometimes see intact syncytium surrounding necrotic stroma, and in other villi the stroma is normal while the syncytium is represented by a narrow necrotic band. It is probable that the syncytium is the more resistant of the two, as more of the first variety of villi are seen.

There is apparently no reaction on the part of the tissue, for we find no infiltration with polynuclear leucocytes. In some of the sections we were able to demonstrate a few streptococci.

The epithelium and Whartonian jelly of the cord are entirely necrotic, the vessel walls partly so, and show a few nuclei. The arteries are apparently free from bacilli; in the veins, however, they are very numerous, but show no tendency to occur in clumps.

Bacteriological report (by Dr. Lanier). Cultures from the placental blood show the *bacillus aerogenes capsulatus* mixed with staphylococci and streptococci. A pigeon was inoculated in the pectoral muscle with 1 cc. of bloody fluid from the placenta and died in about eight hours. At the autopsy there was extensive gaseous crepitation to be made out over the entire chest. On removing the skin, the subcutaneous tissue contained a number of gas bubbles. The muscles were extremely œdematus, of a reddish brown color, and disintegrated to the extent of being almost pulpified. Cultures made from this muscle grew out in the characteristic manner.

A rabbit inoculated in the ear vein with a 24-hour bouillon culture from the original placental blood was killed by a blow on the back of the neck and left for 24 hours. At the autopsy emphysematous crackling could be made out over the entire abdomen and chest, the subcutaneous tissues and all of the organs contained large quantities of gas, slips from which showed large numbers of encapsulated bacilli. Cultures from these organs gave the characteristic growth. The organism was also pathogenic for guinea-pigs.

Pathological diagnosis. Bacillus aerogenes capsulatus (Welch). Infection of placenta and fœtus.

In looking over the literature of the subject we have only been able to find a few cases which can be said to be similar to ours. The first of these cases was reported by Leduc[6] as early as 1597, he was called to see a woman who had been in labor for three days. After a very difficult extraction by means of the blunt hook, he says: "Immediately after the delivery of the body of the child and placenta, a violet-colored flame with a sulphurous odor escaped from the vulva, this flame shot out some distance from the external genitals of the patient, and its heat could be distinctly felt by the hands of the persons who held her." She died several days later. It is highly probable that this gas was generated by the bacillus aerogenes capsulatus, but we can hardly blame the author of that period for giving to his report of the case the somewhat fantastic title of "Le diable au corps."

Doleris[8] reported a case of a woman dead after labor, of a bacillar infection, this was before the work of Welch and Nuttall, but the clinical history is so characteristic of the form of infection we are discussing, a short quotation from his report will not be out of place.

"In 1883 I submitted to the Anatomical Society a case of delivery at term, complicated by a myoma, after which the patient died. The labor was exceedingly difficult and marked by successive intervention (forceps, cephalotripsy, etc.), and I was not able to deliver the fœtus. The patient succumbed to a septicæmia having its origin in an intense putrefaction of the uterine tissue, physometra, and putrid emphysema of the cellular tissue of the hypogastric region. I have studied the case carefully from a bacteriological point of view, and can affirm that it was a typical septicæmia caused by a bacillar organism and not by the streptococcus or staphylococcus."

In 1893 we find reports of two cases, one by Graham Stewart and Baldwin[3] and the other by P. Ernst.[4] As these cases were both worked up very carefully from a pathological and bacteriological standpoint, we give rather full abstracts.

Dr. Stewart[3] was called at 1 P. M. to see a woman who had been previously healthy and accustomed to hard work. He found her suffering with intense pain in the region of the uterus and ovaries. Miscarriage was suspected and denied. As the pain was somewhat relieved by morphia he diagnosed the case as acute metritis following abortion, and left the patient. He did not see her again until several hours later, during which time she became so much worse that another physician had to be called. At Dr. Stewart's third visit at 9.30 P. M., about eight hours after the onset, he found her emphysematous from "the top of her head to the soles of her feet." Shortly after this she died, and swelling of the body began, and increased so rapidly as to greatly alarm the undertaker when he was called in.

At the autopsy Dr. Baldwin reports "on making the usual longitudinal incision, gas bubbles were found in the subcutaneous tissue, which ignited with a characteristic explosion, and a small amount of gas in the peritoneal cavity. The abdominal veins are markedly distended with gas, and numerous bubbles found in all the internal organs. The uterus gave evidence of an abortion at about the third month." There is no record of microscopic examination of any of the organs.

Bacteriological examination of a specimen of blood showed the presence of the bacillus aerogenes capsulatus in large numbers.

It is very interesting to note that in this case production of gas took place to a very marked extent before death.

Ernst,[4] in doing an autopsy on a woman dead after operation for removal of a macerated fœtus, was struck by the appearance of foam on the cut surface of the liver, which on being allowed to stand increased so rapidly as to form a layer several centimeters thick.

Bacteriological examination proved this case to be one of infection with the bacillus aerogenes capsulatus. An abstract of his case is as follows.

Patient 26 years old, with anteflexion of the uterus in her first pregnancy. Entered the hospital suffering with pain in the right side of four weeks' duration. She had also lately

noticed a tumor in the lower abdomen. There being no definite signs of pregnancy, and the microscopic examination of scrapings from the uterus showing decidua, the cervix was dilated to admit manual exploration of the uterine cavity. Digital examination, however, revealing nothing, a vaginal tampon of iodoform gauze was introduced.

After this the patient became so much worse that the tampon had to be removed. A macerated fœtus was found and extracted, and the uterus repeatedly douched with antiseptic solutions; the patient, however, became steadily worse and died.

The autopsy showed fibrinous adhesions between abdominal wall and intestines; cloudy sanguineolent fluid in the pelvis. The musculature of the left ventricle is thickly beset with little miliary abscesses (?), in the centre of each of which is a small punctiform lumen. Fresh fibrinous exudate on the under border of the lungs. Spleen tumor with fibrinous coating and many necrotic areas appearing beneath its capsule. Cloudy swelling of both kidneys. In the liver, which is of a yellowish icteroid color, there are countless yellowish and whitish-gray foci, the size of a millet seed, in the centre of each of which there is a small lumen.

The uterus reaches to the umbilicus, it is 15 cm. long and its walls have an average thickness of 2 cm. The placental site occupies the anterior wall, and here the uterus is thicker (2½–3 cm). The entire uterine wall crackles on account of its containing numerous gas bubbles. The cervical portion of the uterus is 5 cm. long and is gangrenous. The uterine cavity presents a ragged meshed surface of a dirty gray color. A dirty, sanguineolent fluid flows from the venous plexus of the right broad ligament.

The uterus and ovaries are covered with a fibrinous exudate; in the right ovary is a corpus luteum of pregnancy, undergoing cystic degeneration. There is a clot in the right iliac vein which is riddled with gas bubbles.

Ernst was unfortunately prevented from making cultures at this time, and later the organism had died out.

In Ernst's article he goes very thoroughly into the histological changes produced in the internal organs. These changes are similar to those described by Welch and Nuttall, so they will not be mentioned in this report.

The changes mentioned in connection with the uterus are especially interesting to us owing to the fact that we were unable to get an autopsy in our case. Ernst mentions three different organisms: a large bacillus similar to those found in the internal organs, viz. the bacillus aerogenes capsulatus; a short thick bacillus which he considers a saprophyte; and cocci having a tendency to chain arrangement, however, as he says, not the typical chains as seen in streptococci. The short thick bacilli he finds only in the necrotic uterine mucosa, and they show no tendency to invade the deeper structure, while the cocci are found deep down in the uterine muscularis. The larger bacilli, which are found all through the internal organs, are very numerous in the uterine wall; they have formed "gas cysts," which give to the uterus the ragged, mesh-like appearance mentioned above.

In comparing these "gas cysts" with those found in the liver, Ernst says the principal difference is, that while in the liver the bacilli line the cyst in an unbroken zone, in the uterus the organisms are only found lining portions of the cyst wall, and the cyst has a much more irregular contour. This difference he attributes to the difference in structure of the two organs, that of the liver being more or less homogeneous, while the uterine wall is made up of numerous fibres running in different directions.

Thus, when a mass of bacilli begin to form gas in the liver, the resistance met with is equal in all directions and the bubble takes the form of a sphere. On the other hand, in the uterine wall, the resistance not being equal, the bubble when formed will have an irregular contour, and in places along its wall the bacilli will form a very thin zone or be entirely absent.

Ernst is in doubt as to whether the infection took place along the veins or lymphatics, for in his specimens both contained large numbers of bacilli.

In 1895, Krönig,[6] at the Sixth Congress of the Deutsche Gesellschaft für Gynäkologie, reports two cases of puerperal endometritis probably due to the bacillus aerogenes capsulatus.

During the last year Schnell[7] reports a case which, although he does not consider it an infection, has a clinical history so similar to our case that a short abstract will not be out of place.

Primipara, æt. 31. 24 hours after rupture of the membranes was seen by a midwife from the Polyclinic, who found prolapse of an arm. Version was tried, but failed, on account of contraction of the uterus; the child died during this attempt. She was brought to the hospital with marked *tympania uteri* and suffering intense pain; 46 hours after the onset of labor she was delivered by a difficult version. Immediately after labor she did well, but later had quite a profuse hemorrhage, for which the uterus was tamponed with iodoform gauze. She then became steadily worse, and died three and a half hours after delivery.

At the autopsy 18 hours after death, in winter, nothing abnormal was found but gas in the large veins of heart, pericardial vessels, lungs, aorta, liver and spleen.

There is no record of any bacteriological examination, and Schnell considers the death due to air having gained entrance into the uterine sinuses during the successive manipulations.

On looking over and comparing these cases with our own, the following points are of interest: In every case the infection was very rapid and fatal. In all of the cases except that of Graham Stewart and Baldwin, there was for some time a dead fœtus in the uterus, and the organism found an excellent medium for development in its dead tissues and in the placenta, and probably did not gain entrance to the general circulation until after death of the patient. In the case of Graham Stewart and Baldwin, on the other hand, there was nothing in the uterine cavity; it only "gave evidence of a recent abortion." Here it is probable that the infection was more in the nature of a true septicæmia, and the bacilli gained direct entrance to the vessels and lymphatics at the abraded placental site. As this was the only case in which gas was detected in the subcutaneous tissues before death, the above theory is not out of the line of probability.

In Schnell's case we feel sure that had a bacteriological examination been made, the organism would have been found.

There are in our case two questions which deserve consideration, in the first place, the origin of the infection, and in the second, the action of the organism after it had entered the body.

The first question, in the absence of an accurate subjective history, cannot be answered with certainty. Suffice it to say that as the patient had been in labor two days before we were called in, and during that time a midwife had been in constant attendance, it is more than probable that the organisms were introduced by her during her examinations.

In regard to the action of the organism after it entered the body, *i. e.* whether the case was one of sapræmia or septicæmia, we can say as follows: Welch and Nuttall[1] have proved by inoculation into rabbits, that when the organism is introduced into the general circulation, death of the animal does not follow, but if shortly after the inoculation the rabbit be killed, the bacillus develops very rapidly, with abundant formation of gas in the various organs.

In their experiments on rabbits, in only one case did the inoculation prove fatal. This occurred in a pregnant rabbit in which two of the embryos were dead and macerated at the time of the experiment. Here the bacilli gained foothold and developed.

From the above we can then argue that the organisms were introduced by the midwife early in labor. She failed to recognize the obstruction offered by the deformed pelvis, and allowed the case to go on. The child, after becoming firmly impacted in the pelvis, died, and the bacilli, which had before undergone little development, now having the most favorable culture medium for their growth, *i. e.* dead tissue deficient in oxygen, increased to an enormous extent and partly filled the uterine cavity with gas.

Thus, by the time we were called in to see the patient she was not only weakened by the prolonged labor, but also profoundly poisoned by the toxines produced in the uterine cavity.

Why did not her general condition improve after removal of the dead fœtus and placenta? To this it may be replied that the fœtus being so long under pressure, there was considerable sloughing and necrosis of the cervical and vaginal tissues; thus there was still a large amount of favorable media which we could not remove.

One other point deserves consideration. Did the infection of the fœtus and placenta take place before or after fœtal death?

Again referring to the experiments of Welch and Nuttall, the fact of our finding the bacilli and "gas cysts" only in the lumina of the placental vessels is a strong point in favor of the theory that, just as in the mother, the organisms entered the blood before death, but did not undergo rapid development until the fœtus died.

From the above I think we can consider our case as one of septic intoxication rather than a septic infection.

Since writing the above report we have been told by Dr. N. G. Kierle, City Autopsy Physician, that it is not a rare thing to find conditions similar to these, viz. production of gas in the subcutaneous tissues and internal organs, in cases dead after criminal abortion.

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5. Leduc: Le diable au corps. Witkowski's Accoucheurs et Sage-femmes célèbres, p. 184.

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7. Schnell: Ueber einem Fall von gasblasen im Blut einer nach tympania uteri gestorben Puerpera. Monatsschrift für Geburtshülfe und Gynäkologie, IV, 199–203, 1896.

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Discussion.

Dr. Flexner.—I was enabled, through the courtesy of Dr. Dobbin, to see, during life, the patient whose case he reports. At my first visit, some 6 or 8 hours previous to her death, I endeavored to ascertain if there was any evidence whatever of an ante-mortem development of gas within the tissues or vessels in parts remote from the genitalia. No such development was discovered. The next time I saw the case was several hours (6 or 7) after death. At this time the appearances presented were those of extensive gas formation everywhere in the soft tissues and serous cavities. From the nose and mouth frothy bloody serum exuded, which on cover-slip preparations showed many characteristic bacilli. From the account given by the family it was clear that rapid multiplication of the organisms had begun almost at once after death, thus indicating a general distribution of the bacilli during life. I should prefer to consider that other causes than merely the presence of oxygen in the circulating blood are to be taken into account in explaining the absence of any appreciable development of gas, and thus presumably of bacilli, in the body during life. I apprehend that still other factors play a part, and these probably are of the same nature as are reckoned with in other and more usual forms of infection with bacteria. This case is, I believe, the first one which has been encountered in the Hospital in which the invasion followed parturition. It is in itself a confirmation of the prediction made originally by Welch and Nuttall, namely, that many of the cases of supposed entrance of air into the uterine sinuses would be found to be due to infection with a gas-producing micro-organism. The prediction had, however, been abundantly confirmed before by Ernst and Graham, as related in Dr. Dobbin's paper.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of October 19, 1896.

Dr. Thayer in the chair.

The Surgical Significance of Gall Stones.—Dr. F. Lange.

Every physician who has practised for a long time knows that there are cases in which through a number of years attacks of gall stones will recur and eventually the patient will be entirely cured. I have, for instance, for a number of years watched a colleague of mine, a physician, who beyond any doubt has had gall stones, and indeed I have felt the gall stones in his dilated gall bladder. He had all the symptoms of cholangioitis, with frequent chills and high fever, through months and years. He, however, did not like to undergo surgical treatment, and he is now in flourishing health.

I have seen an old lady with a gall bladder packed with gall stones, who was not operated upon, who never had any severe attacks that had been taken for gall stones, but in whom apparently the gall stones have disappeared without any serious symptoms. Pathologists know that the presence of gall stones, especially in elderly persons, at autopsies, is of very frequent occurrence. On the other hand, the disease may call for very prompt and active surgical treatment, and it depends entirely upon the pathological changes—the consequences of the presence of gall stones or their accompanying changes in the gall system—whether the case will present features that call for surgical treatment.

I propose to accompany a gall stone from its usual place of residence through the gall passages, and on this journey I shall mark out some clinical features which we will occasionally be brought in contact with. As long as the gall stones remain quiet in the gall bladder they will hardly ever give rise to any symptoms, but as soon as they become dislodged and commence to travel into the cystic duct or the common duct, then the typical symptoms will commence. They may sometimes grow to a large size and cause very few symptoms. I show you here a specimen of gall stones that came from a lady who for a number of years had been suffering from "dyspepsia," but not until an acute attack of peritonitis had set in, in consequence of impaction of this very large gall stone in the cystic duct, was she ever supposed to be suffering from gall stones. As you see, the gall stones are almost the size of a hen's egg. The gall bladder was full of pus, and peritonitis had commenced. Acute impaction of the gall stone in the cystic duct, in my experience, happens not unfrequently with solitary stones of larger size. Since the first of last October I have had six such cases of acute cholecystitis with septic processes on the surface of the mucous membrane of the gall bladder, or through the entire thickness of the gall bladder, which brought the patient into more or less danger of life. In one of these cases, in which I had operated three years previously, I had the opportunity of observing the changes that had taken place three years after operation. The patient was left with a pretty extensive scar and a hernia formed. She got an acute strangulation of a small omental hernia which necessitated incision. It was in the immediate vicinity of the gall bladder, and the gall bladder on that occasion was opened also. I found, to my surprise, that the gall bladder had assumed an hour-glass shape, through the loss of substance which had occurred in the expulsion of necrotic tissue in the first attack, and there existed two compartments communicating with each other by means of a very narrow canal. In both of these compartments was a considerable amount of mucous material, but no stones. The patient had suffered at the time from a certain degree of catarrh of the gall duct.

I have here a stone of not much smaller size, made up of cholesterine with lime outside. The patient had an acute attack of cholecystitis, and this stone was found impacted in the cystic duct.

This third stone, of smaller size, is from a case in which the destruction of the gall bladder was quite extensive. Eventually the patient made a good recovery.

Solitary stones are not always the cause of this affection. On the contrary, sometimes quite the opposite condition will be found. You will see here in this bottle a large quantity of gravel-like material, coming from the gall bladder of a gentleman who for several years had been complaining of pain about the region of the liver. In the second bottle you will see an amount of tissue coming from the disintegrated mucous membrane, and if you will take a closer look at these pieces you will see that a large number of these small black granules are imbedded in these shreds of membrane. The gall bladder was felt through the patient's lifetime as a very hard, resistant, stony body, and when I tried to remove it it broke off in the region of the cystic duct, and I was able to feel below a hard resisting mass. The patient was in such a weak condition that I did not try to get any further. After about six months she died from a progressing carcinomatous affection of the cystic duct. The cancer of the cystic duct pressed the common duct and led to jaundice and marasmus.

If the gall stone passes beyond the cystic duct into the common duct and is arrested there, of course the symptoms of stagnation of the bile will make their appearance. Very frequently, however, associated with this there is inflammation of the gall system, such as cholangioitis or pericholangioitis or even liver abscess. These cases often necessitate very difficult tasks, and I must say that some of them upon which I have operated are among the most difficult operations I have done. They are, however, very successful operations, and operations by which the life of the patient is saved. In one of them I was able to push the stone back through the dilated cystic duct into the gall bladder, and then did what may be called an ideal cholecystotomy, that is to say, I sewed the gall bladder up again and closed the abdomen. That was ten or eleven years ago; of course I would neither do it again nor would I recommend it. It is evident that through the mechanical injury of the operation and through the inflammatory condition which is present, a certain amount of swelling is kept up for a time, and then the duct will not immediately become patulous after

the sewing of the wound, and so it was in this case. The sewed-up gall bladder was put upon a tension and burst, and the patient died from sepsis.

I have here a small cholesterine stone which led to a bad condition of the patient. A lady, about forty years of age, the wife of a physician, who was very carefully observed, had had one attack of gall stones about four or five months previously to the time I saw her. She was taken with chills, high fever and deep jaundice. I found her, about nine or ten days after the beginning of this attack, in a very low condition, so bad that the only indication at that time was to open the gall bladder, drain it and do away with the stagnation of the bile. About three weeks later this stone was removed from the common duct, and although the patient for a number of months after this presented some febrile symptoms, with occasionally slight chills, she eventually has entirely recovered.

Here is another stone, which has been removed from the ductus choledochus, and one of exceptional size for a choledochus stone.

I have one specimen in which I was obliged, apart from opening the gall bladder, to incise the cystic duct at two different places, and also the common duct. That was a case in which the gall stones were very small, not larger than peas, and which were caught behind the protruding folds and diverticula of the cystic duct, so that they could not be shifted. I sewed up the common duct as well as the cystic duct, and drained the gall bladder. This patient made a good recovery.

The principal point of resistance for gall stones is the region of the papilla in the wall of the duodenum. In a good many instances it has been found that large stones there destroy the surrounding parts and form fistulous communications with the duodenum. I have had the opportunity of operating in one such case, in which I thought I had to do with a malignant affection of the duodenum. The patient was sent to me as a case of cancer of the pylorus. It could be made out easily that the pylorus must be free, because vomited matters contained a large amount of bile. By palpation nothing certain could be made out, and in operating, I cut down through a great many adhesions and a good deal of scar tissue and found the duodenum obstructed by a hard mass, apparently of scar formation. I separated that, but in going further I met with a hard firm body which was apparently adherent to the vertebral column. I stopped the operation. The patient was very much run down. Believing that the duodenum was not sufficiently patulous I made a gastro-enterostomy. The patient rallied from the operation fairly well, but fell into a state of collapse five or six hours later and died. In making the autopsy I found, to my very great surprise, that this large mass behind the duodenum was not a malignant affection, but a large mass of gall stones, partly lodged behind the wall of the duodenum and partly within the wall of the duodenum, with a number of fistulous openings into the duodenum. The constrictions from scars were such that the contents of the duodenum could not easily pass beyond this point, and the symptoms of obstruction of the intestinal tract were the consequence.

I show you here a stone which has been excised from the small intestine. It is a very beautiful specimen of a pure cholesterine stone. Why a stone of this size cannot pass, while a Murphy's button will pass easily, I cannot tell. The patient in this case was an old lady. The operation was done very smoothly and I had good hopes for recovery, but she died in eight hours after the operation, from collapse.

These are the regular ways of the gall stones; but we know that from the gall bladder or from any other point in the gall system, through destruction of the surrounding tissues, they may find an outlet into a neighboring viscus or through the abdominal wall. Cases of this kind have at all times been very interesting and full of medical interest. I show you here specimens from one of my first cases of this kind, which occurred about seventeen years ago. It was a case of abscess of the abdominal wall, at the bottom of which I found gall stones. They were still lodged in the gall bladder. The patient would not submit to further surgical treatment and still has a fistula which discharges bile.

I have here some specimens, some 300 in number, from a case of acute cholecystitis. And here are specimens from another case of cholecystitis, in which I might call your attention to a point of interest, namely, on the cross-cut you see three small gall stones matted together by a binding mass, so that a single stone is simulated. Gall stones in the first stages of their development are very soft masses, and, owing to the beautiful and careful researches of Naunyn, we know that there is an organic substructure for their development.

A very serious complication that has led to fatal issue in several of my cases of advanced cholemia is an inclination of the patients to bleeding. Three of my cases I have lost from secondary hemorrhages. Two of these cases were complicated with malignant disease of the pancreas; at least I think they were cases of cancer of the pancreas. Autopsies were not made, and I can only say that I felt in the region of the head of the pancreas a resistant hard mass which I took for a malignant affection. Lately, Professor Riedel, a surgeon who has perhaps worked more in gall surgery than any other living man, has published cases in which he is inclined to assume that occasionally these apparent malignant thickenings of the pancreas may be but inflammatory thickenings, and he mentions one case which seems to be beyond any doubt. In an elderly gentleman, in whom the operation was abandoned, assuming that this was a case of cancer of the pancreas, the stones merely were removed. A fatal issue was awaited, but the patient lived for years and years and became healthy and strong, and there could be no question about his not having malignant disease. He assumes that through the presence of stones an irritation is kept up in the pancreas, and that this irritation, after the removal of the stone, may cease and the condition improve.

I have lost one of these cases by the separation of the Murphy's button after establishing cholecystenterostomy. The patient had had up to that time small hemorrhages from the inside of the gall bladder. I had purposely kept the gall bladder open, stitched to the abdominal wall, because I had the impression that this probably would be a case of bleeding, and in order to tampon and make counter pressure I kept the gall bladder open, and was able up to the tenth or eleventh day to check the bleeding, but after the separation of Murphy's

button the patient had a profuse hemorrhage into the large intestine and succumbed to anæmia.

In another case there was no proof of any malignant infection. It was a young person with impaction of gall stones in the common duct. The operation went off very well, but on the fifth or sixth day she had a secondary intra-peritoneal hemorrhage which was, I am sorry to say, detected too late. It is a fact that has been observed repeatedly, that in some cases there is an inclination to hemorrhage a certain number of days after operation. These patients who are apt to bleed from cholæmia, show a great tendency to bleed while one is incising the abdominal wall. They are, as a rule, much run down in health.

I will show you here an exceptionally beautiful specimen of gall stones from a case of sarcoma of the gall bladder,—a sarcoma which was not detected at the time of operation. I thought it was a case of stenosis from impaction of a stone in the apex of the cystic duct. To be sure, there was a suspiciously rough surface at the point of this stone. After a number of months a tumor mass sprung up from the gall bladder. Evidently this stone had been lodged with its point on the irregular surface of the tumor, and I think the roughness of the stone is somewhat indicative of its being in contact with an irregular surface and not with the smooth surface of the gall bladder.

As far as the surgical technique of this operation is concerned: To begin with the abdominal incision, I must say that I have entirely abandoned the longitudinal incision; but, according to the proposition of Corvisart and the experience of other surgeons, I do exclusively the operation parallel to the border of the ribs. Correspondingly to the thickness of the abdominal wall, this incision occasionally must be a very large one. A very great difficulty must occasionally be met with through the smallness of the liver. It is an entirely mistaken idea that in consequence of stagnation of bile the liver must be enlarged. On the contrary, I have had the experience that in occlusion of the common duct of long duration, probably through the influence of pressure, an atrophic condition of the liver tissue will take place, and occasionally the liver will be concealed high up behind the ribs, and this may cause a great deal of difficulty in consequence of the high and deep position of the field of operation. I have taken, in eight of these cases, to excising the adjacent cartilages of the ribs, and I should like to commend that. It facilitates the operation very much. On the other hand, of course the enlargement of the liver may be a great hindrance, and, especially in fat and plump persons of short build, it may be quite difficult to get down to the common duct. In one of the cases I was unable, in spite of excision of the ribs, to get effectually down to the point of the trouble, and not until I had pulled the liver as far as I could out of the incision, almost one-third of the liver substance being brought outside of the abdominal wall, was I able to easily get to the cystic and common ducts. It was the case in which I was obliged to open the cystic duct at two different points and, besides that, the common duct at the usual place about the middle of its course. In the cases of acute inflammation it is of course necessary, wherever one has reason to presume that the neighborhood of the gall bladder is infected, to keep everything as much as possible open and give entirely free outlet for the peritoneal secretions. At the same time I always drain the gall bladder with a long tube with the view of having a siphon action upon the secreted gall, and this will act very effectually. Of course occasionally a blockage will take place through mucus or blood clot, and then it will be necessary to change the tube or make a cautious washing through it. I should advise against the injection of any irritating antiseptic solution into the gall bladder. I have observed that occasionally this fluid will cause distressing symptoms, attacks of colic, probably because it may get into the common duct and the hepatic duct and irritate. I only use saline solution or boiled water. I have always found that the bile itself was an antiseptic agent. After a short time the amount of purulent secretion is insignificant, and the healing of the abdominal wounds, although constantly in contact with the bile, is mostly uneventful and without any untoward symptoms.

About stones in the liver substance I have no practical experience. I have once found a stone in the liver after it had perforated the walls of the gall bladder, but I have not had any experience with stones in the liver that have formed in the gall system above the hepatic duct. It is a fact that these stones will occur, and that occasionally quite extensive casts of stone formation will take place in the gall system.

I will not mention comparatively frequent uncomplicated cases, where we have to deal with dilated gall bladders and stones and where the surgical treatment is comparatively simple.

The operation in two sittings I never do. I find that it is entirely safe to operate in one sitting. I have always aspirated as much as possible the contents of the gall bladder through a thick aspirating needle, protecting as cautiously as possible the surroundings to guard against infection.

DISCUSSION.

DR. HALSTED. Dr. Lange's talk has been instructive to all of us. At one of our meetings, not very long ago, I described three consecutive choledochotomies or incisions into the common duct for the removal of gall stones, all of which were successful. Two of these cases I exhibited on that occasion. What Dr. Lange says about the enlargement of the head of the pancreas interests me, because on several occasions I too have noticed in gall-stone cases that the pancreas was hard. On the first occasion, some four or more years ago, I was misled and thought for a time that the patient might have cancer of the pancreas. Since then I have several times found an indurated pancreas in these cases and have spoken of it at the operating table. The induration of the head of the pancreas was especially noticeable in one case. This case was one of great interest irrespective of this hardening. A very large stone occupied and had almost ulcerated through the common duct. There was, however, no local peritonitis. A little scratch and a little pressure on the wall of the common duct were enough to extrude the stone. The stone being extracted, we found quite a large hole in the common duct and duodenum just where they came together. This made a plastic operation necessary; and a very difficult one it proved to be

because we had to do such delicate work at such a very great depth. Even if the parts to be stitched could have been brought to the surface it would have been no easy task to accomplish the repair of the hole. The patient made an excellent recovery. She has gained nearly *one hundred pounds* and has no symptoms of stricture of the ductus choledoctinus. Of the other cases of stone in the common duct, one is interesting because complete obstruction was caused by a very small stone in the diverticulum of Vater, or near it. This stone, not more than 3 mm. in diameter, could not be pushed in either direction. After considerable manipulation we cut down upon it and removed it. It will undoubtedly strike you as very strange that we could not manage to extrude so small a stone. We might possibly have succeeded with the exercise of some violence; but the choledochotomy recommended itself to me as the safer procedure. We might, with a hypodermic syringe, inject oil into the duct and so perhaps make smooth the folds of mucous membrane and dislodge the stone by subsequent manipulation.

Regarding deaths from hemorrhage: Dr. Lange speaks of the so-called parenchymatous hemorrhage in these highly jaundiced patients. We have had one death from this cause. Our first common duct case died on the tenth day from hemorrhage. There were absolutely no symptoms of peritonitis. The patient made a very good recovery from the operation, notwithstanding the fact that he was so weak that we hesitated to operate upon him.

In 1880 or 1881 I performed my first gall-stone operation. At that time only one or two operations for gall-stones had been performed in this country. The case is one of considerable interest. Seven stones were removed from the bladder, which was distended with pus and adherent to the abdominal wall. The common duct could not with safety have been examined even if it had occurred to me to do so. The patient lived for about two years after the operation. At no time after the operation was she entirely free from jaundice, nor was she at any time either before or after the operation profoundly jaundiced. The stools were usually acholic, but occasionally showed unmistakable signs of bile. The sinus which led to the gall-bladder was not allowed to close until a few weeks before the death of the patient. Death was precipitated by a slight local peritonitis. At the autopsy all signs of the sinus which had led to the gall-bladder had disappeared. Nothing but a few connective tissue threads remained to indicate where the sinus had probably been. The gall-bladder was reduced to nothing but a little knob of connective tissue. The liver was perhaps less than one-half its original size. The common duct and one hepatic duct were dilated sufficiently to permit a calculus as large as a plover's egg to glide easily up and down from the duodenum to the interior of the liver. The calculus was somewhat egg-shaped, and could almost be pushed into the duodenum through the opening which partly by ulceration, partly by dilation, it had made for itself. It became engaged at this ring of cicatricial tissue a little beyond its middle when allowed to fall naturally, point downwards, in the common duct, from the liver to the duodenum. The wall of the common duct was very thick. The stone had evidently freely traversed the entire length of this dilated canal, from the very centre of the liver to, and almost into the intestine. At the autopsy which was made by a very distinguished pathologist the calculus was not found until the liver had been literally cut to pieces, so deeply was the stone imbedded in this organ. The occasional presence of bile in the stools and the absence of profound jaundice were thus readily explained by the findings at the autopsy. When the calculus was in the dilated branch of the hepatic duct, bile could escape through its other branch and appear in the feces. When the calculus plugged tightly the orifice into the duodenum the jaundice increased. That it should never have been profound could be explained by the fact that the stone traveled freely everywhere in the duct; a little bile could probably escape except when the stone was engaged at the duodenal end of the duct.

Will Dr. Lange kindly tell us if he always employs drainage of some kind in suture of the ductus choledochus; and if so, how long does he permit his drain to remain? Does he not think that the drainage material, gauze, etc., should be left undisturbed until the rest of the peritoneal cavity is well walled off and protected from reinfection? Quite recently one of Germany's best surgeons removed the gauze in one of these cases on the third day. Peritonitis supervened promptly and the patient died. I have noted that this surgeon and several well-known English surgeons state that no harm is done by leakage from the duct after suture of it, provided one drains down to the sutures. I think that one should, if possible, so suture the duct that its contents cannot escape. Fluid can convey solid and infected particles to places in the general peritoneal cavity which are not protected by the gauze. Furthermore, I have the idea that adhesions take place more firmly about dry gauze than about gauze which is constantly bathed in fluids.

For this reason, if we have sutured a gall-bladder to the parietal peritoneum, or if we have packed gauze anywhere about this gall-bladder which we have opened and propose to drain, we endeavor to prevent leakage for the next three or four days by passing a purse-string suture all along the edge of our opening into the gall-bladder, and drawing it up when we have introduced our gauze or drainage tube into the gall-bladder.

We explore all the ducts and open and evacuate the gall-bladder in one act. Riedel's advice to perform the operation in two acts, opening and evacuating the gall-bladder at the second act, is bad. We have more than once, while removing biliary calculi, remarked that it would have been impossible to extract them without the aid of fingers in the abdomen. Bimanual manipulation is of course impracticable when the bladder is adherent, all around, to the abdominal wall, as it is at the time of the second act in the operation in two acts.

Dr. Lange's suggestion to cut through one or two ribs to facilitate matters where the liver is very small and the gall-bladder so high as to be otherwise almost inaccessible, is undoubtedly an excellent one.*

*Jan. 2nd, 1897. I have recently had occasion to resort to this procedure while removing a tuberculous kidney which was adherent to the diaphragm. After dividing two ribs I could proceed quite easily with a dissection which otherwise might not have been feasible. When the liver is very large this method of gaining room is indicated quite as much a when the liver is small.

Dr. Lange.—I think that in some of my cases I had reason to assume that there was some valve action, especially in one case of stone in the common duct of small size. The patient had had an attack of gall stone some three months before this attack, with jaundice lasting several weeks, most likely because of obstruction from this stone, which was solitary, as judged by its very round, regular shape. Probably after a time this stone shifted back and later on again caused obstruction together with an infection. This we saw not uncommonly in cases of obstruction of the common duct. Even if the stones are ball-like or rounded, at intervals a certain amount of bile will get into the gut. It is almost characteristic that if, in prolonged jaundice, at intervals the condition of the fæces and the urine points to the passage of a certain amount of bile through the duct, we have probably to deal with obstruction from stone.

Regarding the drainage of the common duct, I have tried everything: I have left the duct entirely open, and I have sewed it up with the insertion of a small drainage tube into the lumen of the duct, and I have sewed it up entirely. In cases where the wall of the common duct is healthy, I think it is preferable, if it can be done, to sew up the duct entirely. If there is reason to assume that there is obstruction beyond the stone, I should prefer to drain, and I do this in such a way that I insert a small drainage tube from the wound in the common duct and pack gauze around it. This gauze (iodoform gauze boiled in glycerine) I leave in for five or six days. The tube I leave for a sufficiently long time to secure the proper outlet of any secretion as long as it exists. In draining the gall bladder I pack the gauze around the tube and leave the opening comparatively large, for the reason that, at least in inflammatory cases, the surface of the gall bladder is such that it will necessitate some thorough cleansing and local treatment for a limited time. There will be clots of blood or shreds of tissue or inspissated mucus which might easily obstruct. I mostly remove this tampon in two or three days and give the inside of the gall bladder an additional thorough washing and cleansing.

Besides this we have either sewed the peritoneum to the surface of the gall bladder where there is no infection outside of it, or we have packed around the circumference of the gall bladder in such a way that even if some of the contents of the bladder escape it is not likely to cause a spreading inflammation.

Dr. Halsted has spoken of the necessity of having a proper needle; I have a proper needle.

In one case I dissected the peritoneum from the walls of the abdomen. The case was that of an old gentleman, a physician, who had been suffering for years from attacks which were supposed to be stomach attacks, and there was a suspicion of his having chronic ulcer of the stomach and malignant induration. I opened in the middle line and found nothing, but on palpating the gall bladder I found it full of small stones. The liver was small and the gall bladder very high up. I was obliged to loosen the peritoneum. This gentleman had for five or six days incessant vomiting and the gall bladder was torn away from the peritoneum. He still has his gall stones in his gall bladder, but for a number of years he did not have any attacks. Lately, I understand, he has had them again.

I have also done the sewing of the omentum against the gall bladder in the way that Lauenstein proposes, and have been quite satisfied with it.

Finally, I should like to say that I have regarded the invitation to come here as a very flattering one. I have come with the greatest imaginable pleasure, and for the reason, apart from the friendly relations which I have here, that I have the consciousness of being at a place where science is promoted and sought for in a devoted and unselfish manner. I regard this institution as the pride of this country, and I hope that it will not be the only one,—that others will follow, and that this country will be eager to base medicine on the sound basis of scientific conception.

CORRESPONDENCE.

A Case of Pneumo-Cardial Rupture.

To the Editor of the Johns Hopkins Hospital Bulletin.

Dear Sir:—I send herewith a report of a case of pneumo-cardial rupture which has come under my observation, which you may deem of sufficient interest to publish.

On March 26, 1896, a negro man, age 23, was brought to our hospital in a condition of collapse, with the history that a bank of sand or earth had fallen on him and a fellow-workman, the latter dying in a few hours afterwards from internal injuries. The patient's breathing was shallow, jerky, rapid and very painful, and every few minutes he had a hard spasm of coughing, which distressed him greatly and during which he expectorated a good deal of bright red blood. Morphin to relieve his pain and coughing, and strychnin were given him freely. On the second day he complained of intense pain in the cardiac region, and the stethoscope revealed a very interesting, if not an entirely unique state of affairs. This was a loud double friction sound with a bubbling and splashing sound, which could be distinctly heard with the stethoscope two inches from the chest wall. The diagnosis was a rupture between the pericardium and the lung. On the third day (losing sight of the fact that air from the lung is usually sterile) I supposed that he had a septic pericarditis due to the effusion of blood and air from the lung. An examination of the blood, however, showed no leucocytosis, which proved conclusively that the pericarditis was not septic. This examination was repeated daily for three days, each time with the same result; and as at no time had he much fever, and as the pulse and respiration during this three days gradually improved, a favorable prognosis was given, which was justified later by his complete recovery. The loud splashing and bubbling disappeared by the fourth day. The rough friction sound persisted for three weeks, and after that the heart sounds were in every respect normal.

George S. Brown, M. D.

2220 First Avenue, Birmingham, Ala.

Dec. 16, 1896.

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BULLETIN

OF

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CONTENTS.

IS MALARIA A WATER-BORNE DISEASE?*

By Rupert Norton, M. D., *Washington, D. C.*

There are several points in the consideration of this question which make an exact answer extremely difficult. First and foremost stands the fact that the malarial organisms, those forms producing malarial fever in mankind, have not been recognized outside the blood of human beings. Other similar types or species of organisms have been found in the blood of birds, frogs, etc., but these do not seem to be of the same species as that which produces the fever in human beings. Thus at the outset we are hindered in the investigation of this question by not being able to find and study the life-history of these organisms in any extra-corporeal form. Another difficulty, and not a minor one, is the occurrence of malarial fevers and typhoid fever in the same places at the same time of the year, oftentimes with very similar types of fever. And again it is generally supposed that the malarial organisms exist in the soil, in damp soils, and so possibly in actual water, whether stagnant or running, and as the germs of typhoid fever exist in water, and we know that typhoid fever may be communicated by drinking-water, the belief is a common one that malarial fevers may be induced in the same way.

Proof that malaria is a water-borne disease rests only on evidence that after drinking certain waters people sometimes suffer from so-called malarial chills or fever. It may be shown that they have the malarial organism in their blood, but it cannot as yet be proved that the water they drank contained this organism, so that the chain of evidence is incomplete. We believe there is almost no one who denies the possibility and even probability that malaria is ordinarily an air-borne infection. This makes the proof of the water-borne theory still more difficult, for in every case where the air-borne theory might be tenable as against the water-borne, proof must be brought that the patient was not infected through the air—an almost impossible task. Malaria is almost as wide-spread a disease as typhoid, and yet does not occur in epidemics. No group of cases of malarial fever on land has ever been traced to a single source of infection, as has been done so frequently in epidemics of several of the infectious diseases, especially of typhoid fever. We do not find groups of patients with malarial fevers in towns or elsewhere whose infection can be traced to a single supply of water or milk. We see cases of malarial fever springing up sporadically, apparently having no direct connection with each other, except through the medium of the air: the very name of the disease throws light upon the common idea of its origin. Popular beliefs are against, rather than in favor of the water-borne theory; for example, the general conviction in Rome of the danger of being out after sunset in the Campagna for fear of "catching" malaria, or rather being "caught" by it, and the belief in the security derived from living in the second story of houses in malarious countries, where the dwellers in the first story suffer severely. A similar thought existed among

*Read before the Johns Hopkins Hospital Medical Society, Nov. 16, 1896.

the laborers on the Panama Canal, and they, to escape the effluvia arising at night from the soil, slept in the trees or built houses on stakes high above the ground level. This, of course, is no positive proof against the water-borne theory, but shows what the feeling has been amongst many people as to the larger share which air, rather than water, plays in the etiology of this disease.

To show the difficulty in properly differentiating typhoid and malarial fever, we need only to look at a few statistics and remarks made by men of repute who have written about malaria. Chapin,[1] in 1884, reviewing all the cases that had occurred in New England since 1861, gives the following data. He reports the deaths due to malaria and typhoid fever in Massachusetts, Connecticut, and Rhode Island, and states that from 1878 to 1882, in Connecticut 1217 persons died of malaria and only 1242 from typhoid. In Massachusetts during the same time there were only 159 deaths from malaria to 4349 from typhoid, and in Rhode Island 24 to 794. The table from Connecticut is an interesting one to look at:

	Deaths from Malaria.	From Typhoid.
1876	22	327
1877	73	321
1878	143	260
1879	198	159
1880	265	242
1881	357	257
1882	264	324

As seen from these figures, during the years 1879, 1880 and 1881 there were fewer deaths from typhoid than from malaria. It is not worth while to discuss them. It may be said from what we now know of malaria that the records upon which they are based are absolutely untrustworthy.

Griswold[2] says: "For the main interest of this article, I accept the term 'malaria' as implying that undetermined potency producing the general class of fevers of which intermittent is the most pronounced type, and in which class is included various other diseases that have been very generally regarded as the results of paludal poisoning. In the absence of such specific knowledge as would enable us to give the class a more definite and satisfactory designation, the term answers as well as would any other equally arbitrary." This was written after Laveran's discoveries. Here are two extracts from papers on malaria as seen in New England. Greenleaf[4] states that malaria may be due to drinking water or to food contaminated by the hands, or to air; but he believes that "intermittent fever is a disease always originating locally, thus excluding as etiological factors all causes of a general character." Certainly air and water are causes of a general character, especially the former. Green[5] believes that possibly in the cases reported by him, the water of wells was poisoned by backing up of water, due to a dam or causeway which prevented natural drainage of the adjacent soil.

It is impossible to draw correct conclusions as to the etiology of malarial fevers from such general statements. Finally in the Fourth Annual Report of State Board of Health, New York, 1883, on Malarial Fever at Lakeville, Washington county, we read as follows:

"Malarial fever has also appeared at the house of Mr. Donald Reid, about one-third of a mile from Lake Cossayuna, up the Summit pond brook at a height of one hundred feet above the lake. No other cases of fever were reported in this direction. An examination of the premises of Mr. Reid showed that his house stands upon rock, covered with a comparatively thin layer of clay, and that while the roads and ground a short distance away from the house were dry and dusty, the clay around this dwelling was saturated with water. This water comes from a spring north of the house. The water is brought from the spring to the barnyard through a pipe, and empties into an open trough, the overflow of which saturated the surrounding ground. The surface of the ground here is twelve feet higher than that about the dwelling. The upper stratum is a loose soil some two feet deep, through this the water percolates until it reaches the clay over the rock, along which it readily finds its way down the steep slope to the house and saturates the clay about the dwelling. Water is also brought directly from the spring to the house and empties into a trough on the east side of the dwelling. The overflow of this trough is allowed to saturate the ground within ten feet of the eastern wall of the house. From these facts it appears that saturation of the soil about this dwelling, for which the owner is entirely responsible, is a sufficient cause for malarial fever in a region bordering upon such extensive swamps."

There can be but little doubt that these cases were not malaria, but typhoid; certainly the conditions existing were just such as to produce typhoid. Such unreliable statements as those quoted have led many who have not had the opportunity to investigate the question for themselves to believe that malaria was a water-borne disease.

It is a curious fact that almost all observers who want to prove that malaria may be due to drinking water refer to the cases of illness which broke out on the now famous ship Argo. The *pros* and *cons* of the evidence that these cases were or were not malaria have frequently been discussed and there is no general agreement. It seems quite fair, however and more than probable, to conclude that these cases were not malaria. At any rate the burden of proof lies with those who maintain that the cases were malaria, and the proof they offer is unsatisfactory. If these were malaria, then the water-borne theory needs no further demonstration; but for those who doubt, new proof must be furnished. The story related by Boudin[34] is as follows. I translate freely:

"In the month of July, 1834, the Sardinian ship Argo sailed from Bone (Algeria) with 120 soldiers in good health, and arrived at Marseilles. Thirteen men had died during this short voyage and had been buried at sea; 90 men were brought to the hospital in Marseilles, showing pronounced ("les moins équivoques") symptoms of paludal intoxication, in all its forms and types; in some cases the disease was most severe, or if one prefers to say so, showed the greatest degree of perniciousness. Whereas the soldiers were attacked by choleriform, epileptic, comatose, tetanic and other types of fever, which yielded as though by enchantment to large doses of quinine, the sailors showed a marked contrast in their perfect health. Now what could be the cause of such a difference in individuals who were apparently, at least, subjected to identical conditions?

An official inquiry, of which I had the direction, gave me the most complete information. The investigation showed that if the sailors had kept their good health they owed it to the purity of the drinking water, of which they had a special supply, while the soldiers were forced to drink water drawn from a well in a marshy spot near Bone, which water had been taken on board just on the eve of departure. The soldiers who escaped this poisoning were those who, having saved a little money, were able to buy water from the Sardinian sailors. This fact demonstrates in a peremptory manner how paludal matter absorbed in a liquid form from the gastro-intestinal surface, as by the lungs in a gaseous form, causes intoxication."* In another place the author himself admits that his evidence is not conclusive. He says: "Le fait suivant, dont nous avons été témoin au lazaret de Marseille, in 1834, pourra paraître concluant au premier abord, et pourtant, en y regardant de près, on est contrait de rester dans le doute."

It is strange that nothing is said in this story as to the length of the voyage, nor whether the sailors had been allowed to land at Bone. Algeria is a malarious country, and if the cases were malaria, the soldiers may have been infected on land, and the drinking water may have only aggravated the sickness. In fact there are many points in the story which need elucidation and without which the story is scientifically unreliable.

Oswald Baker[3] relates some cases of a similar sort, but here, too, his proof is insufficient, not so convincing even as that of the Argo. He attributes the cases of illness, which are not described, to the drinking water on board a vessel. Kershner[6] relates the case of a ship in which malaria (?) broke out, and where all the evidence went to prove that it was not due to drinking water. The author does not believe in the water-borne theory. The evidence is not clear as to what the illness really was. These are all the cases that I have found to prove or not to prove the development of malaria on shipboard as due to drinking water. If one case could be definitely shown to have occurred in this way, far from land, where the possibility of an air infection would be reduced to a minimum, the case, even then, would not be proven, for we know that the case might be one of latent infection, developing long after a stay in a malarious country.

On the origin of malaria we find many articles by medical men in various countries, and it will be better to examine these systematically, and thus see what proof has been brought forward to confirm the water-borne theory. Let us first look at some of the Reports of the Surgeon-General of the United States Army. In the report for 1889, pp. 32–33, it is stated:

"Much of this improvement has been attributed, and I believe correctly so, to the introduction of wholesome water supplies. In a recent communication, Col. Charles Page, Assistant Surgeon-General, makes an exception of Fort Sill, Indian Territory, in this connection, claiming that the diminished malarial sick list which followed the introduction of a good water supply cannot be referred to the water, because there was a diminution of malarial diseases at Fort Supply, which had no new water supply, as well as Fort Sill, for several years after the introduction of the water supply at the latter post. He attributes the improvement to some general condition which affected Fort Supply as well as Fort Sill, and considers, therefore, that the theory of a water propagation of malarial fever does not always hold good. He says:

'An examination of the consolidated reports of the medical department of Fort Sill for several years will convince one that the supply of spring water did not diminish the ratio of malarial disease materially. The diarrhœas diminished and the general health of the command was improved, most probably by the beneficial effects of a full supply of good water for drinking and bathing.'

"Here is an example of a garrison suffering from malarial poisoning supposed to be contained in the drinking water, which continued to feel the effects of malaria although the supply of water was changed from that of a doubtful character to one absolutely pure, being filtered for miles through sand, gravel, and lime-stone rock. It is apparent that the poison producing malarial diseases must be sought for in another source than in the drinking water. It is there at Fort Sill in the heat, moisture and soil which produce malarial fevers anywhere, or furnish good culture material for the bacteria that cause it. In New Mexico, where the climate is dry, though hot, malarial fevers do not exist; but turn the waters from the rivers upon the soil by means of acéquias, and malarial fevers soon abound, regardless of the source of the water used for drinking. It will be observed that for several years before the improvement of the water supply at Fort Sill the ratio of malarial diseases was smaller than after the development of the spring which gave the garrison a pure filtered water. . . . In 1881 the ratio was remarkably small, being but 59 per 1000 of mean strength; surely that could not be accounted for by any improved source of the drinking water. There may have been some meteorological cause; we know that in different years there is a marked variation in the prevalence of malarial diseases. . . . The diminution of the cases of malarial diseases at Fort Sill after 1884, when it appears that the greatest number prevailed, must be considered a sequence and not a consequence of the development of the spring of excellent drinking water. The ratio of malarial diseases at Fort Supply for the years 1884, 1885 and 1886 shows a decrease of sickness after 1884. Fort Supply, where the water supply was not improved, like Fort Sill, has a reputation of being malarious. The water supply of this post has recently been materially improved . . . but it remains to be seen if the ratio of malarial fevers will be diminished."

In the report for 1890 it is stated: "Relatively fewer of the colored troops were attacked, but the proportion of remittents to intermittents was greater among them, and the average duration of the remittent was longer—34.8 days for the colored, and only 21.2 days for the white men—an illustration of a well established fact, that when the negro becomes seriously ill he does not rally so readily as the Caucasian."

* "I have said above that the patients showed signs of paludal intoxication in all its types; actually and for the first time at Marseilles, I observed cases of continued fevers, although quinine was administered ("des fièvres continues à quinquina"). Now my investigation showed that the patients with continued fevers were precisely those who appeared to be the most saturated with the marshy water."

The duration of the sickness in these cases is much against any considerable number of them having been malaria, and the use of the words "remittents" and "intermittents" adds to our difficulty in determining the etiology.

In 1890, Fort Brown, Texas, was supplied with distilled water, and the improvement in the general condition of the post after that year is attributed entirely to this factor.

The following quotation is found in the report for 1894, p. 52: Capt. W. Fitzhugh Carter, the post surgeon at Fort Sill, Oklahoma, writing on malarial diseases, says: "There is almost conclusive evidence that the water of the streams in this section of the country is a concentrated malarial poison, and at certain times of the year will give rise to malarial fevers in a large percentage of those who drink it," and he looks to the use of distilled water for the same beneficial results that have already been obtained at Fort Brown, Texas. But in the report for 1895, p. 41, we find that Fort Brown was the fourth army post having highest admission rate for malarial diseases. Washington Barracks, D. C., and Fort Meyer, Va., just across the river from Washington, came first and second in this list; both these places are well-known hotbeds of malaria. The third in rank was Fort Hamilton, in New York Bay, where it is more than probable that the percentage of cases attributed to malaria is too large. From this we do not see that there could have been any great improvement in the condition of Fort Brown, as it never ranked first on the list. The purer water supply does not seem to have reduced the cases of malaria very greatly. On the same page of the report for 1895 we find that "nearly one-fourth of the malarial cases of the army were remittent, with an average duration of 21.5 days; the average of the intermittents was 5.75 days"—a long period for remittent, if by that we are meant to understand malarial fevers, and closely corresponding to the length of time usually given to typhoid. A supply of water supposed to be quite pure has not modified to an appreciable extent the number of cases occurring at the two army posts in Washington. Dr. Charles Smart, of the U. S. A., is an ardent supporter of the water-borne theory, but he has brought forward no convincing evidence of the truth of this theory. He believes surface waters, when used for drinking purposes, to be more dangerous than water from deep wells.

The best, and a very interesting paper that has appeared on malarial fever in these reports is by Dr. Walter Reed in the number issued this year. He has paid special attention to the cases of fever at Washington Barracks and Fort Meyer, and has examined the blood of many patients. Dr. Reed does not believe in the water-borne theory. He tells me that "the water supply at Washington Barracks has not been changed; it has always been the same as that of the city. The supply at Fort Meyer was changed in November, 1894, from well water to Potomac river water. The following year the men and officers drank, as a rule, filtered and boiled Potomac river water, with the result that there were more cases of malarial fever in 1895 at Fort Meyer than during any one of the previous 23 years. It was also higher at the Barracks in 1895 than during any of the previous 23 years." There is much malarial fever in the city of Washington, and it is really endemic along the river flats, but has no apparent connection with the drinking water of the city, since otherwise the people in the upper part of the city should naturally suffer as much, which they do not. The reports from the army posts are hard to analyze, since the officers in charge are frequently changed, and their personal views as to malaria and typhoid fever vary materially. But, as yet, all the evidence coming from the army posts is rather against than for the water-borne theory.

Through the kindness of Dr. G. M. Sternberg, Surgeon-General of the U. S. Army, I have received to-day proof-sheets of an address lately delivered by him in New York. In this he says: The facts which have been developed with reference to the transmission of cholera and typhoid fever, considered in connection with numerous recorded observations relating to the supposed development of malarial fevers as a result of drinking surface waters, have led some authors to the conclusion that malarial infection, also, commonly results from the introduction of the malarial parasite in this way. Without denying that this may occur, I am disposed to believe that much of the evidence which has been advanced in favor of this view is unreliable. In many cases the so-called malarial fevers which have been traced to the use of surface water from wells, streams, etc., have been of a "continued type" and not controlled by quinine. In the absence of positive evidence of the presence of the malarial parasite in the blood, continued or remittent fevers which resist the specific action of quinine cannot, in our opinion, be properly classed with the malarial fevers. If not due to infection by the typhoid bacillus, they are, at least, more nearly allied to typhoid than to the typical malarial fevers."

A large number of general practitioners throughout the United States believe firmly in the water-borne theory, among them Zwisohn,[7] West,[8] Waggener,[9] and Hyland,[10] but the evidence they show to support their view is most incomplete.

Daly[11] wrote a long article attempting to prove this theory, and thought that vegetables washed in marshy water might produce malaria, but his paper is unconvincing. This called forth other articles by Norbury,[12] Jones,[13] and Cadwallader;[14] the first two mentioned agree with Daly, but Norbury gives an account of an epidemic which might have been typhoid, and Jones' paper is still less satisfactory than Norbury's. Cadwallader does not believe in the water-borne theory, but thinks the home of the plasmodia is in the sap of vegetable life rich in sugar, and thinks there is danger of infection in eating maple sugar and sorghum molasses. This startling theory is balanced by an equally strange one put forth by Newton,[15] who thinks "the consumption of water-melons seemed to be provocative of malarial fever." He believes both the air- and water-borne theories have been proven, but most of his evidence is taken from the works of other men, some of whom I have mentioned, and his paper adds nothing material to strengthen the water-borne theory. Hurley,[16] like Daly, attributes malaria to drinking water, "though fruits and vegetables eaten raw may carry it." He does not believe it enters through the lungs. His proof is based on some cases, where people using boiled water were not attacked by some vague symptoms, which those who did not purify their water in this way, suffered from.

Lewis[16] believes "water to be one of the chief avenues, if not

the most important, by which malaria gets into the human system." His ideas are based on inquiries as to the origin of malaria sent to various doctors and laymen in the South; the replies of these gentlemen are almost all of them in favor of the water-borne theory; but the cases given are not described with sufficient detail to rule out typhoid in many instances, nor can infection through the air be eliminated, nor the possibility that the disease was acquired in some other locality than that where the patient was living when found sick. Many of the reports are founded on the disappearance of illness and fewer deaths in families when the supply of water was changed; the source of the drinking water often stood below the level of the houses and could easily have been polluted; many cases of illness were said to be the result of drinking cistern water. The health of the people was improved by a change in position of a well, or from driving deep wells, and not depending on surface water for drinking purposes. Such evidence cannot be accepted as satisfactory proof of malaria being the result of drinking impure water. Cowan[17] reports a number of cases which he believes support the water-borne theory, but his ideas on the subject of malaria are so opposed to the exact knowledge we have at present in regard to that disease that his evidence may be fairly thrown aside as valueless. He says: "We shall, however, assert as true that the malignant types of malarial fever, and in fact almost all forms of malarial fever, are indebted to the water we drink, and not to atmospheric conditions, for the etiological factor in the transmission or reception of the pathogenic material which produces malarial fever. . . . In contradistinction, allow me to say that water in globule never produces malaria, but becomes an absorber and retainer of this pathogenic material, and may become loaded with this poison almost to saturation. Trees, wells, springs, creeks and branches may become so loaded with this poison that a single glass of water may contain pathogenic material sufficient to produce a case of intermittent fever. Without entering further into the manner of its formation or the power of water in globule to absorb or retain this pathogenic factor and disease producer, we will endeavor to give proof that the water we drink is the great factor and principal source of malarial fever in all its forms, but especially in the malignant types."

If the cases reported by Quine[18] could be accepted without hesitation, their evidence might be looked upon as strongly in favor of the water-borne theory, but many of the facts given are so entirely contradictory of what has been proved as regards the effect of quinine on the malarial parasite that we cannot accept them—we feel sure that some mistake was made in the diagnosis. We quote the following cases in behalf of the stand we take:

Case 4. "Miss H., aged 16; has lived in Chicago many years in a good house and neighborhood. No excavations near. April, 1894, she began to be sick gradually with a continued type of fever marked by irregular fluctuations, which was labeled by the attending physician, Dr. Samuel Cole, 'typhoid fever with malarial features.' The fever continued about four weeks, and then, after an interval of normal temperature, lasting a few days, there was a relapse. The patient had taken quinine freely from the beginning. Upon the basis of two examinations made by myself during the month of May, 1894, the diagnosis of the family physician was sustained. Later the blood of the patient was examined by Dr. F. S. Johnson and the fact of malarial infection, previously assumed to exist, was demonstrated. Quinine was administered with great freedom by the mouth, rectum and hypodermic method, and arsenic and iron were also pressed systematically, but without affecting the course of the disease. The patient was seen at this time by Dr. N. S. Davis. Her illness continued over four months, uninfluenced by treatment to an important extent, and finally came to be attended with acute pulmonary tuberculosis. Death occurred five or six weeks later. *The blood of the patient crowded with plasmodia to the last.*" [The italics are mine.—R. N.]

Such resistance on the part of the plasmodia is unknown, especially when persisting in this manner for weeks. It is contrary to all the best evidence we have. Equally doubtful are the following cases reported by him.

Case 5. A girl with an alveolar abscess was thought to have contracted malaria in New York, or on her way to Chicago; but evidently the case was one of acute septicæmia, although Dr. Cole examined the patient's blood and found it stocked with malarial organisms: for "notwithstanding the administration of 40 to 60 grains daily [of quinine], and the fact that the patient was kept profoundly cinchonized, the chills and fever increased in frequency and severity. Some abscesses occurred in the site of subcutaneous injections. Malarial infection of the blood continued till the death of the patient."

Case 10. March, 1895. Woman with rheumatic symptoms and erythematous nodes. "Examination of the blood discovered small endoglobular bodies, and large amœboid endoglobular bodies containing pigmented particles in active motion." "Under anti-malarial treatment the rheumatoid pains disappeared; the erythematous nodes continued, but were lessened in number; *but the chills and fever were not benefited.*" [Italics mine.—R. N.]

Case 13. A child 3 months old was supposed to have contracted malaria from a nurse. "An examination of her blood [the nurse's] showed malarial infection. Examination of the infant's blood revealed large and a few small endoglobular bodies." "*No fever.*" [Italics mine.—R. N.]

In Case 10 the fact that "the chills and fever" were not benefited by quinine, if they were due to malaria, is incredible; and in Case 13 the statement that the child had "no fever," and yet its blood showed numerous malarial parasites, is also questionable. But the following remarks, quoted from his article, show that he does not agree with the best authorities on malaria. He says: "The proofs of water infection are quite as strong as those of air infection, and there is not a doubt that impure water is responsible for the occurrence of paludal disease with immensely greater frequency than is generally known. . . . Nor is the therapeutic test a reliable guide to diagnosis. . . . The entire absence of fever is a characteristic of many cases. . . . Quinine causes some symptoms to disappear, while others persist; and those showing periodicity may be the ones to persist." Such observations

and the doubtful proof of malaria in the cases he relates, minimize the value of the article.

Such is the evidence coming from American physicians, and certainly it is not sufficient to prove the water-borne theory. Let us now look at that offered by certain doctors in India; three papers by Ross,[19] Rogers,[20] and Hehir[21] may furnish some further proof one way or the other. Ross believes that "malaria must be originally a disease among mosquitoes" (a view brought into more prominence by Manson), and says: "We may conjecture that infection may arise from the bite, or from deposition of the parasite by the mosquito *on* the skin of the patient or in his drinking water." Rogers brings no proof, but states: "In addition to the undoubted effect of drinking water in causing malarial fever, it is also universally admitted that perhaps an even commoner mode of entrance of the organism is through being inhaled into the lungs and so reaching the blood of the capillaries." In Hehir's article we find the following:

"Malaria is mixible with water. It is capable of being carried by currents of water through distances and periods of time altogether undetermined, without losing either its toxic effects or faculty of reproduction. It is possible that this means of conveyance has affected its distributions to continents and islands too widely separated to justify a belief that it was wind-wafted. No observations need be adduced to establish the water-borne habit of the malarial poison, or the positive liability to its toxic effects, when received into the stomach through this medium. These facts have been well understood from the time of Hippocrates. The inhabitants of tracts of marshy country are pretty generally agreed that these waters may produce fevers."

He also thinks that milk left outdoors through the night in open pans may catch sufficient quantities of swamp poison to produce sickness, if exposed where malaria is rife. Daly [*loc. cit.*] also thinks that milk may carry malarial infection, through the cans in which the milk is stored being infected by dirty water in washing them. The ancients may have believed that water could cause malaria, but we cannot accept their statement as proof, nor this one of Hehir's. This evidence which comes from India, where as yet the exact differentiation between typhoid fever and malaria is evidently not generally well understood, or where the discoveries of Laveran are not accepted (ex: Surg.-Gen. Laurie), adds nothing convincing to the water-borne theory.

In Germany malaria is not common, but much has been written on this disease by Germans who have studied it in foreign countries. Shellong,[22] who wrote on the malarial fevers in New Guinea, does not believe in the water-borne theory. His is a careful study and his ideas deserve consideration. Steudel,[23] also writing on foreign fevers, believes in the water-borne theory, and refers, like so many other authors, to Hirsch for confirmation. Hirsch's work, "Handbuch d. Historisch-geographischen Pathologie," was published, however, in 1860 and, though valuable as a reference book, cannot be accepted as an authority on malaria. Leonhardt,[24] in a long and careful study, comes to the conclusion that malaria is not water-borne. He says those who believe it taken in with drinking water cannot prove this, because patients are subject to infection by the atmosphere also. Two out of three Germans, we see, do not believe in the water-borne theory. Let us now review the beliefs of the French and Italian observers on this point.

Taking up the papers first which have appeared in French, we find articles by Verdan,[25] Nicolas,[26] Pepper,[27] and Kelsch and Kiener.[28] These contributions, like the German, are on malarial diseases as seen outside of France. The malarial fevers in Algiers are ascribed by Verdan to the water supply, which is very foul, and to effluvia carried by the winds. The work by Nicolas is a long one, but there is no proper differentiation made between typhoid, malaria and other forms of fever, so that his conclusions are not much to be relied upon. He believes stagnant water to be one of the main sources of origin of malarial fevers ("mais nous en savons assez déjà pour nous convaincre que la stagnation de l'eau est nécessaire pour engendrer la malaria"), but says little about drinking water. However, it may be surmised that he believes also in the water-borne theory, since the supplies of drinking water in the countries of which he writes are often stagnant. He recommends good, pure drinking water, and says, "en ce qui concerne la malaria la preuve semble faite: l'eau d'alimentation n'y est pour rien." But as regards typhoid fever he makes the following statement: "en réalité rien n'est moins prouvé que ces relations de causalité entre l'eau et la fièvre typhoïde en particulier si savamment défendues par des observateurs très recommandables." Such statements diminish the value of his observations.

Pepper, who like Verdan wrote on the fevers in Algiers, concludes his paper, which is not a brief one, with certain aphorisms, from which I quote the following:

1. "Dans une region malarienne, la malaria domine presque toute la pathologie."

2. "La malaria est, selon nous, l'aerotellurisme proteiforme."

3. "L'intoxication se produit durant l'acte de la respiration et atteint principalement le système nerveux."

The first statement is very true, not only in Algiers but in many other countries, practitioners commonly attributing many maladies to malaria as a cause where malaria has actually no causal relation to the diseases in question. His third aphorism shows that he lays no special stress on water as producing malaria.

The final paper by Kelsch and Kiener is also against the water-borne theory. They believe infection is through the lungs, that this at least is the most common method. They think the water-borne theory is not confirmed by facts, and that the cases on the Argo do not support the theory. They say, however, that malaria may arise at sea, and relate one instance which furnishes no stronger proof than that of the Argo. Soldiers in Algeria, they note, who while marching drink foul water, are no more affected with fevers than when in camp using pure water. Towns on heights around the Roman Campagna are free of malaria, although their inhabitants drink water coming from malarious regions. This they bring forward as proof against the water-borne theory and say that foul water simply acts as a force to reduce the resistance of the body to morbid influences.

"Professor Colin, of Val de Grace, who is so well known for his researches on intermittent fever, is inclined to question the production of paroxysmal fevers by marsh water. He cites numerous cases in Algiers and Italy where impure marsh water gave rise to indigestion, diarrhœa and dysentery, but in no case to intermittent fever, and in all his observations he had never met with an instance of such an origin of ague." (Sternberg: Malaria and Malarial Diseases, 1884.) According to these French observers, then, the weight of evidence is against the water-borne theory.

The observations made by Italian physicians are among the most interesting we have. Celli,[29] one of the best students of malarial fever, has written a paper of great value on this subject. It is a short article going to prove that water does not transmit malaria. He gives a chart showing that introduction of new water supply into a certain city did not diminish the number of cases of malaria. He says popular ideas on this matter are fallacious, and notes that persons may live in a malarious place and drink pure water and yet have malaria, while others in the same place drinking foul or "paludal" water do not have malaria. He himself gave water from the Pontine Marshes, which are acknowledged to be very malarious, in large quantities to a certain number of patients who had never had malaria, without its giving birth to this disease in them. Similar evidence is furnished by Salomone-Marino.[30] He experimented in the same manner as Celli, giving 5 to 24 litres daily of paludal water for from 6 to 24 days, and did not succeed in a single instance in producing malaria. He says that those cases of malaria which are suspected to have been caused by infection through the digestive tract are usually grave cases with short periods of incubation. He relates two such cases, which, as the blood was not examined in either case, do not furnish proof of his statement. One patient was very ill and took three weeks to recover (typhoid?). Stagnant water is likely, he thinks, to contain poisonous or noxious bodies which could produce gastro-intestinal symptoms similar to those sometimes caused by malaria. Bonizzardi,[31] without relating any cases, concludes one short article with a number of deductions, from which I take the two following: "Intermittent fever may be contracted as well by drinking water as by air," and "infection by air is far more fatal than by water." Moscato,[32] who has also carefully studied the question of malarial fevers, states, without furnishing any proof, that drinking water as a source of infection has been noted daily by observers: "l'acqua potabile, come sorgente del velino palustre fu riconosciuta anche da Ippocrate; quale verita e stata anche sanzionata dagli osservatori odierni." The statement has been made that malaria may be transported from one infected district to another healthy one by a new water supply, but the proof here is not sufficient, since the turning up of the soil for the pipes may have been the real cause. Most of the Italian observers, it is seen, are opposed to the water-borne theory.

Such is the evidence that exists for and against this theory, and though we cannot say that malaria is never contracted from drinking water, yet the best proof is against this common belief. It is impossible to demonstrate that something never occurs, and we must be satisfied with showing that all the evidence that has been so far collected to confirm the water-borne theory is not of sufficiently exact quality to carry much weight. To prove that malaria is water-borne in a given case demands conditions of a peculiar character: first the patient must never have had malaria, and must live and have lived in a district supposedly quite free of malaria; after drinking a certain supply of water and allowing for the proper period of incubation, the malarial parasite must be found in the patient's blood. In the meantime no soil should have been turned up in the patient's neighborhood, he should not have exposed himself to infection in any way, as by traveling into a malarious country, sleeping out at night, etc. Even if all these demands could be satisfactorily met, there would at the present time still be the proof lacking that the malarial parasite lived in the water. Outside of the human body, we know nothing of the life-history of this parasite. It may be discovered later and found to thrive in water, in which case the probability of frequent infection through drinking water would be strongly enhanced. But it may turn out that it does not live in water for any length of time, and then the possibility of infection through this medium would be greatly diminished. All we can say is that no case among all those recorded as water-borne gives a positive finding of the malarial parasite in the blood, certainly one of the most necessary proofs to show that the patient really had malaria.

To confirm our view we have the definite knowledge that drinking water from malarial places does not produce the fever experimentally. And finally, it is probable that a large number of the cases attributed to malarial infection are not malaria, but rather typhoid, and if not the latter, then due to some auto-intoxication from the intestine. We know how many illnesses starting in with vomiting, headache, chills, diarrhœa, and even blood in the stools, sometimes rapidly ending in death, are due to poisonous articles of food; why then should we not have similar attacks which do in a measure simulate malarial infection, where the most marked symptoms are intestinal, as a result of drinking foul waters, as one of the Italian physicians mentioned above suggests? This does not seem unlikely, and until we know more of the life-history of the malarial parasite outside of the human body it is fair to question the water-borne theory of malaria.

Much light may be thrown on this question in the future by further study on the climatic and telluric conditions underlying the existence of malaria in different places; but as yet, though an enormous amount of study has been given to these very points, the results obtained by the observers do not agree altogether, and we are unable to form any definite conclusions which elucidate the life of this obscure parasite. Above all, in the study of this subject it is absolutely necessary that malaria and typhoid fever should not be confounded, as they have been so often in the past.

In conclusion I would simply add the two following paragraphs from Sternberg's Malaria and Malarial Diseases, which, though written in 1884, are as true to-day as then. He says: "It is well established that enteric fever and certain alvine fluxes may result from the use of contaminated drinking water. And in the case of the former disease, we know that even very great dilution does not destroy the infectious properties of the con

taminated water, *e. g.* in those cases where it has been used to wash vessels in which milk was placed, and in which typhoid fever has resulted from drinking this.

"That fevers having an intermittent or remittent character may also be produced in the same way cannot be doubted. But we have already seen, in the introduction to the present volume, that enteric fever frequently presents these characters; that in this case the differential diagnosis from malarial fevers presents great difficulties, and that in many parts of the world fevers of this character are attributed, without question, to malaria. We therefore feel inclined to accept the evidence with a great deal of caution. Moreover, we think that considerable weight should be accorded to the negative evidence. It would seem that if this mode of infection occurs at all, it should occur frequently, and in that case that it would be more generally recognized. From what has been said in the introduction, it will be seen that we cannot accept evidence relating to the production of 'malarial diarrhœa,' or 'malarial dysentery,' or 'mountain fever,' or 'continued remittent fever,' or 'typho-malarial fever' in any of its forms."

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Discussion.

Dr. Welch.—It is clear from Dr. Norton's careful analysis of the existing evidence for and against the water-borne theory of malaria, that the weight of evidence and of authority is decidedly opposed to this theory. It is curious how prevalent is the belief in this theory among both the general public and practitioners of medicine, especially in the southern part of this country. As a matter of fact, the only infectious diseases whose germs we have good reason to believe to be conveyed by drinking water, are typhoid fever, Asiatic cholera, and dysentery. To this meagre list may be added indefinite gastro-enteric disturbances resulting from infection or intoxication from drinking water. The numerous claims that various other infectious diseases, including malaria, may result from infection through the drinking water, do not rest at present upon any substantial basis of demonstrated facts, although it must be admitted that some of these claims have not been positively disproved. The criticism of the drinking-water theory of malaria by Celli and Leri, and above all their

convincing experimental investigations of this question, indicate decidedly that drinking water is not a carrier of the malarial organism in a condition capable of producing infection through the alimentary canal under any ordinary conditions. There seem to me to be at present only two theories of the mode of malarial infection which deserve serious consideration, viz. the theory that infection occurs through the air, and the theory that infection is the result of inoculation with the malarial parasite through the agency of mosquitoes and perhaps other suctorial insects. The question whether or not the malarial parasite may live and perhaps multiply in water would of course not be decided by the exclusion of water as a vehicle of infection, for it is possible, even probable from experiments, that infection with the malarial parasite does not occur from the intact alimentary canal, and the mucous membranes of this canal would be the only natural portal of entry for infectious agents in drinking water. The majority of authoritative writers on malaria have advocated the theory of air-borne infection, but we shall probably, since Manson's publication, hear more and more of the inoculation theory.

Dr. REED.—Dr. Norton has kindly referred to a report which I made to the Surgeon-General during August last, upon the etiology of malarial fevers at Washington Barracks and Fort Myer, during a period extending over twenty-six years. Washington Barracks is situated in the midst of marshy lands at an elevation of not more than twenty feet above the Potomac river, and upon soil deposited from this river. The post has had but one supply of water, viz. Potomac river water. During this time malarial fevers have prevailed to a greater or less extent, certain years being exceedingly severe and others comparatively light. I compared the malarial curve of that station with that of Fort Myer, which is 240 feet above the Potomac and on high ground. I was surprised to find such a close agreement between the two. Indeed, in the last eleven years of this investigation the lines ran accurately together. If the line at Washington Barracks fell below that of Fort Myer, it was accounted for by the fact that the garrison had been sent into summer camp during the malarial season. In investigating the water supply at Fort Myer, I ascertained that until 1886 pure spring water had been furnished. During the latter year certain wells were sunk in low marshy soil, from which the garrison was supplied until 1894. It was curious to note that the supply of "marshy water," which was so much condemned by the various medical officers, did not increase the malarial cases; but that, on the contrary, during the six years immediately following the introduction of this supply, the disease was less prevalent than at any other period in the history of the post. In 1894, wells were discontinued and Potomac water introduced. Filters were placed in the men's quarters and, in addition, the filtered water which the officers drank was boiled. Notwithstanding these precautions, the sick-rate from malarial diseases was higher in 1895 than during the previous twenty-three years, and corresponded accurately with the rate at Washington Barracks. All of which proved to my mind that the water supply had nothing to do with the prevalence of malarial diseases, and that their etiology was to be found in the low marshy lands lying along the Potomac river.

Dr. THAYER.—Certainly all experimental evidence points directly against the idea that malarial fever can be conveyed by drinking water, and more than that against the idea of an infection through the alimentary tract. Grassi and Feletti fed patients upon the dew collected from malarious districts, and further upon fresh blood taken from patients suffering from malarial fever, blood which, as is well known, if introduced hypodermically or intravenously, always results in a transference of the infection, without any positive result. Despite the fact that the patients on whom these experiments were made were often debilitated individuals suffering from chronic nervous diseases, etc., yet as they were, in almost all instances, in hospitals or in situations where they were well fed and well cared for, it would be impossible to entirely refute the critic who might suggest that it was the good surroundings which saved the patients from a progressive infection which otherwise would have occurred. Such a critic might suggest that had these individuals been suffering from distinct gastro-intestinal lesions, infection would readily have occurred. In connection with this possibility it is interesting that out of 46 cases of amœbic dysentery which we have had in the Johns Hopkins Hospital, 5, or nearly 11 per cent., have suffered at the same time from malarial infection. May it be possible that the amœbic ulcers were in these instances the portals of entry for the malarial parasite? It must of course be said, upon the other hand, that most of these instances of amœbic dysentery occurred during the malarial season and came from districts where the malarial parasite is doubtless endemic.

Dr. Norton's quotation from the author who thought he had found a large number of endoglobular, hyaline parasites in infant's blood is interesting, inasmuch as any observer who is familiar with examinations of fresh blood will immediately see how the author quoted has deceived himself. The vacuolic-like figures found particularly in the blood of children or infants who are anæmic or suffering from fever of any sort, simulate often very closely the malarial parasite, and always deceive the uninitiated; to the skilled observer, however, they are readily recognizable.

THE RADICAL CURE OF HERNIA BY IMPLANTING A SECTION OF STERILIZED SPONGE.

By W. B. Platt, F. R. C. S. (Eng.)

[*Read before the Johns Hopkins Medical Society, January* 4, 1897.]

The radical cure of hernia has long enlisted the attention of surgeons, and a method which is efficient, safe, reasonably simple, sacrificing no important part or function, causing little inconvenience and demanding but a short confinement to bed, has been eagerly sought. To simplify matters, the older surgeons cut the Gordian knot by removing the testicle and cord of the affected side. The presence of the cord at the end of a shallow funnel seemed to be the obstacle to the complete closure of the inguinal canal and rings, the pressure of the intestines acting as a wedge to keep them open.

To remove the cord by transplanting it to another location was the next step of the modern surgeon, and an efficient means of cure. The hernia oftener failed to return than by other methods. Certain drawbacks in this procedure are often noted, such as prolonged confinement to bed and great swelling of the testicle, so great in fact as to throw some doubt upon the future function of that organ, while very large incisions in the abdominal wall, a long cicatrix, a multitude of buried sutures, made the operation more complicated to the surgeon and less agreeable in the end to the patient.

The writer has endeavored to efficiently close the inguinal rings and canal by a more simple procedure, and this can be done. The cases are all too recent to prove the permanency of the cure. He can only say that two cases of intractable hernia have been up and about for several months, and have never worn any truss or support of any kind since getting out of bed.

The idea of implanting a section of sponge in the inguinal canal which should form a firm connective tissue barrier to the descent of the hernia, occurred to the writer while experimenting upon rabbits in the Physiological Laboratory of the Johns Hopkins University in the spring of 1882, and observing the normal retraction of the testicle into the abdominal cavity in these animals.

As inguinal herniæ are not readily produced in animals of this kind, I endeavored to so implant a piece of sponge within the inguinal canal as to retain the testicle in the scrotal pouch. The aseptic technique of that day was so imperfect that suppuration ensued and the sponge came out.

Later, I operated on a number of patients at the Garrett Hospital for Children, by simply removing the sac, suturing the conjoined tendon to Poupart's ligament, and sewing up the inguinal canal.

This succeeded very well in most cases. I have one of these cases here to-night, done five years ago. He has had no return of the hernia and wears no support or truss. The return of the hernia, however, in a case where I had every reason to hope for a permanent cure, led me to try the implantation of a section of sterilized sponge. The result certainly proved one thing, viz. that a piece of sterilized sponge as large as half a dollar could be introduced beneath the internal ring and remain there without causing any irritation, the wound healing over it and remaining healed.

Before this healing took place there was in my first case a small sinus at the upper part of the incision and I feared it might be due to the sponge. It turned out to be due to sutures, and these being removed, the wound healed without further trouble, but after five months the hernia came down. I operated upon this patient a second time, intending to insert a second piece of sponge. To my surprise I found an opening less than one-fourth of an inch in diameter in the location of the external ring. I inserted two small sutures, the wound healing promptly over them. The sponge in this first case was simply *laid* beneath the ring.

In the succeeding three cases the section of sponge was secured to the cord. One description of the operation will suffice for these cases.

An incision about two and one-half inches long is made directly over the inguinal canal, following its course, the lower end extending about half an inch upon the scrotum. If the hernia is down, the operation is so much the easier. The canal is laid freely open. The sac, whether congenital or acquired, is opened in its entire length, the hernial contents reduced, and the sac cut away close to the internal ring, if congenital, while if it is an acquired sac it is cut square off after being ligated as high up as possible, and dropped beneath the ring. In the case of the congenital sac it is often necessary to leave the thin inferior layer *in situ* and adherent to the cord.

Next, a section of fine, firm, surgical sponge is cut about one and one-half inches in diameter and one-eighth of an inch in thickness. This is sterilized without boiling, by immersion in soda solution, washed in sterilized water, treated with permanganate of potash and oxalic acid, and thoroughly washed in sterile normal saline solution. A radial cut is made in the section. The constituents of the cord are gathered together as high up as possible and placed in the center of the section and at a right angle to it. The edges of the cut in the sponge are now slightly overlapped, and two sutures inserted in the sponge to keep it in place on the cord which now pierces its center. The sponge section is spread out beneath the internal ring, and the conjoined tendon sewed firmly by two or more quilted sutures to Poupart's ligament, using a needle in a handle.

The inguinal canal is now snugly sewed up with silk sutures, and over all the skin sewed with silk-worm gut. It is absolutely necessary to use some kind of drainage in the upper angle of the wound, as there is invariably some serous oozing and swelling. This may be removed after 24 hours.

The patient is confined to bed and on his back for three weeks. If the patient is a boy it is well to use the Bradford frame, to keep him from sitting up and twisting about in bed. The skin sutures are removed on the 9th or 10th day, the wound being treated on ordinary aseptic principles.

After three weeks the patient is allowed to sit up in bed a day or two, then sits for two or three days in a chair, after

which he goes about as usual. It is unnecessary to use any support over the site of the operation beyond a light strip of gauze to protect the fresh cicatrix from friction.

In two of these cases where I was obliged to remove the deep silk-worm gut sutures before the patient left the hospital in order to close an obstinate little sinus in the upper angle of the wound, the hernia returned, as might have been expected. The trouble with these sutures may have been due to too great tension, or to a defect in the sterilization of the sutures. In none of the four cases was there any trouble from the sponge. In the two cases mentioned the wound healed promptly on removing the offending sutures. In the two other cases there was no difficulty whatever in securing complete permanent first-intention union, and there has been thus far no return of the hernia.

It is of course premature to say that there may never be a return of the hernia, nor do I know the ultimate fate of the sponge, whether it remains as organized tissue or whether it is absorbed.

From its open structure and the ease with which it is retained in the tissues it is not improbable that blood-vessels pass into it, and that it makes a framework for connective tissue, a close imitation of that barrier which nature places beneath all normal, internal, inguinal rings and which prevents every male from being a subject of hernia.

It is hardly necessary to say that the greatest care must be exercised in the perfect preparation of the sponge section to insure perfect sterilization. I have the pleasure of showing three of the four sponge cases; also one of the older cases, where the rings were simply sewed up and no sponge section used.

ABSTRACT OF CASES.

All the following cases were operated upon at the Garrett Hospital for Children, Baltimore.

1) G. L., æt. 4. Complete inguinal hernia, right side, developed at two years of age, and is not kept up by trusses. Operation August 21, 1895. One deep suture causing a small sinus was removed 55 days after operation. Patient was discharged from the hospital, October 22, 1895, with the wound entirely healed. It has never since reopened. Hernia reappeared 5 months after operation. The return of the hernia doubtless due to the early removal of the suture closing the internal ring.

2) S. J., æt. 8 years. Complete inguinal hernia, right side. Hernia developed when 2 years old. No truss effectually keeps up hernia. Admitted June 9, 1896. Operation June 17, 1896. Congenital variety of sac. Patient was walking about July 26, 1896. Discharged with the wound entirely healed, August 7, 1896. There has been no return of the hernia at the date of this paper.

3) T. W., æt. 12 years. Acquired inguinal hernia, right side. Ruptured since 2 to 3 years of age, and has been kept up with difficulty. Admitted to hospital August 4, 1896. Operation August 19, 1896. Out of bed September 18th. Walking about September 23. Discharged well with wound healed September 25, 1896. Patient is a student at the McDonogh Institute. There has been no return of the hernia up to the date of this paper.

4) G. M., æt. 5 years. Complete inguinal hernia, left side. Hernia appeared at 3 years of age. Trusses do not retain the hernia. Admitted to hospital August 18, 1896. Operation August 26. The wound healed at first. After about a week a small sinus appeared at the upper angle of the incision. This persisted, until on December 10th two deep sutures were removed, after which the wound promptly healed, and patient was discharged well with wound healed, December 24, 1896. Patient was seen January 1, 1897, when the hernia had begun to return, as evidenced by an elastic bulging tumor at the seat of the internal ring.

NOTES.

In Cases 1 and 4, where the hernia returned, it is clear that the soft tissues of the recent operation were subjected to undue strain by the early removal of the most important sutures concerned in the operation, viz. those binding the conjoined tendon to Poupart's ligament. In all four cases the sponge remained without causing any irritation, the incision healing in each case.

I have not had an opportunity in any case to discover the actual condition of the implanted sponge after the lapse of time.

If sponge will thus heal in the depth of a wound, there is no reason why mats of silk or of other animal tissue might not also be used, and sutured firmly in place to close the openings of exit for herniæ.

It is not impossible that the addition of these animal tissue barriers may be the element necessary to make the former operation of suturing the rings and canal without transplanting the cord, a success in the very great majority of cases.

In no case was any support worn after the patient got out of bed, and in all cases the hernia was operated on because of the intractable nature of the hernia, no truss or support keeping the hernial contents in the abdomen, with the exception of No. 3, where a truss proved so great an annoyance that his family desired operation.

DISCUSSION.

Dr. BLOODGOOD.—I cannot say from observation whether the scar tissue formed with the sponge is any stronger than that formed without it. A study of the statistics of operations for hernia will show that sometimes very simple operations will cure hernia in children. In looking over the cases of different operations, such as MacKewen's, Banks' and others, we find very few recurrences in children. We have found it so here, even in the cases where the wound suppurated and healed by granulation. It is interesting to know that a foreign body can be implanted in the tissues without giving rise to any trouble. Our observations here have caused us to think that silk sutures are more apt to cause suppuration than silver wire, and that the ideal suture would be an absorbable one.

It is unfortunate that Dr. Platt has not had an opportunity to operate upon a recurrence in order to see what becomes of the sponge. I would ask him if he thinks the sponge remains permanently and if he has any observations to show that the scar tissue about the sponge is any firmer than ordinary scar tissue.

Dr. PLATT.—I have not yet had a chance to learn the ultimate fate of the sponge, but I think I shall determine it in the case of this boy whose hernia has returned. I have been surprised that his hernia has not returned sooner, for when I was obliged to remove the deep sutures to close the sinus I expected that it would soon recur.

My belief is that the sponge becomes incorporated into the tissues by aid of leucocytes and the blood-vessels which enter its meshes from the adjacent structures, and that when their work is done these probably atrophy, leaving scar-connective tissue. Whether it is stronger and thicker than other scar tissue I do not know, but will take the first opportunity to find out. After the ordinary Banks operation a funnel opening is left, and the cord acts as a guide to further the descent of hernia. My idea is that by putting in the sponge you obviated perhaps the last fault in the stitching operation, and thus get on without transplanting the cord. It is, of course, too soon to draw conclusions as to the final result from these four cases. I shall report again after operating upon this patient.

ADDITIONAL CASES OF DERMATITIS DUE TO THE *x* RAYS

By T. C. GILCHRIST, M. R. C. S., L. S. A.

During the time which intervened between the correction of the proofs of my article on "A Case of Dermatitis due to *x* Rays" and its publication, there have appeared in the literature a number of quite recent cases which have come under my notice and which could not be incorporated in my paper (*vide* Johns Hopkins Bulletin, February, 1897). I therefore add five more cases which have been recorded in various journals. Dr. Reid's case is of particular interest because a cutaneous lesion was not only produced on the anterior surface of the chest which was exposed to the rays, but also on the posterior aspect of the chest and on an area which he thinks corresponded to the exit of the rays.

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A. B. Kibbe: New York Medical Journal. January 16, 1897. Vol. LXV. No. 3.
M. Rendu: New York Med. Journal. February 20, 1897. (Abstract from Progrès Médicale. January 30, 1897.)

Recorder.	Duration.	Distribution.	Character of Lesions.	Subjective Symptoms.	Remarks.
Dr. W. Downe.	Eruption appeared 10 days after exposure.	Back of neck and scalp.	Extensive vesication on the back of the neck. The hair fell out over occiput, but the skin remained normal.	At first a sense of pricking heat.	No further observations given.
Dr. Sewell exhibited a similar case at the same society meeting. (See references.)					
Dr. W. Reid (personal).	Eruption appeared in the evening of the same day. Two exposures, varying from 20–90 minutes.	Chest and abdomen.	First an erythema, followed by papules, and later by exfoliation of the epidermis, which exposed a raw, painful, weeping surface 16 days after exposure.	Painful after the weeping surface was formed.	10-inch coil was used 3 inches from the skin.
Dr. A. B. Kibbe.	20 exposures from ½–5 minutes of left hand, and 3 exposures of elbow. Eruption appeared in a day or two.	Both hands and elbow.	First a slight tingling, then a sense of irritation and itching; 10 days later extensive discoloration round elbow. No vesicles appeared.	At first tingling, followed by itching; but there was no sensitiveness or pain.	Arm was covered by the usual clothing, viz. heavy woolen clothing and coat sleeve. Portion of the skin was excised from forearm for histological examination.
Dr. M. Rendu.	Rays applied daily for 55 minutes.	Chest.	After first application of rays intense erythema appeared, followed by vesicles and later by an eschar which did not heal for several weeks.		

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of October 19, 1896.

Dr. Thayer in the Chair.

Rarer Cases of and Observation on Streptococcus Infection. —Dr. Bloodgood.

Case I.—The first case is of especial interest because the patient recovered, although on two occasions pure cultures of the streptococcus were obtained from the blood by aspiration of a vein in the arm. In the records of the hospital only one other such observation had been made—that of Dr. Blumer, in a case of broncho-pneumonia.

In all other cases of streptococcus infection which have recovered, from which blood cultures have been taken, negative results have been obtained.

This case also presents the rare condition of a streptococcus infection of the finger, with an abscess situated between the pectoral muscles, but no evidence of any enlargement of the glands in the axilla. The abscess was distinctly localized and no other abscesses developed.

The patient presented to you to-night was admitted into the hospital, January 28, 1896. A history could not be obtained, as the patient spoke only Polish. He appeared about 25 years of age, strong and well nourished. There were two healed wounds covered with a dry scab on the index and middle fingers of the left hand. The fingers and entire arm presented no evidence of inflammation. The axilla was soft and not tender. The skin over the upper part of the chest was slightly red and œdematous. The greater pectoral muscle was more prominent, and beneath it there seemed to be a fluctuating swelling. The aspirating needle withdrew some thin purulent material. Examination of coverslips demonstrated polymorphous leucocytes and cocci in short and long chains. The rectal temperature registered 104°, pulse 80, respiration 24.

An incision was made through the skin and through the greater pectoral muscle in the direction of its fibres, opening a large localized abscess.

Cultures from this abscess and from the blood taken from a vein in the opposite forearm contained in 48 hours numerous colonies of streptococci. Two days later blood cultures also showed colonies of streptococcus; three observations after the fifth day were negative.

The patient had fever for 16 days, the rise of temperature being from 101° to 104° and frequently 105°. Recovery followed. The wound healed and there was no loss of function of the muscles.

The early diagnosis of fluctuation, due to fluid beneath a large muscle, is a very difficult one. The muscle itself, when relaxed, gives to the fingers a sensation of fluctuation. For this reason in this case the aspirating needle was used to confirm the diagnosis of a deep abscess.

Case II.—The second case presented to-night is of interest because of the very high temperature—106.5° rectal—which was associated with the beginning of an attack of erysipelas of the neck and face. The patient recovered. Five weeks before the attack of erysipelas a large mass of suppurating and adherent glands had been removed from the neck. The wound had healed with the exception of the small granulating area. The patient had been walking about for two or three weeks, with no rise of temperature. There were no cases of erysipelas in the wards. The attack began with a chill, and a temperature of 106.5°, taken one hour after the chill. Coverslips made from the granulating area showed cocci in long chains. No erythema could be seen. The patient was a colored man and only very deep redness can be made out. He was immediately transferred to the isolating ward and given a bath for 20 minutes, the temperature of the water being 70° F. The fever was reduced to 103° and did not rise above 104.6° afterwards. Later the skin of the neck and face became very red and œdematous; no abscesses formed. Coverslip and culture demonstrated streptococcus. Two blood cultures were negative.

The only treatment followed was cold sponging and local application of cold cloths to the neck and face.

During the last two years we have made a great number of coverslip examinations from the surfaces of granulating wounds, and also from cases in which there has been an attack of erysipelas. In almost every case in which there has been an infection of the streptococcus of erysipelas we have demonstrated in the coverslips taken from the granulating wound cocci in short and long chains, and in every case cultures and the clinical course have demonstrated the infection to have been due to the streptococcus. In the coverslips from healthy granulating wounds we have never found the cocci in chains. But only a few were studied also by cultures; in these few, only staphylococci grew. These observations have aided us in the early diagnosis of erysipelas.

Death from streptococcus infection has been a very rare event. These organisms do not seem to have with us the virulence which in former years they must have had. In reading Billroth's and others of the older surgeries one is impressed with the large death rate from erysipelas and streptococcus infection of wounds.

There have been two interesting observations, in both of which, although the skin over a large area, including the lines of incision, was the seat of a very intense erysipelas, yet the healing of the wound was not interfered with. Both patients recovered.

The first patient was an old man, from whom a V-shaped piece had been removed from the lower lip for epithelioma, and the entire chain of glands beneath both sides of the jaw excised. Both wounds were closed. An attack of erysipelas began on the second day, starting from the lip and extending over the entire face and neck. The lines of incision healed *per primam*, and there was no deep suppuration.

The second case was a boy, from whom a large mass of inflamed glands had been excised from the axilla. The mass was very large and very adherent to the vein. Both pectoral muscles were divided to aid in the complete removal. During the dissection along the vein a small abscess cavity was opened, infecting the wound. The wound was irrigated with $\frac{1}{1000}$ bichloride, the pectoral muscles sutured and the skin closed. Cultures from the glands demonstrated streptococcus. The

adenitis followed an infection of the finger. 24 hours after the operation an attack of erysipelas set in, beginning in the line of the incision. The erythema covered part of the chest and neck. Coverslips and cultures from a small opening in the line of the incision demonstrated streptococci. The patient recovered; there was no suppuration of the closed wound; there was no impairment of the use of the pectoral muscles.

These two cases demonstrate that the skin over a closed wound may be the seat of erysipelas and yet the healing of the deep wound may not be interfered with.

Dr. FLEXNER.—The case reported by Dr. Bloodgood is of much interest from a theoretical as well as a practical standpoint. Experiments upon animals have led us to consider that the invasion of the blood by pathogenic bacteria, capable of setting up actual septicæmias, takes place a short time only before death, and in the great majority of instances, if not in all, presages a fatal termination. Flügge pointed out that in anthrax infection in the rabbit the bactericidal effect of the blood-serum is lost before this micro-organism is found in the larger blood-vessels. In pneumococcus infection in the same animal the blood invasion occurs a short time only before death.

Now since cultures are so readily made from the circulating blood of human beings we may expect important contributions to our knowledge of the occurrence of pathogenic bacteria in this fluid, and also of the capacity of the human organism to resist and overcome these parasites when they have once entered the blood and perhaps even increased there.

The elimination of the primary focus of infection must be of the greatest importance in these cases, for it is certainly probable that from this site where the parasites are rapidly increasing not a single infection occurs, but a succession of invasions of the blood takes place. Perhaps after all, where recovery occurs, the power of the body fluids and cells to dispose of considerable numbers of the pyogenic cocci is not actually lost, and those present in the blood have entered from without and temporarily, at least, have not increased in the circulating blood. Under these circumstances the removal of the primary focus of infection before the bactericidal effect is lost, would in all probability determine the issue of the case.

We are told by Baumgarten and by Stern that one does not meet in human beings examples of septicæmia comparable to those seen in some of the lower animals. I think there is reason to doubt these statements, for we have seen at autopsy cases of streptococcus and staphylococcus infection in which the blood was crowded with the organisms and wide-spread capillary thrombi of cocci existed in the internal organs.

Much discrepancy has been noted by writers upon the subject of the virulence of streptococci obtained from severe infectious processes in human beings. The results of the cultivation experiments of Marmorek seem to give the explanation of the variations observed. It is an old observation that a minute quantity of the fluid containing streptococci from the inflamed peritoneum might show great virulence and set up a severe and perhaps fatal infection, while the cultures from this source may be quite without pathogenic effects. Marmorek has made it probable that the difference depends upon the unfitness of artificial culture media for preserving the virulence of the streptococcus pyogenes. Through the use of human blood serum as a medium of cultivation he succeeded not alone in retaining the virulence of these micro-organisms for a time, but actually of increasing it, by successive passages through the bodies of animals and recultivation, to a remarkable degree. Finally it is no criterion of the vitality of streptococci to test them upon artificial media, for Marmorek has also shown that cultures apparently dead are still capable of growth when transplanted to his blood serum medium.

Ophthalmoplegia Externa.—Dr. H. WOODS.

On taking charge of the Presbyterian Eye, Ear and Throat Hospital in September, 1895, I found in the ward, D. C., 72 years of age, under treatment for corneal ulcer of the left eye. This, I was told by my friend and associate, Dr. F. M. Chisolm, had followed an operation performed by him during his service in August, for complete left ptosis. A slight iritis developed after he came under my care, but from this as well as from the ulcer he made a good recovery. Corneal opacity is peripheral, and a few pigment pin-point stains are on the capsule. The right eye is centrally blind from choroidal atrophy, but has eccentric vision. It was discovered during this visit to the Hospital that the extrinsic eye muscles were paralyzed. The paralysis is not absolute, for both eyes can move perceptibly up, down and laterally. He left the Hospital before the corneal ulcer was completely healed, returning in March, 1896. He gives the following history:

Prior to 1861, when he enlisted in the Federal army, he had good sight. He claims to have undergone medical examination at Williamsport, Pa., before enlistment. This is important, for the "Surgeon's Certificate of Disability for Discharge," which I have obtained from Washington, is as follows: "The injury to the eyes of said soldier was caused by over-exertion in lifting heavy timber in the year 1857." Signed by Captain.

The Brigade Surgeon's certificate is: "This is a case of ptosis; but having a suspicion that the loss of vision is feigned, the subject is respectfully referred to the Medical Director for decision." The discharge was approved by the Board of Inspectors. This bears date of February 15, 1862. It appears, then, that the only testimony of trouble before enlistment comes from the captain of his company. Against this there are the patient's statement, the nature of the trouble as given by the Brigade Surgeon—ptosis, and the somewhat weighty improbability of a man with double ptosis being enlisted.

To return to the history, as given by the patient. In November, 1861, while marching rapidly early in the morning, he fell, with a number of others, into a stream and was thoroughly drenched. Within an hour afterwards both eyes were closed. He was unable to raise his lids. He was sent to camp, and discharged the following year, as recorded. For several months he was blind, being able to see only by elevating the upper lid. Then some power slowly returned in the right lid. In 1867, Dr. Brown, of Addison, New York, removed a piece of skin from the right upper lid, adding

greatly to his comfort. From '67 to '95 he relied entirely upon his right eye. Left ptosis remained complete. His occupation was gardening. In the early summer of '95 he noticed occasional floating specks before the right eye; "frequently tried to brush away a fly."

One Monday morning in July he went to his gardening as usual, but soon found he could not see clearly, also that he "put his foot where he did not mean to, *on*, instead of *between* his cabbage rows." He held open the left eye to make his way back to the house, and early in August appeared at the Presbyterian Eye and Ear Hospital. A central choroiditis explained his right blindness. Dr. Chisolm operated as stated, to give him use of his left eye, upon which he now depends. The muscular condition, noted partially in September, and more accurately in March, is as follows: Complete ptosis both sides. The operation on the left upper lid has given a larger palpebral opening than that on the right. The right orbicularis is constantly twitching. Though he can close each eye and wink, that power in the orbiculares is diminished is shown by failure to close the lids tightly—as in blepharospasm, for instance—or to resist in the slightest degree forcible separation of the lids. He seems to retain control of the palpebral and to have lost use of the orbital portion of the orbicularis. The eyes themselves are fixed, the right diverging slightly out and up. When told to look in different directions he turns his head. There is, however, such slight motion up, down and laterally as already mentioned. Convergence and, so far as can be ascertained, rotation by the obliques are lost. The intrinsic eye muscles are spared. Each pupil responds to light, possibly a little tardily in contraction to moderate light, dilates under cocaine and contracts to eserine. He reads ordinary print with a convex 3.5 D, and has with this a range of 2 or 3 inches. Distant vision in the left eye is $\frac{15}{100}$, owing, most probably, to pigment deposit on lens capsule. Each papilla is normal. In the right eye there is central choroidal atrophy. Form field, barring the right central scotoma, is normal. This scotoma extends 10 degrees in all directions, except downwards, where it is 20 degrees.

When C. returned to the Hospital in March he asked, "Why, when I want to put my foot on a place, do I put it where it ain't?" This question is at the bottom of some curious things for which an explanation is not easy. With both eyes open he will reach to the right of an object held in front of him, with his right hand, but grasp it correctly with his left. Similarly, he will put his right foot to the right of an object, a narrow ruler, for instance, upon which he is told to step, but place his left foot correctly. With the right eye closed he grasps correctly with either hand and places each foot correctly. If the left eye be closed he either feels for the object or, turning his head for eccentric fixation, reaches it. When he leans far over, getting close to the ruler on the floor, he places his right foot at times correctly. He did not know his eye muscles were affected until told so at the Hospital last September. I asked my friend, Dr. Thomas, to examine the patient, and his report is appended:

"The frontalis muscles are in constant over-action and possess a normal amount of power. The corrugator supercillii acts with a fair amount of power on both sides. The right orbicularis palpebrarum is the seat of frequent momentary contractions; at intervals there can be seen in the left lower eyelid muscular contractions which are synchronous with these. The right orbicularis is able to close the eye completely, but it is much weaker than normal, as the patient is unable to resist even slight traction on either eyelid. The left orbicularis, weaker than the right, is just strong enough to close the eye. The other facial muscles act well and with equal force on the two sides.

"The muscles of mastication and those of the tongue act normally. No disturbance of sensation can be discovered in the face.

"The electrical examination shows that the facial nerve on both sides can be stimulated with a faradic current of moderate strength, the orbicularis palpebrarum taking part in the muscular contraction.

"To direct stimulation the orbicularis on both sides responds to the faradic and galvanic currents, but stronger currents must be used than is usual. The response to the galvanic current is sharp and quick. The right orbicularis responds to currents of less intensity than the left. The other facial muscles act normally.

"The involvement of the orbicularis in association with ophthalmoplegia is of great interest, bearing out, as it does, Mendel's view that this muscle receives nerve-fibres from the nucleus of the third and fourth nerves. Birdsall and Hughlings-Jackson have reported similar cases.

[Signed] H. M. Thomas."

Dr. Theobald.—I do not know of a case that I have met with in which there was a paralysis of the orbicularis associated with general ophthalmoplegia. I have, however, met with several instances where all of the external muscles of both eyes were involved. I have also met with cases where all of the recti muscles were involved without implication of the oblique muscles. These cases were almost invariably of specific origin.

A Simple Contrivance for Effecting Pneumatic Massage of the Tympanal Membrane and Ossicles.—Dr. Theobald.

Any apparatus which proves of use in dealing with affections of the middle ear is likely to be of especial value, for the reason that middle ear troubles are very common. Probably more than 75 per cent. of all the cases of impaired hearing which we encounter are due to changes in the middle ear. Deafness from nerve lesions is comparatively rare, forming not more than 2 or 3 per cent. of the cases of deafness met with in hospital and dispensary practice. Middle ear deafness is commonly the result of a chronic catarrhal inflammation, or perhaps of an acute inflammation of a higher grade, with plastic exudation. The changes are of one or two characters; either we have a sclerosis of the articulation of the ossicles, especially of the stapes, where it articulates in the oval window; or there is a formation of bands which attach one ossicle to another, or one ossicle to some part of the wall of the tympanic cavity, in such a way as to interfere with the movement of the ossicles in response to the sound waves. Various devices

have been made to overcome this rigidity or ankylosis of the delicate joints in the middle ear, and especially contrivances which have been described as effecting one form or another of massage. There have been several distinct kinds of massage of the ossicles and tympanum proposed. One is a direct form of massage, pressure massage. The original way in which this was accomplished was by pressure with a delicate probe upon some portion of the malleus, either upon the short or the long process. This produced a certain amount of motion throughout the ossicular chain and in the various joints. More recently electricity has been brought into play in this direction, and one contrivance has been made by which the rapid motion obtainable from the electric current has been made use of to operate a delicate probe which has a spiral spring in it. This probe strikes repeated delicate blows upon the long or short process of the malleus. Another form of massage is designated as phonetic massage; that is, sound is used to produce vibrations of the tympanic membrane and ossicles. Several contrivances have been used for this purpose. One form is the phonograph, in which the sound is carried by tubes to the ear. The phonograph cylinders are cut deeply, so that the sounds are especially sharp and distinct and produce greater mechanical effect.

Pneumatic massage obtained by means of variations in the pressure of the air in the auditory canal is a third method. As far back as 1771 this method of influencing the movement of the ossicles was suggested by Cleland. More recently, this early experiment having been lost sight of, Moos suggested it again. There are several ways in which this has been brought about. The use of the Politzer bag is one method. This forces out the tympanic membrane and moves the delicate joints of the ossicular chain. Another method is with Siegel's pneumatic speculum, by means of which the air in the auditory canal is alternately condensed and rarefied, and thus the tympanal membrane is moved back and forth. One objection to this and other similar contrivances is that the power exerted is too great, and unless they are used with much care, serious injury may be done. If the pressure either outward or inward is too great there is a possibility of rupture of the tympanic membrane, or hemorrhage may be produced. I do not think that marked beneficial results can be claimed for any of these forms of massage, although undoubtedly in some instances they do good, and it is a method which every one should be able to employ in treating ear maladies. One or two things are essential in order that this method may be employed with the hope of doing good. In the first place, the nature of the contrivance should be such that harm is not likely to be done in its use, as is the case when large air bulbs are used. If one uses a large air bag like the Politzer bag, a very little pressure of the hand will produce a marked variation in the density of the air in the auditory canal. Such a contrivance as this it is out of the question to place in the hands of a patient. It is essential in these cases, which are almost always chronic, that the massage should be of such a character that the patient may be able himself to practice it, and this is what I had in mind in contriving this apparatus. The bulb should be so small that one can do no harm in using it. This instrument consists simply of the rubber bulb taken from an eye-dropper, placed upon a small hard rubber tube with a bulbous tip which fits tightly into the auditory canal, rendering it air tight. This can be used in two ways. In the first place, we can compress the bulb before inserting the tube in the ear, and then by letting go the small bulb we rarefy the air and draw the membrane out. On the other hand, we can place it in the ear tightly, and then by squeezing the little bulb we drive the drum membrane in. I direct my patients to reverse the action, at one time drawing the membrane out, at another pressing it in. Hynson & Westcott have made these instruments for me of several different sizes, so that they will fit any ear.

Excision of a Parovarian Cyst without Removal of its Ovary or Tube.—Dr. KELLY.

I will speak this evening of a new step in the conservative treatment of the uterus and its appendages. Before speaking of the subject in hand, I will call attention to a few of the advances we have made in the past few years. We no longer think of taking out the ovaries for enlarged Graafian follicles. If such a follicle is found it is simply exsected and the ovaries sewed up; small follicles may be punctured or treated by the cautery as recommended by Pozzi. Cysts of the corpus luteum may be treated in like manner.

These parovarian cysts (showing pictures) were all removed several years ago and treated radically by removing the tube and ovary as well. I would not treat them so now, as I shall shortly demonstrate. This conservatism extends also to the tubes. Prof. Martin of Berlin has succeeded in saving quite a number of diseased tubes without hurt to the patient and with full restoration to health. Last year I removed from a patient the tube of one side and the ovary of the other, laid the ovary and the tube both down behind the uterus, and the lady, who is the wife of a physician, returned home and has since borne a child. Still graver affections also come under this conservative treatment. We have for some years past been treating accumulations of pus behind the uterus, by puncture, evacuation and simple drainage through the vaginal outlet, even when the pus is in both tubes and ovaries. This has been followed by a large number of perfect recoveries. Occasionally the patient will return and require another drainage operation; the ovaries and tubes can be removed later with greater ease, if necessary. In cases of myomatous uteri I have removed as many as 9 myoma through 7 incisions and had perfect recovery and perfect relief follow. I demonstrated last week the possibility of exsecting as many as 16 myoma without opening the uterine cavity.

The particular new subject along these lines of which I wish to speak to-night is simpler than many of the steps already taken, from a surgical standpoint, and yet, so far as I know, it is novel and is one of the last to follow in the line of conservative effort: that is, the removal of certain parovarian cysts without sacrifice of the correlated ovary and tube. To show how simply this may be done, I pass around specimens of such cysts in which the tubes and ovaries were also removed. It is evident at a glance how simple a matter it would be to remove these parovarian tumors and then to sew up the incision area after the enucleation. The first case I operated upon conservatively was in November, '95. The

patient was suffering a great deal with pelvic pain, and the doctor who had examined her felt two tumors in the pelvis and sent her to me with the statement that both ovaries would have to be removed. I found one cyst the size of a hen's egg before the uterus and another behind it. On opening the abdomen the cysts were both found to be parovarian; they were in the mesosalpinx, and the ovaries were displaced and separated from the tubes by them. I treated the tumors in two different ways, both giving the same result. In one, after ligating the larger vessels a little distance from the tumor, I made an incision through the peritoneum where the vessels were fewest, and I easily shelled the tumor out of its bed and then sewed up the peritoneum with a continuous catgut suture. On the other side I excised a portion of the redundant peritoneum while the circulation was controlled by the finger of an assistant, turned the tumor out and stitched up the wound with catgut. The uterus which had lain in retroflexion was suspended by two silk sutures by my method. Both ovaries were thus left intact. The patient made a perfect recovery, has kept her functions, is normal and regular, and in good health. This, I think, with the other circumstances cited, is one of the last and not least important of our gynecological advances, of particular importance to young women and women in the prime of life.

Dr. WELCH.—How large a proportion of these cases are eligible to this treatment? As one who sees the ordinary parovarian cysts after operation and at autopsy, it is not clear to me how they can be taken out without removing at least the tube. The cyst grows between the layers of the broad ligament (there is no mesosalpinx, the layers are all separated), and the cyst comes up against the Fallopian tube, and, in some cases at least, it would be impossible to dissect it from the tube. The ovary may be quite well preserved, but not unfrequently it is spread out over the surface of the cyst. I suppose Dr. Kelly does not mean that the conservative operation can be done in tumors of that kind, but refers to tumors of only moderate size.

Dr. KELLY.—Yes, the operation is most easily applicable to tumors of medium size, but can also be applied to many of the larger ones. In all of those cases where the cyst is thin walled and more or less pellucid, by slitting the capsule and evacuating the tumor, it can then be drawn out from under the tube, even though the tube is flattened out as shown in this specimen which I pass around. I would exclude from such treatment all those cases in which papillary elements are visible.

Meeting of November 16, 1896.

Dr. THAYER in the Chair.

On the Pathology of Hæmatozoan Infections in Birds.—W. G. MACCALLUM.

Peculiar advantages are offered by the tissues of birds for the study of hæmatozoan infections, in that all stages and degrees of infection may be examined without any difficulty in obtaining the materials. The material for the following observations was furnished in the tissues of the birds whose blood has just been described, and often the extent of the changes in the organs was surprising when contrasted with the apparently good health of the birds.

Kruse, Danilewsky and Labbé have noted in a general way pigmentation of the spleen, liver and bone-marrow, and have observed the enclosure of pigment masses in makrophages in the capillaries of these organs. There is nowhere any mention of inequality in the distribution of the parasites as such in the organs of the body, such as has been described in malaria in the human body giving rise to corresponding symptoms; in no communication on the subject have any symptoms been described occurring in infected birds such as to lead to the suspicion of a definitely localized invasion of organisms, nor have we been able to demonstrate in any of our birds such localization or such symptoms.

As to the effects of the products of the organisms on the tissues we cannot speak definitely. No mention is made in the literature of such effects, but we have observed various degenerated areas in liver and spleen, some of which are explained by concurrent bacterial infections, others apparently by the presence of peculiar ovoid bodies with central nuclear particle, which occur in the cells in groups resembling a segmenting organism, while a third variety is still unexplained.

The invasion of the parasite into the red corpuscle appears to be followed eventually by the breaking down of the corpuscle, from the altered hæmoglobin of which there results a straw-colored pigment. This is seen deposited in considerable masses together with the dark pigment formed directly by the parasite. The process of storing these pigments away from the blood stream is similar to that observed in man. The phagocytic cells of the blood are apparently the cells which we have named Rubinophiles,* and in a lesser degree the eosinophiles, although neither of these is very active in engulfing extruded organisms and pigment. Indeed we have never observed in a fresh slide of blood a single pigmented leucocyte, and, although they have been observed to engulf parasites, they have also been seen to attack the parasite, and after disintegrating it to a great extent, to leave the pigment and wander away. Labbé denies the existence of true phagocytosis, and considers the presence of infected corpuscles within leucocytes to a certain extent accidental.

Danilewsky and Sakharoff describe the occurrence of organisms within leucocytes where they undergo part of their development, but we have observed nothing analogous to this. The hæmopoietic organs are of especial interest, and it is in these that the pigmentation has been noted by European writers. The spleen at autopsy is generally somewhat blackened, and on section shows a network of black lines corresponding to the pulp bands where the bulk of the pigment is deposited. This pigment occurs either in large, clear or palely staining makrophages with single or double vesicular nucleus, or in the swollen endothelial cells of the capillaries. In the spleen the large endothelioid cells of the pulp take on the character of makrophages, but in the liver the pigmented

*Cells with whetstone-shaped granules which take on an eosin stain after long standing, but are colored much more readily by acid fuchsin.

cells are all intracapillary. These large cells are seen to contain masses of yellow pigment, masses of black pigment, scattered grains of black pigment, infected corpuscles, shrunken parasites which at first sight look like small masses of yellow pigment, and debris of broken-down red corpuscles and parasites. The liver shows a less marked pigmentation than the spleen, but the character of the deposit is similar. In the bone-marrow which European authors have found so deeply pigmented we have found almost no pigment and but few organisms. The brain, heart, lungs, kidneys, stomach, intestine, pancreas, thyroid and voluntary muscle show no changes and only the presence of organisms which would be expected from the rich blood supply of these organs.

On the Hæmocytozoa of Birds.—Eugene L. Opie.

The presence of parasites closely resembling the malarial organisms of man, within the red corpuscles of birds, is well known. These organisms have been found in varying abundance in the blood of birds of many parts of Europe, but up to the present time they have not apparently been studied in this country. At the suggestion of Dr. Thayer these intracorpuscular parasites have been studied in the Clinical Laboratory of the Hospital. During the months of June, July, August and September one hundred and twenty-five birds have been examined. Of these the greater number, one hundred, were from the neighborhood of Baltimore. Of eighty English sparrows (Passer domesticus) from this locality, nine were infected with intracorpuscular parasites; of twelve red wing blackbirds (Agelaius phœniceus) six were infected; two swamp sparrows (Melospiza georgiana) and one song sparrow (Melospiza fasciata) contained organisms. Of twenty-five birds, including a variety of species from the neighborhood of Dunnville, near Toronto, Ontario, five were similarly infected, namely, one great horned owl (Bubo virginianus) and four crows (Corvus americanus).

Although the small number of the infected birds makes it impossible to arrive at any general conclusions as to the particular species prone to infection or the local conditions favoring infection, a fairly accurate idea of the character of the parasites present in these localities can be obtained. The organisms found resemble the malarial parasites in that they undergo their whole development within the red corpuscle at the expense of its substance, transforming its hæmoglobin into characteristic pigment granules. Like the malarial organism they reproduce by segmentation, and the young parasites come to occupy other red corpuscles. Unlike the malarial organisms the younger parasites do not exhibit active amœboid movements. Unlike the tertian and quartan malarial organisms they show no cyclic development in great groups of which every organism is in approximately the same phase of development, and hence the length of their cycle of growth cannot be readily determined.

Two types of organism, similar to those observed in European birds, are found. Characteristic of each type is the morphology of the full-grown organism. In the one group an irregularly shaped body, approximately round or polygonal, occupies one end of the nucleated red corpuscle; the nucleus has been displaced into a transverse position in the opposite end. In the other group the full-grown organism is an elongated body which lies curved along one side of the normally situated nucleus. The irregular parasite (Proteosoma, Labbé) segments in the peripheral circulation by a process which is almost identical with that of the malarial organisms. Segmenting forms of the elongate parasite (Halteridium, Labbé) are not found in the blood taken, for example, from the wing. Associated with both types of organism are certain large bodies, apparently degenerate and not destined to segment, characterized particularly by the fact that, unlike the ordinary full-grown organism, they contain almost no material with an affinity for stains as methylene blue, safranin, etc. Organisms which flagellate as do those of malaria are observed with both the irregular and the elongate parasites. With the elongate organism, indeed, owing to the abundance of these forms, the whole process of flagellation can be studied with the greatest facility. Among the irregular parasites present in different birds different varieties are not observed. Among the elongate parasites, however, considerable diversity of form exists in different hosts, but the lack of extended observations makes it impossible to establish distinct species, although in certain cases the morphological differences observed are very striking.

Danilewsky, who first observed intracorpuscular parasites in the blood of birds, believed that these organisms are identical with those of the malarial fevers. Certain subsequent observers have attempted to establish an analogy between the different varieties of the malarial parasite and forms which they find in birds. Others have considered the parasites in birds to be entirely independent of those of man. It seems probable that there are in birds at least two distinct species of intracorpuscular parasites. In almost every detail of structure they very closely resemble the malarial organisms of man, but they are, nevertheless, essentially distinct.

Dr. Osler.—The subject which these gentlemen have presented so clearly has a very definite bearing upon the life history of the malarial parasite in man, as it is quite possible that we may get a clue to the outside history of the parasites by a study of the forms in birds. In 1886, I think, just as I was busily engaged for the first time in the study of the malarial parasite, Mr. MacCallum's father, Dr. MacCallum, of Dunnville, Ontario, sent to the Biological Laboratory in Toronto a goose which was supposed to have malaria. I was extremely skeptical about it, as I knew nothing at that time about the parasites in birds, but to my astonishment there were in large numbers the pigmented intracellular organisms, just such as Mr. Opie has demonstrated to us to-night. They were present in very large numbers, and the spleen of the bird was also large and deeply pigmented.

Dr. L. F. Barker.—I have been much interested in this report of the very careful studies of Messrs. MacCallum and Opie. It may be worth while to emphasize the importance in parasitic diseases of the blood and blood-making organs, of studying not only the appearances of the blood itself by clinical methods, but also the appearances of the blood and tissues in microscopic sections after death. One gets a very one-sided idea of the structure of the malarial parasites and their rela-

tion to the cells, if he studies them only in fresh blood or in smear cover-glass preparations, even when dried and stained. In tissues which have been hardened in alcohol it is very easy in sections stained with hæmatoxylin and eosin or with methylene blue, to make out within the half-grown and full-grown tertian parasites of human malaria a relatively large spherical area which stains usually feebly, though sometimes very distinctly in nuclear dyes. Peripheral to this mass is a thin superficial layer which does not stain at all in ordinary nuclear dyes. In this peripheral non-basophile layer of the parasite is situated the malarial pigment when it is present. The internal stainable mass may be centrally placed, though it is more usual to see it situated somewhat excentrically, so that the peripheral layer of non-stainable substance may vary in thickness in different parts of the organism. The internal mass, which is entirely free from pigment, may stain somewhat unevenly, and occasionally it is possible to make out in it an intensely stained nodule which I have thought may correspond to what has been described in stained smear preparations as the nucleus. It would seem more rational to look upon it as the nucleolus or as an aggregation of the chromatin within the nucleus, though for the decision of this point we must wait for further investigations. I should like to ask Mr. Opie and Mr. MacCallum whether or not they have in their studies or in their reading found any indications of or reference to macro-nuclei or micronuclei in malarial parasites, such as have formed the basis of so much interesting research of late years in the infusoria. It is indeed to be hoped that the large size of the malarial parasites in birds will permit of the unraveling of the finer structure of these curious organisms.

I have been much impressed in studying Mr. MacCallum's specimens of the spleens of these birds, by the enormous masses of malarial parasites to be seen there. At first it seemed almost improbable that the huge brownish masses could consist of malarial parasites. It appeared more likely that they could be explained as forms of blood pigment, but careful study with the oil immersion lens will convince any one that they are in reality aggregations of altered malarial organisms.

Mr. OPIE.—I have seen no references to the macro- and micro-nuclei. Labbé, who studied the question most thoroughly, does not mention such structures.

Dr. WELCH.—This is the first investigation of the kind, as far as I know, in this country. It is extremely interesting, and particularly to us, as it was made here. These have a number of points to distinguish them from the malarial organism, and one of the most striking is the absence of movements. I was interested in the statement that all phases of development occur at the same time in the circulating blood. An idea of Golgi as to the development of organisms in groups in the organs of the body would suggest the localized development in this class of organisms. There is no reference here, however, to groups, but each organism developed separately. It suggests that Golgi's observations might be explained by other suppositions.

Dr. OSLER.—I should like to add a word upon the possibility that in very malarial districts man may harbor the parasites without showing special manifestations. We know that in certain regions all dogs have filaria in the blood, and in many parts of Africa the filaria are present in the natives without causing much trouble. It is quite possible, too, that there may be a minor grade of malarial infection in which the organisms are not present in sufficient numbers to cause fever or the characteristic paroxysms.

Dr. THAYER.—Let me also congratulate Mr. Opie and Mr. MacCallum upon their careful piece of work.

The importance of such studies was impressed upon me several years ago by M. Laveran who expressed his conviction that a careful study of the hæmatozoa of lower animals, and especially of those of birds, which so closely resemble the parasites of human beings, was perhaps more likely to throw light upon some of the dark points in connection with the etiology of malaria than any other branch of research which is at present open to us.

Recent observations appear to show that the parasites of birds and human beings are not identical; they are, however, so similar that it is not improbable that the form in which they exist outside of the body and their method of entrance to the body are likewise not unlike the corresponding phases in the life history of the parasite of human beings.

There are, of course, many more points to be studied with regard to the morphological and biological characteristics of these avian hæmatozoa. In these present observations, for instance, no idea has been formed with regard to the length of the cycle of existence of the parasites. Danilevsky believes that he has been able to distinguish an acute and a chronic form, while Celli divided the parasites of birds into three forms with cycles of existence corresponding to the quartan, tertian, and æstivo-autumnal parasites. Here, however, there has as yet been nothing to point out the exact length of the cycle of existence of each generation of parasites.

Further, it would be advisable to make careful measurements and observations of the temperature in infected birds, observations which, to be sure, have been made by other authors, but with regard to which there is as yet a lack of agreement.

It is also, I think, very important that the intimate structure of the parasites of birds' blood should be carefully followed out; this can be done with much greater facility than in the human being, inasmuch as specimens of tissues can be instantly obtained at any time desired.

But really the most important point, it seems to me, as Bignami has emphasized in a recent paper, is to determine, if possible, the manner in which the parasite exists outside of the body, or more particularly its manner and portal of entry. It may well be possible that careful and continued observations of this sort may bring us nearer the solution of the greatest questions in connection with malarial infection.

With regard to the remark of Prof. Osler concerning the possibility that a human being may harbor the malarial parasites in an active condition for a considerable time without showing distinct clinical symptoms, I must say that the more of the disease one sees, the more reasonable seems the possibility that this condition may exist with relative frequency. In many cases of tertian fever after insufficient doses of quinine, or during attempts at spontaneous recovery, a few parasites may be found in the blood for very con-

siderable periods of time without actual clinical symptoms resulting. Dr. Gamble tells me that in private practice he has found the parasite in a number of instances in the blood of patients complaining of vague symptoms who had not as yet had any actual paroxysm. In these instances it is in every way probable that the parasites had not as yet accumulated in sufficient number to produce a chill. If now in a certain number of instances a single tertian paroxysm may be followed, without treatment, by so extensive a destruction of the organisms that fever does not recur for a week or ten days (a not very infrequent occurrence), theoretically there would seem to be no reason why in certain instances a similar destruction might not occur in groups which have not as yet reached a size sufficient to produce actual manifestations; thus there would result an indefinite prolongation of what one might call the incubation period of the infection. That such conditions exist is, I believe, not only possible but probable, though definite proof has yet to be advanced.

Meeting of December 7, 1896.

Dr. THAYER in the Chair.

Discussion of Dr. Bloch's Paper on "Agglutination of Typhoid Bacilli, etc." [See BULLETIN, Nos. 68–69.]

Dr. FLEXNER.—In this connection I wish to speak of some interesting and highly suggestive results just obtained by Pfeiffer and Kolle, with reference to the possibility of successfully vaccinating human beings against typhoid fever. You may recall that Stern pointed out several years ago that the blood of typhoid fever convalescents contains protective principles similar to those present in the blood of animals rendered immune from experimental typhoid infection. It is probable that these protective substances are those on which the phenomenon of agglutination depends; they are different from the alexines or defensive proteids of the normal blood, which possess little or no power of producing agglutination of bacteria, and are destroyed at a considerably lower temperature. These protective principles are exerted against the bacterial cell, are bactericidal and not anti-toxic in nature; thus they differ from the anti-toxines of diphtheria and tetanus, whose actions are directed against the toxin and not the bacterial cells as such.

Proceeding on the basis of Haffkine's results in vaccinating against cholera, which they accept as conclusive, Pfeiffer and Kolle have in a similar manner injected suspensions of typhoid bacilli subcutaneously beneath the skin of the back into three persons who had never had typhoid fever. The symptoms following the injections were elevation of temperature, chill, malaise; but these quickly passed away without leaving unpleasant effects. Following the cessation of the symptoms they found the blood of the vaccinated persons to contain an amount of the protective substances, measured by the power to protect animals from experimental typhoid infection, in excess of what is found ordinarily in typhoid convalescents. Assuming that there exists a relation between these principles and immunity from typhoid fever, it would appear as if in this simple manner an artificial protection from infection with the typhoid bacilli might be given. Appreciating the difficulties in the way of a conclusive and satisfactory test of this method in ordinary life, they suggest that it be given a trial in outbreaks of typhoid fever in barracks and army corps, where, as is well known, large and destructive epidemics sometimes occur.

Dr. REED.—I have had no experience with the serum test. I have made use, however, of Johnson's modification of Widal's method, and, so far, have examined the blood in thirty-four supposed cases of typhoid fever. When I began with this method—that is, the use of the dried blood—Johnson's paper had not been published, so I had to feel my way, as it were. I began by examining a small quantity of the blood dissolved in distilled water, placing a drop on a cover-slip and then inoculating it with an agar culture. I found the method worked fairly well in certain drops, while in others I had introduced too many bacilli, and, while many clumped, there were highly motile organisms to be seen after the lapse of two or three hours. I had just fixed upon a bouillon culture as the proper medium when Johnson's paper appeared, and being convinced then that I was on the right road, I reviewed my cases with this method. I then had distinct clumping with arrest of motility in cases in which I did not get it when using the solid culture. So far I have examined the blood of thirty-four cases, twenty-eight of which have given me a positive reaction, that is, loss of motility and agglutination of the bacilli. It will be seen that I have met with success in a greater percentage of my cases than Dr. Block has reported to-night. Six cases failed to give the reaction. In two of these I found the æstivo-autumnal parasite. A third case that did not give the reaction was considered to be a severe case of typhoid fever in the Freedman's Hospital. The patient had tympanites and high temperature. I examined the blood with negative result. The patient died the following day, and it was found that there was general peritonitis, having its origin in the appendix. The fourth case was a child who manifested distinct brain symptoms, and the attending physician had not been certain that it was a case of typhoid. Two other cases, one in the third and one in the sixth week, failed to give the reaction. Whether they were real cases of typhoid I do not know. The earliest case in which I have examined the blood was that of a soldier at Fort Myer. Soldiers are generally put to bed early, and the reaction here was quite distinct on the fifth day After I had obtained a positive reaction in twenty-two cases, the particular bouillon that I was using—an old glucose bouillon (because there was no other in the laboratory at the time)—became exhausted and I began to use ordinary bouillon. I tried this latter in two new cases from the Freedman's Hospital, and was surprised to find prompt arrest of motility, but no clumping. For the sake of comparison I took the blood of an undoubted typhoid case and tested it with plain bouillon, and had no clumping until more than an hour had passed. I then tried some of my old glucose bouillon cultures, and to my surprise all three cases gave me good agglutination within fifteen or twenty minutes. I then began to examine my hanging drops, in plain and glucose bouillon, at the end of twenty-four hours, to see if I could distinguish any difference between them, and found that from the margins of the

clumps in plain bouillon the bacilli had always grown out as delicate threads radiating across the field and forming a network, whereas the clumps in glucose bouillon do not show any growth. I have repeated the observation many times with the same result. In the Fort Myer case I got good clumping with the glucose, but not with the plain bouillon. So it has seemed to me that possibly the bacilli grown in the glucose bouillon are somewhat more vulnerable to this peculiar action of typhoid blood.

In order to see whether motility of a culture had anything to do with its agglutination, I examined bouillon cultures at periods of seven, thirteen and sixteen days, and ascertained that the old cultures, in which there is no motility, clump about as promptly as recent ones. I then tried, as a matter of interest, to see whether the dead bacilli would agglutinate, and ascertained that massing of the bacilli took place about as promptly in the dead as in the living cultures. I also observed that blood heated to 60° C. for half an hour acts about as well as the non-heated blood. It occurred to me that by heating the blood to 60° one might destroy its normal germicidal action and still leave behind the peculiar body upon which the clumping depends. I have observed the reaction in dried blood after twenty-six days. I have failed to obtain arrest of motility of the bacilli in normal blood, but in one case, probably latent tuberculosis, there was prompt, distinct partial clumping; the non-agglutinated bacilli, however, remained actively motile at the end of three hours.

Dr. Thayer.—There is one point, it seems to me, which must be carefully looked into before we draw too many conclusions, namely, the length of time during which this bacteriocidal power may remain in the blood after recovery from typhoid fever. In one instance at present in the Hospital the reaction is marked 16 months after the attack of fever. It must be said, however, that there is a typhoid osteomyelitis present which might well be the direct cause of the reaction.

NOTES ON NEW BOOKS.

A Treatise on Surgery, by American Authors. Edited by Roswell Park, A. M., M. D., Professor of Surgery in the Medical Department of the University of Buffalo, etc., etc. Vol. I. General Surgery and Surgical Pathology. 799 pp., 356 engravings, 21 plates in colors. *Lea Brothers & Co., Philadelphia and New York*, 1896.

It was not one of the lightest proofs of the true inspiration of the sacred writers that they have handed down to us such nuggets of truth for all ages as the familiar "Much study is a weariness of the flesh, and of making many books there is no end."

Any volume which steps into the crowded arena of medical literature to-day must expect to be challenged at once to show not only negative virtues, the absence of faults, but some positive and original ones besides, some clear *raison d'être*, or excuse for its very existence. Especially is this true of that realm of medicine known as the surgical, in general, and of American surgery in particular, where the new challenger must win his spurs against such giants of the pliocene as Gross and Agnew, and such hydra-headed antagonists of the pleistocene and contemporary as Ashurst, Dennis, and Keen. Hence the first question to be asked is, does this particular aspirant show proof of such approved superiority or peculiarity in weapons, or skill and training in feats of arms, as to give promise of holding his own in such a contest? We believe that he does in several respects. One of these is that the work is, in the broadest and best sense of the term, American, national, catholic. By this we mean, first of all, that singularly fruitful combination of scientific knowledge and breadth with "Yankee" ingenuity of application and intensely utilitarian tendency, so well typified by its distinguished editor and part-author, which has so rapidly won a world-wide recognition alike for American surgery and American scientific discoveries and mechanical inventions. Our whole inventiveness, progress and enterprise are born of the double fact that the thinker must needs do and the doer is able to think.

Again, in glancing over the list of contributors to the volume, no one, I think, can fail to be impressed with the fact that it is nationally representative in the broadest sense. Names which range from Maine to Louisiana, from Philadelphia to St. Louis, and from Tennessee to Michigan, are certainly ample proof of this, and when we remember that the proudest triumphs of American surgery, as represented by the names McDowell, Batty and Sims, to say nothing of a host of minor ones, had their origin not among the polished consultants of the great centers, but among the sturdy general practitioners of the rural districts of the South and Southwest, we see that this arrangement has not merely its fairness, but a genuine basis of practical scientific advantage to recommend it. At the same time an admirable homogeneity approaching that of the classic surgical monographs is given to the work, both by the careful supervision exercised by the editor and the large proportion of chapters in this volume contributed by him personally, much to the reader's satisfaction and advantage. The first five chapters of the volume covering the domain of surgical pathology are contributed by the editor himself. The subject is presented in a comprehensive and yet concise manner, its most prominent characteristic being the clear-cut division which its author insists upon between hyperæmia and its consequences, and the process of repair on the one hand and of inflammation upon the other. The use of the latter term is limited strictly to those reactions of the tissues which result from the introduction of some noxious irritant, usually of bacterial origin. This limitation possesses decided advantages in point of clearness, both of thought and practice, and it is probably desirable that the use of the word should be so restricted in the future from the surgical standpoint; and we believe that the admirable classification which is based upon it, and which it alone makes possible, will go far to recommend it to the profession. From a biological standpoint, as its author himself would frankly admit, the difference between the two processes is one of degree rather than of kind. But divisions are no longer made, either in pathology or biology, in the old hard-and-fast pre-Darwinian sense, and in actual experience the two classes are so sharply distinguished in their characters, their origins and their results as to be entitled to the writing of true and distinct species.

A somewhat novel feature is the introduction of a chapter upon the pathology of the blood, which, however, abundantly vindicates its right to appear in a surgical treatise, as some excellent diagnostic and prognostic tests are based upon it.

Another instance of the breadth of view which pervades the whole treatment of the subject is the careful discussion of the many factors which, by lowering the resistance of the tissues, may predispose to an attack of surgical infection. With a candor which is rare in the operating surgeon, full credit is given to the extraordinary power on the part of both the leucocytes and fixed cells of the body to ward off infections and to repel invaders of every description; and the story of the "battle of the cells" is given in the most graphic manner. This view of the matter is particularly well developed in what is, to our view, one of the most original and valuable chapters of the volume, that upon "Auto-Infection in Surgical Patients." Here the author impresses with convincing clearness and abundant illustration the too-little recognized truth that any secretion of the body tissues may become a poison to the entire system if its elimination is in any way interfered with, not only medi-

cally but surgically. The surgeon is urged to see to it that his patient is thoroughly aseptic externally and internally, particularly as to the alimentary tube. As the author declares, "There is perhaps no condition which so predisposes to sapræmia, septicæmia, or even pyæmia, as this vague condition of intestinal toxæmia, which nevertheless is so often present." The "hard-and-fastness" of some of the definitions in classification of surgical fevers will challenge decided criticism, but for enabling the subject to be clearly grasped, especially by the student, even this has its practical advantages.

A decided novelty in works upon surgery is found in two excellent chapters by the editor upon "Diseases Common to Man and the Domestic Animals." These fill a gap in the knowledge of the practitioner which is already being widely felt, and will prove among the most attractive chapters of the volume. The pathological paragraphs are particularly suggestive, the biological basis of morbid processes and the individual part played by the various tissue-cells being so vividly developed as to give even tubercle-formation the fascination of a story from life.

The chapter upon Syphilis, while covering the ground well, is so much compressed as to produce in places a style so bold and even dislocated as to seriously interfere with clearness. We very much doubt whether any student would be able to recognize a set of Hutchinson's teeth from the extremely brief (and inaccurate) description upon page 209. Indeed it suggests a doubt as to the clearness of the writer's own conception, and we are not surprised to find it followed by the statement, "The appearance described is often absent in syphilitic patients or may result from other causes." The "wax-work-like" tints of the colored illustrations of this chapter also leave much to be desired.

The pathological suggestions in the chapter upon Rickets are most interesting. One, that the disease is essentially a loss of balance between lactic or some other excrementitious acid, on the one hand, and calcium salts on the other, calls up at once Loew's discovery of serious disturbances in plants on account of a similar imbalance between oxalic acid and the magnesium salts. And we doubt if the essence of the rachitic process has ever been better epitomized than in the description of the layer of osteoid tissue of the epiphyseal lines "which is not cartilage and will not become bone."

In Chapter XIV we find the editor's "creed," which is consistently lived up to throughout the whole of the volume. After speaking of the "artificial and unfortunate separation of surgery from so-called internal medicine," he well declares that "it has been no small part of the benefit resulting from modern teachings that these imaginary boundaries and limitations have been swept away, and one of the lessons which this text-book is intended to inculcate is that broad principles underlie disease-conditions, and that one must appreciate their bearings thoroughly in order to practice either medicine or surgery successfully."

The chapters upon Minor Surgery are clear, concise and well illustrated.

The discussion of Cysts and Tumors is comprehensive and thoroughly up to date, the classification (based largely upon that of Sutton) being particularly commendable for its scientific simplicity and ease of comprehension. Growths are regarded as aberrant or "rebellious" groups of living tissue-cells differing mainly from each other in the particular tissues which they reproduce or imitate and in the perfection of their imitation. We would prefer, however, to transfer epithelioma from the "Tumors of Epithelial Type" to those of "Glandular-tissue Type," as its deadly qualities seem to be solely due to its power of "dipping down" or burrowing into the tissues, in its attempts to imitate the sebaceous, sweat or mucous gland of the surface where it originates.

The chapter upon Surgical Diseases of the Skin, while in most respects admirable, especially in its discussion of dermal tuberculoses, includes a good deal of ground which has already been covered, such as neuroma, myoma, epithelioma, lipoma, etc., and is disfigured throughout by the characteristic "Scabies perpetualis sive septennialis" of our dermatologist brethren, for pompous and sonorous Latin terms of classification, whose dignified sound barely covers their childish meaning. Thus, the common every-day wart is teased under a dissecting microscope with a literary needle and forceps into "Verruca vulgaris, Verruca filiformis and Verruca acuminata"; Cancer of the skin parades as "Carcinoma cutis" with two divisions, "Carcinoma tuberosum" and "Lenticular cancer." It is obvious that potatoes in a bin might be "classified" in precisely the same manner and with as euphonious results.

The chapter upon Diseases of the Lymphatic Vessels, by Dr. F. H. Gerrish, is a most original and valuable contribution to a subject which has never received the attention which its importance merits; probably largely on account of the inherent difficulties of the subject and our imperfect understanding of it.

The remaining chapters of the volume maintain a high average, but present nothing sufficiently characteristic or distinctive to call for special comment.

The illustrations throughout are excellent, with a few exceptions, and a most refreshing feature is the large proportion of them which are entirely new, most of them from original photographs. We feel almost lost, though, without our old familiar friend the "opisthotonos" man (but perhaps he will come to cheer us in the second volume), and grievously miss those numerous and beautiful pictures of surgical instruments, with the maker's name in large black letters upon either the blade or handle.

Even the camera, however, has its little weaknesses, and we are further confirmed by these cuts in our conviction that the photograph is in many cases no more necessarily "true to life" than is the "realism" of modern fiction. In not a few of even this carefully selected series, while the outlines are clear, the details of the central area are so indistinct that the assistance of the title and side-lettering is needed to discriminate between them, while in several even this assistance fails to render them entirely clear, as for instance the cut of varicose ulcers (p. 541) and that of fracture of the patella (p. 741). Most of them, however, are clear, as they are typically illustrative, and will constitute valuable and permanent additions to our surgical picture-gallery.

As a whole, the work is fresh, clear, and practical, covering the ground thoroughly yet briefly, and well arranged for rapid reference, so that it will be of special value to the student and busy practitioner. The pathology is broad, clear and scientific, while the suggestions upon treatment are clear-cut, thoroughly modern and admirably resourceful.

Our only general criticism takes the form of a regret that the editor, in some of his chapters, felt himself so much under the necessity of condensing and systematizing and could not give his thought fuller and freer play. But a chapter or volume which fails by being too short is not far from a decided success, and we have Vol. II to look forward to for consolation. W. H.

A Manual of Syphilis and the Venereal Diseases. By James Nevins Hyde, A. M., M. D., and Frank H. Montgomery, M. D. 1 vol., 618 pages. (*Philadelphia: W. B. Saunders*, 1895.)

For several years there has existed the need of a condensed and at the same time sufficiently comprehensive book on venereal diseases, which would enable medical students and practitioners, at a moderate cost, to obtain the latest opinions as to syphilis, and also to keep up with the advancing bacteriological work which is being done in genito-urinary diseases.

The Manual of Syphilis and the Venereal Diseases, by Hyde and Montgomery, is a book which well answers this purpose. It is extremely attractive in appearance, the printing and illustrations (which are numerous) being all that could be desired. The full-page illustration in colors of "Gonococci in gonorrhœal pus" is a beautiful example of the possibility of enlarging from a photomicrograph.

The chapters on Syphilis are written in a most attractive style,

and condensed so skilfully as to make a thorough review of the whole subject in a comparatively few pages. In their discussion of the treatment of syphilis the authors express some views as regards the inadvisability of using opium in combination with mercury which may not obtain the endorsement of the profession.

The chapter on Chancroid closely follows the articles on this subject in Morrow's System of Genito-Urinary Diseases, and in addition furnishes a valuable table, in parallel columns, for the differential diagnosis of chancre and chancroid.

Cystitis and pyelitis are not given the prominence or attention that these comparatively frequent diseases merit, and no mention is made of the value of the cystoscope as a means of diagnosis in vesical and renal diseases.

The articles on Urethritis Acute and Chronic (including Endoscopy) are especially well written, and give a thorough and scientific presentation of the subject.

The aim of the authors has been a compilation of the most recent literature and thought on "Syphilis and the Venereal Diseases," rather than to put forward any original work or ideas of their own.

A. B. G.

Transactions of the American Gynecological Society. Vol. 21, for the year 1896. (*Philadelphia: Wm. J. Dornan, Printer*, 1896.)

The Society is to be congratulated upon the almost unanimous tendency to conservatism displayed in its papers and their discussion, which gives a tone of advance, not so prominent in past meetings.

It is not surprising that the paper by Segond, of Paris, on the radical treatment of uterine myomata and inflammatory disease of the tubes and ovaries by vaginal hysterectomy gave rise to a most vigorous discussion and met with many pertinent objections; the consensus of opinion of the American gynecologists seeming strongly against its unqualified acceptance.

Dr. Kelly, in a paper on the treatment of extra-uterine pregnancy, urges strongly the vaginal puncture and drainage in cases ruptured in the early months, but not in the acute stage, and proves most conclusively the value of this conservative method by the cases he cites.

Dr. Henrotin, in a paper on the same subject, dwells on the necessity of immediate abdominal operation at time of rupture, even when the patient is in shock. Now that we have come to recognize that shock is but a term expressing all the symptoms of hemorrhage, Dr. Henrotin's advocacy of immediate interference is sustained.

Dr. Noble's paper on suspensio uteri with reference to its influence on labor deserves special mention. The recent condemnation of the vaginal fixation of the uterus by its originators because of its frequent serious interference with labor greatly increases the value of Dr. Noble's careful study and statistics of the abdominal operation. Unfortunately, the statistics do not represent a uniform method of suturing the uterus to the abdominal wall, and it is difficult to draw accurate conclusions. The two cases of dystocia which he cites in his own experience were true fixations, consequently the suspension method cannot be held responsible for the difficulties which he has described.

The statistics collated by Dr. Byrne with reference to the remote results of operations for cancer of the uterus are most painstaking and creditable, but do not point the way to any advance in treatment. Statistics to be of value must contain a complete picture of every case, and here this paper is found sadly wanting, especially on the laboratory side. In every case suitable for radical operation a microscopic diagnosis should be made before it is undertaken. A failure to do this may lead to most appalling mistakes. After removal, sections should be made through the critical points for microscopic study to determine whether the disease has all been removed. If this were done Dr. Byrne would find that the morbid cell changes beyond the primary growth of which he speaks, were a simple extension of the disease into tissue which appears to the eye and touch unsuspicious. Not until these precautions are taken and the results put into statistical tables will one be able to judge fairly of the remote results of operative treatment of cancer of the uterus. The statistics of to-day are absolutely valueless. Winter, in his most excellent article on the question of recurrences (Zeitschrift für Gynec. und Geburt., Band XXVII, Heft 1), apparently depends entirely upon the macroscopic appearance to define the limits of the disease. One who has studied these tumors microscopically can testify to the utter impossibility of fixing the outermost limits of the disease by the eye or touch. On this account one cannot accept Dr. Byrne's conclusion as to the value of his method of performing vaginal hysterectomy by the cautery. Dr. Halsted has proved, by the astonishing results of his operation for the removal of the breast for cancer, that a wide dissection and removal of the glands are demanded; and the same is true in cancer of the uterus, which can only be successfully removed by the abdominal operation.

W. W. R.

Transactions of the Chicago Pathological Society from October, 1894, to November, 1895. Vol. I. (*Chicago: American Medical Association Press*, 1896.)

This little book contains the transactions of a society which is not wholly pathological, and many of the articles are of medical rather than of pathological interest. The pathological papers, however, are well done, as, for example, "The Contribution to the Study of Malignant Growths in the Lower Animals," by Dr. Field, upon which the paper of Dr. Livingood in a recent BULLETIN is an interesting commentary; the report of cases of Leukemia and of Pernicious Anemia, and the paper on Embolic Abscesses due to the Micrococcus Lanceolatus. The papers on Appendicitis, Nephrorrhaphy for Movable Kidney and Tubal Pregnancy, although not strictly pathological, are of general interest to medical men.

It is to be regretted that the volume is not uniformly printed, which will not seem strange when it is stated that the matter appeared first in the current numbers of a medical journal. If such a system of printing is continued in future, it would add materially to the appearance of subsequent volumes to have successive reports set up in a uniform type. The book deserves a better mechanical appearance.

Medical and Surgical Reports of the Boston City Hospital. Seventh Series. By GEORGE B. SHATTUCK, M. D., W. T. COUNCILMAN, M. D., and HERBERT L. BREWELL, M. D. (*Boston: Published by the Trustees*, 1896.)

It is pleasant to know that the issue of reports by the Boston City Hospital has been resumed, and the volume before us is a worthy successor of those which have preceded. A marked feature of the book is the thoroughness of its report on pathological work. This is notably shown in the valuable study of the Lesions in Selected Autopsies by Prof. Councilman and Dr. Mallory, also in Adeno-Carcinoma of the Pancreas, by Dr. Wright. The preliminary essay on Surgical Morals, by Prof. Cheever, is a new departure in hospital reports and one which can be commended. The paper also on Methods of Routine Treatment in the Surgical Outpatient Department is of great value. Altogether the seventh series is worthy of high praise.

Annual Report of the Supervising General of the Marine Hospital Service of the United States for 1894. (*Washington: Government Printing Office*, 1895.)

In addition to routine reports concerning the operations of the Marine Hospital Service, and full accounts of the various hospitals and quarantine stations under its control, this volume contains much that is interesting to the medical man. Among these may be mentioned detailed histories of the cholera and yellow fever epidemics of 1894, and Prof. Kitasato's Preliminary Notice of the Bubonic Plague in Hongkong, China.

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BULLETIN

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CONTENTS.

POSTURAL METHOD OF DRAINING THE PERITONEAL CAVITY AFTER ABDOMINAL OPERATIONS.

By J. G. Clark, M. D.

The general trend of recent medical literature relating to intraperitoneal drainage through the abdominal incision has been towards the limitation or reduction of the number of conditions demanding its employment, and a few European gynecologists have even gone so far as to discard drainage entirely, leaving the peritoneum to protect itself.

In a forthcoming article* on drainage based upon the bacteriological study of a large number of cases and upon the clinical records of 1700 cases of abdominal section performed in the gynecological department of the Johns Hopkins Hospital, I have been forced, notwithstanding my preconceived ideas in favor of drainage, to draw conclusions against it and to coincide with those few writers who discard it altogether.

The benefits to be derived from any form of drainage when used for the purpose of removing infectious matter from the peritoneal cavity, are infinitesimal compared with the untoward or disastrous results which may follow its use.

The greatest safety lies in closing the abdomen without drainage, except in cases of purulent peritonitis or in operations when there has been extensive suturing of the intestines, and in a few other rare conditions which I shall consider in detail in my paper on drainage.

Escape of pus during an operation, oozing of blood or serum, extensive raw areas in the pelvis, are usually supposed to indicate the necessity of some form of drain; on the contrary, these are the cases which should be left to the care of the peritoneum, as demonstrated by a comparative study in our series of 1700 cases of abdominal section of a hundred cases each of similar pelvic inflammatory affections, drained and undrained. The undrained cases presented by far the best results.

Every surgeon recognizes the dangers of dead spaces in the abdominal cavity and endeavors to prevent their formation, but frequently this is impossible. Mikulicz first called attention to this subject in a forcible paper, and devised a special drain for the prevention of oozing and for the removal of fluids from dead spaces; but this method, like all others, is unsatisfactory because the principle upon which it is based is wrong.

In an article (1889) by Lande the statement is made that it is not the principle but the methods of drainage which are wrong. I would reverse this statement by saying that it is not the method but the principle which is wrong. Zweifel claims that the subject of drainage should no longer be considered in surgical treatises, but should be relegated to medical history.

The chief objections to drainage of dependent pockets in the pelvis or abdomen through an abdominal opening are, first, fluids are frequently not removed, but on the contrary are pent up by the gauze drain; and second, instead of removing infection, the gauze or tube may be the means of introducing it from the outside into the degenerated fluids.

*A Critical Review of 1700 Cases of Abdominal Section from the Standpoint of Intraperitoneal Drainage. The Johns Hopkins Hospital Reports, Vol. VII.

To overcome the dangers of dependent pockets and dead spaces in the pelvis, I would suggest the elevation of the patient's body after operation to a sufficient height to start the flow of collecting fluids from the pelvis towards the diaphragm, and thus promote the rapid elimination by the normal channels of exit from the peritoneal cavity, of infectious matter and of vital fluids which may stagnate in these pockets and form a culture medium for pyogenic micro-organisms.

Although it would appear at first sight that this method of drainage is opposed to sound surgical principles, I hope to offer proof from a review of recent literature bearing upon the function of the peritoneum under normal and pathological conditions, sustained by the clinical report of three cases, that it is not only a safe but may be a life-saving measure.

Function of the Peritoneum under Normal and Pathological Conditions.

G. Wegner,* the first investigator who by experiments upon animals endeavored to arrive at some definite conclusion concerning the ability of the peritoneum to rid itself of injurious fluids or solid particles, was convinced that a comparatively large quantity of infectious matter could be eliminated or encapsulated by the peritoneal exudate without serious harm to the animal.

Grawitz† next took up the experimental study of infection of the peritoneum, pursuing his investigations under improved bacteriological technique, and arrived at the following conclusions:

1. The introduction of non-pyogenic organisms into the abdominal cavity, either in small or large quantity, or mixed with formed particles,‡ produces no harm.

2. Great quantities of organisms which ordinarily produce no symptoms, may give rise to a general sepsis if the absorptive function of the peritoneum is impaired.

3. Injection of pyogenic organisms into the peritoneal cavity may be quite as harmless as injections of non-pathogenic varieties. (In these experiments he injected a flocculent emulsion of staphylococcus albus and aureus and the streptococcus pyogenes in ten cubic centimeters of water without any visible reaction.)

4. The introduction of pus-producing cocci into the normal peritoneal cavity produces a purulent peritonitis, first, if the culture fluid is difficult of absorption, and second, if irritating materials are present which destroy the tissues of the peritoneum, thus preparing a place for the lodgment of the organisms, and the production of an exudate upon which they may grow.

Pawlowsky,§ in an excellent experimental study, reviewed Wegner's and Grawitz's work, with whom he agreed in many particulars, but disagreed in others. The main point of difference, however, between Pawlowsky and Grawitz related to the ability of the normal peritoneum to deal with the staphylococcus aureus.

Pawlowsky found that the large quantities of staphylococci injected by Grawitz without harm into dogs produced death very rapidly in the animals upon which he experimented, and that only a minimum quantity was harmless.

Reichel* went over the same ground in an experimental research, and in the main agreed with Grawitz. The essential points of value in Reichel's paper are, that peritonitis usually arises, first, because more organisms gain entrance than can be handled by the peritoneum, and second, because the stagnation of degenerating fluids in dead spaces favors the growth of the organisms.

He also accounts for Grawitz's and Pawlowsky's conflicting results, on the ground that some animals are more susceptible to infection than others, and that there are marked differences in the virulence of cultures of the same organism under varying conditions.

A carefully conducted experimental research by Waterhouse,† carried out under the oversight of Orth, appears to me to satisfactorily settle the question of the ability of the normal peritoneum to take care of infection.

He injected 6 cc. of a cloudy culture of staphylococcus aureus into the abdominal cavity of dogs, employing both the methods of Grawitz and Pawlowsky, and all of the animals survived. The same results were obtained with the streptococcus, bacillus pyocyaneus and the intestinal bacteria.

Waterhouse then endeavored to simulate the conditions occasionally met with after operations, by introducing 8 cc. of urine and small quantities of blood with the cultures, and again the results were negative. If, however, 15 to 20 cc. of fresh blood were introduced into the peritoneal cavity, followed in a few minutes by the staphylococcus aureus, severe peritonitis was produced.

In these experiments Waterhouse agreed with Pawlowsky and Grawitz that the dangers of peritonitis are increased by tardy absorption of fluids, which in effect leaves a culture medium for the growth of the organisms.

After the introduction of blood clots 3 cm. in size, followed by the staphylococcus aureus, death occurred from peritonitis in 24 hours.

Waterhouse also found that the purulent exudate from acute abscesses is extremely virulent, 2 cc. of the staphylococcus aureus and 1 cc. of the streptococcus from this source causing death in twenty-four hours. If a very small quantity of the pus, however, was introduced with water, the animals frequently survived.

After the introduction of turpentine with the organisms, as done in Grawitz's experiments, peritonitis did not follow, which is explained by Waterhouse on the ground that the organisms are rendered inactive or are killed by the turpentine. He proved this point by injecting the turpentine first

* Chirurgische Beobachtungen über die Peritonealhöle mit besonderer Berücksichtigung der Ovariotomie. Verhandlung der deutschen Gesellschaft für Chirurgie, Berlin, 1877.

† Charite Annalen Jahrg., XI, 1886.

‡ A solution of fecal matter containing solid particles was injected; the fluid was absorbed while the larger particles were encapsulated.

§ Virchow's Archiv, No. 117, p. 469, 1889.

* Beiträge zur Aetiologie u. chirurg. Therapie der Sup. Peritonitis. Deutsche Zeit. f. Chir., Vol. XXX, 1889.

† Virchow's Archiv, Vol. 119, p. 342, 1890.

and following it in a short time with the infecting germs; in every instance the animal died of peritonitis.

Dogs with a strangulation of the intestines were easily infected.

In three instances the staphylococcus aureus was introduced into the peritoneal cavity of cats suffering from ascites, followed quickly by death from peritonitis, which resulted, as Waterhouse says, because there was a favorable culture material, a diminished absorption, and an injury to the peritoneal endothelium.

Burginsky* in a series of experiments also came to the conclusion that the discrepancies in the results of Pawlowsky's and Grawitz's experiments were due to variations in the virulence of the cultures employed.

Halsted† confirmed and extended the views of previous observers concerning the resistance of the normal peritoneum to infection, and called attention to the dangers of introducing pyogenic organisms about a ligated or strangulated area, or in conjunction with insoluble bodies. Pieces of sterile potato introduced into the peritoneal cavity of control animals were soon encapsulated and produced no disturbance, but when infected with pyogenic cocci, invariably caused peritonitis.

A recent paper by Cobbett and Melsome,‡ on "Local and General Immunity," contains some valuable observations bearing upon the resistance of the peritoneum to infection.

Notwithstanding the injection of large quantities of virulent streptococci, a few of their animals survived. They state that "in those animals which succumbed quickest, free cocci were very numerous in the peritoneal exudation, and in those which survived longest they were either absent or contained within phagocytes."

These observers, in order to discover how quickly the organisms disappeared from the peritoneal cavity, killed two rabbits which appeared about to recover. "In the first, which had received 5 cc. of broth culture thirty hours before, only one chain of streptococci was found after prolonged search, but many cocci were contained in cells, and broth inoculated with this fluid grew a good culture."

"The second rabbit having shown no signs of illness after an injection of 6 cc. of anaerobic broth culture, received next day 10 cc. of a similar material swarming with streptococci. When killed five and a half hours later, not only could no streptococci be seen, either free or in cells, but no growth grew on cultures made from the abdominal fluid."

From this review of the literature bearing upon infection of the peritoneum I make the following summary:

1. Under normal conditions the peritoneum can dispose of large numbers of pyogenic organisms without producing peritonitis.

2. The less the absorption from the peritoneal cavity the greater the danger of infection.

3. Solid sterile particles, such as fecal matter, potato, etc., are partly absorbed and the remainder are encapsulated without the production of peritonitis.

4. Death may be produced by general septicæmia, and not by peritonitis, where large quantities of organisms are taken up by the lymph streams.

5. Irritant chemical substances destroy the tissues of the peritoneum and prepare a place for the lodgment of organisms which becomes the starting-point for peritonitis.

6. Stagnation of fluids in dead spaces favors the production of peritonitis by furnishing a suitable culture medium for the growth of bacteria.

7. The association of infectious bacteria with blood clots in the peritoneal cavity is especially liable to produce peritonitis.

8. Traumatic injury or strangulation of large areas of tissue are strong etiological factors in the production of peritonitis when associated with infectious matter.

The accumulated evidence of all these investigators proves beyond question that the peritoneum, under normal conditions or even when greatly handicapped by disease or artificial conditions, is capable of overcoming the invasion of comparatively large quantities of pyogenic bacteria.

Mechanism of Absorption of Fluids and Solid Particles in the Peritoneal Cavity.

Recent investigations by Muscatello* on the histology of the diaphragmatic peritoneum and the mechanism of absorption of substances from the peritoneal cavity, when considered in conjunction with the above conclusions, give ample ground for my suggestion of the elevated posture as a prophylactic measure against post-operative peritonitis.

Muscatello accepts Bizzozero's and G. Salvioli's classification of the component parts of the diaphragmatic peritoneum which occur in the following order: endothelium, membrana limitans and connective tissue framework. Up to the time of Muscatello's publication, histologists were equally divided on the question of the presence or absence of stomata between the endothelium. He proved beyond doubt that these openings are optical illusions, due to the defective preparation and staining of the microscopical sections. According to Muscatello's opinion, minute foreign particles, leucocytes and fluids pass through openings between the endothelium of the diaphragm made by the retraction of the protoplasm of the cells.

Beneath the peritoneal endothelium of the diaphragm and between the connective tissue fibres are open spaces 4 to 16 mm. in diameter, occurring in groups of 50 to 60, which communicate with the lymph vessels. A careful search for these spaces failed to reveal them in any other portion of the peritoneum.

G. Wegner first proved that the peritoneum was capable of absorbing the most remarkable quantities of fluids, equivalent to three to eight per cent of the bodily weight in one hour, or the animal's entire weight in twenty-four hours.

By the injection of foreign particles suspended in a fluid medium into the peritoneal cavities of dogs, Muscatello was able to demonstrate the existence of an intraperitoneal current which carried fluids and small particles towards the diaphragm, regardless of the animal's posture. The rate of transmission

* Baumgarten's Jahresbericht, Vol. VII, 1891.
† The Johns Hopkins Hospital Reports, Vol. II, 1891.
‡ Journal of Pathology and Bacteriology, 1895.

* Virchow's Archiv, 1895.

of the foreign particles from the peritoneal cavity to their ultimate repository, the lymph glands, could, however, be increased or retarded by the influence of gravity.

In those dogs which were suspended with head down, carmine bodies appeared in the retrosternal and thoracic lymph glands in from five to seven minutes, while in animals in which the posture was reversed it was five and a half hours before they could be recovered from these glands.

Muscatello proved that small particles were carried from the peritoneal cavity into the lymph spaces of the diaphragm through the opening made by the retraction of the endothelium, then into the mediastinal lymphatic vessels and glands, then into the blood current, by which they were transported to the various organs of the body, from which they were picked up by the lymph vessels and deposited in the collecting glands of each organ. For this reason the large vascular organs, such as the liver, stomach, spleen and pancreas, show the particles first and in the greatest numbers, while the lymph glands of the mesentery, which gather their vessels from a limited area of the intestine, contain but few of the granules.

The function of the leucocyte is of especial importance in the elimination of foreign particles from the peritoneal cavity.

Muscatello and other observers find, on examining the precipitate in the peritoneal cavity after injecting innocuous foreign particles or bacteria, wandering cells interspersed among the particles, some of which are lightly laden with granules, while others are apparently distended to the point of bursting, and still others which have not yet taken up their burdens.

In some instances where the granules are too large for one leucocyte to encompass it, two or more join forces to surround the invader. The leucocytes are found in greatest abundance beneath the omentum. From the peritoneal cavity Muscatello traces the course of the leucocyte through the channels above described and finally finds them deposited in the lymph glands in various parts of the body.

In Muscatello's experiments the leucocytes were able to dispose of the innocuous particles rapidly and without apparent ill effect to the animals. In Pawlowsky's, Cobbett's and Melsome's experiments, on the other hand, the conditions were different, the leucocyte having to meet an antagonistic invader. In those animals which survived the injection the infectious organisms were quickly encompassed by the leucocytes and carried into the general circulation, while in the fatal cases the peritoneal exudate was found swarming with free organisms and only a comparatively few enclosed in leucocytes.

The points in Wegner's and Muscatello's articles which I wish to draw especial attention to are:

1. Large quantities of fluids may be absorbed by the peritoneum in a remarkably short time. (Wegner.)

2. Minute foreign particles are carried from the peritoneal cavity through the diaphragm into the mediastinal lymph vessels and glands, and thence into the blood, by which they are transmitted to the organs of the body, especially those of the abdomen, and later appear in the collecting lymph glands of these organs. (Muscatello.)

3. The leucocytes are largely the bearers of foreign particles from the peritoneal cavity. (Muscatello.)

4. There is normally a current in the peritoneal cavity which carries fluids and foreign particles towards the diaphragm, regardless of the posture of the animal, although gravity can greatly favor or retard it. (Muscatello.)

Postural Method of Draining Dead Spaces in the Pelvis.

The many bacteriological studies in cases of experimental and post-operative peritonitis and in experimental infections of the peritoneum show conclusively that the infecting organisms are quickly distributed more or less generally in the peritoneal cavity, from whence they are carried into the system at large.

Where there is no persistent source of infection, virulent species of bacteria may be destroyed effectually in this way; but when a nidus of infection exists in which the micro-organisms are propagated, the patient is either carried off by a rapidly fatal septicæmia or peritonitis, or the peritoneal exudate forms a barrier to the further distribution of the infectious matter, which then follows the clinical course of any localized collection of pus.

To avoid this danger the most scrupulous care should be observed in every abdominal operation not to leave behind any condition which may furnish a starting point for an infectious process.

Oozing should be controlled as far as possible, injury and exposure of the peritoneum should be guarded against, raw areas should be covered with adjacent healthy peritoneum when practicable, and all debris and fluids should be removed as far as possible before the abdomen is closed.

Notwithstanding every precaution, dead spaces will be left after many operations, which may become collecting places for degenerating fluids. In addition to these artificial spaces, oozing serum and blood may collect in Douglas' cul-de-sac or in the ante-uterine space, and become the focus of a general peritonitis or a localized pelvic abscess.

To offset these dangers all dependent spaces should be drained as rapidly as possible, thus preventing the collection and stagnation of vital fluids, which are active germicides when first secreted, but become excellent culture media when degenerated.

By elevating the pelvis after operation, the normal intra-peritoneal current may be assisted greatly in at once draining dead spaces, and thus give the general peritoneal cavity and system at large the best opportunity to meet the invading organisms before they have had time to increase in numbers. To remind one of the incredible rate of multiplication of micro-organisms it is only necessary to quote Cohn's classical statement that "one germ under proper conditions may give rise to more than a half million of similar organisms within twenty-four hours."

Stagnating fluids in the dependent parts of the abdominal cavity or in dead spaces may furnish such a favorable culture bed that a few organisms may quickly generate myriads of others and overcome the most resistant germicidal forces; if on the other hand these spaces can be prevented from filling with fluids the organisms may easily be overcome.

In addition to the mere transportation of the organisms from an area of decreased resistance to one of normal resistance, the irritant chemical toxines elaborated by the bacteria are diluted and the infectious matter is divided into a fine granular state, thus giving the leucocytes the best opportunity to encompass the organisms.

Although fatal septicæmia may be produced in animals by the absorption of large quantities of organisms from the peritoneal cavity, it appears to me correct to assume that after a well-conducted abdominal operation no such quantities of organisms will be left behind as are necessary to produce septicæmia in the animal experimentally. If such a condition should exist the patient would certainly die from the rapid multiplication of the organisms in dependent cavities. Hence I conclude that the better chance for the patient's recovery lies in the direction I have indicated.

My arguments therefore in support of this postural method of drainage are, first, stagnating fluids are prevented from collecting in dead spaces in the pelvis; second, infectious organisms are quickly carried into normal areas of the body where they are destroyed before they can increase in numbers; and third, toxic substances elaborated by the organisms are diluted and prevented from expending their irritant effects on a wounded area.

The method which I desire to offer is briefly as follows: At the conclusion of an operation all fluids and debris should be removed as far as possible by sponges, after which the abdominal cavity should be thoroughly irrigated with normal salt solution until the fluid comes away clear.

When the irrigation fluid is all sponged out, 500 to 1000 cc. of salt solution should be poured into the peritoneal cavity, so that when the patient is elevated after she is returned to the ward the artificial current may be started at once towards the diaphragm, thus supplementing the normal current.

After the introduction of the salt solution the omentum and intestines should be replaced in an orderly way and the abdomen closed.

As soon as the patient is returned to her room, the foot of the bed should be elevated about 20 degrees, which gives sufficient inclination of the posterior pelvic wall to assist the flow towards the general peritoneal cavity. This posture should be maintained for twenty-four to thirty-six hours, after which the bed may be lowered.

Leaving the salt solution in the abdominal cavity is not a novel procedure, as it has been done in a large number of cases during the last two years in the gynecological department, and other abdominal surgeons have used it with good effect.

This postural method of drainage is offered as a prophylactic measure against post-operative peritonitis, but *not as a curative measure after the peritonitis is established.*

It should therefore not be employed when an operation is performed for the relief of purulent peritonitis or for inflammatory conditions associated with general peritonitis, as for instance some cases of appendicitis.

From the experiments of Waterhouse in which he proved the danger of infection in cats suffering with ascites on account of the defective absorptive mechanism, it would also appear unsafe to adopt the postural method in cases when this complication is coincident with the surgical affection. Pawlowsky has shown in his excellent experimental investigations that the lymph channels leading from the peritoneal cavity are choked with the infectious bacteria and inflammatory products in purulent peritonitis, and therefore advises free drainage through an abdominal incision.

In these cases it is evident that the multiplication and virulence of the organism have been too great for the phagocytes to overcome successfully, and that the only method of treating this condition is to remove as much pus as possible by irrigation with salt solution or by mopping the peritoneal surfaces with sponges wet with salt solution, as suggested by Finney, and then to insert a very free drain.

Only one of the cases which I report in this paper showed organisms on culture. The presence of pyogenic organisms is not a contraindication to the employment of the postural method, because all investigations have proved conclusively that the peritoneum can overcome the invasion of large numbers of the most virulent organisms. Cases of pelvic inflammatory diseases, however, rarely come to operation while the organisms are yet active, as shown by Miller of the Johns Hopkins Hospital, Schauta, Menge and others.

In forty-four cases of hysterectomy, mostly for pelvic inflammatory disease, examined by Miller, the cultures made from the interior of the uterus were negative, and cultures from the pus obtained from 51 cases of pyosalpinx, ovarian abscess and pelvic abscess, were negative in all but one case which showed gonococci.

Report of Cases in which the Postural Method of Drainage was employed.

Case I.

In this case all of the conditions usually supposed to indicate imperatively the employment of some one of the established methods of abdominal drainage were present.

Among these the chief indications were a septic temperature with great prostration of the patient before operation, and during the operation the separation of wide-spread adhesions which produced extensive injury to the peritoneum and free oozing of blood, the escape of a large quantity of pus and degenerated blood clots into the abdominal cavity. In addition to these conditions portions of the cyst wall and degenerated matter, and, most dangerous of all, a large cup-shaped dead space beneath the intestines and mesentery, were left at the close of the operation.

Gynecological No. 4946. E. B. L., admitted January 18, 1897. Married, age 47 years.

Complaint. Pain in the lower abdomen, more marked on the right side. Slight cough.

Marital History. Married 16 years; one child 16 years old; labor easy, puerperium normal, no miscarriage.

Menstruation. Began at 13 years, regular, normal. Last period terminated December 18, 1896.

Present Illness. November 15, 1896, she had a severe chill, lasting two hours, followed by fever. The next day she had great pain, which continued one week and was accompanied with diarrhœa. Since then she has grown steadily weaker,

fever and chills occurring frequently, and for the last week she has been confined to bed.

General Condition. Well nourished woman; tongue slightly coated, bowels regular, appetite poor. Micturition and defecation painless. For the past four weeks she has had a dry cough.

Examination of heart and lungs negative.

Temperature on admission 103° F., pulse 110.

Diagnosis. Large suppurating ovarian cyst.

Operation by Dr. Kelly, January 20, 1897. Cystectomy; part of cyst wall could not be removed.

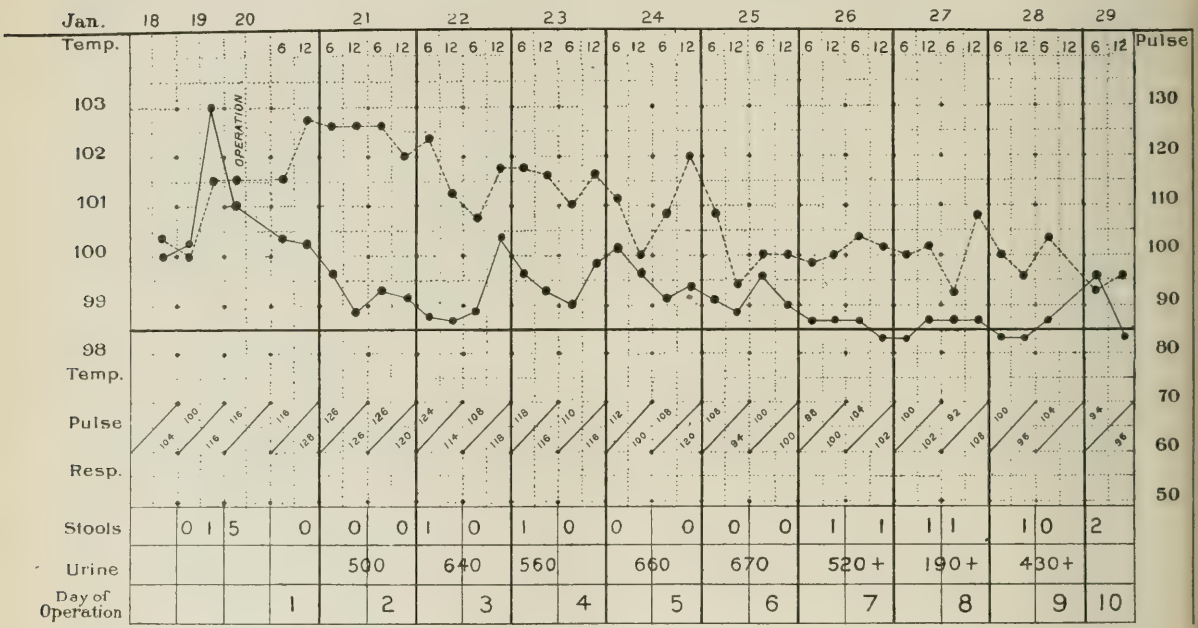
Complications. Extensive adhesions to mesentery, bowel and vermiform appendix. Adhesions to entire posterior pelvis, to omentum, to bladder, and to anterior abdominal wall. Patient greatly prostrated, pulse before operation 118, at close 144, during operation as high as 156.

Incision 14 cm. in length, exposing red mottled and whitish cyst wall, closely adherent to anterior abdominal wall over a surface 10 cm. above symphysis pubis. Omentum adherent to anterior face of cyst over an area 10x8 cm. Adhesions separated; free oozing from thickened omentum checked by catgut sutures, no omentum removed; just above this point there was a fringe of flat adhesions, binding cyst to intestines and skirting the whole upper border of tumor from left to right. Adhesions so dense that separation was impossible without great injury to intestines.

Tumor tapped, about 3000 cc. of thick, fetid, yellow pus evacuated; the puncture was then closed with sutures.

Ten minutes were spent in separating tumor from anterior abdominal wall, bladder and anterior pelvic wall.

Large Fallopian tube on left side was exposed up to a point



CASE I.

Plain line indicates temperature. Broken line indicates pulse.

where it was lost in the tumor. Adhesions to uterus, to pelvic floor on right side, and to part of left pelvic wall divided. On floor of pelvis a sac containing 300 cc. of thick brown pasty blood was evacuated. Ovarian vessels at left pelvic brim exposed by dissecting with knife, fingers and scissors, and ligated, the left cornu uteri was then tied off and cyst cut loose from top of left broad ligament.

In separating adhesions on pelvic floor a sac was ruptured, discharging a large quantity of fetid pus into the peritoneal cavity. This was quickly mopped out and the hole in the sac stuffed with gauze. Cyst cut loose, leaving a portion of abscess wall 5x8 cm. in dimensions on the pelvic floor. Gauze packed over this to protect it during the rest of the operation. Sac was peeled up and out of a dense bed of adhesions in the pelvis; it was then found that the adhesions, extending between the entire length of the mesentery and out onto the intestines, were too extensive for further separation. The outer layers of the cyst wall were slit 2 cm. from bowel on all sides and dissected out from beneath the mesentery, thus completing the enucleation and leaving behind a large cup-shaped dead space. Slight capillary oozing occurred from the portion of cyst wall remaining behind.

The portion left in the pelvis also required six or eight ligatures to control oozing. Small epithelial cyst on right side

punctured. Right ovary normal. Right tube adherent and closed.

Adhesions of right ovary to sac bled freely, requiring two sutures to control hemorrhage.

At completion of operation the abdomen was freely irrigated with many litres of salt solution, after which 700 cc. of salt solution were left in the abdomen. Abdomen closed with buried silkworm gut and subcutaneous catgut sutures.

Day of Operation. Patient's cough very troublesome, pulse 116, temperature 101° F. before operation. Returned from operating room at eleven o'clock, pulse 140, respiration 48, profuse perspiration over entire body. Twelve o'clock, pulse 132, respiration 46. One o'clock, pulse 129, respiration 44. Two o'clock, foot of bed elevated twenty inches. Five o'clock, pulse 116. Six o'clock, pulse 116, temperature 100.4° F. Twelve o'clock, temperature 100.3° F., pulse 128. Patient uncomfortable, but not suffering great pain.

Second Day. Six o'clock A. M., temperature 99.6° F., pulse 126. Patient slept in all about two hours, often rendered uncomfortable by cough and heavy perspiration. Bed lowered.

Twelve o'clock noon, temperature 98.8° F., pulse 126. Patient has been comfortable up to this time, cough more troublesome, she now feels nauseated. Six o'clock, patient has vomited four times during afternoon, but is now comfortable, temperature 99.4° F., pulse 120.

Twelve o'clock midnight, temperature 99.3° F., pulse 124. Cough troublesome.

Third Day. Patient slept most of the night, awakened at intervals by paroxysms of coughing. Bowels moved. Temperature 98.8° F., pulse 124.

Twelve o'clock noon, temperature 98.6° F., pulse 114. Six o'clock, temperature 98.8°, pulse 108. With exception of pain produced by coughing, patient has passed a comfortable day.

Twelve o'clock midnight, temperature 100.4° F., pulse 118.

Fourth Day. Six o'clock, temperature 99.6° F., pulse 118. Bowels well moved, patient comfortable. Twelve o'clock noon, temperature 99.4° F., pulse 116, patient very comfortable. Six o'clock, temperature 99° F., pulse 110.

From the fourth until the tenth day the patient made as perfect a recovery as the most uncomplicated cases of abdominal section. The abdominal dressings were removed on the tenth day; incision healed *per primam*, subcutaneous suture entirely absorbed. Cough ceased about this time. Patient sat up in bed on the sixteenth day, and was out of bed in a wheel chair on her nineteenth day, and was able to walk on her twenty-fifth day. She was discharged from the hospital on her thirty-fifth day, feeling perfectly well.

Case II.

In this case the operation was very difficult and attended by many complications. The peritoneum was injured extensively, pus escaped during the operation, the intestine was injured and required suture, free oozing occurred during the operation and persisted at its completion, and large denuded areas were left in the pelvis.

Gynecological No. 4892. A. E. T., widow, aged 34 years.

Complaint. Pain in the right inguinal region, pain in the rectum, and swelling of the abdomen at times.

Menstruation began at fourteen, flow scanty but regular, lasting two to three days; always painful before marriage, since then painless.

Marital History. Married 14 years ago; husband has been dead eight years. Four children, oldest 14 years, youngest 8 years of age. First labor instrumental, the others were easy. No miscarriages.

Family History. Negative.

Present Complaint. Three years ago she was confined to bed for three weeks with fever and chills and severe pain in the lower abdomen, which began in the right side and then shifted to the left. During the attack she had a constant discharge of thick tarry blood from the uterus. After the attack she was able to get up, but it soon recurred, and the abdomen became greatly distended and excessively painful. Ten days ago another attack began, which has not been so severe up to this time as the former ones. She complains of pain during defecation and micturition, backache and bearing-down pains. Temperature on admission 101° F., pulse 120.

Diagnosis. Pyosalpinx duplex; retroflexio uteri adherens; pelvi-peritonitis.

Operation. Enucleation of both ovaries and tubes.

Complications. Dense adhesions binding pus sacs to pelvic walls and rectum, close relation of abscess on right side with the iliac vessels, persistent oozing following operation, escape of pus during the operation into the abdominal cavity.

Incision 12 cm. through thin abdominal walls, intestines packed back into abdomen with gauze bolsters. Impossible to differentiate pelvic structures at first on account of the dense adhesions covering in and binding all of the organs together.

Sigmoid flexure released from mass to which it was bound by dense adhesions. Outer coat of the bowel torn for about 3 cm. during the separation, but was at once closed with interrupted catgut sutures.

The enucleation was then begun on the floor of the pelvis, working upward and freeing the ovary and tube which formed a sac containing 30 cc. of pus. These structures were then tied off and cut away from the pelvic wall.

The fundus of the uterus was then partially liberated from adhesions, but this was discontinued on account of the free bleeding and danger of tearing into the rectum.

A long fusiform mass on the right side extended along the iliac vessels, with which it was closely adherent, around in front of the bladder. The sac contained 60 cc. of thick white pus, which partly escaped during the operation.

After freeing all the adhesions, the round ligament and ovarian vessels were tied off and the mass excised.

Active oozing to the right of the fundus over the ureteral area, also posterior to the fundus. After controlling several of these points there was still free hemorrhage at a point on the pelvic floor to the left of the rectum and from another point on the under surface of the broad ligament. This oozing was sufficient to stain a sponge as fast as it could be applied. The abdomen was irrigated thoroughly with salt solution, after which the bladder and fundus and the fundus and parietal peritoneum were stitched together to control oozing and to cover the raw areas with peritoneum.

500 cc. of salt solution left in abdomen. Pulse at beginning of operation 92, at end 150. Time of operation one hour and a half.

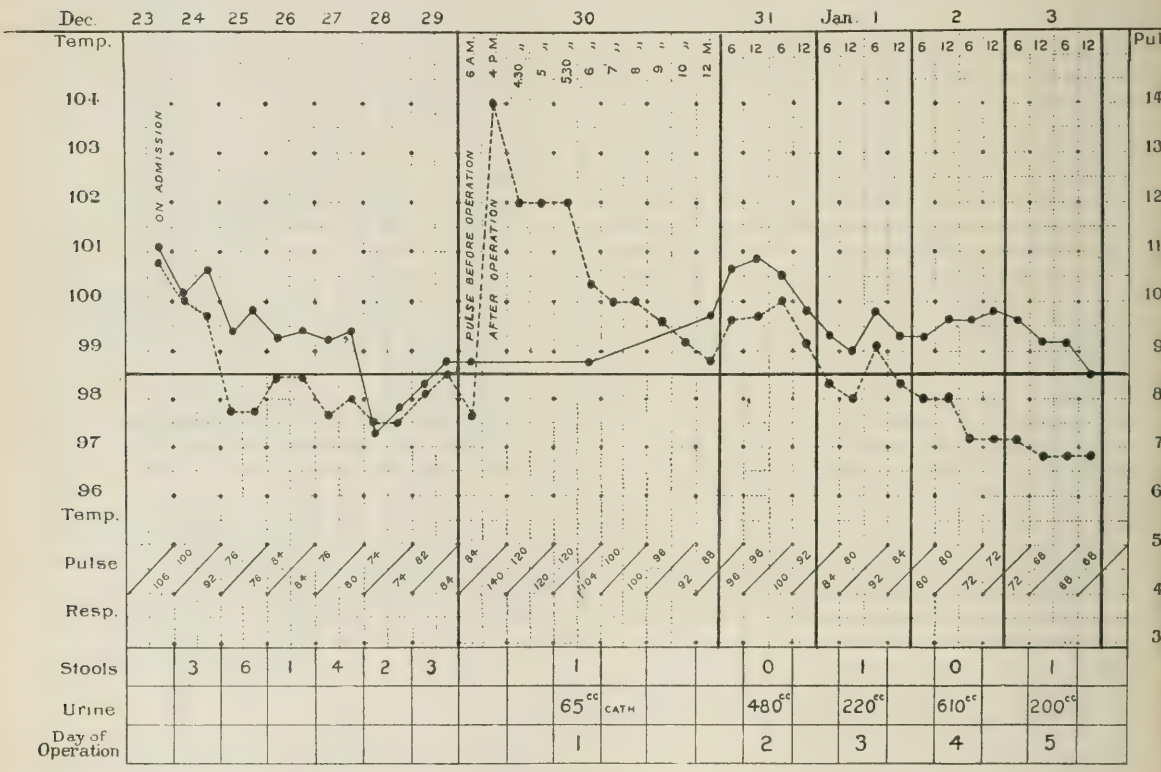
First Day. Patient returned to ward at four P. M., pulse 140. Bed elevated. Four thirty P. M., pulse 120, of good volume; six o'clock, pulse 104; seven o'clock, 100; nine o'clock, 96; twelve o'clock midnight, 88. Patient recovered quickly from ether without symptoms of shock.

Second Day. Six o'clock A. M., temperature 100° F., pulse 96. Patient complains of much pain. Twelve o'clock, pulse 92, temperature 100.8° F., patient sleeping quietly. Six o'clock P. M., temperature 100° F., pulse 100. Twelve o'clock midnight, temperature 99.8° F., pulse 92. Patient sleeping quietly.

Third Day. Six o'clock A. M., pulse 84, temperature 99.3° F. Bowels slightly moved. Condition remained about the same during day. Patient complained of some nausea, but did not vomit.

Fourth Day. Six o'clock A. M., pulse 80, temperature 99.4° F. Patient rested well, still slightly nauseated.

Fifth Day. Six o'clock A. M., temperature 99.6°, pulse 72. Bowels effectually moved, well formed stool. Patient passed a very comfortable day. From this time on the patient made a good recovery. On the tenth day after her operation the temperature rose to 100° F., and continued about this point until her seventeenth day, when it dropped to normal. At the time of her discharge she was feeling well.



CASE II.

Plain line indicates temperature. Broken line indicates pulse.

CASE III.

In this case there were dense adhesions binding a large suppurating ovarian cyst to the intestines and the abdominal wall. A suppurating fistulous track extended between the caput coli and one loculus of the cyst, requiring a number of silk sutures to repair the opening in the intestine left after the enucleation of the cyst. Pus escaped into the abdominal cavity, and large handfuls of clotted blood were ladled out of a large cavity in the pelvis. Pieces of the cyst wall and much debris remained behind at the completion of the operation.

There was considerable oozing and extensive traumatism produced by the separation of the wide-spread adhesions.

Pus from the cyst injected into a mouse killed it within twenty-four hours.

Notwithstanding all these complications the patient made a good recovery.

Gynecological No. 4928½. A. E. S., admitted January 9, 1897. Single, age 35 years.

Complaint. Increasing size of abdomen, severe constipation, feeling of obstruction in abdomen. Menstruation began at 15 years, recurring every 28 days, 4 to 5 days duration, normal.

Family History. Negative.

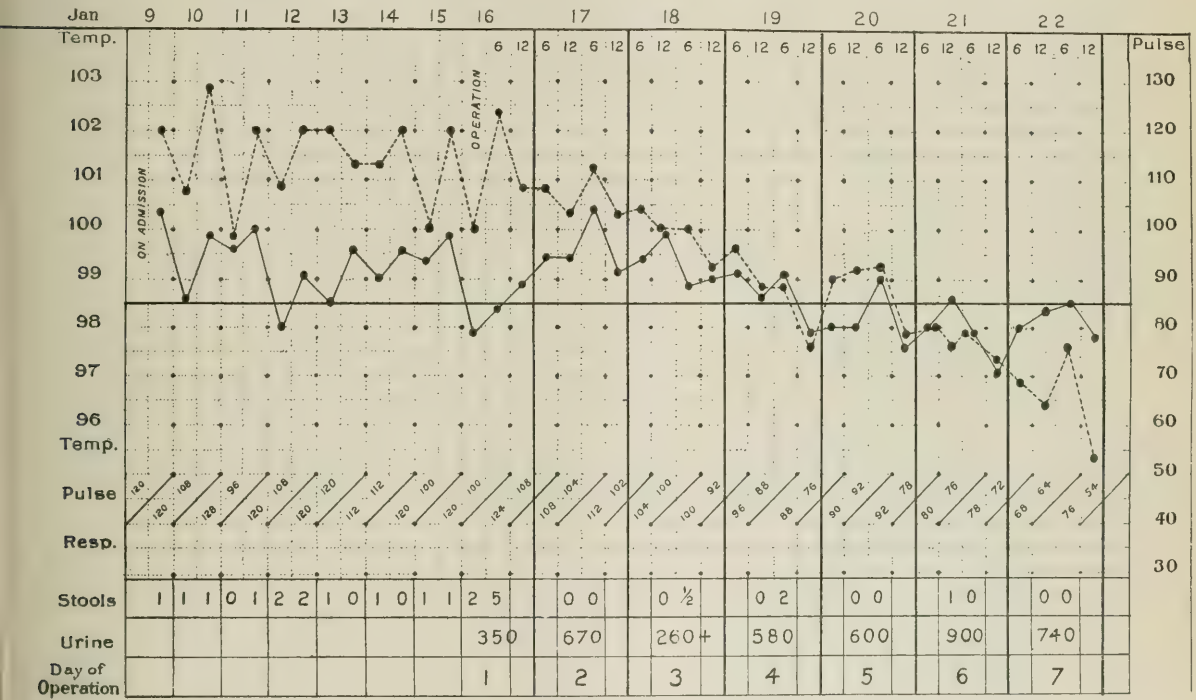
Present Illness. Patient was always strong and well until four years ago; at this time she suffered with indigestion, and was treated by her physician for displacement of the uterus. She had an attack of peritonitis in September, 1895, which confined her to bed four weeks. In October, 1896, she suffered with "chills and fever," which lasted eight weeks. During the attack she passed pus from the rectum, her abdomen was swollen and very tender to pressure. Enlargement of the abdomen persisted after this attack, and has lately been increasing rapidly.

She suffers from stricture of the rectum, which followed an operation for hemorrhoids performed in 1892.

Present Condition. Body emaciated, complexion pale, expression anxious. Appetite good. Micturition normal.

Examination of heart and lungs negative. Temperature on admission 100.5° F., pulse 120.

Diagnosis. Suppurating ovarian cyst.



Case III.

Plain line indicates temperature. Broken line indicates pulse.

Operation by Dr. Kelly, January 16, 1897. Cystectomy.

Complications. Dense adhesions between cyst and intestine, fistulous opening between intestine and cyst. Pyogenic area over bladder and anterior abdominal wall.

Puncture and evacuation through the abdominal incision of 2800 cc. of fetid pus, part of which escaped into the abdominal cavity. During enucleation of cyst it tore, allowing 150 cc. of pus to escape. Large hematoma filling lower pelvis opened and handfuls of thick putty-like blood were ladled out, in all about 200 cc. Hydrosalpinx and adherent ovary on the right side released, but not removed.

Adhesions between caput coli and tumor released, exposing a fistulous track between the two 5 cm. in diameter. Appendix thickened and twice its normal size, adherent to a black ragged area 2x2 cm. It was not removed, as it showed no disease and the patient's condition was very critical.

On right side the tumor was adherent to the anterior abdominal wall over an irregular area 6x3 cm., running down to cornu uteri. This area was scraped free of pus and lymph and covered with peritoneum from side to side.

Ragged area on colon covered in by base of appendix, which was sutured over it with interrupted catgut ligatures. Silk sutures were used to close the opening in the colon. Abdominal cavity thoroughly irrigated. Salt solution infusion (500 cc.)

under breasts, 500 cc. of salt solution left in the abdominal cavity. Pulse before operation 132, after 150.

First Day. On returning from operating room the pulse was 136, having dropped 14 beats in twenty minutes. Foot of bed elevated. Five o'clock in the evening pulse 128. Nine o'clock, 120. Twelve o'clock, 108. Patient comfortable and complaining of little pain.

Second Day. Pulse 108, temperature 99.4° F. Patient complained of pain during the night, but slept three hours. Twelve o'clock noon, pulse 104, temperature 99.4° F. Six o'clock, pulse 104, temperature 100.4° F. Comfortable day. Foot of bed lowered.

Third Day. Passed an uncomfortable night. Pulse 104, temperature 90.4° F.

Afternoon, patient comfortable, pulse 100, temperature 99.8° F. Small liquid movement.

Fourth Day. Pulse 96, temperature 99° F. Considerable pain in abdomen.

Fifth Day. Temperature 98°, pulse 90. Patient had a comfortable night.

Sixth Day. Pulse 80, temperature 98° F.

Tenth Day. Convalescence has been uninterrupted. Dressings removed from abdomen, union of incision *per primam.*

Patient sat up on her 20th day.

Bacteriological Examination. Cover-glass preparations showed many cocci and bacilli. Two cc. of pus injected into a guinea-pig produced death from septicæmia in twenty-four hours. Cultures from pus at the time of operation and from autopsy of guinea-pig became contaminated, consequently it is impossible to make a definite statement as to the species of organisms present. The fact, however, that the cyst communicated with the intestine makes it practically certain that all of the intestinal bacteria were present in the pus.

REPORT OF FIVE CASES OF INFECTION BY THE BACILLUS AEROGENES CAPSULATUS (WELCH).

By Edward K. Dunham, M. D., *Professor of Bacteriology, Bellevue Hospital Medical College, New York.*

Within the past year the writer has had occasion to study five cases of infection in which he believes the bacillus aerogenes capsulatus, described by Welch and Nuttal, and Welch and Flexner, either caused or hastened death.

In all but one of these cases the bacillus was found in material taken from the tissues of the patient during life.

The first case died on the 11th of March, 1896.

The patient was a woman, aged 23 years, who was admitted to St. Vincent's Hospital, New York, on the 7th of that month, and then gave the following history:

Three days before her admission to the hospital she had noticed a swelling beneath the lower jaw on the left side of the neck. This swelling was the seat of throbbing pain.

From the time she first noticed this swelling she suffered increasing malaise, with chilliness, headache, loss of appetite, nausea, and pains in the back.

At the time of her admission she had difficulty in swallowing, stiffness of the jaw, and pain, with a sense of constriction, in the throat. The left submaxillary triangle was swollen, pale and œdematous. There was no fluctuation in the swelling, though it appeared somewhat softer near the angle of the jaw. On the left side of the lower jaw some of the teeth were carious. The floor of the mouth bulged upwards and was tense. The left tonsil was enlarged, but showed no signs of inflammation. Temperature 101.2°, respiration 22, pulse 98.

Hot applications were made to the neck, and a mouth-wash of listerine prescribed. She also received morphine subcutaneously, and phenacetine and quinine by mouth.

The next day, March 8th, the swelling had increased considerably in size, swallowing was very difficult, and the patient suffered somewhat from dyspnœa. The neck was stiff and gave great pain on the slightest motion. Articulation was also interfered with. An exploratory puncture of the swelling failed to reveal the presence of pus.

On the day following, March 9th, the pain in the neck was excruciating; swallowing was practically impossible; the voice was husky and the dyspnœa marked. The swelling was hard and rapidly increasing in size, the pulse rapid and weak, the facies drawn and anxious. The urine was found to contain "5 per cent." of albumen. On this day the patient began to show signs of delirium.

During the afternoon of the succeeding day, March 10th, œdema of the glottis set in and at one time completely arrested respiration, but by means of an O'Dwyer tube and artificial respiration for a few minutes the patient was restored and the tube could be removed. The patient gradually lapsed into a comatose condition.

On this day an incision was made into the swelling and a small quantity of fetid, "very virulent-looking" pus obtained.

The next morning, March 11th, there was no discharge from the wound, but emphysematous crackling was felt at the angle of the jaw. At 6 A. M. the patient was dead.

The pus obtained on the 10th of March reached the Carnegie Laboratory on the 11th, accompanied by a message stating that it came from an acutely septic case in which infection with the anthrax bacillus was suspected.

Cover-glass preparations of the very fluid pus revealed the presence of cocci and of bacilli of large size.

Agar tubes in four dilutions were prepared and placed in the incubator. Upon these two sorts of colonies developed, one of a yellow color and the other white. All of these colonies were made up of cocci, the bacilli in the pus having failed to grow. Subsequent cultures of the cocci served to identify them as the staphylococcus pyogenes aureus and albus.

On the same day that the pus was received bouillon tubes were inoculated from it and placed in a Novy jar, in an atmosphere of hydrogen, at 37° C. The next day the broth in these tubes was cloudy, and a hanging drop showed the presence of cocci and bacilli.

A guinea-pig was inoculated subcutaneously with 1 cc. of one

of these bouillon cultures and died during the following night. At the autopsy the subcutaneous tissue was œdematous and emphysematous, and the fluid contained both cocci and bacilli, the latter predominating.

An effort was now made to isolate the bacillus and obtain it in pure culture for the purpose of identifying it.

A minute quantity of the broth culture used to inoculate the guinea-pig was distributed over the surfaces of several oblique agar tubes, which were placed in hydrogen in the incubator. No colony entirely devoid of cocci was found in any of these tubes, but one in which the bacilli greatly predominated was used to inoculate four rather dry blood-serum tubes, and upon these pure colonies of the bacillus were obtained and utilized for further study.

The bacillus was a large straight rod, about 0.9μ in diameter, with rounded ends, usually occurring singly or in pairs, but occasionally forming threads made up of four or five individuals. It stained readily with methylene blue, gentian violet and carbol fuchsin, and was very retentive of the dye when stained by Gram's method, resisting the decolorizing solution of iodine for ten minutes or longer. No spores were observed in any of the cultures, except those upon blood serum, though occasionally old agar cultures contained involution forms with an intimation of beginning sporulation, but without spores demonstrable by differential staining. In the subcutaneous fluid of animals it possessed a capsule, but this was usually not observed in cultures on artificial media.

It formed a moderately thin, moist, gray growth upon agar, and sometimes produced bubbles of gas in the condensation water at the bottom of the tube or between the agar and the wall of the tube.

Bouillon was rendered cloudy, and usually a few bubbles formed at its surface, while a gray sediment appeared at the bottom. In hanging drops, to which air had access, no evidence of motility could be detected.

Milk was coagulated in 24 hours and rendered acid, with a production of gas.

In all the media the bacillus proved to be a strict anaerobe.

The bacillus grew well in bouillon to which 1 per cent of glucose had been added, and these cultures evolved a considerable amount of gas when incubated in an atmosphere deprived of oxygen by means of potassium pyrogallate.

In order to determine the nature of this gas, six fermentation tubes containing glucose bouillon (1 per cent of glucose) were inoculated with the bacillus, and, after 24 hours, the gas collected in a eudiometer over mercury. 28.6 cc. of gas were obtained. This was subjected to the action of caustic potash, and when no more shrinkage in volume took place, air was introduced and an electric spark passed through the mixture. This was repeated until no more shrinkage in the bulk of the mixture resulted after the passage of a spark.

In this way the following approximate composition of the gas was determined:

Hydrogen	64.3 per cent.
CO_2	27.6
Nitrogen (?)	8.1*
	100.00 per cent.

On the 22d of March, *i. e.* eleven days after the pus was received at the laboratory, a guinea-pig was inoculated, subcutaneously, with a pure 24 hour culture of the bacillus in bouillon, one cubic centimeter being injected. The animal was found dead the next morning. The hair over the body was loosened so that it could be readily plucked from the skin, leaving it smooth and clean. The subcutaneous tissue was œdematous, and so friable and filled with gas that the skin could be reflected from the abdominal wall without dissection. The gas burnt with a pale blue flame. The organs were of a dull gray color and very friable. The subcutaneous fluid contained great numbers of the bacilli surrounded by capsules, and apparently no other micro-organisms.

On April 3d, 23 days after obtaining the material from the hospital, another guinea-pig was inoculated, by means of a platinum needle, with a very small amount of a three-day culture of the bacillus on agar. The animal became very ill on the second day after inoculation and it was thought at that time that he would surely die in the following night, but he recovered after two days and remained well.

When injected into the blood of a rabbit, which was then killed after the lapse of a few minutes, the bacillus caused enormous swelling of the body of the animal within 20 hours, and the liver, kidney and spleen, as well as the subcutaneous tissue, were the seat of a very marked emphysema. The skin was rendered so tense by the accumulation of gas that it seemed on the point of rupturing.

The foregoing characters of the bacillus under study appear to identify it with the bacillus aerogenes capsulatus of Welch, the only point of difference being the spore-formation which was observed in cultures on blood serum. As the authors mentioned do not describe cultures on this medium, this spore-formation cannot be regarded as evidence against the identity of the two bacteria.†

A number of observations were made upon the resistance of these spores, and it was found that when taken from the condensation water of a blood-serum tube they could endure a temperature of 94° C. for one minute, but that an exposure of 5 seconds to the temperature of boiling water (99.5° C. at the time the observations were made) killed them. After being dried upon threads for 5 months and then immersed in water, they survived a temperature of 99° C. when subjected to it for one minute.‡

The vegetative form of the bacillus appeared to be killed by a temperature of 55° C. within one minute.

Ten months of desiccation and exposure to the air failed to kill the spores, which, at the end of that time, grew readily

*The composition of the residual gas in the eudiometer was not determined, but it did not contain CO_2, for no diminution occurred when a fresh piece of caustic potash was introduced. This fact proves the absence of marsh gas or of any other hydrocarbon.

†In a letter to the writer, dated February 19th, 1897, Dr. Welch states that the bacillus aerogenes capsulatus in his possession produced spores when cultivated on Loeffler's blood serum. This observation tends to still further establish the identity of the bacillus isolated by the writer.

‡The author has observed that the spores of bacillus subtilis are much more easily killed by moist heat when freshly formed than after a lapse of time and drying.

when placed in broth at the body temperature under anaerobic conditions, and those cultures caused the same extensive production of gas when injected into the blood of a rabbit which was soon thereafter killed, as did the earlier cultures obtained from the original material.

The spores stain readily in hot solutions of fuchsin in anilin water, and are not decolorized by a moderate exposure to the action of a 3 per cent. solution of hydrochloric acid in absolute alcohol.

They have an oval shape and are usually situated near the middle of the bacilli in which they have been formed, their long axes coinciding with those of the bacilli. Their short diameter exceeds the diameter of the bacilli, so that the latter appear swollen at the points where the spores are situated.

The cultures containing the spores frequently contain involution forms of the bacilli and threads of the latter, which stain but faintly with methylene blue, and appear more attenuated than the individuals in fresh cultures on other media.

A partial autopsy of this first case of infection was made on the day following the death of the patient by my assistant, Dr. Harlow Brooks, from whose notes I take the following data:

General nutrition excellent. Rigor mortis present. There was extensive post-mortem discoloration about the neck on the left side, and the tissues in this region were the seat of marked emphysema.

The incisions in the neck made before the death of the patient were opened and a focus of suppuration was found, which apparently arose from the left tonsil. The walls of this abscess cavity were not well defined, but appeared necrotic, and this condition extended far into the fasciæ of the neck.

The liver, kidneys and spleen were examined, but did not appear emphysematous. Microscopical examination of bits of those organs failed to reveal the bacillus.

Sections from the organs of the rabbit into the veins of which the bacillus was injected, when stained by Gram's method, revealed the presence of the bacillus in great numbers in the blood-vessels. (See "I," temperature chart.)

The second case of infection occurred in a boy, seven years of age, who fell over a banister from the fourth to the ground floor of a house and sustained a compound comminuted fracture of the right humerus. This accident took place at 3 p. m. on the 19th of September, 1896.

After being under the care of a physician not connected with the hospital for a couple of hours, the patient was admitted to the Gouverneur Hospital at 6 p. m., in a semi-conscious and delirious condition. He had a lacerated wound of the forehead as well as a fracture of the humerus. The arm was very dirty and its tissues much contused. The wounds were treated antiseptically and the patient sent to the ward in a poor condition.

At 8 p. m. his temperature was 100°, respiration 44, pulse 130 and very feeble.

On the 20th he was delirious throughout the day.

On the 21st the dressings were removed and the arm and shoulder found to be much swollen, the skin over them tense and of a greenish bronze color, the discoloration extending over the pectoral region. There was no sign of emphysema noted at this time.

Free incisions were made and the subcutaneous tissues found in a necrotic condition. The wounds were washed with mercuric chloride and drained.

On September 22d the patient was still delirious, very weak, with a fluttering pulse. The dressings were again removed and fresh incisions made in the arm. The œdema had extended well into the pectoral region and down to the elbow, and at this time, I believe, some emphysema of the tissue was noticed. There was, however, no discharge from the wounds, owing to the prostration of the patient.

At 3 p. m. the patient died, just three days after the accident which resulted in the fracture of the humerus.

Some of the discharge from the incisions made on the 21st of September was collected in a sterilized test-tube and sent to the Carnegie Laboratory. It was delayed in transit and had an offensive odor when received. Cover-glass preparations showed it to contain cocci and a large bacillus, with rounded ends, positive to Gram's stain, and, in some fields, surrounded by a capsule.

Slant tubes of agar were prepared and placed in the incubator; one-half in a Novy jar with pyrogallate of potassium, the other half with access of air.

After 48 hours the aerobic cultures showed only colonies of cocci, while the anaerobic cultures contained colonies in which both cocci and bacilli had developed. The latter tubes gave evidence of gas production, the agar being raised from the bottoms of the tubes. These colonies, though not pure, were used for the preparation of bouillon cultures grown under anaerobic conditions, and, after 24 hours, they were cloudy and covered with a froth, due to the evolution of gas. In hanging drops both cocci and bacilli were found, the latter in greater number. One cubic centimeter of one of these cultures was injected under the skin of a guinea-pig, and in a few hours the animal showed signs of illness. Its fur was ruffled, the animal drew itself together and avoided the light. But it recovered, and after three days appeared to be quite well again.

A few drops of the same culture were introduced into an ear-vein of a rabbit and five minutes later the animal killed. The next morning its body was greatly distended by universal emphysema of the subcutaneous tissues. Puncture of the skin permitted the escape of a gas which burned with a pale blue flame.

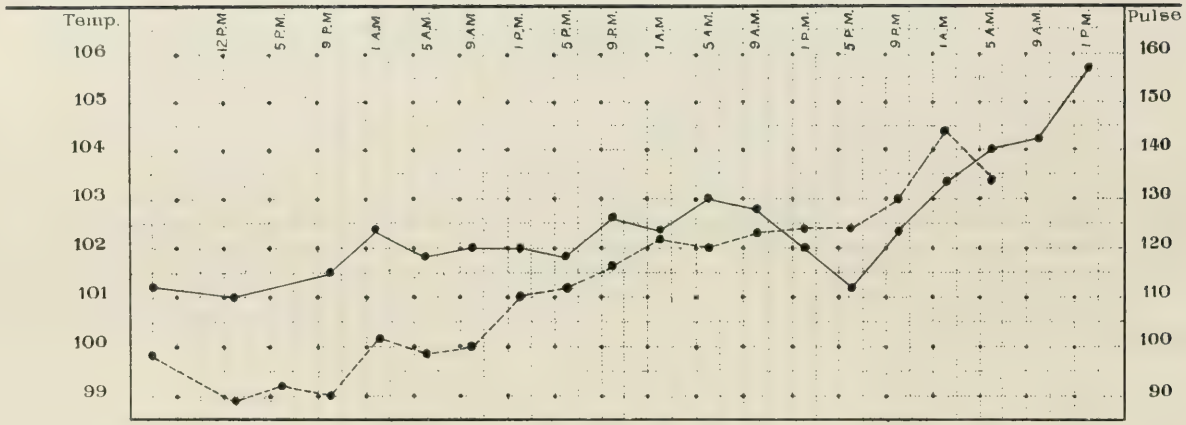
On autopsy the abdominal cavity was found to contain much gas, and the liver, kidneys, spleen, and the mucous membranes of the digestive tract and bladder were emphysematous.

Cover-glass preparations from the viscera and subcutaneous fluid demonstrated the presence of the bacillus, accompanied by a few cocci.

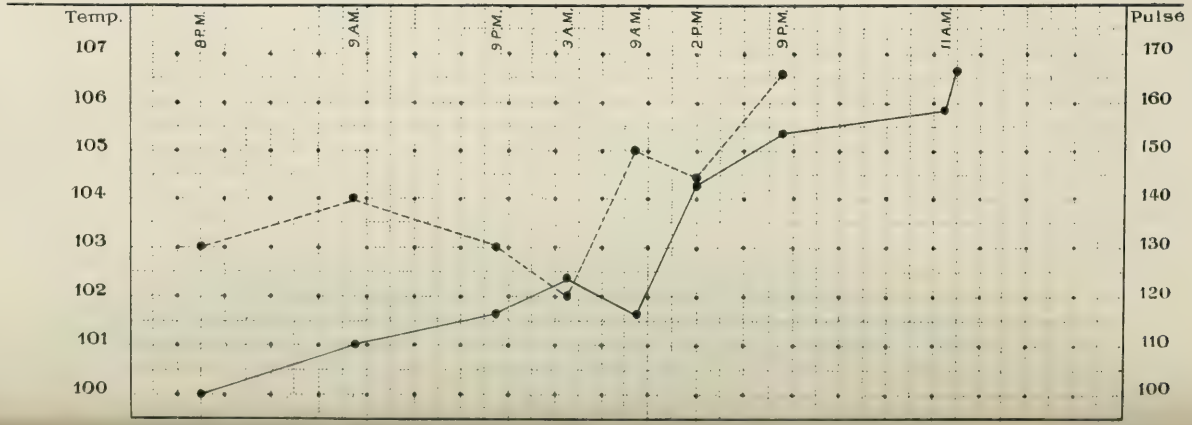
Agar cultures prepared from the organs of this rabbit formed the basis of future pure cultures, which served to identify this bacillus with that found in the first case. No spores were found in any of the cultures, but, unfortunately, the bacillus was not grown on blood serum.

No autopsy was performed on this second case of infection. (See "II," temperature chart.)

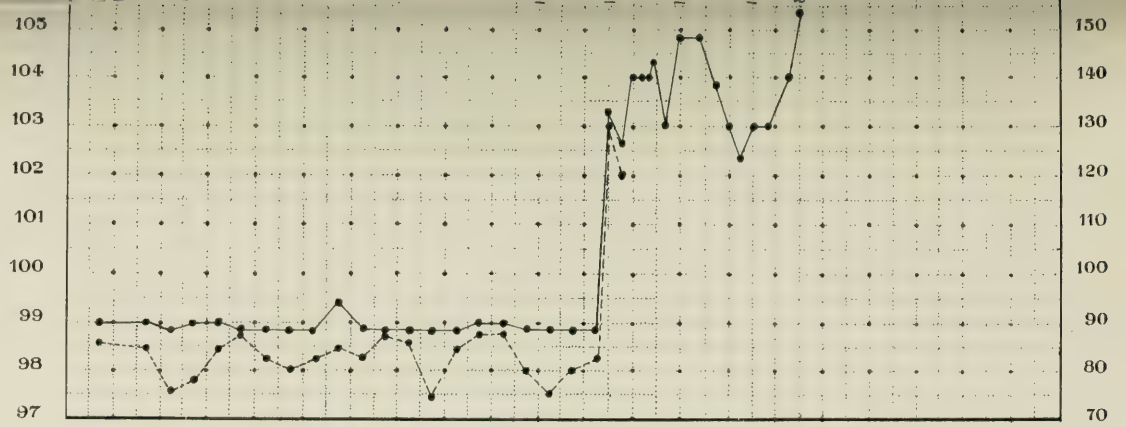
The third case of infection was a man, æt. 33, of alcoholic habits, who had suffered from urethritis on two occasions the



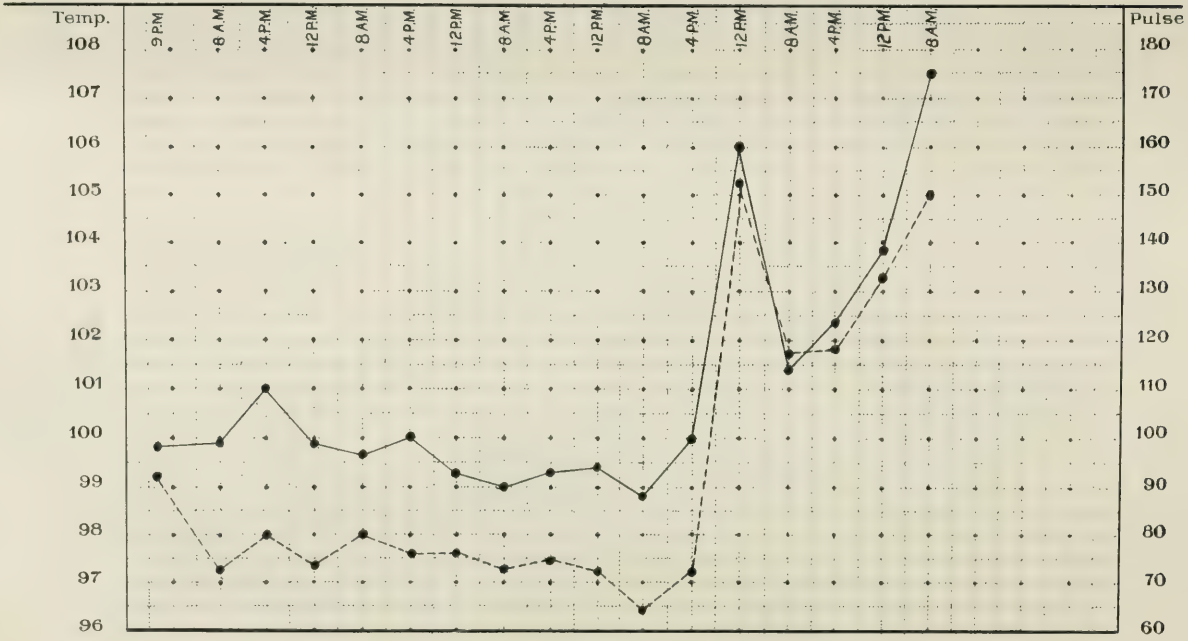
Case I.



Case II



CASE III.



CASE IV.

Plain line indicates temperature. Broken line indicates pulse.

last time three years before he presented himself for final treatment at Bellevue Hospital.

When he was admitted to the hospital, on November 6, 1896, he had difficulty in voiding his urine, owing to a stricture of the urethra which could not be passed by instruments.

On December 5th, at 3.30 p. m., external urethrotomy was performed, and the patient did well until 2.30 p. m. on December 8th, when a sound was passed.

Twenty-one hours after this procedure a chill ensued, which was followed by severe pains in the joints and back, and from that time the patient rapidly grew worse and died on the 10th of December at 8 p. m.

At 9 p. m. on the day preceding death, an area of subcutaneous emphysema appeared over the front of the right thigh, and others over both shoulders. These areas increased rapidly in size up to the time of death and afterwards.

The following notes on the bacteriological examinations of material from this case and of the autopsy are kindly furnished me by my assistant, Dr. F. M. Jeffries, who conducted them. At 4 p. m. on December 10th, *i. e.* 4 hours before the death of the patient, three agar tubes were inoculated from the subcutaneous tissue in the emphysematous area on the thigh. These, although placed under anaerobic conditions, failed to develop, probably because of excessive acidity of the agar.

At the autopsy made 18 hours after death, cultures on agar and in bouillon were made from the heart, lungs, liver, brain, and the emphysematous area on the thigh. These cultures were incubated under anaerobic conditions in Novy jars with pyrogallate of potassium.

After 24 hours the cultures from all these sources had developed, with evolution of gas. They all consisted of bacilli resembling the bacillus aerogenes capsulatus. They were not motile and stained well by Gram's method. All the cultures contained only this one bacillus, without admixture of other bacteria.

Intravenous injection of a bouillon culture in a rabbit which was killed five minutes later, resulted in the post-mortem changes already noted in the other cases just described.

The bacillus produced spores when cultivated on blood serum.

The autopsy on this case was performed on December 11th, 1896, at 2 p. m.

The general nutrition was good.

Subcutaneous emphysema was noted, extending over the whole body, with a greenish discoloration over the thorax, right thigh and posterior surface of the body; most marked over the penis, scrotum and anus. Puncture of the emphysematous area permitted the escape of gas, which burned with a faint blue flame.

The connective tissue under the skin of the thorax and abdomen was soft, pulpy and emphysematous. There were emphysematous areas on the pleuræ and pericardium. There was general emphysema of the lungs. The cavities of the heart were distended, their walls soft and œdematous, and the blood they contained dark and fluid.

The liver was of a dark chocolate color, soft and the seat of emphysema.

The spleen was dark plum-colored, extremely friable and emphysematous.

The kidneys were enlarged, showed subcapsular emphysema, and were plum-colored.

The mucous membrane of the bladder was extremely emphysematous.

The brain showed submeningeal emphysema, its substance was soft, the ventricles normal.

Microscopical examination of smears from the organs revealed the presence of large encapsulated bacilli resembling those found in the cultures. (See "III," temperature chart.)

The fourth case was a man, 23 years of age, who was admitted to the J. Hood Wright Memorial Hospital on the 6th of January, 1897.

Four years ago he had gonorrhœa, which persisted for eight months, and three years ago he had another attack of the same trouble which lasted three months. Neither of these attacks was accompanied by symptoms pointing to inflammation of the bladder or testes.

Two years ago, *i. e.* about one year after the beginning of the second attack of gonorrhœa, he felt pain on urination and noticed that the stream of urine was diminished in size. Shortly after this he had retention of urine, and was catheterized with some difficulty, and the urethral stricture then gradually dilated with sounds, the treatment lasting for two months. Since that time he had omitted all treatment.

At the time of his admission to the hospital the patient complained of pain on micturition, but there was no discharge from the urethra or increased frequency of urination. The urine was acid; sp. gr. 1029; no albumen or sugar.

A urethral examination gave the following results:

No. 23 (French) bougie à boulé passed the meatus, but was stopped just beyond the urethral orifice.

No. 30 entered the urethra for a distance of 2¾ inches.

No. 25 slipped past a constriction at 2¾ inches, but was arrested at about 6¼ inches.

No. 30 and No. 15 sounds met with an obstruction at the same point.

No. 4 and No. 2 bougies also failed to pass that point, as did also a filiform bougie. Even a bunch of filiform bougies failed to demonstrate a passage, although, subsequently, after etherization in preparation for the operation, a filiform bougie was successfully passed.

External urethrotomy was performed on January 9th, at 4.40 p. m., and a perineal drainage tube was left in the bladder, held in place by a silk ligature passing through the skin. The bladder and urethra were irrigated with saline solution and an aseptic dressing applied to the perineal wound. The urethra admitted a No. 34 (French) sound.

The patient was returned to the ward at 5.20 p. m., and a conducting tube, with its distal end immersed in a 2½ per cent. solution of carbolic acid, was attached to the perineal drainage tube.

At 6.30 p. m. the patient vomited some blood. The dressings were found to be saturated with blood and were renewed. A slight oozing of blood from a wound in the bulb of the urethra was noticed. This had ceased at 9 p. m., and the patient then felt comfortable.

At 10.30 the bladder was again irrigated.

On January 10th the patient felt well and the bladder was draining nicely.

At 1.30 the urethra and bladder were irrigated with a warm saturated solution of boric acid. The anterior urethra contained some dark fluid blood which was washed away, and the perineal wound then dressed.

On the 11th and 12th of January the patient was doing well and the bladder was simply washed out.

The patient complained of some pain in the penis on the 13th, and at 2.30 p. m. sounds were passed down to the stricture, and gradually increasing in size up to No. 32 (French). The perineal drainage tube was then removed and a No. 32 sound passed through the entire urethra into the bladder, without difficulty. The perineal wound appeared healthy, and there was no discharge from the urethra except a small amount of blood which followed the manipulations. The anterior urethra was irrigated with saline solution and the perineal wound dressed. The patient felt somewhat chilly and received half an ounce of whiskey.

At 9.30, seven hours after the sounds were passed, the patient had a severe chill, lasting half an hour.

At 2.30 a. m., January 14th, a slight bleeding took place from the urethra.

At 8 a. m. pain in the left shoulder was complained of.

At 11 a. m. a catheter was introduced through the perineal wound and about 3 ounces of bloody fluid having a foul odor evacuated from the bladder, which was then irrigated with saline solution. The bladder and anterior urethra were again washed out at 5 p. m., this time with a solution of permanganate of potash, $\frac{1}{2500}$. The wound was dressed at this time and looked clean. The patient complained of pain on pressure in the left buttock.

At 9 p. m. the pains in the shoulder and buttock had become severe, and at 11 p. m. these parts were found to crepitate on manipulation. The skin over these areas was not reddened and the parts were only slightly swollen. The area on the left buttock did not extend to the perineum, but was limited to the region about the trochanter and the external aspect of the ilium. The area at the shoulder was confined to the region overlying the left scapula.

On January 15th, at 4 a. m., the emphysematous areas had become somewhat larger and more swollen, firmer to the touch, and a little darkened in color. The patient, who was conscious, had an anxious expression and presented an extremely septic appearance,

At 7 a. m. the body was jaundiced, except over the emphysematous areas. Of these, that on the buttock looked much darker than before and was irregularly mottled with purple spots.

At 8.15 a. m. an incision, two inches in length, was made into the emphysematous area on the left buttock. A considerable amount of gas escaped through the wound, and a slight oozing of sanguineous fluid took place, but there was no sign of pus. Material for culture and bits of tissue for microscopical examination were taken from the walls of the incision.

At 9.30 the patient was still conscious, but died at 10.10 a. m., forty-five hours after the sounds were passed on the 13th of January.

Dr. Brooks performed the autopsy on this case, and the following account is taken from his notes :

The autopsy was made 5 hours after death, while the body was still warm.

Rigor mortis was marked; the general nutrition good.

Post-mortem discoloration was extreme from the pelvis up, and there was emphysematous crepitation over the abdomen, especially in the suprapubic region; over the back, the buttocks, and the thigh, leg, and dorsum of the foot on the left side; also, though in less degree, on the right side.

Puncture of the emphysematous areas permitted the escape of a gas which burned with a blue flame.

The abdominal wall was greatly distended, and when an incision was made the inflated intestines protruded.

The liver was of a light clay color and crepitated under the fingers. Its tissues were very friable, and filled with minute vesicles containing gas. The cut surface appeared œdematous.

The spleen was enlarged, of a dark purple color, and very friable.

The kidneys were enlarged; their capsules adherent.

The lungs were somewhat œdematous.

The cavities of the heart were distended on both sides by fluid blood which contained bubbles of gas.

The autopsy was necessarily both hurried and incomplete, as the relatives of the patient refused to have any of the organs removed from the body.

During the autopsy agar tubes were inoculated by Dr. Brooks from the blood in the left auricle and from the tissues of the liver, spleen and kidney. A bouillon culture was also made from the blood. These cultures were then incubated in a Novy jar with pyrogallate of potassium, and after 14 hours developed pure cultures of a bacillus identical with those found in the preceding cases.

When grown upon blood serum these bacilli developed spores identical in character with those produced by the bacillus isolated from the pus from the first case.

Cover-glass preparations made at the autopsy from the same organs from which cultures were taken showed the presence of the bacillus.

One cubic centimeter of the bouillon culture from the blood was used to inoculate a guinea-pig subcutaneously. Within three hours the animal was manifestly ill, appearing to feel cold and to wish to avoid the light. It died within 20 hours, and at the autopsy presented marked emphysema of the areolar tissues and organs.

A rabbit was also inoculated, intravenously, with the bouillon culture, killed and put in a moderately warm place. The next day it showed the emphysematous condition of the subcutaneous tissues and internal organs which has already been described in connection with the other cases.

The material removed when the incisions were made into the emphysematous area on the buttock at 4 p. m. on the day of the death of the patient was used to inoculate agar tubes, part of which were cultivated with access of air, the rest under anaerobic conditions. Those exposed to the air showed no growth. Those grown with exclusion of oxygen contained

a growth of a non-motile bacillus, positive to Gram, and morphologically resembling the bacillus aerogenes capsulatus. These cultures were lost and no further observations could be made, but as considerable work on this bacillus was being done at the time, no doubt exists as to the identity of the bacillus.

About 2½ hours after the death of the patient a sterile cotton swab was introduced into the urethra, and the moisture thus obtained used for the preparation of cultures.

Two bacilli developed in these cultures, and as they were both at least facultative anaerobes, efforts to separate that which proved to be a strict anaerobe were unsuccessful. One was smaller than the other and grew when air was admitted to the cultures. The other was morphologically identical with the bacillus aerogenes and did not grow in cultures exposed to the air. The smaller bacillus was thought to be the bacillus coli communis. A mixed bouillon culture of the two bacilli was injected into one of the veins of a rabbit's ear, and 15 minutes later the animal was killed. The next day the body was bloated and the large bacillus was found in the subcutaneous fluids, which were both emphysematous and œdematous.

As a check upon this experiment a second rabbit was inoculated with a pure culture of the colon bacillus in the same manner and at about the same time as the first rabbit. The next day there were no signs of emphysema in its body. (See "IV," temperature chart)

The fifth case occurred in the private practice of a New York physician, who has kindly furnished the writer with the following facts concerning the history of the case.

The patient was a man, 73 years of age. His general condition was good, there being no organic trouble except some hypertrophy of the prostate.

On January 17th, 1897, the patient complained of pain and uneasiness in the perineum. This was traced to enlargement and tenderness of the prostate and of the tissues near the rectum in the median line.

The next day the pain was more severe, and a diagnosis of prostatitis was made. The pain was alleviated by means of opium and belladonna suppositories, and by the 20th of January the patient felt able to be about again.

That night, because of difficulty in voiding his urine, the patient passed a hard rubber catheter and drew some blood.

On the 21st, pain in the right ischio-rectal fossa was noticed, and the tissues at the site of the pain were found to be firmer than normal.

On the 22nd the pain in the right buttock was more severe. The patient was in bed, felt prostrated, and had a dry tongue and some fever. Temperature about 101°.

On the 23rd the general condition was about the same as on the day before. Temperature 102°. There was increased hardness of the tissues of the right buttock, and the pain there was very great.

On the 24th there was evidence of a pointing abscess in the buttock, in which the pain was excessive.

At midnight a sudden rupturing of this abscess into the neighboring tissues was felt, and immediately the scrotum became enlarged and the pain in the buttock was relieved.

The next morning, January 25th, the attending physician found the scrotum emphysematous, with spots of gangrene upon it. Temperature 103°.

Later in the day the perineum was tense and distended, red and tympanitic. The scrotum was the size of a child's head (8 to 10 inches in diameter), dark in color, in places almost black, and cold to the touch. The skin of the penis was ballooned with gas and dark.

Very extensive incisions were made to the right of the raphé, from the penis to the tuberosity of the ischium. No pus was found, except at one point near the anus, where there was a cavity containing a dirty grayish-yellow pus of offensive odor.

The areolar tissue of the scrotum and penis were of an inky blackness and emphysematous, but contained no pus. A slight œdematous condition prevailed in the deeper structures.

The tissues were irrigated with mercuric chloride and an iodoform dressing applied.

On the following day, January 26th, the emphysema had extended over the pubes and the hypogastric region, the skin being raised about half an inch. The color of the skin over this area was either normal or had a pinkish blush.

Two free incisions were made to evacuate the gas, and it was discovered that the subcutaneous areolar tissues were blackened. No pus was present.

A portion of this black slough was removed with sterile instruments and put in a sterilized bottle for examination.

On the 27th the emphysema and necrotic area had extended upwards to the sternum, and laterally to the shoulder-blades, and fresh incisions were made. A single focus of pus found above the navel.

In all the places where prior incisions had been made the sloughing had extended so as to include the skin, but without the formation of pus.

The patient lapsed into a low typhoid condition, then into coma, and died on the 31st of January.

Cover-glass preparations of the material removed from this patient on January 26th were examined on that day at the Carnegie Laboratory, and showed the presence of three species of bacteria: 1, a large bacillus, resembling the bacillus aerogenes capsulatus; 2, a more slender bacillus; 3, streptococci.

The slender bacillus was identified as the bacillus coli communis, and when obtained in pure culture, produced no emphysema in the body of a rabbit killed shortly after the injection of the culture into a vein of the ear.

Experience with the mixed cultures, obtained from the cotton swab used to collect material from the urethra in the fourth case, had shown the difficulty of separating the bacillus aerogenes capsulatus from the bacillus coli communis. Without waiting, therefore, to obtain pure cultures of the large bacillus found in this case, a mixed bouillon culture of the two bacilli was injected, intravenously, into a rabbit, which was shortly afterwards killed. The usual post-mortem emphysema was produced within a few hours, and from the subcutaneous fluids pure cultures of the bacillus aerogenes capsulatus were finally obtained. These, unfortunately, died out in future cultures, owing, it is thought, to the reaction of the agar which was employed as a culture medium and which was found to be strongly acid.

No accurate temperature chart could be obtained in this case, and there was no autopsy.

The foregoing cases appear of interest as showing that the bacillus aerogenes capsulatus is sometimes capable of rapid development within the human body, during life, and of causing an acute and speedily fatal infection.

They serve also to show that the bacillus is of pretty wide distribution; for within eleven months these five cases have come under the observation of a single individual and were, notwithstanding, wholly unconnected with each other, occurring as they did in various parts of the city of New York and coming under the care of different physicians.

The mode of infection was not the same in all of the cases. But it is a striking circumstance that in three of the cases the infection started near the perineum after injury to the urethra, and in two of these the bacillus aerogenes capsulatus was associated, as far as the wound was concerned, with the bacillus coli communis.

In the case in which the site of infection was the wound of a compound fracture of the humerus, the history states that the wound was covered with dirt. This fact naturally leads to the suspicion that the bacillus aerogenes capsulatus, like so many of the anaerobic bacteria with which we are familiar, may occur in the soil; and the occasional production of spores, noted in the account of the first case and also observed in similar cultures from the fourth case, might readily explain the persistent vitality of the species under conditions which would otherwise be fatal to it.

From the soil to the intestinal tract of man would be a simple route by which the bacillus might gain access to the human body and find conditions not unfavorable to its development and, perhaps, spore-formation.

If the bacillus once gained access to the intestinal tract its presence in the perineal region could occasion no surprise. And if, through the wounded urethra, or some other lesion, it once reached the subcutaneous tissues and possessed sufficient virulence, the gangrenous process illustrated by these cases would ensue as a matter of course.

OBSERVATIONS TO DETERMINE THE MOTILITY OF THE BACILLUS AEROGENES CAPSULATUS UNDER ANAEROBIC CONDITIONS.

By E. K. Dunham, M. D.

Bouillon cultures of the bacillus were studied in flattened capillary tubes from which the oxygen of the air had been absorbed by means of pyrogallate of potassium. Although these cultures were examined at intervals varying from 15 minutes to 24 hours, at no time could any evidence of motility on the part of the bacilli be detected.

The details of the experiment were as follows:

The cultures were obtained by putting threads, containing spores of the bacillus, which had been kept in a dry state for 11 months, into tubes containing sterile bouillon. Three such tubes were prepared, and after incubation in a bottle containing pyrogallate of potassium, they all showed an abundant growth of the bacillus within 24 hours. These cultures proved to be pure. One cubic centimeter of one of these cultures was then mixed with about 2 cc. of fresh sterile bouillon, in order that the bacilli present might have a good supply of nourishment, and this mixture used for the observations on motility.

The capillary tubes were prepared by heating a piece of glass tubing, about 8 inches long and with a bore measuring about $\frac{1}{8}$ of an inch, strongly in the middle, then bringing the two halves parallel to each other and separating them about two inches (Fig. 1). In this way a U-shaped tube with a flatted bend was obtained. The limbs of this tube were then bent at right angles, so that their axes were in the same straight line. The ends of the tube were plugged with cotton and the tube sterilized by dry heat (Fig. 2).

A few moments before use, the middle of the flattened portion of the tube was heated until quite soft, and then rapidly drawn out to form a capillary tube. This was then broken in the centre and the end immersed in the bouillon culture. A portion of the culture quickly filled the capillary part of the tube for a distance of from 2 to 3 inches. The end of the capillary tube was then sealed in the edge of the flame of a Bunsen burner. Enough pyrogallic acid to closely fill about 1 inch of the tube was then introduced into its large end, this was moistened with a 50 per cent. solution of caustic potash in water, and then the end of the tube was closed by means of a piece of rubber tubing plugged at the other end with a bit of glass rod (Fig. 3).

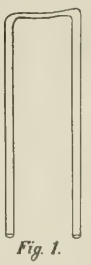


Fig. 1.

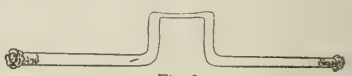


Fig. 2.

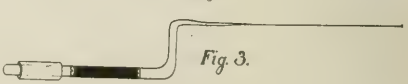


Fig. 3.

When prepared in this way the capillary tube containing the culture was so flat that it was possible to examine the whole contents of the tube under a $\frac{1}{12}$ oil immersion objective.

Eight such tubes were prepared, and four of them preserved at the room temperature, the other four being placed in the incubator where the temperature was maintained at 35° C. They were examined at intervals of 15 minutes, 1 hour, 2½ hours, 21 hours and 24 hours. In no case could any locomotion of the bacilli be detected.

After two and a half hours the bacilli were present in

greater numbers than when the cultures were first introduced into the tubes, showing that the conditions were favorable for their multiplication. At the end of 24 hours the number had increased enormously, and there were two small bubbles of gas in one of the tubes which had been kept in the incubator.

It might, perhaps, be thought that the chilling, occasioned by removing the tube from the incubator for the purpose of examining its contents under the microscope, would be sufficient to check the locomotion of the bacilli, before a clear view of them could be obtained. That this was not the case is shown by the fact that in all the tubes the bacilli soon subsided to the bottom, leaving the bouillon above them free from bacilli. If the tube was turned a little about its long axis and kept in that position for a time, the bacilli settled towards the lower side of the tube.

These observations appear to demonstrate that this bacillus does not possess the power of locomotion, even under anaerobic conditions.

MULTIPLE TUBERCULOUS ULCERS OF THE STOMACH, WITH A REPORT OF THREE CASES.

By Alice Hamilton, M. D.

[*From the Pathological Laboratory of the Johns Hopkins University and Hospital.*]

Tuberculous ulcer of the stomach is conceded by all writers on pathology to be of extremely rare occurrence, some indeed of the earlier ones considering that organ almost immune from tubercular infection. Again, some few of the earlier writers claim to have found it with comparative frequency in the autopsies of tubercular subjects; but as their results vary so greatly from those of the large majority, one is forced to believe that they have included cases of simple ulcer among the number. Förster, Rokitansky, Cornil et Ranvier, Ziegler, Orth, Birch-Hirschfeld and Klebs are unanimous in declaring the extreme rarity of this lesion.

Single cases purporting to be of this disease are reported from time to time in the literature, but it is impossible to accept all of these as actually cases of tubercular ulcer. As the greater number were reported before the discovery of the bacillus tuberculosis, one does not expect to find the diagnosis resting on its presence; but in many of these cases no histological examination was made, and in others no details of such examination are given. All such cases must be dismissed as doubtful or merely probable. Only those can be classed as proven where the report shows by a detailed description of the results of the microscopic examination that the histological characteristics of tubercle were present and which were confirmed or not, as the case may be, by the demonstration of the bacillus tuberculosis.

The earliest of these is Litten's. It was a case of tuberculosis of lungs and peritoneum with no lesion in the intestines, but with a single ulcer in the anterior wall of the stomach, which on microscopic examination showed typical caseating tubercles with giant cells. Talamon also describes tubercles found in the walls of ulcers in the stomach of a child which had died of pulmonary tuberculosis. In this case the ulcers were seven in number, scattered over the surface from cardia to pylorus. Bréchemin's case resembled Litten's in presenting no lesion in the intestines. There was a single ulcer—its location not mentioned—with thickened edges and a floor covered with nodular elevations consisting of "caseated masses surrounded by embryonic and lymphoid cells." Eppinger's two cases are described in great detail and are interesting in being the first cases of multiple ulcer which have been accurately reported. Here, too, the intestines in both cases were intact. The first one was a case of general miliary tuberculosis, and the stomach contained many miliary tubercles as well as innumerable small losses of substance in the mucosa. These ulcers had hard, elevated, regular "rampart-like" walls, and their bases were covered with whitish granulations, which on section proved to be caseated. His description of the microscopic appearances leaves nothing to be desired in either of the cases, the second resembling the first very closely.

Barbacci's case showed tuberculosis of lungs, peritoneum and intestines, besides which the stomach contained five ulcers near the pylorus, two of them having a diameter of 6 cm. These showed nodules of embryonic cells with caseation in the centre. The case of Pozzi is not quite positive. He found an ulcer near the greater curvature in the stomach of a man who had succumbed to pulmonary and intestinal tuberculosis. The walls and base of this ulcer showed no nodules, only "diffuse tubercular tissue." As it was impossible that the diagnosis here should be confirmed by the discovery of the tubercular bacillus—the case was published in 1868—it must be regarded as somewhat doubtful. Duguet's case of a single ulcer near the pylorus in a phthisical patient is so obscurely described that one can come to no definite conclusion about it. Marfan rejects it in his résumé of tubercular lesions of the stomach.

Coats was the first to demonstrate the bacillus in a gastric ulcer. His case, a child with pulmonary tuberculosis, presented numerous losses of substance in the mucosa of the stomach, and the examination showed not only the histological elements of tubercle, but also the specific bacillus. Serafini, Musser and Mathieu et Rémond also found the bacillus in their cases. Mathieu et Rémond's case goes to swell the list of those which showed no lesion in the intestine.

J. Kühl reports four cases from the Pathological Institute at Kiel. He examined all for the tubercle bacillus, but failed to demonstrate it in the two older specimens which had been a long time in the museum. Nevertheless, the histological appearances in the first of these cases point quite positively to tuberculosis; in the second his description is too scanty and obscure to place it above question. The third and fourth instances, which were recent, are described as containing caseating nodules with tubercle bacilli. R. G. Hebb and G. Lava

report each a case of single ulcer—at the lesser curvature and at the pylorus respectively—and describe the microscopic findings as tubercles with caseation and giant cells. It is to be regretted that these observers failed to make any search for the bacillus tuberculosis. This omission is still more striking in Letorey's otherwise exhaustive description of a case of diffuse ulceration near the pylorus. He states that tubercle bacilli were found in the lungs and in the diseased part of the femur, but seems not to have looked for them in the ulcers, where he, however, found typical caseating nodules.

In the following cases it is difficult to decide whether the lesions described are really tubercular or not, the authors having satisfied themselves of the correctness of their diagnoses, but having failed to establish them by giving the facts on which they were founded. So, for instance, Hattute merely states that his case showed "elements of tubercle in the granulations." Lorey, Anger, Matthieu, Cazin and Beadles give no details at all. Finally, a large number must be utterly rejected as, according to the explicit statement of the authors, no microscopic examination was ever made. Such are the cases of Bignon, Paulicky, Chvostek (four), Hebb (second case), Lange, Barlow and Quénu, which last rests for its diagnosis on a mere statement of the author, no description of its macroscopic appearance being given. Several others which have been placed in the list of tubercular ulcer were really miliary tubercles in the walls of the stomach. Kühl's fifth case is an example, also Barth's. Labadie–Lagrave's case showed a cicatrix near the lesser curvature, its tubercular origin being merely hypothetical. Oppolzer's is described as a perforating ulcer connecting stomach and colon, supposedly of tubercular origin, but it was impossible to say in which organ it originated. This covers all of the authentic literature so far as I have been able to discover, and it will be seen that it contains fifteen undoubted cases and nine more which are probable but not proven.

The two cases which I wish to report are, I think, undoubtedly tubercular, although neither could be considered as strictly typical. Indeed, the histological findings in the second case were so little suggestive of tuberculosis that, had it not been for the discovery of the tubercle bacillus, I should not have ventured to class it as tubercular, but the large numbers of bacilli present leave no doubt that they were the prime factor in causing the ulcerative process. The first case, which contained very few bacilli, presented an appearance that was much more characteristic of tuberculosis. I will omit the histories of these cases, which offered nothing of special interest, merely stating that both patients were admitted to the Johns Hopkins Hospital, to the service of Dr. Osler, in the advanced stages of pulmonary phthisis. The autopsies were performed by Dr. Flexner, from whose reports I will give merely the essential points.

Case 1. Colored female, aged 30 years. The right lung contained near the apex a cavity about the size of a small walnut, with smooth walls; the lung tissue adjacent was densely infiltrated and converted into a caseous mass. In the lower portions of the upper lobe, beneath the anterior surface and near the middle line, a small cavity existed with smooth walls which communicated freely with the bronchi. Its walls were caseous, and adjacent to it were large caseous masses surrounded by œdematous and congested tissue, which often presented a gelatinous appearance. The upper portion of the lower lobe was taken up by a series of cavities, more or less communicating, the deepest of which extended almost to the pleura, and was separated from this only by thin granulation tissue in which could be seen many opaque tubercles. Over this cavity the two layers of the pleura were adherent. The dependent portion of this lobe anteriorly was drawn out to a tongue-like appendage in which were caseous masses, the intervening lung tissue presenting a gelatinous appearance. Firm, dry and caseous tissue surrounded the cavity in the upper lobe, and most of the remainder of this lobe was converted into similar tissue. The lower lobe contained scattered caseous foci, while the pleura covering all of the left lung was scattered over with gray and opaque tubercles. The bronchi, larynx and trachea showed numerous superficial losses of substance reaching only through the mucous membrane. This ulcerative process in the larynx extended to the mucous membrane of the mouth and tongue, but did not pass to the œsophagus. The bronchial lymphatic glands were pigmented, enlarged and caseous. Tubercles were observed in the liver and kidneys.

The intestines were the seat of numerous ulcerations, which occurred at intervals, beginning 165 cm. below the duodenum and extending to within 10 cm. of the rectum. They were partly circular, partly elongated—"girdle-ulcers"—and penetrated to the muscular coat. In many, small tubercles were visible in the depth. On the peritoneal surface a few tubercles were seen. The appendix vermiformis was free from ulceration.

The stomach showed a large number of losses of substance, from 115 to 120, scattered over the entire organ, but most thickly on the anterior aspect near the greater curvature. These ulcers were round or oval, usually smaller than a penny, with rounded thickened edges, generally smooth and undermined for a variable distance.

The chief interest for our purpose centers in the ulcerations existing in the stomach. Our studies embraced the examination of many of these, often in serial sections, both with respect to their pathologic histology and to the presence of tubercle bacilli. Ulcers of various sizes were sectioned, stained and examined microscopically. The details are purposely omitted. The ulcers vary in their histological appearances, depending somewhat upon the extent of their development. Even in the youngest and most superficial the glandular elements are much disturbed, and a considerable proliferation of cells has taken place in the mucosa. The cells are small, round and lymphoid in type, but among them are also some which have the character of epithelioid cells. The deeper ulcers show a greater number, even a preponderance, of cells of an epithelioid habitus, and an arrangement at times into nodules of the size and roughly of the appearance of miliary tubercles, whose centres are formed by epithelioid, and whose peripheries by lymphoid elements. Giant cells were not discovered. On the other hand, necrosis of cells existed with fragmentation of nuclei, and, within the new tissue, even larger areas suggesting definite caseation. The nodules with central necrosis were sometimes in the mucous membrane, perhaps in

the overhanging edges of the ulcers, and again upon the floor formed by the submucosa, which was always found when exposed to be infiltrated with new cells, partly lymphoid, partly epithelioid in character. The thickened, undermined edges showed an increase of spindle-shaped cells, suggesting a new growth of connective tissue, forming at times a decided band. Tubercle bacilli (Ziehl-Neelsen method of staining) appeared in small numbers along the free surface of the ulcers, and singly, imbedded in the tissues, among the clusters of epithelioid cells.

Case 2. Male, colored, age fifty years. The right lung was bound by adhesions to the chest wall and the diaphragm, and the lobes were bound to each other. On section the whole lung was quite consolidated. Old fibrous processes extended in all directions through the lung, but they were most abundant posteriorly and at the apex. Small foci of caseation partly calcified were found, and in addition actual cavities lined with thin pyogenic membranes, the largest of them not exceeding the size of a walnut. The bronchial glands were enlarged, caseous and partly calcified.

The left lung, on the other hand, was free from adhesions except at the apex, the upper lobe was retracted at the apex, slaty in color and contained caseous masses, but elsewhere this lobe was quite smoothly consolidated. The lower lobe was voluminous, congested, containing very little air. In some smaller branches of the pulmonary artery partly decolorized thrombi existed, without infarction. Both bronchial and mediastinal glands were enlarged and caseous.

The small intestines were free from ulceration, but in the patches of Peyer in the ileum near the valve there were several elevated gray nodules, about the size of bird-shot or a little larger, with central depression, doubtless small tubercles with loss of substance in the centre. The large intestines were free; the appendix vermiformis contained about its centre an elevated grayish nodule similar to those in the ileum.

The mucous membrane of the stomach was congested and covered with sticky mucus, and along the greater curvature, almost over its entire extent, small losses of substance occurred, 70 to 75 in number. They presented worm-eaten edges and uneven bases, which sometimes, but rarely, were covered with small granulations. They extended usually only partly through the mucosa. The follicles of the œsophagus were enlarged, but without ulceration.

The histological and bacteriological examinations of these ulcers were carried out in the same manner as in the preceding case, fourteen of the ulcers in all being subjected to study. For this purpose ulcers of various sizes were chosen. With the exception of two or three, those examined involved only the upper layers of the mucous membrane, and the deepest ones did not extend beyond the muscularis mucosæ. The edges of these ulcers were never deeply undermined, and the infiltration of the mucous membrane passed a very little way only beyond the ulcerations. In general the appearances presented were those of superficial and small ulcerations, whose floor was formed by the infiltrated mucous membrane, still showing glands or vestiges of glands, but in which the proliferation of cells had so altered the latter that they were often with difficulty recognizable. The new cells consisted chiefly of the lymphoid variety, and they were diffusely scattered, but epithelioid or larger cell elements were not entirely absent. Only once was a perfectly distinct nodule, the size of a miliary tubercle, discovered, and this consisted of epithelioid cells more centrally and lymphoid more peripherally placed. On the other hand, in the floor of the ulcer it was possible to distinguish more nodular formed masses of lymphoid and epithelioid cells, but definite and typical tubercles, in the usual sense, were entirely wanting. The free surface of the ulcers showed more or less necrosis; the deeper layers, which were in an excellent state of preservation (the tissue having been perfectly fresh), were quite free from such indications. Tubercle bacilli were present in great numbers; in no section were they wanting, and often they occurred in great clumps. The main masses were on the free surface of the ulcers, but they were also found deeper down among the glands or within their lumina.

The foregoing cases seem to possess sufficient interest to warrant recording them, even though it is now admitted generally that the stomach at one time or another becomes directly involved in tuberculosis of the alimentary tract. It is interesting to consider for a moment a fact alluded to by many writers, that there is a want of correspondence between the appearance of lesions of a tuberculous nature in the stomach on the one hand and in the intestine on the other. While in the great majority of cases the latter shows great disposition for the development of tuberculous ulcers, it is interesting and striking to see how often in the cases reported in the literature, where ulcers existed in the stomach, the intestines entirely or almost entirely escaped. Every pathologist must be impressed with the unexpected variations in the localizations of tuberculous lesions, and must have observed instances in which the alimentary tract entirely escaped infection when the conditions seemed most favorable for it. It is impossible at the present time to give any satisfactory explanation of such occurrences.

Concerning the multiple nature of the ulcers in the two cases discovered above, they are in this respect, compared with other cases (except Eppinger's), peculiar. It is questionable whether they may be considered as having shown any special predilections for situation, except in the second case to avoid the pylorus, apparently the most common seat of single ulcers. Two points may be considered in this connection, one of which is borne out by the bacteriological examination of the second case. The size of some of the ulcers and their limitation to the mucous membrane agree not a little with the small erosions following ecchymoses into the mucosa, the so-called hemorrhagic erosions. The absence of a specific histological structure peculiar to tubercle, in many of the more superficial losses of substance, is not inconsistent with such an origin. That such erosions are very common in many diseases is of course well known, and it may therefore with propriety be asked whether a part of the ulcers in the second case do not owe their origin to this cause, and the tubercle bacillus is responsible only secondarily for a further destruction; the production of those lesions more nearly resembling histological tubercles. Eppinger long ago declared that the œsophagus was invulnerable to the tuberculous virus, unless a

previous lesion existed to enable it to get a foothold; and while this statement has perhaps been disproven, yet that such a previous injury may act as a predisposing cause is more firmly established now than when he wrote (see Cordua). And if for the œsophagus, it may be asked why not for the stomach? The facts in our second case point more towards such a view, namely, that many small erosions, probably of hemorrhagic origin, existed in the stomach, some or all of which became invaded by tubercle bacilli swallowed with the sputum, than that they owe their production to a direct invasion, in the absence of a previous lesion, of the mucous membrane of the stomach, by the bacillus tuberculosis.

In closing I wish to express my gratitude to Dr. Flexner for the advice and assistance most kindly given me in the course of this investigation.

Addendum.

After the completion of the above report, a third case of gastric ulcer came under observation, which proved also to be of tubercular origin, and the specific character of which was far more easily determined than in the other two cases. The lesions here conformed in every way most closely to the usual type of tubercular ulcerations. The ulcers were in this case but two in number, of large size, and accompanied by the formation of tubercles which were evident even to the naked eye.

Case 3. The patient was a colored girl of eleven years of age. She entered the medical department of the Johns Hopkins Hospital (service of Dr. Osler) on June 16th. Tubercular peritonitis was diagnosed, and she was transferred to the surgical side, where the diagnosis was confirmed by an exploratory operation, the peritoneum being found covered with miliary tubercles and the intestines matted together. The patient recovered from the operation and lingered until December, when death occurred. The autopsy was performed by Dr. Livingood, from whose report the following extracts have been taken.

The body was much emaciated. Extending from below the costal margin to a point opposite the umbilicus was the scar of an imperfectly closed incision, the floor of which consisted of a sloughing surface covered with pus. Near the umbilicus the tissues were darkened and necrotic in appearance. On attempting to open the peritoneum, the transverse colon and the upper part of the omentum were found completely coherent. Below, the intestines were closely matted together by fibrinous and fibrous bands, which could be stripped apart, though with difficulty, especially at the umbilicus. The parietal layer of the peritoneum was thickened and studded with conglomerate and miliary tubercles. The peritoneal cavity contained a large amount of turbid, yellowish-white fluid with fine flocculi. It had a slightly fæcal odor. The serous coat of the intestines was studded with numerous caseous tubercles, usually about the size of a cherry-stone, but ranging larger and smaller. The appendix vermiformis was so matted in the mass that it could not be found.

The anterior mediastinal and the lower cervical glands were enlarged and caseous. The visceral and parietal layers of the pleura on the right side were studded with caseous tubercles, some of which reached the size of a bean.

The pleural cavity was partly obliterated by fibrous adhesions. The lung contained in its apex numerous small nodules, some of them caseous; it was congested over the remainder of its extent, and small tubercles could be seen and felt scattered through it. The left pleural cavity was completely obliterated, and the lower lobe of the lung could not be freed from the diaphragm, but had to be removed with it. Miliary tubercles were scattered over both layers of the pleura, especially thickly along the lines of the ribs. A large area of caseation was formed where the lung was in contact with the diaphragm, and this process seemed to have extended directly through the diaphragm to the spleen and liver beneath. The upper lobe of the left lung showed more extensive tuberculosis than did the right lung, being filled with numerous tubercles in all stages of caseation, but without definite cavity formation. Small nodules were scattered through the lower lobe, which was much congested and, at its lower extremity, in the early stage of consolidation.

The spleen was adherent to the diaphragm and to the parietal peritoneum. Its capsule was thickened and was the seat of large caseous tubercles, but there were no distinct tubercles in the substance. One small caseous tubercle was found in the right kidney. The mucous membrane of the uterus was the seat of a number of yellow and gray miliary tubercles. Both tubes were enlarged and adherent to the surrounding structures. Some of the lymphatic glands in the broad ligament were caseous, and the vaginal mucous membrane contained a single tubercle. The capsule of the liver was covered with numerous minute tubercles, and others were found in the substance of the organ. The pancreas was closely adherent to the caseated retroperitoneal lymph glands, and its substance showed large caseating areas.

The stomach was adherent to the transverse colon, the pancreas, and to the mass of enlarged peripancreatic lymph glands. The serous coat was covered with small and large caseous tubercles. Midway between the pylorus and the cardia on the posterior aspect of the lesser curvature, was a large, irregularly oval, crater-like erosion, 3 cm. by 2 cm. in size. The edges were raised and somewhat undermined and more deeply congested than the surrounding parts. The floor was irregular, the deepest part of the crater measuring 8 mm., while the remainder was formed by projecting caseous tubercles. Directly behind this ulcer was a caseous lymphatic gland, so closely adherent to the stomach wall at this point that it was impossible to tell whether or not it formed the floor of the ulcer. A second smaller erosion was found above this one, in the middle of the lesser curvature. Its edges were slightly elevated, and in one place deeply undermined, the floor being formed by the muscularis. Here and there scattered through the mucous membrane were minute grayish white and yellow points looking like, but not proven to be, miliary tubercles. In the duodenum, just beyond the pyloric orifice, was a large ulcer with caseous tubercles covering its base; a similar but still larger one was found in the cæcum, and smaller ones scattered through the small intestines.

In the microscopic examination of the larger of the two gastric ulcers, the section passed also through the adherent lymph gland, which was found to be completely necrotic. It

was intimately adherent to the stomach, separated only by the remains of the muscular wall from the caseous masses within the stomach wall proper. The mucous membrane for quite a distance around the ulcer was infiltrated, becoming more or less necrotic at the edges, which were elevated and undermined. The deepest part of the ulcer had for its floor the muscularis, but the walls were formed by large caseous tubercles, some of which were completely necrotic. In the overhanging edge, which was formed by mucosa, and throughout the mucosa generally, were found small tubercles which, for the most part, had originated in the submucosa or muscularis mucosæ. They represented all stages of tubercle formation. Giant cells were present in great numbers. Sections stained by the Ziehl-Neelsen method showed numerous tubercle bacilli, both in the superficial and deep layers.

In this case the question naturally arose whether or not the ulcerative process in the stomach was merely secondary, having been caused by the adherent lymph gland which had ulcerated through to the free surface. The microscopic examination proved, however, that the process in the stomach was quite independent in its origin, as the still intact muscular wall could be traced along the whole extent of the ulcer between it and the caseous gland behind.

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STUDIES ON TRICHINOSIS.

By T. R. Brown.

[*Abstract of remarks and discussion before the Johns Hopkins Hospital Medical Society.*]

The clinical history of the case which forms the basis of these remarks resembles in some respects the classical picture, though the symptoms were unusually mild. The patient, a man 23 years of age, was admitted to the hospital on March 3, 1896, complaining of general muscular pains. He had been ill six weeks, and for the two weeks before entry the pain had been so severe that he had scarcely been able to move about. There were irregular fever and extreme muscular tenderness, particularly in the arms and legs. The diagnosis of a myositis, probably due to trichinosis, was made and confirmed by the finding of actively motile trichinæ in pieces of muscle removed from the arm.

He remained in the hospital for over two months, being discharged well.

During his stay in the hospital the blood was examined daily. The number of leucocytes per cm. was determined and a differential count was made of the various forms; frequent examinations of the urine were made with quantitative determinations of the uric acid, urea and total nitrogen. The two small pieces of muscle which were removed were subsequently subjected to careful microscopical examination. The results of the studies may be summarized as follows:

(*a*) *The blood.* The study of the blood was carried on continually during the course of the disease, a determination of the leucocytes and a differential count of the various forms of leucocytes being made daily. The result of these observations showed: (a) A gradual rise of the proportion of eosinophiles, reaching 68.2 per cent—35 per cent. higher than any previous record—and from this point a gradual decline to 16.8 per cent. on the patient's discharge; (b) a coincident depression of the polymorphonuclear neutrophiles, reaching at one time 6.6 per cent., while for two weeks these forms showed an absolute decrease in the blood, notwithstanding (c) the marked leucocytosis, reaching on some occasions above 30,000 per cubic millimetre.

In fact, the neutrophiles and eosinophiles showed at all times an inversely proportional relation, and the eosinophilic rise could be seen to be distinctly at the cost of the neutrophiles, the other forms showing relatively little fluctuation.

The presence of such quantities of eosinophiles suggests their possible diagnostic value in trichinosis, and perhaps, if it be found on further studies to be characteristic of this disease, may help to clear up the cases which are regarded *intra vitam* as rheumatic in nature and which, years afterward, the autopsy table shows to have been cases of trichinosis.

As an association has for a long time been noted between

the eosinophiles and the Charcot-Leyden crystals, various experiments were made with the blood which contained such large quantities of eosinophiles, to see if the crystals could be derived directly from these cells. In all cases, however, the results were negative, seeming to show that the crystals are, at least, not direct crystallization products from the eosinophiles, but that something besides the presence of these cells is necessary for their formation.

(*b*) *The urine.* The quantitative determinations of the uric acid, urea and total nitrogen were carried on mainly in connection with the ideas of Horbaczewski, that the uric acid, derived from the destruction of nuclein-holding material, comes normally in large part from the leucocytes and is therefore increased in leucocytoses.

Although the uric acid per 24 hours was determined on 23 different days, and on four of these the urea and total nitrogen also, on no occasion did the total uric acid excretion, or the relation between the nitrogen of the uric acid to that of the urea or to the total nitrogen exceed the normal limits, showing that the views of Horbaczewski are not universally correct. In this case, however, the leucocytosis differed somewhat from the ordinary in that here the eosinophiles were the cells markedly increased; in his cases the ordinary polymorphonuclear neutrophiles.

(*c*) *The muscle.* The changes in the muscle were extensive. There was a great proliferation of the muscle nuclei throughout the section; about the fibres containing trichinæ this proliferation was very marked, especially in the second specimen; not so extensive in the earlier specimen. In fact, in a few places where the parasite had but just wandered into the primitive bundle no change in the muscle substance nor any proliferation of nuclei was visible. Most of the fibres containing the worm showed a conversion of the muscle substance into a finely granular faintly-staining material containing many large swollen nuclei, *i. e.* the proliferated muscle nuclei; and about many of the proliferated nuclei, both in the more and in the less degenerated portions, distinct vacuoles could be made out.

Throughout the specimens the muscle showed various forms of disintegration, in some places a longitudinal splitting of the fibres into fibrillæ, in other places the formation of what might be called muscle cells, the muscle nucleus taking about itself some of the muscle substance and separating itself from the fibre; while in still other places a peculiar transverse splitting up of the muscle into disks, the nuclei here proliferating transversely instead of in the usual longitudinal method, was noted.

Besides these changes there were seen in the first specimen many polymorphonuclear cells, some showing a finely granular protoplasm which did not stain to any extent with acid stains (the so-called neutrophiles), some distinct eosinophiles with large deeply-staining granules, and beside these, cells which somewhat suggest transitional forms, showing in the protoplasm of the cell body fine granules, but with a distinct affinity for the acid stain; and all these cells seemed to be acting as phagocytes in the disintegrating muscle, being often seen in little lakes or bays in the degenerating bits.

In the second specimen there were decidedly fewer neutrophiles and many more eosinophiles than in the first. That in both cases these were typical eosinophiles was shown by staining them in the different acid stains and in the Biondi-Heidenhein triple stain.

At the same time with this greatly increased proportion of eosinophiles in the extra-vascular leucocytes in the muscle, *the blood vessels in the interfascicular connective tissue showed the same proportion of neutrophiles and eosinophiles as was found in the blood count for that day.*

In another specimen of muscle from a case of acute trichinosis which was obtained from the pathological museum, great quantities of eosinophiles were also found.

The study of the blood, showing the steady increase of the eosinophiles at the expense of the neutrophiles, together with the identical character of the nuclei of the two forms, would tend to support the view held by some observers, that the former variety of cells is derived by some transitional change from the latter.

That such a change might take place in the muscle is suggested by the presence here of neutrophiles, eosinophiles, and what may be regarded as transitional forms, in large quantities. Particularly suggestive is the great disproportion between neutrophiles and eosinophiles seen in the second muscle specimen. Here the eosinophiles were much increased, the neutrophiles correspondingly decreased, while the blood-vessels in the interfascicular connective tissue showed but the same proportion of these forms as was to be made out in the specimens of the peripheral blood for the same days. It is further noteworthy that the eosinophiles increased in number soon after the increase in severity of the muscle symptoms, and shortly after the decrease of those symptoms, diminished gradually, descending toward the normal point as the symptoms abated. Suggestive also is the presence of large numbers of eosinophiles in a specimen of muscle from another case of acute trichinosis.

Dr. Osler.—This is the only case of trichinosis which has been in the hospital, or it is safer to say the only case recognized, since we know that not infrequently the disease escapes recognition or is mistaken for some other disorder. This is the second case which I have seen clinically, while in the post-mortem room I have found on eight or ten occasions the calcified cysts. Mr. Brown is to be congratulated on the very thorough way in which he has followed this case.

Dr. Thayer.—The evidence offered by Mr. Brown in favor of the origin of the eosinophilic cells by transition from the so-called neutrophiles is very suggestive. The total number of polymorphonuclear cells found in the circulating blood was practically what one would expect in a leucocytosis of that extent. And yet, examining this percentage which normally should consist almost absolutely of so-called neutrophilic leucocytes, we find the great majority represented by eosinophiles. The fact also that in the affected parts the blood-vessels contained the same relative proportion of eosinophiles and neutrophiles as did the peripheral vessels, while the tissues round about contained an enormously greater percentage of eosinophiles, is very interesting.

That the so-called neutrophilic granules stain often with acid coloring matters is well known. With good acid dyes

these granules almost always take a slight stain, and by some observers both eosinophiles and neutrophiles are classed as acidophilic cells. They stain, however, much better in fluids consisting of a mixture of acid and basic coloring matters. As Mr. Brown has sharply pointed out, this acid staining of the smaller granules was not to be made out at all in the specimens of blood and in the blood-vessels in the tissues, and the fact that outside of the vessels in the affected parts numerous apparent transitional forms between the non-granular polymorphonuclear wandering cells and the true eosinophiles existed is very suggestive. That these cells were true eosinophiles in the sense of Ehrlich, Mr. Brown has proven by careful tests with a number of different acid coloring matters.

The idea that the eosinophiles represent a further change in the cell which we know as the neutrophile is, as Mr. Brown has said, not a new one, but I am not aware that any argument in favor of this view as forcible as that which he presents has yet been published.

With regard to the actual blood condition—the increase of the eosinophiles—no similar case exists in the literature; the percentage of eosinophiles in this instance is more than twice as large as has been reported in any other case.

Dr. Barker.—Mr. Brown has referred, in speaking of the degeneration of the muscle, to a splitting up of the muscle fibre into transverse disks. I should like to ask him whether or not he has been able to make out just where the splitting occurred. Though several histologists have emphasized the fact, it does not appear to be generally known that the splitting in the muscle fibre may occur with some reagents at one level, with other reagents at an entirely different level. Thus in the formation of the so-called Bowman's disks through the action of alcohol, the two layers Q (doubly refractive substance of Brücke) with the layer M (Hensen's line) in between are always present in the disk. On the other hand, on treatment of muscle with certain acids (acetic, picric or hydrochloric), the splitting occurs between the two layers Q, each disk having then in its middle the layer Z (Krause's transverse line or membrane). It would be interesting to know, for the degeneration described, whether the splitting occurred at either of these two levels or at still another level.

I gather from his paper that Mr. Brown favors the view that the eosinophile granules represent the cyto-mikrosomas of the cells in which they occur. This view, recently supported by Lovell Gulland, was previously urged by Martin Heidenhain, who found that the eosinophile granules stain black with his iron-hæmatoxylin staining method, and that it is often possible to make out an arrangement of the granules radial to the attraction sphere of the cell. Both these observations are in favor of the cyto-mikrosomal nature of the granules.

The occurrence of such an enormous number of eosinophiles in the circulating blood is truly remarkable and makes the case unique in the bibliography.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of December 7, 1896.

Dr. Thayer in the Chair.

On Certain Visceral Pathological Alterations, the Result of Superficial Burns.—Mr. Bardeen.

Extensive superficial burns are followed by severe constitutional symptoms. The great pain felt at first is followed by a benumbing of the senses and by sleepiness. At times there may be delirium and cramps. The pulse becomes weak, the respiration shallow and irregular. The temperature, after a short rise, falls below the normal. There may be vomiting and diarrhœa, and hæmoglobin may appear in the urine. Death within 48 hours usually follows a burn which has involved two-thirds of the surface of the body. The burn need not be of an extreme grade. Death has often followed burns so superficial as to give rise merely to an erythema.

It is clear from this latter class of cases, at least, that alterations in the internal organs may follow the burning of the skin which cannot be accounted for on the supposition that they are directly caused by the heat. Thus arises the question as to the nature of the physiological relations between the lesions produced in the skin and the resulting constitutional effects. Many hypotheses have been advanced to answer this question, some of which have been supported and others destroyed by experimental work on animals.

Many of these hypotheses have been based upon the conception of a loss of normal cutaneous activity. But experiment has shown quite conclusively that death after burns is to be ascribed neither to the retention in the blood of products normally excreted through the skin, nor to heat radiation due to paralyzed blood-vessels in the latter structure.

Again death has been referred to changes produced in the blood itself directly acted upon by the high temperature. It is known that erythrocytes are destroyed by a comparatively low temperature (55° C.). This has led to the supposition that the general pathological effects are due to loss of functional red blood corpuscles, or to irritation produced in the kidneys and other internal organs by the products of their disintegration. But a more generally accepted view is that the blood is so altered by the elevation of temperature as to give rise to extensive thrombosis, death resulting from the disturbances of circulation.

Another view has been advanced more recently. Kijanitzen, who extracted from the blood of dogs experimentally burned, substances similar to Brieger's ptomains, and Reiss, who found toxic substances in the urine of persons accidentally burned, believe that they have brought forward evidence in support of the idea that the blood in severely burned animals is rendered toxic.

During the past year five small children were brought to the Johns Hopkins Hospital so severely burned that death in each case followed within a very few hours of the accident. At the suggestion of Dr. Flexner I took this opportunity of studying

the histological alterations found in the tissues of the body after burns. A careful autopsy was made in each case by Dr. Flexner, and parts of the various organs were preserved and prepared for microscopic examination.

The lesions in all five cases were strikingly similar. Of the gross lesions the most notable were cloudy swelling of the liver and kidney, acute swelling of the spleen, and swelling and congestion of the lymphatic glands and other lymphatic tissue.

Microscopically, the most interesting lesions noted were parenchymatous degeneration of the kidneys and liver, focal areas of necrosis in the liver, and pronounced focal necrosis in the lymphatic tissue.

The lymphatic tissue was affected throughout the body. The Malpighian corpuscles of the spleen, the tonsils, gastric lymphatic follicles, enteric solitary and agminated follicles and the lymphatic glands all showed essentially the same changes.

The lymphatic glands were much swollen and at times congested. The earliest changes were in the follicles and consisted of an œdematous swelling. This was more marked towards the centre of the follicle, in an area corresponding to the germinal centre. In areas of less advanced alteration the lymphocytes were merely less closely packed together than is usual. But in the areas of more marked change, the lymphocytes were swollen and their nuclei fragmented. In these cases the follicle presented a remarkable appearance. It was not only greatly swollen, but at the edges a rim of closely packed lymphocytes existed, while at the centre swollen and distorted lymph cells, bits of protoplasm and fragments of nuclei were seen scattered about, some lying free, others enclosed in large flat endothelioid cells.

The lymph cords as well as the follicles were swollen, while the lymph sinuses seemed less distinctly marked off than usual from the reticulum in which the lymphocytes of the cords lie imbedded. Here and there throughout the gland groups of degenerating cells might be seen, but the areas of distinct focal degeneration were confined as described above, to the follicles.

Calvert has shown that the terminal artery breaks up in the centre of the follicle into capillaries which radiate towards the periphery of the follicle. It seems possible that the lesions focalized just at this region may in some way hold special relation to the circulation of the blood. For if the blood in these cases contains toxic materials, it is conceivable that it is just at the centre of the follicle that the poisonous plasma acts with greatest intensity on the lymph cells.

In the lymphatic follicles of the tonsils and stomach and in the Malpighian bodies of the spleen focal degeneration essentially similar to that of the follicles of the lymphatic glands occurs. In the intestines the greatly swollen lymphatic follicles, solitary and agminated, showed extensive focal areas of degeneration.

In these areas of degeneration in the lymphatic tissue we find appearances essentially similar to those seen after the injection into the body of various bacterial and other toxalbuminous substances. Indeed, the lymphatic glands from our cases of skin-burn might readily be mistaken for the lymphatic glands of children dead of diphtheria. The lesions in the other organs are also essentially similar to those found in the bodies of persons dead from the acute infectious diseases. It seems, therefore, justifiable to consider that one of the main causes of death after burns is to be sought in a toxæmia caused by alterations in the blood and tissues, the direct effect of the elevation of temperature; a view which is further strengthened by the clinical evidences and the experimental work of Kijanitzen and others.

NOTES ON NEW BOOKS.

The American Year-Book of Medicine and Surgery: being a yearly digest of scientific progress and authoritative opinion in all branches of medicine and surgery, drawn from journals, monographs and text-books of the leading American and foreign authors and investigators. Collected and arranged, with critical editorial comments, by J. M. Baldy, M. D., and twenty-six other physicians, under the general editorial charge of George M. Gould, M. D. (*Philadelphia*, 1897: *W. B. Saunders*, 925 *Walnut Street.*)

This year-book amply justifies the high expectations which were excited by the excellent character of the similar volume published last year. It is an encyclopedic collection of new medical literature gathered from all lands and every field of medical knowledge. It is not a mere aggregation, but a discriminating digest of the latest knowledge in medicine, with frank opinions and critical comments by painstaking and competent men. The special comments of the editors as distinguished from the authors are enclosed in brackets, to facilitate reference to them.

The completeness of the department of medicine, which has had the editorial supervision of Pepper and Stengel, is shown by the fact that it covers more than 180 pages. Among other interesting matter the sections on the Schott method, typhoid fever, malaria and myxedema are probably of the most interest. In view of the extravagant claims for the different methods of aborting typhoid fever, it is gratifying to notice that the authors ask that all cases treated by these methods be more carefully studied and the symptoms more minutely described.

Under the head of surgery, which occupies 248 pages of the volume, Keen and DaCosta give a valuable résumé of the most recent work in anæsthetics, with sensible comments upon the dogmatic assertions of many experimenters. It is refreshing to read the following: "Wunderlich, from a statistical study, concluded that albuminuria was more apt to be induced by chloroform than ether. Beck from a statistical study concluded that albuminuria was most apt to be caused by ether. We are thus confronted by carefully compiled reports which are diametrically opposed and absolutely contradictory. The humble surgeon who venerates statistics too much to use them is lost in uncertainty. We are told that figures cannot lie, and yet only one of these statements can be true. Which is the truth we cannot yet decide, as we know of no birthmark to prove identity."

The operative treatment of perforation in enteric fever would seem to be presented in too gloomy colors, in the light of Finney's recent statistics.

The article on diseases of the gall-bladder is quite full and satisfactory. The same may be said of the careful and conservative article on the use of the *x* rays.

Obstetrics, under the editorship of Hirst and Dorland, occupies about 100 pages, and presents many topics of special interest to the general reader, notably the sections on the pathology of pregnancy, abortion and extra-uterine pregnancy.

The section on gynecology, by Baldy and Dorland, occupies upwards of 200 pages, and touches upon a variety of interesting

matter. The objection presented to Clark's radical operation for the relief of uterine cancer, that but few patients can endure the shock of the prolonged etherization, seems hardly tenable in the light of actual practice. The chapter on nervous and mental diseases, by Church and Patrick, is thoroughly well worked out, and presents a good review of the work of the past year. The section on materia medica is an excellent feature of the book. All things considered, the book is well arranged, admirably edited and well printed. Every physician who does not have leisure to inform himself on the latest advances in medicine and surgery from original sources, should procure and carefully read the volume.

Architecture of the Brain. By Wm. Fuller, M. D., Grand Rapids, Michigan. 1896. Pages 1-183, with many illustrations.

In this volume are described and pictured the general gross relations of the brain as seen (1) from the external surface, (2) on dissection, and (3) in a series of frontal sections. The author has had a large experience in dissection of the central nervous system and in the preparation of castings in plaster of the dissections which he has made. No person except one who has busied himself in work of this kind can easily estimate the amount of labor which has preceded the publication of the book.

After a description of the membranes, the cerebro-spinal axis as a whole is described. The cerebrum is then taken up and the method of dissecting it outlined. A discussion of the structure of the cerebellum, of the pons varolii, of the medulla oblongata and spinal cord follows. Throughout the book the main stress is laid upon the gross morphology, but there are brief chapters concerning the nerve tracts of the cerebro-spinal axis and the central origin and relations of the cranial nerves. On pages 130–133 there is a brief discussion of topographical cerebral localization. L. F. B.

Annual Report of the Supervising Surgeon-General of the Marine Hospital Service of the United States for 1893. Vols. I and II. (*Washington: Government Printing Office*, 1894–1895.)

These volumes present a very complete and satisfactory account of the operations of the Marine Hospital Service for 1893. The most valuable papers are a carefully prepared account, by Surgeon Stoner of Baltimore, of the origin and development of this Service, which should be read by all who desire to familiarize themselves with its history, and the "Report of the Commission to Investigate the Cholera Epidemic," prepared by Dr. Walter Kempster and Surgeon Fairfax Irwin, who made an extensive trip in Europe to procure data for it. It is to be regretted that the Commission, while entering into very great detail as to its operations, does not formulate and publish its conclusions in connected form. Scattered throughout the report are many valuable suggestions touching the prevention of infectious diseases and the transmission of contagion, which can only be found by reading many unimportant details. These should have been gathered in an accessible form, so that they might be easily read.

Medical and Surgical Report of the Presbyterian Hospital in the City of New York. Vol. I., January, 1896. By Andrew J. McCosh, M. D., and Walter B. James, M. D. (*The Knickerbocker Press, New York.*)

This report is the first of a series. It is carefully edited and well illustrated. Many of the papers are carefully written and of great interest to the general profession. The pathological reports are meagre and the protocols published are in most instances brief abstracts. Several of the papers have appeared elsewhere. One of them, that of Dr. Northrop, on Gonorrhœal Arthritis, is more popular than scientific, and portions of it read as if the author were thinking aloud. The results of thinking rather than mental operations would be preferable. Taken as a whole, the surgical papers seem to be of the greater value. The volume, however, is worthy of the institution from which it issues and the high character of its editors. It is to be hoped that it will have an annual successor.

BOOKS RECEIVED.

Transactions of the American Gynecological Society. Vol. 21. 1896. 8vo. 490 pages. Wm. J. Dornan, Printer, Philadelphia.

Prize Essays on Leprosy. By Newman, Ehlers and Impey. 1895. 8vo. 227 pages. New Sydenham Society, London.

Practical Notes on Urinary Analysis. By William B. Canfield, A. M., M. D. Second edition. 1896. 12mo. 106 pages. G. S. Davis, Detroit, Mich.

A Pictorial Atlas of Skin Diseases and Syphilitic Affections. In photo-lithochromes from models in the Museum of the Saint-Louis Hospital, Paris. With explanatory woodcuts and text. By E. Besnier, A. Fournier, etc. Edited and annotated by J. J. Pringle, M. B., F. R. C. P. Fol. Parts IV and V. 1896. W. B. Saunders, Philadelphia.

Lectures on Pharmacology for Practitioners and Students. By Dr. C. Binz. Translated from the second German edition by Arthur C. Latham, M. A., M. B. Oxon., M. A. Cantab. Vol. 1. 1895. 8vo. 389 pages. The New Sydenham Society, London.

Autoscopy of the Larynx and the Trachea. (*Direct Examination without Mirror.*) By Alfred Kirstein, M. D. Authorized translation (altered, enlarged and revised by the author) by Max Thorner, A. M., M. D. 1897. 12mo. 68 pages. The F. A. Davis Co., Philadelphia.

The Practice of Medicine. By James Tyson, M. D. 1896. 8vo. 1184 pages. P. Blackiston, Son & Co., Philadelphia.

Anomalies and Curiosities of Medicine. By George M. Gould, A. M., M. D., and Walter L. Pyle, A. M., M. D. 1897. 4to. 968 pages. W. B. Saunders, Phila.

A Pictorial Atlas of Skin Diseases and Syphilitic Affections. In Photo-Lithochromes from Models in the Museum of the Saint Louis Hospital, Paris, with explanatory woodcuts and text. By E. Besnier *et al.* Edited by J. J. Pringle, M. B., F. R. C. P. Part VI. 1896. W. B Saunders, Philadelphia.

A Treatise on Cholelithiasis. By B. Naunyn, M. D. Translated by Archibald E. Garrod, M. A., M. D., F. R. C. P. 8vo. 197 pages. 1896. The New Sydenham Society, London.

Principles or Guides for a Better Selection or Classification of Consumptives Amenable to High Altitude Treatment and to the Selection of Patients who may be more Successfully Treated in the Environment to which they were Accustomed Previous to their Illness. By A. Edgar Tussey, M. D. 1896. 8vo, 144 pages. P. Blakiston, Son & Co., Philadelphia.

Twentieth Century Practice. An international encyclopædia of modern medical science, by leading authorities of Europe and America. Edited by Thomas L. Stedman, M. D. Vol. X. 1897. 859 pages. 8vo. Wm. Wood & Co., New York.

Transactions of the College of Physicans of Philadelphia. Third Series. Vol. XVIII. 1896. 8vo. 263 pages. Printed for the College. Philadelphia.

Injuries and Diseases of the Ear. Being reprints of papers on otology. By Macleod Yearsley, F. R. C. S. 12mo. 1897. 40 pages. The Rebman Publishing Co., Ltd., London.

The American Year-Book of Medicine and Surgery. Being a yearly digest of scientific progress and authoritative opinion in all branches of medicine and surgery, drawn from journals, monographs and text-books of the leading American and foreign authors and investigators. Collected and arranged, with critical editorial comments, by J. M. Baldy, M. D., *et al.* Under the general editorial charge of George M. Gould, M. D. Profusely illustrated. 4to. 1897. 1257 pages. W. B. Saunders, Philadelphia.

Inebriety. Its Source, Prevention and Cure. By Charles Follen Palmer. 12mo. 1897. 109 pages. Fleming H. Revell Co., New York.

The Medical Annual and Practitioner's Index. A work of reference for medical practitioners. Fifteenth year. 1897. 12mo. 851 pages. John Wright & Co., Bristol.

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BULLETIN

OF

THE JOHNS HOPKINS HOSPITAL.

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CONTENTS.

THE ASSOCIATION BETWEEN THE SO-CALLED PERINUCLEAR BASOPHILIC GRANULES AND THE ELIMINATION OF THE ALLOXURIC BODIES IN THE URINE.

(From the Medical Clinic of Prof. Kraus in Graz.)

By T. B. Futcher, M. B., *Instructor in Medicine, Johns Hopkins University and Asst. Res. Physician, Johns Hopkins Hospital.*

In 1894 Neusser described a peculiar granulation in the leucocytes of patients suffering from a uratic diathesis. This term was given a wide meaning, and under it he included gout, uratic lithiasis, as well as the various forms of "irregular gout," as muscular rheumatism, nervous asthma, skin affections, gastro-intestinal derangements, diabetes, leukæmia, neuralgia and neurasthenia. These granules were brought out by staining freshly dried specimens of the blood with a modified Ehrlich's triacid mixture in which the basic ingredient was relatively increased. They are basic staining granules, and with this mixture appear as greenish black or dense black droplets over and about the nuclei of the leucocytes. They vary considerably in size, the smallest being about the size of the neutrophilic granules, and the largest considerably larger than the eosinophilic granules. Often they have a glistening or refractile appearance. They are always in immediate contact with the nucleus, never being present amongst the ordinary granules of the leucocytes. They give one the idea that they constitute some substance which has been squeezed out of the nucleus. Neusser found them most abundant in the mononuclear leucocytes, in which they often form a complete ring about the nucleus, but stated that they were also present in the polynuclear leucocytes and eosinophiles. He believed that they were of the nature of a nucleo-albumin in composition, and saw in their presence a sign for an increased uric acid production in the organism. This assumption was based on the analysis of the urine of 100 patients, in whom, along with the already described blood condition, an elimination of from 0.8 to 1.5 grams of uric acid, and a uric acid coefficient within the limits of 1:30 to 1:20 (1:50 being normal) were found. It is important to note that the patients on whom these observations were made were not brought under a condition of nitrogenous equilibrium.

The clinical interest of these basophilic granules would be very great if it could be proven that in an extended series of cases they were associated only with a uric acid diathesis and were entirely absent in other affections. If such could be proven we would then have a ready clinical means of differentiating symptoms due to a uratic diathesis from those arising from some other cause. Neusser himself states that they are also to be found in a certain percentage of cases of tuberculosis, and believes them to be of prognostic value. He claims to have

found that cases showing the granules run a more favorable course, and that the lung infiltration is more likely to undergo fibroid change than in cases where the granules are absent.

Kolisch, a pupil of Neusser's, has advanced the theory that a uric acid diathesis is not due to an anomaly of in the formation of or in the relative solubility of uric acid, but in the increased production of the alloxuric bodies (uric acid + xanthin bases), out of the products of nuclein destruction. He found that in cases where the perinuclear granules were abundant that there was a definite increase in the quantity of alloxuric bodies eliminated. The increase was due to a marked increase of the xanthin bases, the uric acid being relatively diminished; and it was to the presence of these bases circulating in the blood that the symptoms of a uratic diathesis were due, and not to any anomaly in the formation or excretion of uric acid. Neusser and Kolisch, although they both believe that the basophilic granules bear an intimate association with the causation of the uratic diathesis, differ in their views as to which ingredient of the urine is increased by their presence. Neusser found an increased elimination of uric acid, while Kolisch found that the uric acid was relatively diminished, and the xanthin bases markedly increased, resulting in a total increase in the amount of the alloxuric bodies eliminated.

With the exception of the above difference, Neusser and Kolisch agree that the occurrence of the perinuclear basophilic granules indicates an increase in the nuclein constituents of the blood. Direct analyses of the blood for the amount of nuclein contained in it were naturally not made; and pure color reactions, even from a qualitative standpoint, are unreliable, as shown by L. Heine. If one accept without further questioning Neusser's view that the perinuclear granulation is a morphological criterium for an over-production of nuclein derivatives from the cell nuclei, it is not easily explainable why an increase in the quantity of the alloxuric bodies eliminated in the urine should follow. If one considers these granules identical with the pyrenogenic granules of Löwit found in the leucocytes of the river crab (in the arthropoda the uric acid is not formed from the nuclein materials) and in certain normal leucocytes of the bone-marrow, then they fall under the general heading of karyorhexis or breaking up of the nucleus, and would more likely indicate a chromatolytic degeneration of the leucocytes. Prof. Kraus was able to demonstrate similar granules in the liver cells when portions of the liver substance were removed from the body while still warm and kept in a moist chamber at 40° C. At a definite stage in the breaking down of the nuclei he found granules in the protoplasm of the liver cells resembling and staining similarly to those found in the leucocytes by Neusser. If such a condition takes place under any circumstances, either physiological or pathological, in the living person, an increase in the alloxuric bodies eliminated might be expected.

In studying the subject of Neusser's granules I have endeavored to determine whether there is any regular coincidence between the presence of these granules and the elimination of the alloxuric bodies, and further, whether the granules are found only in cases showing the symptoms of a uratic diathesis.

Doubt as to this intimate association arose in my own mind while examining the blood of patients for the basophilic granules, at first without studying their effect on metabolism. In a very large number of cases examined, both in healthy and diseased persons, I have never failed to find the granules present. Four of these cases were cases of true gout with typical joint affections and well defined tophi in the ears. In two of these cases the granules were very abundant, but not more so in the mononuclear than in the polymorphonuclear leucocytes. In the remaining two cases they were on the whole not very abundant, and the polymorphonuclears showed the granules more numerous than did the mononuclears. Further, I was able to convince myself, both in Baltimore and in Graz, that the granules were not more marked in the blood of patients suffering from the so-called uratic diathesis than in other diseases, or even in certain apparently healthy individuals. The fact that the granules are found in other diseases than in uratic diathesis, and also in healthy persons, lessens their clinical interest. Neusser believed their presence in tuberculosis was a favorable sign. In this disease I have observed cases with abundant granules and others with few granules without noticing any difference in its subsequent course. The granules vary in richness in the leucocytes from day to day in the same individual, notwithstanding his living under the same conditions of nourishment, etc. This fact seems to diminish the significance of the granules. It seems more common for variations of this kind to occur than for the granules to remain constant from day to day. No method seemed practicable for making an accurate count of these granules, and in the following cases reported it seemed sufficient for all practical purposes to stain the specimens of dried blood and to compare from day to day the amount of granulation present in the different forms of leucocytes.

The following cases, in which the basophilic granules and their effect on metabolism were studied, were undertaken especially to ascertain whether the amount of granulation present really influenced the quantity of the alloxuric bodies eliminated in the urine.

In all, 8 cases were carefully studied. Blood specimens were stained each day with Neusser's staining mixture, and the same technique followed from day to day. The patients were as nearly as possible brought under the conditions of nitrogenous equilibrium before the observations on the urine were concluded. Each case was followed for a period of 5 to 6 days, and during this time the same amount of food was taken each day, and the body weight from day to day remained practically constant. The total amount of nitrogen ingested in the food and eliminated in the urine and fæces was estimated daily. In all the cases the alloxuric bodies were estimated, and in two cases the uric acid as well. The nitrogen was determined according to the method of Kjeldahl, the uric acid according to Ludwig's, and the alloxuric bodies according to the Krüger-Wulf* methods.

In order to assist in the understanding of the following tables I give what is considered the normal amount of nitrogen in grams contained in the alloxuric bodies for the 24 hours, as found by various observers who have made determinations up to the present date.

* Zeit. fur physiol. Chemie, Bd. XX.

For the 24 hours:

Kolisch gives	0.260 gram.
Weintraud	(1) 0.344–0.360
	(2) 0.433–0.534
Richter	0.380
Magnus–Levy	0.506
Richter	0.387
I myself found in healthy persons	(1) 0.499
	(2) 0.551

Judging from these analyses it may be considered that values above 0.4 gram are physiologically high, while those above 0.5 gram may be regarded as pathological.

Case I.—Dr. K., aged 32 years, weight 79.5 kilograms, with a well-marked tendency to a gradually increasing corpulence. Not inclined to undertake great muscular exertion, but in every respect perfectly healthy. After nitrogenous equilibrium had been established, 1.5 liters of Carlsbad water (Mühlbrunn) were drank daily for a period of 8 days.

The daily diet was as follows: Ham, 150 grams; roast beef, 100 grams; milk, 500 grams; 6 breakfast rolls; butter, 65 grams; rice, 60 grams; sugar, 3 pieces; black coffee (infusion), 100 grams; sherry, 100 grams; soda water, 2 bottles.

The above diet represented about 1968 calories (about 25 calories per kilogram body weight), which were made up as follows:

Albumin	362.17 calories.
Fat	837.73
Carbohydrates	646.35
Alcohol	122.15
Total	1968.40

TABLE I.—THE URINE.

Date.	Day of observation.	Daily amount of urine in ccm.	Total nitrogen in grams.	Nitrogen in alloxuric bodies in grams.	Uric acid—nitrogen in grams.	Percentage of alloxuric body—N of total nitrogen of the total nitrogen.
July 6	1	995	14.7638	0.6042	.....	4.16
" 7	2	1240	12.8898	0.4318	.....	3.35
" 8	3	1630	14.7759	0.5262	.....	3.56
" 9	4	1200	14.0700	0.4169	.....	2.97
" 10	5	1080	15.5547	0.4430	.....	2.84
" 11	6	1160	15.0666	0.5602	0.2550	3.71
" 12	7	1630	15.4947	0.5058	.....	3.26
" 13*	8	2270	15.7582	0.4149	.....	2.63
" 14	9	2800	14.1159	0.4459	.....	3.16
" 15	10	2345	15.3560	0.4042	.....	2.63
" 16	11	2700	13.9482	0.3780	.....	2.71
" 17	12	3120	15.5719	0.3849	.....	2.47
" 18	13	3045	12.9062	0.3810	.....	2.95
" 19	14	2920	14.9825	0.3244	.....	2.16
" 20	15	2840	14.3732	0.4025	0.2613	2.80

* From 13 to 20 Carlsbad water was drunk.

TABLE II.—NITROGEN BALANCE (N IN GRAMS).

Date.	Day of observation.	Body weight in kilograms.	Nitrogen ingested.	NITROGEN ELIMINATED. Urine.	Fæces.	Total nitrogen eliminated.	Balance.
July 10	5	79.300	.....	15.5547		.....	.....
" 11	6	79.800	16.2347	15.0666	1.1832	16.2498	.....
" 12	7	79.900	15.9769	15.4947	1.1832	16 6779	—0.7010
" 19	14	79.050	.....	14.9825	.....	.....	.....
" 20	15	79.050	18.6598	14.3732	3.3325	17.7057	+0.9541

Condition of the leucocytes with reference to Neusser's granules: During the period in which no Carlsbad water was taken the granules were present only in very moderate numbers. On the other hand, from July 16th to 20th, during which the water was drank, there was a very distinct increase in the number of granules present in all the forms, particularly in the mononuclear leucocytes. At the same time it will be seen that there was a marked diminution in the alloxuric bodies as represented by the amount of nitrogen eliminated.

Observation II.—Dr. L., a perfectly healthy man, aged 25 and weighing 69.5 kilograms. Muscular, moderate panniculus adiposus, and of a quiet disposition. My colleague, after bringing himself to a point of equal daily nitrogen elimination, drank Carlsbad water for a period of 4 days (1.5 liter of Mühlbrunn per day).

The daily diet was as follows: Ham, 250 grams; veal, 250 grams; milk, 100 grams; wine, 500 grams; tea (black infusion), 250 grams; rum, 15 grams; butter, 50 grams; breakfast rolls, 3.

The above food represented about 1895 calories daily (27 calories per kilo body weight), which were made up as follows:

Albumin	511.73 calories.
Fat	785.49
Carbohydrates	341.69
Alcohol	256.88
Total	1895.79

TABLE III.—URINE.

Date.	Day of observation.	Daily amount of urine in ccm.	Total nitrogen in grams.	Nitrogen in alloxuric bodies in grams.	Uric acid—nitrogen in grams.	Percentage of alloxuric body—N of total nitrogen.
June 12	1	1430	25.2421	0.5710	.....	2.27
" 13	2	1815	30.1310	0.5595	.....	1.85
" 14	3	1800	28.1925	0.5237	.....	1.85
" 15	4	1880	30.3996	0.5791	.....	1.90
" 16	5	2000	30.0650	0.5217	0.4222	1.73
" 17*	6	1890	27.2868	0.6515	.....	2.38
" 18	7	3110	29.4983	0.5421	.....	1.83
" 19	8	2840	28.40	0.6908	0.4222	2 43
" 20	9	2730	27.30	0.6162	.....	2.10

* From June 17 to 20 Carlsbad water was drunk.

TABLE IV.—NITROGEN BALANCE (N IN GRAMS).

Date.	Day of observation.	Daily weight in kilograms.	Nitrogen ingested.	NITROGEN ELIMINATED. Urine.	Fæces.	Total nitrogen eliminated.	Balance.
June 14	3	69.700	.....	.....	.....	.....	.....
" 15	4	69.700	31.7345	30.3996	.....	.....	.....
" 16	5	69.800	31.5645	30 0650	1.3142	31.3792	+0 8536
" 19	8	70 200	31.6679	28.40	.....	.....	.....
" 20	9	70.000	31.5979	29.30	1.2619	30.5702	+1.5643

Relation of Neusser's granules in the leucocytes: In the period before Carlsbad water was taken, with the amount of the alloxuric bodies above the normal (and with a large amount of uric acid), the granules were not particularly abundant. In the second half (June 17–20), when the water was taken, the amount of the alloxuric bodies eliminated was still higher,

whereas the granules had become distinctly diminished in number, particularly in the small mononuclears.

Observation III.—A. F., a young woman, 33 years old, and a cook by occupation. She had a severe anæmia (red corpuscles 1,900,000 per ccm., leucocytes 6800, and hæmoglobin 25 per cent, according to Fleischl's hæmometer). The temperature was normal during the observation. Pulse averaged 110 per min. Slight dyspnœa even when at rest. Patient was of rather large frame, and the panniculus adiposus was not particularly reduced. No œdema; urine free from albumin. Had suffered previously from some gastric trouble, but the symptoms had disappeared. From June 25th to July 7th her weight had become reduced from 57 to 53.4 kilograms.

The daily diet was as follows: Ham, 100 grams; white bread, 100 grams; milk, 500 grams; wine (white), 250 grams; water, about 1000 grams.

The diet administered represented about 928 calories (17 per kilo body weight), which were made up as follows:

Albumin	207.46 calories.
Fat	219.20
Carbohydrates	379.49
Alcohol	122.50
Total	928.65

TABLE V.—URINE.

Date.	Day of observation.	Daily amount in ccm.	Spec. weight.	Total nitrogen in grams.	Nitrogen in alloxuric bodies in grams.	Percentage of alloxuric body—N of the total nitrogen.
July 1	1	1300	1022	.....	.....	.....
" 2	2	1400	1010	10.0940	0.4827	4.78
" 3	3	1100	1014	8.8358	0.4832	5.46
" 4	4	950	1018	8.0964	0.3608	4.44
" 5	5	1100	1016	9.9715	0.3735	3.72
" 6	6	750	1028	7.7963	0.3793	4.86

TABLE VI.—NITROGEN INGESTED (IN GRAMS).

Date.	Day of observation.	Ham.	White bread.	Milk.	Wine.	Total nitrogen.
July 1	1	4.4480	1.5236	2.9925	0.0568	9.0209
" 2	2	4.4480	1.5236	2.9925	0.0568	9.0209
" 3	3	4.4480	1.5236	2.9225	0.0568	8.9509
" 4	4	4.4480	1.5236	2.9225	0.0568	8.9509
" 5	5	4.4480	1.5236	2.9575	0.0568	8.9859
" 6	6	4.4480	1.5236	2.9575	0.0568	8.9859

TABLE VII.—NITROGEN BALANCE (N IN GRAMS).

Date.	Day of observation.	Body weight.	Nitrogen ingested.	NITROGEN ELIMINATED.		Total nitrogen eliminated.	Balance.
				Urine.	Fæces.		
July 1	1	54.200	9.0209	.....	.....	.....	.....
" 2	2	54.300	9.0209	10.0940	0.3879	10.4819	—1.4610
" 3	3	54.200	8.9509	8.8358	0.3879	9.2237	—0.2728
" 4	4	53.900	8.9509	8.0964	0.3879	9.4843	—0.5333
" 5	5	53.600	8.9859	9.9715	0.3879	10.3594	—1.3735
" 6	6	53.200	8.9859	7.7963	0.3879	8.1842	+0.8017

Relation of Neusser's granules in the leucocytes: On the day before the analyses were begun the granules were present in very small numbers in the leucocytes. This was also the case on July 1st and 2nd, when a relatively high amount of alloxuric bodies was being eliminated. On July 3rd there was an apparent and on the following days a very marked increase in the number of granules, whilst the nitrogen of the alloxuric bodies both absolutely and in percentage became diminished.

Observation IV.—Patient was a woman 45 years of age. Fourteen years ago she had her first severe attack of articular rheumatism, although she has had milder attacks since 1881. Both hands at present show characteristic deformities. Since 1891 she has had symptoms of some cardiac lesion. In 1895, tricuspid and aortic insufficiency was diagnosed. During the period that the patient was under observation she was comparatively well; good diuresis and no œdema. Average pulse-rate, 80; respirations, 22. Moderate body exertion was possible without dyspnœa. Cyanosis was quite marked.

The diet was as follows: Ham, 100 grams; breakfast rolls (4), 208 grams; milk, 500 grams; wine (white), 250 grams; tea (infusion), 500 grams; rum, 30 grams; sugar (6 pieces), 30 grams; Rohitsch water, 300 grams.

These food materials represented about 1286 calories (26 calories per kilo body weight), which were made up as follows:

Albumin	234.19 calories.
Fat	223.47
Carbohydrates	643.19
Alcohol	185.50
Total	1286.35

TABLE VIII.—URINE.

Date.	Day of observation.	Daily amount of urine in grams.	Spec. gravity.	Total nitrogen in grams.	Nitrogen of alloxuric bodies in grams.	Percentage of alloxuric body—N of the total nitrogen.
July 19	1	2400	1012	8.2320	0.3276	3.97
" 20	2	2800	1007	9.6530	0.4459	4.61
" 21	3	2150	1012	9.9706	0.3517	3.52
" 22	4	1400	1014	9.6530	0.3463	3.58
" 23	5	700	1023	9.9356	0.4383	4.41

TABLE IX.—NITROGEN INGESTED (IN GRAMS).

Date.	Day of observation.	Ham.	Bread.	Milk.	Wine.	Tea and rum.	Total nitrogen.
July 19	1	5.2052	3.3473	2.9837	0.0785	0.1312	11.7459
" 20	2	5.2052	3.3473	2.9837	0.0785	0.1312	11.7459
" 21	3	5.2052	3.3473	2.8787	0.0785	0.1312	11.6409
" 22	4	5.2052	3.3473	2.6950	0.0785	0.1312	11.4572
" 23	5	5.2052	3.3473	2.9312	0.0785	0.1312	11.6934

TABLE X.—NITROGEN BALANCE (N IN GRAMS).

Date.	Day of observation.	Body weight.	Nitrogen ingested.	NITROGEN ELIMINATED.		Total nitrogen eliminated.	Balance.
				Urine.	Fæces.		
July 19	1	47.700	11.7459	8.2320	0.9985	9.2305	+2.5158
" 20	2	47.400	11.7459	9.6530	0.9985	10.6515	+1.0944
" 21	3	46.800	11.6400	9.9706	0.9985	10.9691	+0.6718
" 22	4	45.700	11.4572	9.6530	0.9985	10.6488	+0.8084
" 23	5	46.000	11.6934	9.9356	0.9985	10.9341	+0.7593

Relation of Neusser's granules in the leucocytes: On the first two days of the observation the granules were compara-

tively few. On July 21 they were relatively increased, whilst the alloxuric bodies, which had been comparatively high on the 20th, were distinctly diminished in quantity.

Observation V.—The patient was a brewer, 30 years old, with hypertrophic cirrhosis of the liver. Since 1895 he has had icterus, with tenderness in the region of the liver. The jaundice has had a tendency to disappear and reappear. The fæces at times would be distinctly bile-tinged, and at other times free from biliary coloring matter. Appetite good. At present there is a characteristic enlargement of the liver and spleen, no ascites, and no well marked evidence of collateral circulation. No elevation of temperature. Rather poorly nourished; weight has varied between 62 and 59 kilograms since April 10. Has a retinitis. Urine is free from albumin.

The daily diet was as follows: Ham, 300 grams; bread, 700 grams; wine, 500 grams; tea (infusion), 500 grams; rum, 30 grams; sugar (6 pieces), 30 grams; soda water, 4 bottles.

These food materials represent about 2806 calories (47 calories per kilo body weight), which were arranged as follows:

Albumin	516.27 calories.
Fat	256.21
Carbohydrates	1726.10
Alcohol	308.00
Total	2806.58

Table XI.—Urine.

Date.	Day of observation.	Daily amount.	Specific gravity.	Total nitrogen in grams.	Nitrogen of alloxuric bodies in grams.	Percentage of alloxuric body-N of total nitrogen.
May 15	1	1630	1026	13.2511	0.4773	3.60
" 16	2	1830	1023	14.6564	0.4153	2.83
" 17	3	1550	1023	16.2778	0.5089	3.12
" 18	4	1700	1024	17.2238	0.4918	2.85
" 19	5	2040	1024	20.2051	0.4118	2.03
" 20	6	1600	1022	16.4352	0.4771	2.90

Table XII.—Nitrogen Ingested (in Grams).

Date.	Day of observation.	Ham.	Bread.	White wine.	Total nitrogen.
May 15–19	1–5	13.0454	7.9398	0.2625	21.2477
" 20	6	11.3237	7.9398	0.2625	19.5260

Table XIII.—Nitrogen Balance (N in Grams).

Date.	Day of observation.	Body weight.	Nitrogen ingested.	Nitrogen eliminated.		Total nitrogen eliminated.	Balance.
				Urine.	Fæces.		
May 15	1	59.200	21.2477	13.2510	2.2526	15.5036	+5.7741
" 16	2	58.500	21.2477	14.6564	2.2526	16.9090	+4.3387
" 17	3	58.500	21.2477	16.2778	2.2526	18.5304	+2.7173
" 18	4	58.900	21.2477	17.2238	2.2526	19.4764	+1.7713
" 19	5	59.400	21.2477	20.2051	2.2526	22.4577	−0.7900
" 20	6	60.000	19.5260	16.4352	2.2526	18.6878	+0.3611

Relation of Neusser's granules in the leucocytes: Several days before the commencement of the chemical analyses the granules were much more numerous than they were during the period of examination. There was no variation observed during the latter period. Altogether the granules were only moderately numerous, but not more so in the mononuclear than in the other varieties of leucocytes. Some of the mononuclears were without granules. It will be seen that the amount of the alloxuric bodies was relatively high.

Observation VI.—This patient was a man also with hypertrophic cirrhosis of the liver. Since 1893 he had complained of gastric and intestinal symptoms. In 1895 enlargement of the liver and spleen was noticed. Icterus has been persistent, with the exception of one interval when he was free. Weighed 49 kilo when he came to the clinic, but has gained slightly since. The blood examination showed 2,500,000 red corpuscles, 7900 leucocytes, and 55 per cent hæmoglobin (Fleischl).

The daily diet was as follows: Ham, 300 grams; white bread, 450 grams; milk, 500 grams; wine (red), 300 grams; tea (infusion), 500 grams; rum, 30 grams; sugar (6 pieces), 30 grams; Rohitsch water, 2 bottles.

The above diet represented about 2370 calories (48 per kilo body weight), which were made up as follows:

Albumin	515.65 calories.
Fat	385.02
Carbohydrates	1161.38
Alcohol	308.00
Total	2370.05

Table XIV.—Urine.

Date.	Day of observation.	Daily amount of urine in ccm.	Specific gravity.	Total nitrogen in grams	Alloxuric body-N in grams.	Percentage of alloxuric body-N of the total nitrogen.
June 7	1	2500	1015	14.4813	0.6650	4.59
" 8	2	2050	1017	16.3590	0.6188	3.78
" 9	3	3200	1013	15.5680	0.7056	4.53
" 10	4	4000	1011	16.2400	0.5425	3.34
" 11	5	2500	1014	15.8375	0.7131	4.50

Table XV.—Nitrogen Ingested (in Grams).*

Date.	Day of observation.	Ham.	Bread.	Milk.	Red wine.	Total nitrogen.
June 7 & 8	1 & 2	12.2257	6.3503	2.8525	0.1225	21.5510
" 9 & 10	3 & 4	12.2257	6.3503	2.8175	0.1225	21.5160
" 11	5	12.2257	6.3503	2.6162	0.1225	21.3147

* Tea, rum and sugar not analyzed.

Table XVI.—Nitrogen Balance (in Grams).

Date.	Day of observation.	Body weight.	Nitrogen ingested.	Nitrogen eliminated.		Total nitrogen eliminated.	Balance.
				Urine.	Fæces.		
June 7	1	49.500	21.5510	14.4812	1.6595	16.1407	+5.4103
" 8	2	49.400	21.5510	16.3590	1.6595	18.0185	+3.5325
" 9	3	49.200	21.5160	15.5680	1.6595	17.2275	+4.2885
" 10	4	50.000	21.5160	16.2400	1.6595	17.8995	+3.6165
" 11	5	49.600	21.3147	15.8375	1.6595	17.4970	+3.8177

Relation of the Neusser's granules in the leucocytes: Altogether the granules were very few in all the different forms. Most of the white corpuscles are entirely free from the granules, and many almost entirely free. During the period that

the patient was under observation there was no apparent variation in the richness of the granules. On the other hand, the alloxuric body nitrogen was both absolutely and relatively high (0.67, 0.71 gram per day).

Observation VII.—A man, 20 years old, with physical signs of a commencing left-sided pulmonary tuberculosis. No tubercle bacilli were found in the sputum, however, after repeated examinations. His weight on May 26th was 57 kilo; he was fairly well nourished. During the period of observation he was free from fever. Leucocytes were 10,000 per cmm.; hæmoglobin 70 per cent (Fleischl).

The daily diet was as follows: Ham, 300 grams,; white bread, 450 grams; milk, 500 grams; wine, 500 grams; tea (infusion), 500 grams; rum, 30 grams; sugar (6 pieces), 30 grams; Rohitsch water, 2 bottles.

The above food represented about 2370 calories (41 per kilo body weight), which were made up as follows:

Albumin	515.65 calories.
Fat	385.02
Carbohydrates	1161.38
Alcohol	308.00
Total	2370.05

Table XVII.—Urine.

Date.	Day of observation.	Daily amount in ccm.	Specific gravity.	Total nitrogen in grams.	Alloxuric body—N in grams.	Percentage of alloxuric body—N of the total nitrogen.
May 27	1	4200	1010	15.5820	0.6064	3.89
" 28	2	3450	1012	19.6822	0.5796	2.89
" 29	3	2700	1013	21 3097	0.5953	2.79
" 30	4	3000	1012	18.7950	0.5853	3.11
" 31	5	3400	1014	20.3490	0.5533	2.72
June 1	6	3350	1012	20.2842	0.5803	2.86

Table XVIII.—Nitrogen Ingested (in Grams).*

Date.	Day of observation.	Ham.	Bread.	Milk.	Wine.	Total nitrogen.
May 27 & 28	1 & 2	15.3515	5.8262	3.9094	0.0350	25.1220
" 29	3	15.3515	5.8262	2.7956	0.0350	24.0083
" 30	4	17.4240	5.8262	2.7956	0.0350	26.0808
May 31 & June 1	5	17.4240	5.8262	2.9198	0.0350	26.2050

*Tea, rum and sugar not analyzed.

Table XIX.—Nitrogen Balance (in Grams).

Date.	Day of observation.	Body weight.	Nitrogen ingested.	Nitrogen eliminated.		Total nitrogen eliminated.	Balance.
				Urine.	Fæces.		
May 27	1	57.700	25.1222	15.5820	1.2634	16.8454	+8.2763
" 28	2	56.200	25.1222	19.6822	1.2634	20.9456	+4.1766
" 29	3	55 400	24.0083	21.3097	1.2634	22.5731	+1.7352
" 30	4	56.200	26.0808	18.7950	1.2634	20.0584	+5.9214
" 31	5	56.200	26.2050	20.3490	1.2634	21.6124	+4.5826
June 1	6	56.200	26.2050	20.2842	1.2634	21.5476	+4.5574

Relation of Neusser's granules in the leucocytes: The granules are altogether extremely numerous, particularly in the small mononuclears. There was no appreciable variation in the granules from day to day. In this case, with the large number of granules, there was found to be an elimination of a large quantity of alloxuric body nitrogen.

Observation VIII.—The patient was a woman 45 years of age, with cirrhosis of the liver. Since 1895 she had complained of gastric symptoms; pain in the epigastrium. Had emaciated considerably. Had been jaundiced. The gastric juice showed a very marked acidity; free and combined HCl 0.35 to 0.41 per cent, and free HCl alone 0.22 to 0.28 per cent. The liver was enlarged, hard and nodular. Spleen was not much enlarged, but was hard and could be palpated at the costal margin. Body weight averaged about 60 kilos. Vomiting was frequent and patient was moderately anæmic.

The daily diet was as follows: Bread, 300 grams; milk, 500; wine, 500; tea (infusion from 6 grams), 250 grams; rum, 30 grams; sugar (6 pieces), 30 grams; Rohitsch water, ½ bottle.

These food stuffs yielded about 1752 calories (28 calories per kilo body weight), which were made up as follows:

Albumin	283.31 calories.
Fat	233.43
Carbohydrates	927.33
Alcohol	308.00
Total	1752.07

Table XX.—Urine.

Date.	Day of observation.	Daily amount in ccm.	Specific gravity.	Total nitrogen in grams.	Alloxuric body—nitrogen in grams.	Percentage of alloxuric body—N of the total nitrogen.
June 24	1	1350	1023	12.4504	0.4831	3.87
" 25	2	1000	1022	10.7800	0.4498	4.17
" 26	3	550	1027	8.1428	0.4591	5.63
" 27	4	850	1025	11.5133	0.5087	4.32
" 28	5	1050	1020	11.0618	0 5375	4.85
" 29	6	1500	1018	11.1938	0.4594	4.10

Table XXI.—Nitrogen Ingested (in Grams).*

Date.	Day of observation.	Ham.	Bread.	Milk.	Wine.	Total nitrogen.
June 24	1	8.8242	5.6056	2.7037	0.0350	17.1685
" 25	2	6.3491	5.6056	2.7037	0.0350	14.6934
" 26&27	3 & 4	4 8425	5.6056	2.6095	0.0350	13.0926
" 28&29	5 & 6	4.8425	5.6056	2.8875	0.0350	13.3706

*The variation in the nitrogen in the ham was due to the fact that the patient could not continue to take the full quantity (220 grams) that she was first given.

Table XXII.—Nitrogen Balance (in Grams).

Date.	Day of observation.	Body weight.	Nitrogen ingested.	Nitrogen eliminated.		Total nitrogen eliminated.	Balance.
				Urine.	Fæces.		
June 24	1	60.700	17.1685	12.4503	1.3508	13.8011	+3.3674
" 25	2	60.400	14.6934	10.7800	1.3508	12.1308	+2.5626
" 26	3	59.600	13.0926	8.1427	1.3508	9 4935	+3.5991
" 27	4	59.900	13.0926	11.5132	1.3508	12.8640	+0.2286
" 28	5	59.700	13.3706	11.0617	1.3508	12.4125	+0.9580
" 29	6	59.500	13.3706	11.1937	1.3508	12.5445	+0.8261

Relation of Neusser's granules in the leucocytes: The granules were very numerous, especially in the mononuclears,

although there was considerable variation in the granules from day to day. As will be seen from the table there was a large amount of alloxuric body nitrogen eliminated.

These observations that have been made do not in any way confirm the theory that there is a regular coincidence between an abundance of the granules and an increased excretion of the alloxuric bodies, nor do they favor the view that Neusser's granules occur exclusively in patients with an alloxuric diathesis. Cases occur in which, with numerous granules in the leucocytes, there is a relatively small amount of the alloxuric bodies eliminated in the urine, while on the other hand the granules may be almost entirely absent and the alloxuric bodies be excreted in increased amount. Such directly opposed conditions may occur in different individuals having the same disease, as in the two cases of hypertrophic cirrhosis of the liver. Not infrequently the granules become increased or diminished in the same person without there being a corresponding increase or diminution in the excretion of the alloxuric bodies. In fact, increase in the number of granules may be accompanied by a diminution of the alloxuric bodies and *vice versa*.

From the information obtained by the study of the above cases one seems justified in concluding that the supposed relationship between the perinuclear basophilic granules and an alloxuric diathesis, as claimed by Kolisch, is purely empirical.

In conclusion, I must thank Professor Kraus and his assistants for many kindnesses and for valuable aid in carrying on the above analyses.

ENCYSTED DROPSY OF THE PERITONEUM SECONDARY TO UTERO-TUBAL TUBERCULOSIS AND ASSOCIATED WITH TUBERCULAR PLEURISY, GENERALIZED TUBERCULOSIS AND PYOCOCCAL INFECTION.

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The following case is of interest not so much because of lesions in themselves unique, as because of the rare combination of many lesions, the extensive character of these lesions, and the multiple nature of the infection.

The case has many features in common with that reported by Gardner,[4] of Montreal, in the year 1885, and is similar to those described by Wm. T. Howard,[7] of Baltimore, the same year.

Clinical History.

N. A., primipara, aged 30 years; colored. Admitted to the Maternité of the Hospital of the Good Samaritan, in the service of Dr. B. B. Browne, November 19, 1894.

The patient had been married several years; had no children, no miscarriages. Menstruation commenced at the age of 15; it had always been regular, painful and profuse, lasting from six to eight days, during which time she was compelled to remain in bed. Her last period occurred about the middle of March, 1894.

Past History. No family history could be obtained. The patient had measles after reaching adult life. Five years ago she suffered with an attack of "malaria" which lasted three months; at this time she claims to have been "very sick." The attack recurred in September, 1894.

History of Present Condition. The patient is in the eighth month of her pregnancy. Throughout this time she has been feeling ill; she has had pain in the back and abdomen, increased on exertion. At present there are constant backache, and pain in the lower part of the abdomen. Appetite is good; bowels constipated; urine of low specific gravity, otherwise normal.

Examination. Fœtus occupies the left occipito-posterior position. In the right iliac region is a mass, partly soft, partly resistant, which seems to be connected with the uterus, and is not painful except on deep pressure.

On November 18 at 9.30 p. m. the woman was delivered of a healthy child, but owing to uterine inertia the placenta had to be removed. The labor was protracted, lasting 38 hours. The perineum was lacerated and repaired at once. Two days after delivery the patient was attacked with a chill followed by fever and sweating. The record of the puerperium shows an irregular temperature of septic character whose highest point was 104.3°, whose average was 102°. There was no fever after the second week and the patient's condition was recorded as good.

On January 19, 1895, she was discharged from the hospital apparently in fair health. The following April the patient visited the hospital clinic for treatment, considering herself again pregnant since February. In July, 1895, she returned with enlarged abdomen and general discomfort. At this time she claimed to have felt the fœtal movements; in August she was seen at the clinic by Dr. B. B. Browne, who, after examination, did not think her pregnant.

Second Admission. In October, still believing herself pregnant, the woman was readmitted to the Maternité. After careful examination under an anæsthetic, pregnancy was definitely excluded from the diagnosis. At this time a large hard mass was found to the right of the uterus and apparently connected with it. The nature of the tumor could not be determined. Following the ether examination the woman became quite ill. There was great pain in the lower part of the abdomen and sudden rise of temperature. The patient was then transferred to the gynecological department of the Hospital of the Good Samaritan. After the second day the abdomen began gradually to swell, and on December 1st it was much distended. The patient was losing flesh and strength. The temperature showed a typical hectic range, being normal or subnormal in the morning, with an afternoon rise fluctuating between 100° and 103°. The lowest point reached was 95.4°, the highest point 104°.

Repeated examinations of the sputum showed no tubercle bacilli.

Diagnosis. Encysted dropsy of the peritoneum, probably tubercular.

Operation. For removal of the dropsical fluid. On February 26th a laparotomy was performed by Dr. Browne. An incision 5 cm. long was made in the median line of the abdomen. From this opening about eight litres of transparent, pale greenish fluid escaped. The entire anterior portion of the peritoneal cavity was found to be converted into a suppurating cyst. An additional litre of semi-solid caseous material resembling masses of congealed fat was removed by the hand of the operator from the lower part of the sac where it covered the pelvic viscera on the right side. After evacuation of the fluid the surface of the peritoneum was found thickened and converted into a necrotic membrane resembling the caseous masses which floated in the pus.

Examination of Fresh Abdominal Fluid. The macroscopic appearance was that of a turbid, pale greenish yellow fluid in which floated shreds and flakes of caseous material. On standing it separated into two layers, an upper transparent, greenish fluid and a lower dense, creamy mass. The microscopic examination of this fluid showed numerous pus cells, some red blood corpuscles and shreds of necrotic tissue entangling pus cells. Stained cover-slip preparations of the fluid exhibited numerous cocci in pairs, clusters and short chains, but no tubercle bacilli were found.

Immediately following the operation the patient's condition was much depressed. She rallied, however, responding to stimulation. Her general condition improved and she became much more comfortable until the tenth day, when without pain or other distressing symptom she died suddenly, March 6, 1896. The autopsy was made three hours after death.

Anatomical Diagnosis. Tuberculosis of the Fallopian tubes, uterus, ovaries, peritoneum, pleura, and viscera generally. Acute fibrino-purulent and caseous peritonitis; acute serofibrinous and hemorrhagic pleurisy; mixed tubercular, staphylococcus and streptococcus infection; congestion of viscera; general arterio-sclerosis.

The body is much emaciated. In the median line of the abdomen is a gaping incision. It begins 3.7 cm. below the umbilicus and extends 5 cm. downward, exposing a sloughing, puriform cavity from which bubbles of gas are evolved on pressure. The subcutaneous fat is quite absent; the muscles are brownish red in color.

Abdomen. On opening the abdomen the entire anterior portion of the peritoneal cavity is found to be converted into a suppurating cyst. This extends from the liver above to the pelvis below, and traverses the lateral diameter of the abdomen from flank to flank, dipping deeply on both sides. The walls of the sac are made up of dense, opaque, yellow necrotic material about 5 cm. in thickness. The cavity contains a small amount of the same puriform material found at operation. Extending across the cavity obliquely downward, and from before backward, as if to support its somewhat flaccid walls, are four or five dense fibrous bands covered by caseous material, continuous with that lining the general suppurating sac. Of these the largest is in the median line. It is long and almost cylindrical, measuring 3.7x2.5 cm. in diameter. Its anterior and upper attachment is to the abdominal wall 2 cm. below the umbilicus. Its posterior attachment below is by a broad expansion upon the posterior wall of the sac where it dips down to cover the pelvic viscera. A second organized band, smaller, but similar in character to the one just described, is found on the left side. A few adhesions are also found in the posterior wall of the sac on the right side. On transverse section these bands show an organized, pink, fibrous groundwork thickly inlaid with miliary tubercles and limited by a zone of caseous material. The posterior wall of the pus sac is found so densely adherent to the intestines and other adjacent viscera that separation is difficult. No trace of the normal omentum can be found, and the probabilities are that it enters largely into the composition of the suppurating cyst and the traversing fibro-caseous bands.

The coils of intestine are densely matted together by old fibrous bands and by more recent and lighter adhesions, studded everywhere with yellow miliary tubercles, and form a single compact mass filling the greater part of the abdominal cavity. Not only are the intestinal coils adherent to each other, but they are bound to all neighboring viscera. The mesentery is greatly thickened and contracted, and is thickly infiltrated with yellow miliary tubercles.

The mesenteric lymph glands are enlarged, indurated and caseous.

Upon separation of the more delicate adhesions between the upper coils of intestine, several smaller cysts about the size of a hen's egg are found. They contain clear straw-colored fluid. There is a slight excess of clear fluid in the posterior peritoneal cavity, which appears to have been more recently infected.

Liver. The liver measures 35x17.5x8.7 cm. in its various dimensions. The capsule is much thickened, and strong adhesions unite it firmly to the diaphragm. The left lobe is drawn out into a tongue-like process, which extends completely across the abdomen, covering the spleen on its anterior and left lateral surfaces. So completely adherent are these two organs that only on section can a line of organized union be made out. The lower surface of the liver is also in contact with the upper wall of the pus sac, with the stomach and with the intestines, to which it is bound by firm adhesions. On breaking up these adhesions and freeing the surface of its caseous membrane, the capsule is found thickly beset with yellow miliary tubercles. The surface is mottled. On section the parenchyma shows the characteristic appearance of nutmeg liver. Scattered throughout its substance are numerous tubercles, both grey and caseous. They are mostly submiliary, but larger ones exist.

Spleen. The spleen is considerably enlarged. It is densely bound down by old fibrous adhesions to all neighboring structures. Its anterior and lateral surfaces are almost completely concealed from view by the tongue-like expansion of liver. The capsule is irregularly thickened and contains caseous miliary tubercles. The consistence is much diminished. It tears readily. On section it is congested and contains grey and yellow tubercles, miliary, submiliary and conglomerate in form.

Kidneys. The kidneys are slightly enlarged; the capsules are somewhat thickened, but strip off with moderate ease. The surface of the right kidney shows a shallow circular scar-like depression about 12 mm. in diameter, somewhat paler than the surrounding cortex. Under the capsule of this kidney is also seen a solitary caseous tubercle about the size of a split pea. Upon section the kidneys are congested, somewhat increased in consistence, and contain an occasional isolated tubercle of large size. The circular depression seen upon the surface of the right kidney is found to be the base of a dense, pale, pyramidal area which extends quite down through both cortical and boundary zones, and contains in its centre a small cyst.

Ureters. The ureters are normal, except for a slight dilatation of the right ureter in its upper portion.

Pancreas. The pancreas is pink and firm. Its capsule is thickly studded with miliary and conglomerate tubercles; none, however, can be seen in its substance.

Stomach. The stomach is adherent to all adjacent structures. Its mucous membrane shows congestion, most marked along the rugæ. Some ecchymoses are found at the cardiac end.

Intestines. In some places the felt-like adherent sac wall forms a partial covering to the intestines. Beneath it, as elsewhere, the peritoneal coat is tolerably smooth, congested, and contains numerous miliary and conglomerate tubercles. The mucous membrane is more or less congested throughout the entire extent. The congestion is most intense upon the valvulæ conniventes. There are no tubercular ulcers, but in places tubercles can be seen extending inward from the peritoneal coat. The walls of the large intestine are thin and very deeply congested. The abdominal lymph glands are enlarged and caseous.

Thorax. The sternum and costal cartilages cannot be readily lifted because of adhesions between the two layers of the pleura on the right side.

Left Pleural Cavity. The left pleural cavity contains about 2.5 litres of blood-stained fluid with flocculi of fibrin. There is one dense organized band of tissue connecting the two layers of the pleura (about the region of the seventh rib). There are also a few delicate adhesions in the posterior and lower part of the cavity. The apex is firmly adherent to the chest wall. The lung is compressed by the excess of fluid in the pleural cavity. Both layers of the pleura present a coarse reticulated mottling, as though a loose-meshed network of fibrin had been laid upon a dark red hemorrhagic background. Tubercles are also seen.

Upon the parietal pleura, as it covers the sixth rib, are seen two softened caseous tubercles, each about the size of a split pea. Cover-slip preparations made from one of these immediately at autopsy show the presence of tubercle bacilli and micrococci in large numbers.

Left Lung. The left lung is compressed and atelectatic, except the anterior margin of the upper lobe, which contains a little air. Scattered irregularly and sparsely through the lung substance are miliary and conglomerate grey and caseous tubercles. No cavities nor old tubercular foci can be made out.

Right Pleural Cavity. The right pleural cavity is dry. The lung is bound down throughout its entire extent by easily detached adhesions. At the base and posteriorly the adhesions are pretty firm.

The pleura is covered with a layer of fibrin of irregular thickness, more or less organized at the base of the lung. It contains caseous tubercles.

Right Lung. The right lung is also considerably contracted by the upward pressure from the abdomen and the lateral pressure from the left thorax. The lower lobes are atelectatic and congested. The upper lobe contains a little air and exhibits along its anterior margin a few emphysematous patches. The distribution of tubercles in its substance corresponds with that of the left lung.

The bronchial and mediastinal lymph glands are enlarged and caseous.

Heart. Owing to the excess of fluid in the left pleural cavity, the heart occupies a position behind the sternum, almost in the median line. The pericardium, the pericardial fluid, the endocardium and heart valves are normal. The aorta contains thickened yellow atheromatous plaques.

Cranial Cavity. There is a slight increase of cerebral fluid. The meninges of both cerebrum and cerebellum are congested, particularly on the under surface. The pia arachnoid at the base of the cerebellum contains two or three yellowish white bodies resembling miliary tubercles.

Cover-slip preparations made from these nodules show no tubercle bacilli.

The pelvic viscera were removed at autopsy and placed in formalin, for detailed description later.

Pelvic Viscera. Uterus. The uterus is 8.5 cm. long, 5 cm. broad and 2.5 cm. in the antero-posterior diameter. Both the anterior and posterior surfaces are covered by an opaque, yellowish white, felt-like membrane, varying from 2 to 6 mm. in thickness. This membrane passes directly from the uterine walls to the other pelvic viscera, forming a complete blanket, and constituting the lower part of the large pus sac which occupied the anterior portion of the peritoneal cavity. Projecting from the middle third of the posterior wall is a myomatous nodule about the size of a large walnut, attached to the uterus by a short and broad pedicle, Fig. 1, M. Springing from the fundus of the uterus about 2 cm. anterior to the right cornu is another pedunculated myoma, large, ovoid, and 9.5x7.5x5.5 cm. in diameter, Fig. 1, M. From the left surface of this tumor springs a cylindrical band about 3 cm. long and 13 mm. in diameter, attaching it loosely to the coiled-up mass of intestines behind. This band is of the same general nature as the fibro-caseous bands which traverse the abdominal cyst. Another band, broad, flattened, and 6 mm. thick, is attached to the right surface of the tumor. This forms part of the general peritoneal sac. On stripping back the dense, felt-like membrane covering these tumors, their surfaces are found studded with tubercular nodules of a yellowish white color, and from one to three mm. in diameter. The smaller tumor can be easily shelled out of its capsule, owing to a peculiar orange-yellow caseous material separating the two in the region of the pedicle. The myomata, so far as can be seen, do not contain tubercles in their interior. The uterine wall measures 1 cm. in thickness at the fundus, Fig. 1, F. U., 2 cm.

anteriorly and 1 cm. posteriorly. It is pale pink in color and is studded with sparsely scattered, yellowish, miliary and conglomerate nodules.

The cervix is 2.5 cm. in length. The mucous membrane of the body presents a shaggy, moth-eaten appearance, of yellowish color and friable consistence. The mucous membrane of the cervix, which is much less rough and friable, still presents indications of the normal rugæ. The mucosa varies from 2 to 5 mm. in thickness.

Right Appendages. Springing from the right uterine cornu and extending backward and downward, so as to be completely concealed from view by the large myomatous tumor which filled the right inguinal region, is a mass 8 cm.x5.5 cm.x2.5 cm. in size. It presents at first sight the appearance of an enlarged ovary, covered by the general pyogenic membrane, beneath which, as in the uterus and elsewhere, are miliary and conglomerate tubercles studding the surface. Upon section, however, it is seen to consist of the convoluted tube, thickened and necrosed, with its exaggerated coils held together in a stroma of dense organized connective tissue studded with miliary tubercles. Beneath the lower part of this convoluted mass is seen a portion of the ovary, so completely covered by and adherent to the tube as almost to have lost its own identity, Fig. 1, r. Ov. A longitudinal section through this tubo-ovarian tumor gives transverse, oblique and longitudinal sections of the much distorted tube. They lie like scattered caseous islands with ulcerated centres, in the tubercle-dotted stroma. The walls of the tube are from 3 to 8 mm. thick, and are for the most part uniformly caseous. Here and there is a nodular studding which gives the mucosa an uneven surface; or again a rich infiltration of the other coats with barely agglomerated caseous tubercles is observed. The fimbriated extremity, dilated, and curled outward in trumpet-like expansion, is directly continuous throughout its circumference with the anterior peritoneal sac, Fig. 1, r. F. E. The folds of the fimbriated end are everywhere visible and appear densely thickened and ragged; the extremity itself measures 2.5 cm. in diameter.

Left Appendages. The left tube is exceedingly tortuous, and from the uterine cornu outward gradually increases in size, terminating in a fimbriated extremity 4.5 cm. in diameter. It is 11 cm. long in its contracted state, Fig. 1, F. E. The folds of the fimbriæ are transformed into a greatly thickened, moth-eaten membrane, from whose surface project numerous papillary processes varying in size and shape and measuring from 10 to 14 mm. in length. The interior of the tube bears some general resemblance to the necrotic membrane which covers its surface and which represents the walls of the abdominal sac with which both tubes appear to be directly continuous. The convolutions of this tube, while excessive, as are those of the right side, are not embedded in a dense organized stroma, but are held together by tolerably firm adhesions. These, as well as the surface of the tube, exhibit caseous, miliary tubercles, Fig. 1, l. T. Longitudinal and transverse sections through the tube show extreme necrosis of its walls. They are more extensively ulcerated toward the outer third, where the condition is most advanced. The lumen at this point is increased to 13 mm. in diameter. The walls of the tube are here from 3 to 5 mm. thick and consist mainly of caseous material with a narrow outer border of organized tissue. This forms a capsule which can be readily stripped away from the central necrotic mass. The thickness of the tube about its middle portion is 2 cm. There is no lumen visible on cross section, but the entire tube seems made up of one dense, yellowish, homogeneous mass.

The left ovary lies behind and beneath the tube, to which it is bound by adhesions similar to those connecting the convolutions of the tube, Fig. 1, l. Ov. From this it may be detached with moderate ease. It is about normal in size and position. The surface is covered by the same necrotic membrane, and exhibits upon its removal sago-like bodies. On section the structure is smooth, firm, grey and glistening, showing several corpora fibrosa, and one flattened tubercle just beneath the surface.

Connected with the pelvic viscera and binding them together are portions of the peritoneum which went to make up the original sac wall but which were torn away at autopsy. They are of the same general appearance as the necrotic membrane covering the viscera. A similar sac, collapsed and dipping down behind and to the left of the cervix uteri, is covered in by the small myoma above described. This represents the remains of an abscess about the size of an orange which ruptured at autopsy, discharging thick, greenish yellow pus.

The Vagina. There are several small, greyish, flattened elevations upon the surface of the mucous membrane, irregular in size and shape, some round, measuring from 1 to 2 mm. in diameter; others with irregular edges measuring about 6x3 mm. in diameter. There is also a small superficial ulcer in the posterior vaginal wall just below the cervix. It is about the size of a split pea, has sharp irregular edges, but contains no tubercles in its walls. The vagina is otherwise normal.

The *bladder* is contracted and is apparently normal.

The *rectum* is partly covered by necrotic membrane, but shows no abnormalities.

Histological Examination.

Pelvic Viscera.

Uterus. The surface epithelium has entirely disappeared, and the uterine mucosa shows a granular necrosis throughout the inner fourth of its thickness. Beneath this the normal stroma is invaded by diffuse tubercle tissue with discrete caseating nodules. It is the union of these nodules near the surface of the mucosa which results in the granular necrosis. In the depth of the membrane the uterine glands are preserved, although the epithelium is swollen and invaded by mononuclear and polymorphonuclear cells. They are often dilated, and contain swollen desquamated epithelial cells, polymorphonuclear leucocytes and granular detritus. The diffuse tubercle tissue consists largely of lymphoid and epithelioid cells, with an occasional giant cell. The discrete caseating nodules present the typical structure of caseous tubercles. The giant cells of both stroma and nodule are round, oval or irregular in shape, with a mural or polar arrangement of the nuclei. The epithelioid cells of the diffuse tubercle tissue are usually round or polyhedral, with small vesicular nuclei. Those of

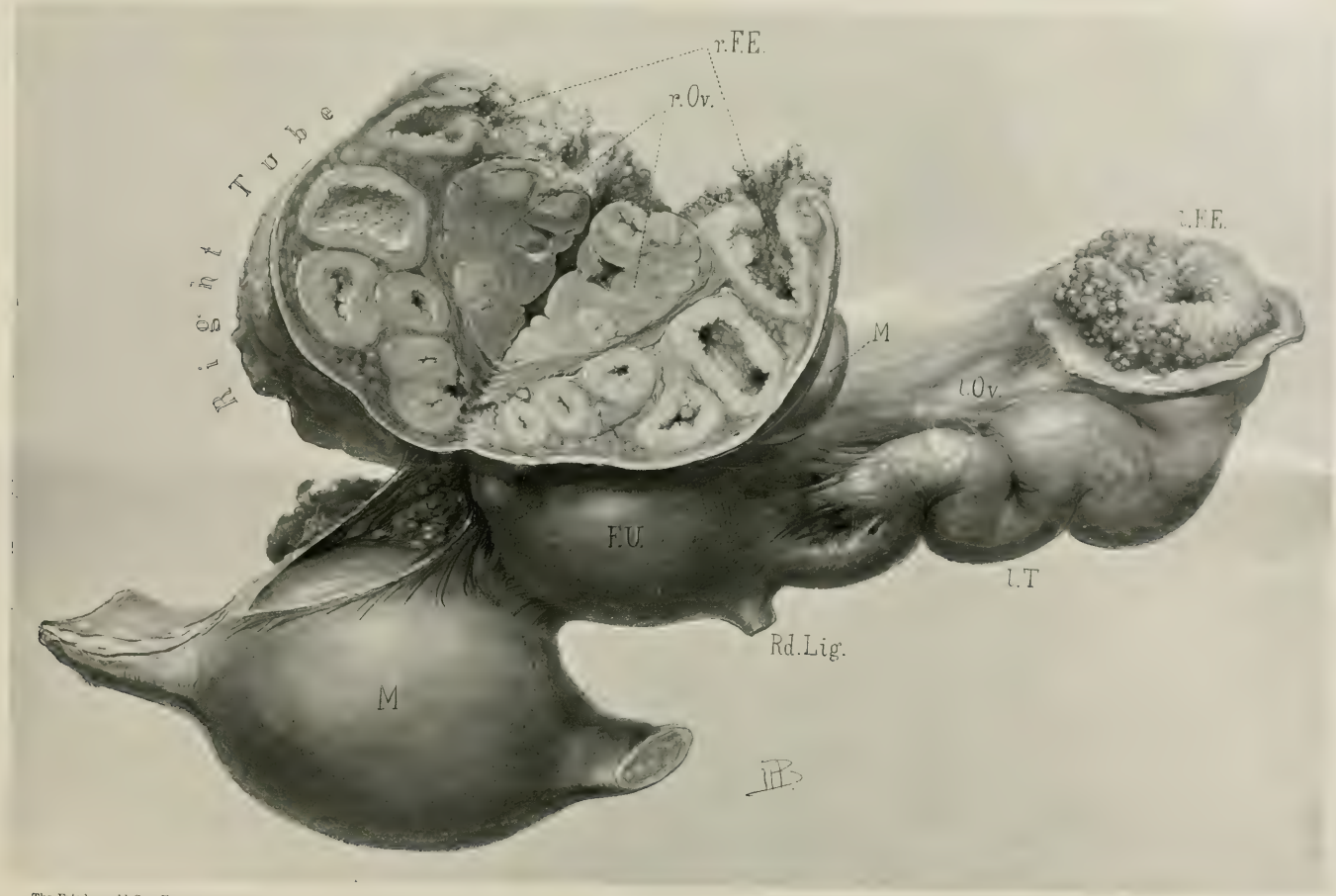

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FIG. 1.

the caseating nodules are irregular and elongated, with oval, bizarre and wavy nuclei, the close packing of which in the periphery of the nodule gives the appearance of a radiating fringe.

The muscular coat is infiltrated throughout its entire thickness with diffuse tubercle tissue and discrete miliary nodules, most of which are caseous. The diffuse infiltration is represented by small cells with solid and vesicular nuclei, arranged in longitudinal strands between the muscle bundles. The caseous nodules lie next to the peritoneal surface, and are irregularly triangular in shape, with bases toward the serosa. Sometimes the bases coalesce and form a continuous scalloped caseous zone. The muscle cells are increased in number, and here and there are myomatous foci which consist of dense aggregations of cells containing elongated club-shaped nuclei.

The blood-vessels of the muscular coat present interesting features; some of them show the typical changes of endarteritis obliterans, with more or less encroachment upon the lumen. But the most characteristic lesion is the tubercular involvement of the vessel walls. This process sometimes begins in the intima and remains limited to this coat, or extends to the media or adventitia. Sometimes it takes origin in the adventitia and perivascular tissues, and spreads inward in like manner through the other coats. It may be diffuse or circumscribed, it may be a cellular proliferation simply, or show all stages of degeneration, from an early nuclear fragmentation and karyolysis, to advanced caseation in which all the coats and even the vessel contents are transformed into a dense hyaline mass. The corpuscular contents of the vessels are often preserved intact, notwithstanding advanced changes in the vessel walls. Again there are thrombi, hyaline or mixed, in various stages of transformation. Sometimes the vessels are the centre of a tubercular process, in which case their fibrinous contents are continuous with a fibrillated fibrin which extends out into the surrounding tissues. Where the tubercular change is early and begins in the intima, the endothelium is sometimes preserved intact; here there is subendothelial proliferation of the connective tissue cells, forming epithelioid cells of a round or polyhedral shape, with moderate or abundant protoplasm and small round nuclei. But in other cases there is evidence of endothelial proliferation, these cells enlarging, becoming at times cuboidal, and forming a lining of two or more rows to the lumen, with occasional complete occlusion.

In the serous membrane the changes are most marked; on the surface is a dense, opaque, necrotic coat, granular, fibrillated and hyaline. Beneath this is a narrow zone of nuclear fragmentation, while yet below and forming a line of demarcation between the necrotic portion of the serous coat and the scalloped caseous zone of the muscular coat is a narrow band of œdematous, vascular connective tissue containing a few muscle fasciculi, and showing infiltration with lymphoid, epithelioid, polymorphonuclear and occasional giant cells.

The process is least advanced in the cervix, most advanced in the fundus. In the cervix there is no invasion of the muscular coat, and the vaginal portion contains no evidence of tubercular involvement other than a solitary cellular tubercle under the stratified epithelium in its upper part, and a cellular proliferation of the corium, gradually disappearing as the outlet is approached.

Among the diffuse tubercular tissue are found numerous homogeneous, highly refractive globules of various sizes, occurring singly or in groups. They show especial affinity for acid aniline dyes, and also stain intensely with gentian violet. In shape they are invariably round; in size they vary from that of a micrococcus or a basophilic granule to that of a lymphoid cell, some even exceeding this. Their average diameter is that of a red blood corpuscle; in fact, when uniform in size, and occurring in masses, they are readily mistaken for such in specimens which have been stained with hæmatoxylin and eosin. The little globules are, however, more homogeneous and solid and more highly refractive than red blood corpuscles. These appear oftenest more or less closely packed within cell bodies, the nuclei of which are still preserved. Sometimes they accompany a more advanced degeneration, in which case the nucleus stains poorly or not at all. Again, they are free from cellular inclusion, and lie in groups or scattered through the tissues. The groups are circular, elongated or irregular, and contain from two to thirty or more members. With Weigert's fibrin stain they stand out conspicuously as deep blue spheres, homogeneous and structureless. With Russell's fuchsin stain they strike a bright red hue; with eosin they stain pink. In many respects they correspond with the hyaline bodies considered by Lubarsch[9] as a form of albuminous degeneration, found by various observers in both normal and pathological conditions, and described by Russell[12] as "Fuchsin bodies." In the present case they contain neither nuclei nor spores such as Russell and others have described.

In all three coats of the uterus micrococci are found arranged in pairs, clusters, or chains of greater or less length, numbering from three to sixteen members. They are especially numerous along the superficial caseous zone of the peritoneal coat, where they form a thick, irregular border and extend deep into all fissures of its necrotic structure. In the muscular coat they are less numerous, and are found for the most part within and about blood-vessels in the bands of the infiltrated tubercle. In the mucous membrane they are again present in considerable number, somewhat sparsely scattered at times or occurring on the surface as dense aggregations. Where scattered, their arrangement is usually in the form of pairs and chains.

Tubercle bacilli are also found in the uterine tissues. They occur in the interior of vessels, either free or enclosed within cells, in the vessel walls, and in the tubercle tissue outside.

The uterine myoma is covered by newly formed connective tissue, with rich infiltration of diffuse and circumscribed tubercles and many pus cells. The capsule is made up of strata of well preserved fibro-muscular bands. But the interior of the tumor is necrotic throughout. Near the surface of the necrotic myoma is a narrow zone of calcareous matter; the walls of all blood-vessels in its vicinity are likewise calcified. A still broader zone of necrotic myomatous structure, including the calcareous band, is dotted over with spiculated spherules of golden yellow pigment. No tubercles are seen. Russell's fuchsin bodies are numerous in the tissue covering the myoma, but none are found in its substance. Micro-organisms similar

to those found in the uterus are likewise found in the tubercular covering of the tumor.

Right Fallopian Tube. The mucous membrane of the right Fallopian tube at its uterine end has an almost intact epithelium. In one place, however, the epithelium is wanting, and here the stroma is invaded by a mass of tubercle tissue, some of which has broken off and lies free and degenerating in the centre of the lumen, together with the desquamated epithelium. The middle coat of this part of the tube retains its muscular structure; bands of muscle, however, are separated from each other by serous infiltration or by alternating bands of diffuse tubercle tissue. The serous coat is composed of solitary caseous tubercles so blended as to form a continuous scalloped zone. On passing outward from the uterine end the tubercular process becomes more marked, and when the middle portion of the tube is reached the walls are so intensely involved as to form a thickened necrotic mass, with no evidences of structure except a narrow fibro-cellular zone encircling the tube about 2 mm. from the periphery. The necrotic substance is hyaline in the centre, where it is pierced by a ragged slit-like lumen. It corresponds here with the remains of the mucous membrane. There is nuclear fragmentation within the fibro-cellular zone, and among the nuclear fragments isolated bands of muscle are preserved in scanty number The surface necrosis corresponds essentially with that of the uterine serosa, while the middle fibro cellular zone is continuous with the thickened, œdematous, vascular connective tissue of the uterus, which there formed a line of demarcation between the necrotic portion of the serous coat and the scalloped caseous zone of the muscular coat. Here, as there, it contains a few isolated muscle bundles, the only normal elements of the original Fallopian tubes. Here, as there, it is infiltrated with tubercular cellular tissue and polymorphonuclear cells, and here, as there, it shows many vascular changes, both sclerotic and tubercular, similar to those described in the uterine muscular coat.

There are numerous dilated lymph spaces and blood-vessels with subendothelial proliferation or a lining of cuboidal cells. Occasionally a well-defined giant cell takes origin in the endothelium of a vessel and projects into the lumen, filling it more or less completely. Sometimes such a cell is found free in the vessel. Indeed, the giant cells are numerous throughout the middle coat, and are especially abundant near the necrotic mucosa. They are often situated in little caverns, which are sometimes surrounded by lymphoid cells. Where not so situated, they are more apt to be surrounded by an irregular zone of epithelioid cells. They are elongated or irregularly ovoid in shape, of various sizes, and contain nuclei at their poles or about the periphery, seldom in the centre. Sometimes they are invaded by polymorphonuclear and lymphoid cells.

In the fimbriated extremity the degeneration is extreme. The lumen is considerably dilated, the walls are convoluted and thick. The mucous membrane is composed of three strata representing gradations of tubercular change. Next to the lumen is a narrow necrotic border, which takes an intense eosin stain. It gives occasional evidence of original structure in the preserved outlines of old blood-vessels, of connective tissue bands, of giant cells, and even of an occasional caseous tubercle which has not yet lost its identity by coalescence with the general necrotic border. Outside of this is nuclear fragmentation with structural outlines still better preserved; while yet beyond is the normal stroma invaded by infiltrated tubercle. The middle coat is a comparatively narrow band of fibro-cellular tissue, not yet degenerated, forming less than a third of the whole tubal thickness, and presenting the same interesting features as the corresponding coat of the middle portion of the tube. The thickest part of the wall is the peritoneal coat; it is entirely involved in an extensive necrosis which is at one time fibrillated, at another granular or hyaline.

The little refractive globules described in the cellular tubercular tissue of the uterus as Russell's fuchsin bodies are present also in the tube in considerable number. They lie by preference in the middle coat, in which the tubercle tissue is best preserved. They present the same general characteristics as the hyaline bodies of the uterus, but are somewhat smaller. Indeed, whereas in the uterus their average diameter is that of a red blood corpuscle, in the tube their average size is that of a micrococcus; and, where Weigert's fibrin stain is used, they could readily be mistaken for such, were it not that upon careful examination they show less uniformity in size, take a more solid stain, and because larger globules, both free and in cells, are found in the same neighborhood. Extra-cellular spheres of large size grouped with smaller hyaline globules are sometimes found occupying open spaces in the tissues.

The borders of the necrotic zones, both mucous and serous, in all parts of the tube, are invaded to some depth by deeply staining micrococci, which in form, size, grouping and arrangement in the tissues, resemble the organisms found in the uterine coats. Similar organisms are found at times in the blood-vessels of the middle coat. The streptococci predominate, and the average length of the chains is six members. Tubercular bacilli are likewise found.

Right Ovary. The right ovary is somewhat enlarged. Its surface presents a smooth, wavy outline and is covered by a thick, œdematous, vascular connective tissue which contains lymphoid and epithelioid cells, but no giant cells. There are also numerous dilated lymphatic vessels filled with lymphocytes. The edges of this connective tissue covering are ragged and represent the remains of old fibrous adhesions between the ovary and neighboring structures. Deep within the ovarian stroma are several isolated and conglomerate caseous tubercles. There are many advanced corpora fibrosa, and an unruptured Graafian follicle in the process of retrograde metamorphosis. Russell's fuchsin bodies are numerous in the tubercular tissue covering the ovary, and in the ovarian tissue itself. They are present where the degeneration is least advanced, and may be seen, not only in the tubercular areas, but in association with other degenerative changes—in the hyaline degeneration of corpora fibrosa and in the retrograde metamorphosis of unruptured Graafian follicles.

Streptococci, staphylococci and tubercle bacilli are present. Of these the streptococci are most abundant and occur in long chains, at times reaching the length of fourteen members. They are located within the lumen of blood-vessels, in the blood-vessel walls, or in the perivascular lymphatics of the

connective tissue covering the ovary, and are oftenest free, but may be found enclosed in cells.

Left Fallopian Tube. The left Fallopian tube has the same general structure as the right, the only difference being that the tubercular lesion is more advanced. The middle portion of the tube is converted into a dense necrotic cord, the transverse section of which shows a ragged longitudinal rift in the centre of an oval area of hyaline necrotic material. This is surrounded by a fibro-cellular border, whose surface is roughened by fibrous shreds torn in the process of separation from adjacent structures. The fibro-cellular border corresponds with both middle and outer zones of the other tube. The fimbriated extremity, like its fellow, is extensively degenerated, and the lumen is also much enlarged. Its walls, however, are less uneven and are but half the thickness of those of the corresponding tube. Continuous with the middle portion of the tube the fimbriated extremity likewise has an outer border of fibro-cellular tissue and an inner hyaline necrotic coat. In this tube there are fewer giant cells than in the other, and the tubercle tissue in places shows fibroid change. Russell's fuchsin bodies are present in small number.

The micro-organisms found are similar to those in the other tube.

Thus, while both tubes show in the main the same tubercular lesions, they differ in that the left tube has somewhat thinner walls, contains a smaller number of giant cells, exhibits in places fibroid change, and the thickened necrotic serous coat is wanting.

Left Ovary. The left ovary is smaller than the right and is surrounded by diffuse tubercular tissue. In gland-like spaces near the surface are found great accumulations of nuclei, bound together by hyaline and fibrillated fibrin, and often presenting the appearance of the tubercle giant cell. In this ovary there is but one solitary caseous tubercle, about the size of a split pea, which projects slightly above the surface and dips down into the stroma. Fuchsin bodies and micro-organisms are present, resembling in every respect those found in the right ovary.

The Vagina. The vagina shows no tubercular involvement. The elevated greyish white patches observed on macroscopic examination consist of swollen, distorted, stratified epithelial cells. Occasional polymorphonuclear and mononuclear cells have wandered up into the epithelium. There is slight proliferation of the cellular elements in the upper portion of the corium. Fuchsin bodies are found in these proliferating areas. More densely stained globules are seen in the swollen epithelium above. Upon the surface of the mucous membrane there are a few cocci and long bacilli. Within the blood-vessels of the vaginal wall, and especially in the larger ones, cocci occur in pairs and chains, both within cells and outside of them.

The *bladder* and *urethra* show nothing abnormal.

Pus Sac. The wall of the pus sac, portions of which remain adherent to the pelvic viscera, is from 4 to 6 mm. in thickness. It consists of three coats not sharply differentiated one from the other. In the inner necrotic coat, which represents about one-third of the thickness of the sac wall, the degeneration is extreme. Its surface is edged by dense aggregations of micrococci which in places extend deep into the necrotic structure. The middle coat is fibro-cellular and contains a few isolated clusters of fat cells. It is infiltrated with diffuse tubercular tissue. The outermost coat is not sharply separated from the middle, and differs from this in containing numerous closely packed caseous tubercles. Fuchsin bodies are present as intracellular and extracellular globules. They are of all sizes, and contrary to what occurs elsewhere, they are found in the most advanced necrosis. In such places they take a less intense gentian-violet stain and merge gradually into the surrounding necrotic structure. Micrococci are found in all three coats arranged in pairs, clusters and chains. They are especially numerous upon the inner surface of the sac, where they form a continuous irregular layer. Tubercle bacilli are also present in small number.

General Viscera.

The *lung* shows very little that is abnormal. The visceral *pleura* is considerably thickened and presents an irregular wavy outline. Its surface is covered by a layer of fibrin formed by the coalescence of highly refractive clumps. These, in places, extend deep into the tissues, where they appear as densely hyaline whorls, or the fibrin remains limited to the surface, where it forms a meshwork enclosing polymorphonuclear cells. The more hyaline portions are at times invaded by organizing connective tissue. Beneath the fibrinous covering is a layer of highly vascular granulation tissue which contains closely-set flattened tubercles. These tubercles project here and there between the clumps of hyaline fibrin, extending at times to the surface, or dip down into the lung substance. They are more or less caseous and show the same general structure as the tubercles already described. Where less advanced they contain many giant cells. The deeper layers of the pleura contain dark brown and black granular pigment, both free and enclosed in cells.

The parietal pleura resembles the visceral in its general histological features. It is composed of a superficial layer of fibrin, beneath which are granulation tissue and caseous tubercles. Quite beneath is a third layer consisting of œdematous connective tissue, the meshes of which are widely separated by serum and the spaces of which are occupied by swollen mononuclear cells. In the parietal pleura there are small extravasations of blood. Both layers of the pleura contain the fuchsin bodies and basophilic cells. A few pairs and chains of cocci and tubercle bacilli are present.

Liver. The capsule is thickened by tubercular growth. The lobules show dilatation of the central veins and adjacent capillaries. The hepatic cells in the centre of the lobule contain a brownish yellow pigment. The peripheral cells are filled with fatty globules.

Distributed thickly through the liver substance, in close relation with the blood-vessels, are countless tubercles, most of which are of microscopic size. Large nodules evident to the naked eye are less abundant. The former consist for the most part of lymphoid cells or of lymphoid with a central accumulation of epithelioid cells. The larger tubercles are evidently older and exhibit the typical structure of miliary tubercles with advanced central necrosis. There are a few pairs and chains of cocci in the liver capillaries.

Spleen. The capsule is thickened by a new growth of cellular connective tissue containing caseous miliary tubercles. The spleen parenchyma shows an increase in its cellular elements. Much blood pigment and many red blood corpuscles are found. The arterial walls are considerably thickened, and an occasional hyaline thrombus in one of the smaller vessels is seen. There are numerous tubercles, both young and old, scattered through the splenic substance. Fuchsin bodies are present. Micrococci in pairs, masses and chains are found. They are sometimes arranged within cells, but are usually extra-cellular.

Kidney. The kidney shows parenchymatous and fatty degeneration of the epithelium lining the Malpighian tufts and the convoluted tubules. There is a slight increase of connective tissue, especially under the capsule. The tubules are here compressed, but elsewhere they are at times dilated. Hyaline and granular casts are found. The wedge-shaped area described among the macroscopic lesions is found to consist almost entirely of connective tissue in various stages of development. It compresses the tubules, many of which are completely obliterated; while others persist with intact epithelium or with lumen distended by hyaline casts. The Malpighian tufts are small and fibrous, and in places are converted into hyaline balls. Indeed, the connective tissue invades all structures in the triangular area, and tubules, blood-vessels and glomeruli are alike involved. The central cyst is lined by cuboidal or flattened epithelium. Its walls appear to contain a large number of muscle fibres which have an irregular arrangement and include masses of lymphoid cells. It is continuous with several smaller tubular dilatations and is undoubtedly a retention cyst. At the apex of the triangle is a large dilated blood-vessel with irregular thickened walls and lumen containing remnants of a probable thrombus. The area resembles an infarct in the process of cicatrization, but for the presence of apparently functioning structures. A few cocci arranged in pairs are found within a blood-vessel of the kidney.

Pancreas. The capsule is considerably thickened by a new growth of connective tissue, alternately fibrous, cellular, vascular and œdematous. Numerous closely-set tubercles are embedded in the capsule. They are round and project beyond the surface, or they may be flattened and elongated. They show the typical structure of cellular, caseous and fibroid tubercles. The capsule contains the fuchsin bodies and masses of micrococci.

Lymph Glands. The bronchial lymph glands are invaded by lymphoid, epithelioid and giant cells and show a tendency to fibroid change. Some of the central arteries are sclerotic, others show tubercular lesions. Masses of basophiles are present in the centre of the glands, especially grouped around blood-vessels, and the fuchsin bodies are found at times occupying the interior of basophilic cells. Micrococci occur in pairs and chains within blood-vessels and in the perivascular connective tissue.

In the mesenteric lymph glands the tubercular process is more advanced. The centre is necrotic, with original structural outlines still preserved. The periphery of the gland retains its lymphoid nodules, but these are invaded by tubercle tissue. The blood-vessels are thickened, and basophiles are found. The gland is covered by œdematous tubercular tissue. Diplococci and staphylococci are numerous in the surrounding connective tissue, and beaded tubercle bacilli are found in the interior of the gland.

The *aortic valve*, the *aorta* and the *coronary arteries* show irregular thickening of the intima due to increase of connective tissue which in places is swollen, and the interstices between the branching connective tissue cells are occupied by translucent, highly refractive masses. Or again, the tissue is non-cellular and diffusely hyaline. On the edge of the aortic valve where it appears necrotic a few diplococci are found.

Fibro-caseous bands. The fibro-caseous bands extending across the abdominal pus cavity, and those in the pleural sac, are made up of fibrillated connective tissue, everywhere invaded by diffuse tubercle tissue and circumscribed tubercles in all stages of growth or of retrograde metamorphosis. The peripheries of the bands consist of necrotic zones edged by a closely packed layer of micrococci. The connective tissue stroma shows every stage of organization from young granulation tissue to dense hyaline bands; the blood-vessel walls are thin and easily ruptured, and extravasations of blood are sometimes found. The diffuse tubercle tissue consists for the most part of lymphoid and epithelioid cells grouped usually in the neighborhood of blood-vessels. Few giant cells and some basophiles are found. The tubercles exhibit every stage of growth and of retrograde metamorphosis. At times they present a typical cellular structure with giant cells in the centre. Again, the centre is occupied by a blood-vessel, and the lumen of such vessel may contain well preserved fluid contents, fibrillated fibrin, or a hyaline or mixed thrombus. The caseous peripheral zone is from 2 to 6 mm. in thickness. It contains no cells nor nuclear fragments, but is made up of a structureless necrotic substance, alternately granular, fibrillated and hyaline. Fuchsin bodies are easily demonstrable. They are of all sizes, from that of a basophilic granule to a lymphoid cell, and are both intracellular and extracellular. They occur in the diffuse tubercle tissue where degeneration has just begun. The micrococci found on the surface of the band sometimes extend deep into its substance; they occur in pairs, in masses and in chains. In the bands of the abdominal pus cavity compressed lobules of adipose tissue exist.

Bacteriological Examination.

Cover-slip preparations made at autopsy from a tubercle upon the pleura demonstrated large numbers of long beaded tubercle bacilli and clusters of micrococci. Cultures made from this tubercle enable one to isolate white, lemon yellow and orange colored colonies. Inoculations from these colonies into the various culture media exhibit the peculiar cultural characteristics of the staphylococcus pyogenes aureus, citreus and albus, and cover-slip preparations from the various cultures invariably show cocci arranged in clusters and in pairs. Unfortunately, no cultures could be made from the abdominal viscera, but hardened sections of the organs stained by Gram's, Weigert's and Gabbet's methods exhibit staphylococci, streptococci and tubercle bacilli in all.

Summary of Histological and Bacteriological Examination.

(1) The condition is a mixed infection due to the tubercle bacillus, the streptococcus pyogenes, and the staphylococcus pyogenes aureus, citreus and albus.

(2) Miliary tubercles, both grey and caseous, are found in all the viscera of the body except the heart and pancreas; in the lymph glands, and in all serous membranes except the pericardium.

(3) Diffuse tubercle tissue is found only in the more chronic lesions—in the pelvic viscera, the lymph glands, the pleura, the peritoneum, in the wall of the newly formed abdominal sac, and fibro-caseous bands. In the viscera this is usually cellular, but may be caseous. In the serous membranes it is always caseous.

(4) Tubercle bacilli are numerous in the tubercular lesions throughout the body. They are especially numerous in the pelvic viscera, lymph glands and abdominal pus sac.

(5) The products of ordinary inflammation are often found associated with the tubercular lesions.

(6) Staphylococci are found in all the organs. They are most numerous in the lining of the abdominal pus sac and the fibro-caseous bands.

(7) Streptococci are likewise found throughout the body, but are especially abundant in the pelvic viscera, the pus sac and the fibro-caseous bands.

(8) Russell's fuchsin bodies are found wherever the tubercular tissue is beginning to degenerate and occasionally where the degeneration is extreme.

(9) The viscera are congested and there is general arteriosclerosis.

Conclusions.

From the clinical history, gross anatomical lesions and histological appearances, we therefore conclude that the disease began as a tubercular inflammation of low grade in the pelvic viscera some time before pregnancy.

That the tubercular process spread by direct extension or by the lymph channels to the anterior part of the abdomen, which thus became shut off from the rest of the peritoneal cavity by chronic adhesions.

That the phenomena incident to pregnancy and the puerperium excited the process to increased activity, to which, either at this time or later, was probably superadded a pyogenic infection.

That this infection remained limited to the pelvic organs because of occlusion of the tubes by previous tubercular adhesions or by the more recent inflammatory process, until manual examination of the already much diseased organs caused unavoidable rupture into the anterior abdominal sac.

The pain, rise of temperature and abdominal distension were the result of the secondary pyogenic infection of this cavity, from which the general infection took place.

The general tubercular infection doubtless spread, partly by direct extension, partly by the lymph channels, but principally through the blood-vessels. The first two modes of invasion are shown by the extensive diffuse infiltration of all structures continuous with and contiguous to the pelvic viscera and the abdominal pus sac. Infection through the blood is evidenced by the general miliary tuberculosis of all the viscera of the body.

Tuberculosis of the tubes and peritoneum is usually a secondary condition. It may follow tubercular disease of any organ of the body, but is seen most commonly associated with tuberculosis of the lungs. In this case, however, the process must have originated either in the peritoneum or in the tubes. The lungs showed no old tubercular foci, but were involved only in the general miliary tuberculosis. The pleura was diseased, but to a much less extent than the peritoneum or the tubes. The intestines were not at all involved, and the lymph glands were enlarged and caseous, but not extensively diseased.

The question arises, what was the relation of the tubercular disease in the tubes to that in the peritoneum? Which was primary, which secondary? Considerable difference of opinion exists as to the relation between tubercular peritonitis and tuberculosis of the tubes. In his monograph on "Tubercular Peritonitis" Osler[11] says: "The Fallopian tubes are often affected, but the proportion given by various writers differs much. It is safe to say, I think, that in 30 to 40 per cent. of the cases in women the tubes are found affected. The process is commonly confined to the distal ends and may be primary—which is usual—or is secondary to the peritoneal involvement."

In this opinion of primary tubal involvement the majority of observers agree.

On the other hand Williams[14] asserts that "Tuberculosis of the Fallopian tubes is far more frequently of secondary than of primary origin, and when it occurs in combination with tubercular peritonitis, it is far more often the result of than the cause of the latter. The fact that the fimbriated extremity of the tube is the portion most frequently affected is of itself evidence in favor of its secondary origin, and in several cases of tubercular peritonitis we have found tubercles on the exterior of the tube and its fimbriated end, but none in its interior, showing that the process was extending from above downward." Among others, Sänger and Borschike confirm his view.

In this case the only indication pointing to the peritoneum as the source of disease is the extensive caseous involvement of its anterior part. On the other hand, primary disease of the tubes is indicated by the still more extensive involvement of their walls, by the presence of numerous giant cells, considered by Baumgarten[1] as significant of primary tubal disease, and by the clinical history which points to the pelvic organs as the first affected. As shown by the foregoing studies, the fimbriated extremity of the left Fallopian tube must be regarded as the probable starting point of the whole tubercular process.

If then the tubercular disease of the tube is of primary origin, the further question presents itself, how did the disease arise? Primary tuberculosis of the tubes may originate in two possible ways: (1) By infection through the blood, and (2) by infection from without. Primary infection through the blood is a matter of pure speculation and is highly improbable. The more likely source of infection is through the vagina from without. Although no history of such invasion could

be obtained in this case, yet it is regarded as the most probable portal of entry. The fact that the uterus was less involved than the tube, and that the vagina was not all diseased, does not negative this theory of infection, since the tubercle bacilli, failing to find conditions favorable for their growth until the left fimbriated extremity was reached, here set up their characteristic lesions. Thence they probably spread to the fundus of the uterus, to the uterine cavity and cervix, to the opposite tube, and to the peritoneal cavity, from which the general infection took place.

The associated involvement of pleura and peritoneum must be considered of diagnostic value, since coincident inflammation of both these membranes is so often of tubercular origin.

Besides the extensive character of the lesions, there are several unusual features in the case. In the first place, considerable interest attaches to the fuchsin bodies so numerous in this case. These bodies resemble the little globular masses described by Russell[12] in 1890 as "a characteristic organism of carcinoma," and correspond in every particular with the description of these bodies as given by Lubarsch[9] under the head of "Albuminous Degeneration."

There is scarcely a normal condition or pathological process in which they have not been found, but their relation to malignant tumors has been especially noted. They are not of constant occurrence in any pathological change.

With regard to their nature, the view of Russell that they may be considered as yeast fungi is no longer held. They have been variously interpreted as protozoa, hyaline thrombi, altered Altmann's granules, von Recklinghausen's hyaline, bodies resembling corpora amylacea, transformation of the cell protoplasm, and as a product of the tissue fluids in which a degenerative process is added to a beginning coagulation process.

Lubarsch himself inclines to the view that the Russell's fuchsin bodies are the product of cell protoplasm, the granules of which have undergone certain chemical and physical changes. He believes that they may be due either to a secretion or to a degeneration of the cell, the former occurring in normal conditions, the latter in pathological processes. Lubarsch also refers to the relative increase of basophiles in areas in which the fuchsin bodies abound—a phenomenon noted by Niehus and Klien, and observed also in the present case. In explanation of their coincident occurrence he attributes the formation of the fuchsin bodies to a chemical change and confluence of the granules of the former and some of the wandering cells, and suggests that both are due to active tissue transformation. From the description given in the present case, this mode of origin seems probable.

A second point of interest is the rare combination of tuberculosis in both body and cervix of the uterus. Regarding this Williams[13] says: "The affection is almost always limited to the body of the uterus, rarely extending beyond the os to involve the cervix; and of the few cases of tuberculosis of the cervix on record, a considerable portion occurred without any involvement of the rest of the uterus. Tuberculosis of the uterus which also involves the cervix is rarely met with, and as far as we can ascertain from a careful survey of the literature, has only been noted in seven cases."

In this connection may also be mentioned the tubercular invasion of the muscular coat of the tube, which, as a rule, escapes involvement even in advanced tuberculosis.

The large sacculated exudation occupying the anterior portion of the peritoneal cavity and simulating ovarian cyst is rare. Among the few recorded cases of tubercular peritonitis with encysted collection of fluid are those reported by Bernutz, Spencer Wells, Gardner, Howard, Erich, Ewing, Mears and Atlee.

A feature of special interest is the thick fibro-caseous band which extends across the pus sac in the median line of the abdomen, and is probably the remains of the rolled-up omentum. In structure it bears some resemblance to the thickened strands described by Klebs[8] as passing transversely across the abdominal cavity below the umbilicus, and which he attributed to retraction of the omentum. Such omental tumors are not uncommon and have frequently been described. In location, however, this fibro-caseous band does not correspond with the transverse omental tumors, since its direction is antero-posterior and from above downward, and its attachment is by its extremities. In explanation of this formation one can only assume some distortion of the original omentum, with displacement, thickening, caseation and complete transformation into the fibro-caseous band.

In conclusion, I wish to thank Dr. Flexner for valuable suggestions during the course of this work, Dr. B. B. Browne for kindly allowing the use of his clinical notes, and Mr. Max Brödel for the accurate drawing which accompanies the text.

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Description of Plate.

Pelvic viscera fixed in formalin and hardened in alcohol, viewed from above. Right tubo-ovarian mass seen in cross-section.

F. U., fundus of uterus.
Right tube, showing cross-sections of tubercular lumen.
r. F. E., fimbriated extremity of right tube.
r. Ov., right ovary.
M., myoma.
Rd. Lig., round ligament (left).
l. T., left tube.
l. F. E., fimbriated extremity of left tube.
l. Ov., left ovary.
From the left surface of the larger myoma projects a fibro-caseous band. To the right is attached a portion of the abdominal pus sac.

A VISIT TO BAD NAUHEIM, WITH THE PURPOSE OF INVESTIGATING THE "SCHOTT TREATMENT" FOR CHRONIC HEART DISEASE.

By C. N. B. Camac, M. D., *First Assistant Resident Physician.*

Last November, at Dr. Osler's suggestion, we undertook to introduce into the hospital the Schott treatment of exercises and medicated baths for cases of chronic heart disease. After consulting the bibliography of the subject, several cases were placed under treatment according to the instructions contained therein. At once, however, we were confronted by numerous questions, answers to which it seemed quite impossible to find in any of the references at hand. Although the literature dealt at length with changes in the cardiac outline, the position of the cardiac maximum impulse and the respiration, the theories upon which the beneficial effects were based, etc., no answers to such practical questions as the following were given:

(1) Is any massage to be employed during or after the bath?

(2) What drugs are to be employed during the treatment, and what drugs are contraindicated?

(3) Should the baths and exercises be given together; or if separately, which should precede?

(4) Are stimulants to be administered before or after the bath?

(5) What should be the diet of the patient?

(6) Are cases of hydrothorax or ascites to be tapped? etc., through quite a list with which it is hardly necessary to weary you.

Finding many of these questions unanswered, it was with considerable interest that I received Dr. Osler's suggestion to visit Bad Nauheim, the home of the treatment and of Dr. Schott, its originator.

Nauheim is in the Grand Duchy of Hesse, three-quarters of an hour from Frankfurt a. M. and two hours from Homburg. Nearly in the centre of the northeastern half of what geologists have called the Mayence Basin (Mainzerbecken) Frankfurt is located, and at the eastern slope of the Johannesburg, the last spur of the Taunus mountains, is situated Bad Nauheim. As one approaches Nauheim he is struck by the great trestle-work structures in the midst of the fields. On examining these more closely they are found to be frame structures about 200 to 300 feet long and about 50 feet high, supporting switches closely stacked one upon another. The salt waters are raised to the top of these trestles and allowed to filter through the interlacing switches, upon which, by the evaporation of the water, the salt is deposited. These switches are removed every few months or so, the salt broken from the branches, ground and refined, and serves as the commercial salt of the surrounding country. The most beautiful forms result from these deposits, and by the clever devices of the natives the most grotesque figures are produced. I have some of the figures thus produced.

An estimation of the commercial value of these works to-day may be made by the value put upon them in 1806, when they were considered by Napoleon an adequate reward to Marshal Louis Nicolas Davout (erroneously written Davoust) for his services in the French army; and again in 1866, when they fell to Hesse Darmstadt in exchange for Homburg. Since 1834 the reputation of Nauheim for the efficacy of its springs has been steadily coming to the notice of Europeans. Frankfurt up to this time forming the centre and battlefield of many of the German disputes with France, rendered Nauheim scarcely a fit place for invalids.

It was therefore not until 1834 that we begin to hear of Nauheim as a resort for invalids. It was not until 1860, however, that Dr. Beneke of Marburg considered scientifically the value of the medicated bath treatment. From 1859–1870 several articles by Beneke of Marburg, upon the waters of Nauheim, appeared in the Berlin. Klin. Woch. From 1870 to 1890 August and Theodore Schott and J. Groedel were frequent contributors on this subject to the Berlin. Klin. Woch., also to the Deutsch. Med. Zeitung. August Schott died, but his brother Theodore continued the work, and published in 1892 an article in the Lancet which caused little comment.

In 1894 W. Bezley Thorn became an ardent advocate of the bath treatment, and published an article in the Lancet and also a small book in which he described quite fully the baths and exercises. With the appearance of this systematic little book up to the present the treatment has been very popular in

England. Nauheim, its waters, and the resistance exercises, have been frequent topics in English and German medical journals. In France and America the treatment has as yet received no very thorough trial. It is interesting to note here the increase in the number of visitors from 1871 to 1895. In 1871 the visitors numbered 5,249; in 1891, 9,244; 1892, 10,272; 1893, 10,384; 1894, 11,681; 1895, 14,136.

Although the season was over when I visited Bad Nauheim, I had the opportunity of seeing the baths through the courtesy of Dr. Hirsch, Dr. Schott's assistant, who showed me over the grounds and described very fully the details of the treatment. It can best be described in Dr. Schott's own words: "The springs of Nauheim may be divided into two classes, those suitable for bathing and those suitable for drinking. Together with other ingredients the bath waters contain from two to three per cent of sodium chloride, from two to three per 1000 of calcium chloride, various salts of iron, above all, very large amounts of carbonic acid.

Coming from the depths of the earth, they have a temperature of 82–95° F. Springing from a depth of 180 metres, supercharged with carbonic acid gas by the pressure to which they are subjected, the waters gush far above the surface; for example, spring No. 12 rises to a height of 56 feet and falls again in white seething masses." This is a most striking condition; so richly charged with carbonic acid are these waters that the reservoir into which they fall has the appearance of a great mass of clouds. "Conveyed directly from the main by means of subterranean pipes, these waters charged with their natural gas are allowed to completely cover the body of the bather. Little bubbles of gas are seen to immediately cover the whole surface of the body; the waters of springs Nos. 7 and 12 escape from a pressure of from 1½ to 2½ atmospheres, and afford a surf bath which compares accurately with the strongest surf bath of sea water."

The first question which arose when this matter came to be scientifically investigated was, how do these baths and exercises act? That they were very efficacious in the relief of chronic cardiac disease had been demonstrated for some years back, but their action had never been investigated. There are several explanations given:

(1) That given by Dr. Schott in the following words: "Physiological research of recent years seems to show that the salts held in solution in water externally applied have no direct action on the system; the light and mobile molecules of the gas, on the other hand, pass rapidly through the skin to the corium with its rich supply of blood. We must look upon the salts held in solution as passing by imbibition through the outermost layer of the epidermis, and so acting on the terminal nerves of the skin as to exert a reflex action on the internal organs. The warm baths act in their own peculiar manner on the organism as a whole; increased tissue change seems to be induced by an increase of the oxygen absorbing power of the cells, and hence follows the sense of the need of rest and sleep as an immediate consequence of the bath, as well as influences speedily brought to bear on the nervous system as a whole. Excessive bathing induces an excitable state of the nervous system, sleeplessness, loss of appetite and consequent loss of strength. The principal changes which ensue in the system and in the function of the special organs are that the heart beats more slowly and strongly, the pulse becomes full and increases in force, and the blood pressure may rise to the extent of 20, 30 mm. of mercury; the breathing becomes regular and quiet, and the capacity of the lungs increased.

While the patient is in the bath he becomes flushed and a feeling of comfort and warmth ensues which may even rise to one of an agreeable intoxicating character. Almost invariably the excretion of urine is increased; exudates in the body cavities, especially from the peritoneum, pericardium and pleura, are absorbed. This latter action and that on the valves of the heart can only be explained on the theory of reflex action produced by influences acting upon the terminal nerves."

Another explanation is that given by Dr. Bezley Thorn, that there is a dilatation of the muscular arteries and afterwards those of the skin, and thus there is a relief of the heart from backward pressure.

In Lauder-Brunton's massage experiments he demonstrates that more blood flows through the massaged part and that blood pressure at first rises and then falls, and that on the conclusion of massage more blood collects in the massaged part. These experiments were confirmed by Dr. Oliver.* T. Grainger Stewart† concludes that the passive exercises (1) improve the circulation of lymph within the tissues, and (2) bring a larger volume of blood into the muscles. He quotes the conclusion of Ludwig to the effect that the capacity of muscles for blood is equal to the combined capacities of the internal organs and the skin. If therefore this be so and Dr. Lauder-Brunton's experiments be correct, the increased amount of blood in the muscles must indicate a relief of the congestion in the internal organs.

In Dr. Schott's explanation there are two actions:

(1) A cutaneous excitation induced by the mineral and gaseous constituents, and

(2) a more prolonged stimulation of the sensory nerves excited by imbibition into the superficial layer of the corium. The salt producing this excitation is the calcium chloride.

Whatever the explanation of their action may be, two points seem established:

(1) That the apex beat alters its position;

(2) the area of cardiac dulness is diminished. These two facts, especially the first one, were most strikingly obvious in our first cases, and both facts were most forcibly demonstrated to me in the cases which I saw abroad. One can scarcely credit the results published until he has seen for himself these marked changes.

The case reported by Dr. Bowles in the Practitioner for July, 1896, shows a change of 3 cm. in the apex beat before and after a bath of ten minutes duration, and he says after his visit to Nauheim, which was made for the purpose of seeing for himself, "that which I thought impossible is shown to be quite possible." This case reported by Dr. Bowles was one of chronic myocarditis, moderate pleural effusion, general anasarca and general enlargement of the heart. The age of

* Brit. Med. Jour., June 13, 1896.
† *Ibid.*, September 19, 1896.

the patient was not given. I shall not at this time attempt to report cases, but merely mention this one of Bowles in order to confirm what has been our experience of the effect of the bath upon *the position of the apex beat*, and many other reports confirmatory of this remarkable change are to be found in the literature on this subject.

The diagrams of the cardiac outline made by Dr. Bowles are not quite accurate, but there can be little difference in opinion as to the position of the maximum cardiac impulse.

To quote Dr. Schott again: "The methods of administering the baths are of the greatest importance. It is advisable to begin with a 1 per cent salt bath containing $\frac{1}{1000}$ of chloride of calcium, freed from gas and at temperatures varying from 92° to 95° F., the bath lasting from six to eight minutes. The course of treatment should be interrupted by frequent intervals of one day. The temperature of the bath should, if possible, be gradually lowered, while the proportion of solids in solution and the duration of the bath are gradually increased. At a later stage it is permissible to proceed to the baths containing carbonic acid. The temperature may then be rapidly lowered, especially if chloride of calcium be added in order to increase the mineral strength of the bath."

The course consists of six baths: the first and the second being simply with salts, calcium chloride and the sodium chloride; the third, fourth, fifth and sixth contain carbonic acid as well as these salts.

The preparation of the baths artificially was taken up especially by W. Bezley Thorn, in London, in 1895, since which time Ewart, Bowles and Broadbent have employed them in London, Moeller in Brussels, and Heinemann in New York. Following the analysis of the Nauheim waters made by the chemist Fresenius of Wiesbaden, the artificial baths may be readily prepared. We have now packages made up at our pharmacy each containing the proportion of salts for the different strengths of the baths, each package corresponding to 40 gallons of water, which is just about enough to entirely immerse the body. The baths of different strengths are given to appropriate cases.

I have not attempted in this note in any way to speak for or against the treatment nor to report cases. I have thought it best for the present simply to give an outline of the trip to Bad Nauheim, the purpose of which was to see the effects of the treatment and to learn something about it with the object of trying it in the Hospital here. We have now five cases under treatment, and I trust by keeping careful records of the effects of these baths and exercises that we shall be able to pass judgment upon the weak points as well as the strong points of the method. Only by a careful trial can one place himself in a position either to recommend or to condemn the treatment. I take this opportunity of expressing my appreciation of the patience with which Dr. Schott heard and answered my many questions. I also wish to thank Dr. Heineman for the instruction in the movements which he so carefully gave me.

In regard to the exercises, which are worthy of a lengthy description, something must be said. They consist of nineteen movements, each movement restrained by the very lightest resistance. This part of the treatment, under the supervision of a physician, is entrusted to the nurses, to whom we have given careful instructions as to the method of carrying it out.

The following are the instructions which we have laid down for the nurses in the administration of the bath, also the chart showing the observation which should be made.*

RULES FOR SCHOTT BATH.

(1) Always understand clearly from the doctor the following points: (1) Strength of the bath to be given; (2) temperature of the bath; (3) length of time patient is to remain in the bath. *Note.*—Give the bath in the morning unless otherwise ordered.

(2) Observe carefully the chart and note the points therein called for. (1) Give bath on an empty stomach. (2) Note the time from the moment patient is immersed to that when he is taken out. (3) Allow the patient to make as little exertion as possible; assist him in every way. (4) A sheet may be drawn over the tub, but not around the patient. (5) Be sure the entire body is immersed. (6) Keep the finger on the pulse during the entire time the patient is in the bath.

Danger Signals.—Cyanosis (bluing of the face), dyspnœa (difficult breathing), apnœa (gasping), inappreciable pulse. On the appearance of any of these, take the patient out of the bath immediately, put him to bed and keep him as quiet as possible. Friction while in the bath is not necessary, but if the fingers and toes become bluish the extremities may be rubbed slightly towards the trunk. Friction should be cautiously employed; when the patient is out of the tub rub him to a glow; give him a glass of milk or cup of bouillon and allow him to rest for an hour.

Diet.—Small quantity q. 4 h. Meat—boiled chicken, mutton chops; eggs, two a day; oysters, raw or panned; vegetables—peas, beans, lettuce; liquids—beef tea, bouillon, cocoa, lemonade, milk. *Note.*—Never give more than 4 ounces of fluid at a time. Should be sipped. Wine—Port, Rhine, sherry, brandy, dram to half ounce.

Note.—Something light (cocoa and toast) should be taken one-half hour before the bath; something light and hot (bouillon, milk punch and toasted crackers) should be taken directly after the bath. If the heart's action is poor, sherry, brandy or port wine may be given after the bath. Last meal to be taken three hours before retiring.

Bath No. I. Sodium chloride, 4 pounds; cal. chlor., 6 ozs.

Bath No. II. Sodium chloride, 5 pounds; cal. chlor., 8 ozs.

Bath No. III. Sodium chloride, 6 pounds; cal. chlor., 10 ounces; sodium bicarb., 6 ounces; HCl, 7 ounces.

Bath No. IV. Sodium chloride, 7 pounds; cal. chlor., 10 ounces; sodium bicarb., 8 ounces; HCl, 12 ounces.

Bath No. V. Sodium chloride, 9 pounds; cal. chlor., 11 ounces; sodium bicarb., 1 pound; HCl, 1 pound.

Bath No. VI. Sodium chloride, 11 pounds; cal. chlor., 12 ounces; sodium bicarb., 1 pound; HCl, 2 pounds.

Each bath consists of 40 gallons of water.

NOTE.—By using a little more $NaHCO_3$ than is required

* These rules are made after perusal of the literature, also from instruction obtained from Dr. Schott personally.

to take up the HCl, the metal tubs may be employed without doing them any harm.

$$\underbrace{NaHCO_3}_{83.75} + \underbrace{HCl}_{36.37} = NaCl + H_2O + CO_2.$$

The Exercises.*

The exercises are called by Dr. Schott "Widerstandgymnastik," or resistance gymnastics, and consist in slow movements executed by the patient and resisted by the physician or operator. A short interval is allowed after each movement, during which the patient sits down. The exertion employed must be very small, and should cause no increase in respiratory movements, flushing or pallor. The patient should be loosely and lightly clothed, and instructed to breathe quietly. The resistance made should be of such a kind that the patient may always feel himself easily the master. The operator must not grasp or in any way constrict the limb, but should oppose by the hand held flatly. The movements are nineteen in number:

Arm. (1) Arms extended in front of body on a level with shoulder, hands meeting; arms carried out until in line, and brought back to original position. (2) Arms hanging at sides, palms forwards; arms flexed at elbow until tips of fingers touch shoulder, back to original position; *one arm only moved at a time.* (3) Arms down, palms forward, arms carried outwards and upwards until thumbs meet over head; back to original position; one arm only moved at a time. *Not always advisable.* (4) Hands in front of abdomen, fingers flexed so that the second phalanges touch those of opposite hand; arms raised until hands rest on top of head; back to original position. (5) Arms down, palms against thighs, arms raised in parallel planes as high as possible; back to original position.

Trunk. (6) Trunk flexed on hips; return to original position. *Resist with both hands.* (7) Trunk rotated to left, to right; return to original position. *Resist with both hands.* (8) Trunk flexed laterally. *Resist with both hands.* (9) As No. 1, but fists clenched. *Resist with both hands.* (10) As No. 2, but fist clenched. *Resist with both hands.*

Large Arm Movements. (11) Arms down, palms against thighs, *each in turn* raised forwards and upwards until arm is alongside of ear, then turned outward, and arm descends backwards. Not always safe. (12) Arms down, palms to thighs, *both together* moved backwards in parallel planes as far as possible without bending the trunk forwards. Not always safe.

Legs. (13) Thighs in turn flexed on trunk, opposite hand resting on chair. (14) Lower extremities in turn extended fully, and bent on trunk forwards and backwards to extreme limits of movement, opposite hand resting on chair. (15) Legs in turn flexed on thigh, both hands on chair. (16) Feet together, lower extremities in turn abducted as far as possible and brought back to original position, opposite hand on chair.

Hands and Feet. (17) The arms, extended horizontally outwards, are rotated from the shoulder-joint to the extreme limits forwards and backwards. (18) The hands in turn are extended and flexed on the forearm to extreme limits, and brought back in line with arm. *Resist with both hands.* (19) The feet in turn are flexed and extended to extreme limits, and then brought back to their natural position. *Resist with both hands.*

We have arranged these in 5 groups, as in this way they may be more readily committed to memory.

Rules for Operators.

1. Each movement to be performed slowly and evenly at an uniform rate.
2. No movement to be repeated twice in succession in the same limb or group of muscles.
3. Each single or combined movement to be followed by interval of rest. Count five.
4. Patient's breathing should not be accelerated.
I. *Avoid.* 1. Dilatation of the alæ nasi (dilating of nostrils).
2. Drawing of corners of mouth.
3. Duskiness and pallor of cheeks and lips.
4. Yawning.
5. Sweating.
6. Palpitation.

If any of the above make a complete interval, or if excessive, stop the exercises for the day.

5. Direct patient to breathe regularly. If he holds his breath, make him count in a whisper.
6. Do not constrict the part which is being moved.

*The description of each movement is taken (with a few modifications) from "Chronic Disease of the Heart" by W. Bezley Thorne.

Johns Hopkins Hospital.

SCHOTT METHOD OF BATHS AND RESISTED MOVEMENTS.

Diagnosis..... *Name*..... *Hospital No.*..... *Ward*.....

Date	Bath and Temp. of same and Movements	TIME Begin	TIME End	Respiration, Pulse and Heart [Pulse Tracing Cardiac Outline] In bed R.	In bed P.	Just before R.	Just before P.	1st half R.	1st half P.	2nd half R.	2nd half P.	Immed. after R.	Immed. after P.	10 min. after R.	10 min. after P.	SEE HISTORY (Should be recorded once a week) Pulse Pressure Before	Pulse Pressure After	Calibre of Radial Before	Calibre of Radial After	Point Maximum Impulse. Before	Point Maximum Impulse. During	Point Maximum Impulse. After	Color of Skin {White Livid Cyanosed Red} Before	Color of Skin During	Color of Skin After	Amt. Urine in 24 hrs.	Remarks

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A CASE OF POROKERATOSIS (MIBELLI) OR HYPERKERATOSIS EXCENTRICA (RESPIGHI) WITH A REMARKABLE FAMILY HISTORY.*

PRELIMINARY NOTICE.

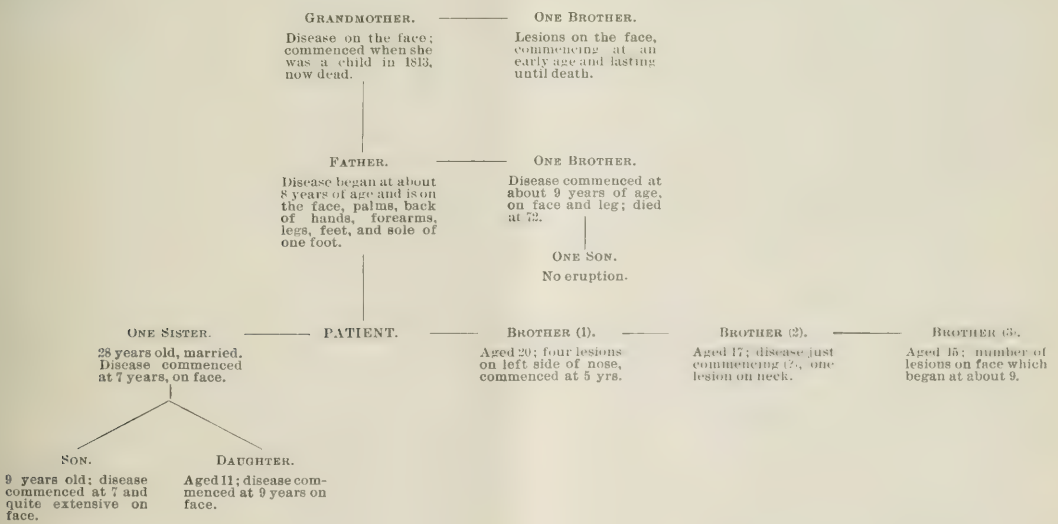
By T. Caspar Gilchrist, M. R. C. S., L. S. A., *Associate in Dermatology, Johns Hopkins University.*

In October, 1893, Mibelli, of Italy, described three (slight references were made to three others) cases of a new disease which, after a careful and detailed histological examination, he named *Porokeratosis.* The disease began at an early age, and was chiefly distributed on the backs of the hands, feet, other portions of the extremities, neck, face and scalp. The lesions commenced as minute, dirty brown, dry, cone-shaped elevations of different sizes and forms, which became much altered as they very slowly increased in size. The lesions extended centrifugally, and the central portion gradually sank in and still remained callous, but the margin was represented by a raised wavy ridge which presented the features of a raised seam. Some patches grew to a very large size and covered almost the whole forearm. Mibelli gave the name porokeratosis to this disease because the most important anatomical lesion was the hyperkeratosis of the sweat duct and sweat pore. In one instance a brother and sister had the disease, mainly on the face and neck. The disease was exceedingly chronic and was unaccompanied by any inflammation or any subjective symptoms.

On January 15, 1894, Respighi, also of Italy, described seven cases of a disease which was recognized by Mibelli as belonging to the same group. Respighi gave the name of "Hyperkeratosis excentrica" to this affection. In one of the cases the father of the patient also was affected with similar lesions. Two years later, three more cases were described by the same author. A single case has been recorded outside of Italy, by Dr. M. B. Hutchins, of Atlanta, Ga., in the *Journal of Cutaneous and Genito-Urinary Diseases* for October, 1896. In Hutchins' case the disease began at two years of age, on the palm of the left hand. The patient is now a man, 32 years old, and has the disease on the left palm, the back of the hand and forearm, and on the face. No histological examination was made. Hutchins compares the boundary of the patches to the "outside of a seam with a thread-like line dividing its lateral halves, and consisting of horny epidermis." No other member of the family had it. In all the cases which have thus far been recorded, only two gave histories of other members of the same family having the disease. In the one case (Mibelli's) a brother had it, and in another (Respighi's), the father of the patient had it.

The patient whom I exhibit this evening is a young man, 21 years of age, who has had the disease since he was five years old, when it commenced on his ears, nose, chin, neck, back of hands and right forearm. The lesions were extremely slow in appearing and in growing. The most remarkable feature about the whole case is the family history, which is here given in a tabular form, together with a very brief description of the disease in each case.

*Exhibited before the Johns Hopkins Hospital Medical Society, March 1, 1897.



It will be seen that eleven persons in one family have had this disease. The patient gave me this history after careful inquiry, and I have since been able to verify his statements with reference to seven of the cases, viz. father, three brothers, a married sister and two of her children, by personal observation. The patient's description of the lesions in his father and brothers, whom I examined later, was so correct that I feel confident the other descriptions are also true, especially since the remaining family history was verified by his father and mother. The father of the patient also described to me the disease as it existed on his mother, an uncle and brother. I will not go any further into the history or description of the lesions occurring in other members of the family, but will reserve that for a more detailed histological description with photograph and drawings, which will appear later.

The patient first came under my care eighteen months ago, and my attention was then only directed to the lesions on the face. I did not diagnose the disease until I had made ten or more histological examinations of excised portions and had seen Mibelli's and Respighi's articles.

The eruption consists of lesions of various sizes and forms which appear to take on two characters according to their age. The smallest variety, which are distributed chiefly over the face, consist of minute (less than 1 mm. in diameter), dirty brown, semi-globular elevations of a horny nature. When they reach the size of a small pinhead the centre becomes depressed and the margin in some is slightly raised, round, oval or slightly irregular, and presents the appearance of a raised seam, along the centre of which runs a thin black line. As the patch becomes very slowly larger the base takes on a somewhat atrophic character. In a few of the lesions, especially those on the neck, a number of minute conical elevations are distributed along the ridge, giving it an irregular appearance, and sometimes one or two of these minute cones appear in the central portion of the plaque. The largest patches are about the size of a split pea.

After removing some of the diseased portions with a curette and applying very thoroughly the silver nitrate stick, I have seen on four or five occasions the disease return within a month or two in the manner described, viz. a very minute, dirty brown papule, which within two or three weeks apparently began to clear up in the centre. Other lesions return in the form of a ring or oval ridge. If one of the patches is curetted it is fairly easily removed, but the operation is followed by almost as much bleeding as the removal of a small epithelioma. Examination of the scrapings, either fresh or after treatment with liquor potassæ, is negative. While watching the course of the disease week by week, I have seen new lesions arise which I had not detected the week previous.

One or two of the lesions appeared to have formed round a hair follicle, but others did not exhibit any such relationship.

A histological examination of a large number of sections from the most recent as well as from the oldest patches showed that the disease consisted of a marked hyperkeratosis of the sweat pore and duct and of the adjacent hair follicle. In some of the material excised from the face it was not clear that the hyperkeratosis had commenced in the mouth of a hair follicle, but in other sections, especially of the smallest variety of lesions, the disease had undoubtedly commenced about the sweat pore. The oldest lesion, especially from the ear, presented a picture almost identical with that of a mild psorospermosis follicularis (Darier).

From the clinical and histological characters of the disease there was no doubt of the diagnosis of all the cases, but the special feature of this rare lesion was perhaps most marked in the case of the father of the patient, who presented on the hands lesions which showed the well-defined raised wavy edge with a thin blackish line along the centre.

The character of the disease on the hands agreed perfectly with the descriptions of Mibelli and Hutchins. Mibelli has reported 6 cases, Respighi 10 cases, and Hutchins 1. I am able to record a group of eleven in one family, which fact seems at first sight to point to a strong hereditary taint. The histological features will be discussed in detail and a fuller clinical description will be given in a later article.

A RAPID METHOD OF MAKING PERMANENT SPECIMENS FROM FROZEN SECTIONS BY THE USE OF FORMALIN.

By Thomas S. Cullen, M. B., *Resident Gynecologist.*

In April, 1895, I published two methods under the above title in the Bulletin.

Since then, numerous requests have been made for reprints or for copies of the Bulletin of that number, and as the supply is exhausted, it has been thought best to publish the article again with one or two minor alterations. The methods have been continuously employed in the Hospital, and especially in the gynecological department, and have proved uniformly satisfactory.

A complete freezing outfit has been placed in close proximity to the operating room, so that as little delay as possible may occur in examining a specimen. For example, if a carcinoma of the uterus is suspected, the patient is brought to the operating room prepared for hysterectomy. The uterus is curetted and the scrapings are examined while the usual preparations for abdominal section are being made. By the time all preparations are completed the diagnosis is given; if negative, the patient is returned to the ward with the assurance that there is no cause for alarm; if positive, the organ is immediately removed. The woman is thus saved from taking an anæsthetic twice, and avoids the period of anxious suspense of four or five days generally required by the ordinary methods to ascertain whether she has malignant trouble or not.

Any one who has hardened tissues in formalin will be im-

pressed with the rapidity of its action, with the firm consistence of the tissue, and with the absence of the contraction of the specimen so often seen when alcohol is used as the hardening medium. Microscopical examination of a specimen hardened in formalin, as we all know, shows almost perfect preservation of the cellular structure. Recently it occurred to me that formalin might be used in the preparation of frozen sections.

One of the greatest difficulties experienced in rendering frozen sections permanent lies in the fact that when passed through alcohol the section frequently not only contracts but contracts irregularly, distorting the specimen; further, such specimens will often stain imperfectly. The use of formalin will obviate these difficulties, allowing one to make an excellent permanent specimen from the frozen section. My method is as follows: The tissue to be examined is frozen with carbonic acid or ether and then cut; the sections are then placed in 5 per cent. watery solution of formalin for 3 to 5 minutes, or longer if desired; in 50 per cent. alcohol 3 minutes, and in absolute alcohol 1 minute. The tissue is now thoroughly hardened and can be treated as an ordinary celloidin section, being stained and mounted in the usual way. On examining this mounted section one might readily take it for a well preserved alcoholic specimen. Supposing we stain with hæmatoxylin and eosin, the entire process is as follows:

Method I. *a.* Place the frozen section in 5 per cent. aq. sol. formalin for 3 to 5 minutes.

b. Leave in 50 per cent. alcohol 3 minutes.*

c. In absolute alcohol 1 minute.

d. Wash out in water.

e. Stain in hæmatoxylin for 2 minutes.

f. Decolorize in acid alcohol.

g. Rinse in water.

h. Stain with eosin.

i. Transfer to 95 per cent. alcohol.

j. Pass through absolute alcohol, then through either creasote or oil of cloves, and mount in Canada balsam.

The blood is lost in frozen sections. To overcome this Prof. Welch suggested that the specimen be first fixed in formalin and then frozen. I tried this and found that we were able to preserve the blood, but that it did not stain very distinctly. For convenience this second procedure will be called method II. The essential factor is the same in each case. The latter process, however, requires at least two hours. A small piece of the tissue is thrown into 10 per cent. solution formalin for two or three hours. It is then put on the freezing microtome and thin sections can be readily made. The sections are stained in the usual way. The detailed procedure of method II is as follows:

Method II. *a.* A piece of tissue 1x.5x.2 cm. is placed in 10 per cent. aq. sol. formalin for 2 hours. Rinsed in water.

b. Frozen sections are made.

c. Left in 50 per cent. alcohol 3 minutes.*

d. In absolute alcohol 1 minute.

e. The sections are now run through water and stained in hæmatoxylin for 2 minutes.

f. Decolorized in acid alcohol.

g. Rinsed in water.

h. Stained in eosin.

i. Transferred to 95 per cent. alcohol.

j. Passed through absolute alcohol, then either through creasote or oil of cloves, and mounted in Canada balsam.

For ordinary use method I is all that is required. Given a piece of tumor from the operating room, it is possible to give as definite a report in 15 minutes as one would be able to give after examining the alcoholic or Müller's fluid specimens at the expiration of two weeks. Method II is of especial value in the examination of uterine scrapings. Instead of putting them in the 95 per cent. alcohol in the operating room, they may be immediately dropped into 10 per cent. aq. sol. formalin. By the time the pathologist receives them, which is at least two hours afterwards, they are firm enough to be frozen without difficulty, and permanent sections can be immediately made. The second method is to be recommended for all delicate tissues. In employing these methods one must remember, as for example in epithelioma, that some of the cell-nests will drop out, there not being anything to hold them *in situ*, as there is when celloidin is used. We have, however, hardened and stained epithelioma of the cervix by this method without the slightest difficulty.

*The slight modification of Method I, recently suggested by L. Pick, Centralblatt f. Gyn., Bd. XX, S. 1016, 1896, I cannot recommend. When first experimenting with formalin, among other procedures I tried staining the sections after hardening in the formalin and before placing them in alcohol, as Pick now suggests. The results were fair, but the definition so obtained was not to be compared with that gained by first passing through 50 per cent. and absolute alcohol for the short period. I accordingly abandoned it and did not think it worthy of publication.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of December 7, 1896.

DR. THAYER in the Chair.

Typhoid Perforation treated by Surgical Operation.—DR. FINNEY.

In 1762 Richter, in Vienna, first suggested the advisability of opening and draining the peritoneal cavity in cases of general suppurative peritonitis. The operation did not come to general notice, however, until 1884, and was not applied to cases of suspected perforation of the intestine in typhoid fever until 1887. Since that date 46 cases have been reported, to which may be added 6 unpublished cases, including 3 of Dr. Finney's, making a total of 52.

According to statistics taken from various sources, perforation of the intestine occurs in from 1 per cent. to 2 per cent. of all typhoid fever cases. In 80 per cent. of the cases it occurs in a thickened and inflamed Peyer's patch of the ileum, from 2 cm. to 1 m. above the ileo-cæcal valve. In over 12 per cent. it occurs in the large intestine, and in 5 per cent. in the appendix vermiformis. There is usually but one perforation. In twelve cases, however, multiple inflamed Peyer's patches were observed. It occurs more often in men than in women; more frequently between the ages of 20 and 30 years, and usually during the third week of the disease. The duration of life is usually short. In typhoid fever, perforation is always followed by suppurative peritonitis, either general or local; however, peritonitis may arise during the fever without any discoverable perforation. It occurs much more frequently in mild than in severe forms, and the symptoms may be severe, mild, or wanting. The most constant and characteristic symptom is sudden, severe abdominal pain, persisting with increasing intensity; there may be collapse, nausea and vomiting. A few of the cases have shown chill, hiccough, a marked fall of temperature, and absence of the liver dulness. Owing to the great difficulties of diagnosis it is impossible to get data as to the number of recoveries without operation.

A study of the reports of the operations brings out the following facts. The time between the onset of the symptoms of perforation and the operation varied between 2 and 12 hours. The condition of the patients at the time of operation was usually markedly unfavorable. Ether and chloroform were used about equally; in one case both were used. The median incision was the most common. Thirty-three of the cases showed marked general septic peritonitis with foul pus and exudate. Fæcal matter was usually present, and the mesenteric glands opposite the ulcerated Peyer's patches were, as a rule, enlarged and softened. In the treatment, irrigation of the peritoneal cavity was employed more often than simply wiping. As regards the perforation itself, in 8 cases the edges were incised before suturing; in 2 a wedge-shaped piece of the bowel was removed, and in 1 the edges of the bowel were stitched to the abdominal wound while an artificial anus was established. Including all of the 52 cases, there have been 17 recoveries; but if doubtful cases are excluded, the result is 13 recoveries from 47 cases, making a percentage of 27.65. In 19 of the fatal cases autopsies were obtained.

These data are hardly sufficient for general conclusions, but several points are brought out quite prominently in studying the group as a whole. The best time for operation is apparently as soon as possible after the patient has recovered from the shock attending the perforation. This is usually in a few hours. There is a remarkable uniformity in the condition of the peritoneum and viscera; intense congestion, much feculent pus and exudate, with distension of the bowel. As the ileum is the usual place of perforation, it should be examined first; a suture should be taken over any suspicious-looking patches, and the appendix should be removed if it be at all abnormal. If the inflammation does not involve the whole peritoneal surface, irrigation with the necessarily mild fluids might tend to spread the infection. In dealing with the perforation, to excise the edges takes too long, and healing usually takes place without. Should the wall be in such a condition as to make suture impossible, it would be better to pull out the loop of intestine and leave it until the patient had recovered from his fever. The line of suture must be determined by circumstances; the mattress suture of Halsted is to be preferred. Drainage should always be employed. The fact that in 8 cases a wrong diagnosis was made shows how little dependence can be placed on the so-called characteristic symptoms. However, the systematic examination of the blood promises to be of the greatest assistance. During typhoid fever there is no leucocytosis, but immediately after a perforation a marked increase in the number of white corpuscles occurs. Cabot mentions a case of 8,300 before and 24,000 after; in Porter's case the figures are 6,500 and 10,600; in his (Dr. Finney's), 3,000 and 16,400.

Fitz has pointed out the striking similarity of the symptoms of typhoid perforation to those of inflammation of the appendix. Dieulafoy recognizes two forms of typhoid appendicitis capable of producing peritonitis; one, "peritonitis by propagation," involving the lymphoid tissue of the appendix, the other, "para-appendicitis," which is of the usual variety.

The symptoms of peritonitis quickly follow perforation. Examination shows that pyogenic cocci, especially the streptococcus pyogenes, are rarely absent, indicating that they are common inhabitants of the intestine. The Johns Hopkins Hospital autopsy reports show in 4 cases a mixed infection of streptococcus pyogenes and bacillus coli communis, in one a pure culture of the streptococcus, and in one a pure culture of the colon bacillus. The absence of the bacillus of Eberth and Gaffky is probably due to its being destroyed by its more active companions, streptococcus pyogenes and bacillus coli communis. In Dr. Finney's third case pure colon bacillus was found; in other cases the typhoid bacilli were present in liver or spleen or in a peritoneal abscess.

As regards the incision, the median has obvious advantages in general, but if the abdominal muscles are too rigid, it is better made over the part most often affected. Its length should always be amply sufficient. On the other hand, the

time consumed in operation should be as short as possible. The autopsies showed that healing was always well under way. Death usually occurred from septic absorption, but the records show some other complications, obstruction of the intestine, a second perforation, defective drainage or an abscess. General peritonitis makes a case very serious, but with operation the chances are about 1 in 4. The treatment of a case of perforating typhoid ulcer involves three things: (1) Finding and closing the perforation; (2) emptying and cleansing the peritoneal cavity; (3) the establishment and maintenance of effective drainage.

For these ends the following method, employed in his (Dr. Finney's) third case, has proved the most satisfactory. An oblique incision, about 6 inches, is made in the right iliac fossa. The cæcum is found as a guide to the ileum (or appendix); the coils of small intestine, beginning with the ileum, are pulled out systematically. One assistant wipes vigorously and thoroughly the coils with a gauze sponge wrung out of hot salt solution as they are withdrawn, while another keeps them covered with warm sterile gauze. If necessary the entire small intestine is pulled out through the wound and laid to one side, covered with warm gauze. The peritoneal cavity is then wiped out thoroughly, and the coils uncovered and irrigated outside the abdomen with hot salt solution. They are then replaced in the abdomen. The worst or sutured coil is placed with its suture next the abdominal wound, and is packed about with strips of bismuth gauze to insure good drainage. The abdominal wound is closed tightly except a small opening for the gauze drain. In case of distension the bowels should be moved early and thoroughly by calomel in broken doses, followed by salts, and if necessary, a high turpentine and soapsuds enema. If stimulation is necessary, use hypodermics of strychnia, enemata of hot black coffee, or transfusion of a quart or more of the normal salt solution into the cellular tissues under the breast.

Finally, in summing up the experience of himself and others, he concludes that (1) of all the so-called diagnostic signs of perforating typhoid ulcer, most reliance is to be placed upon the development during the third or fourth week of an attack of typhoid fever, of severe, continued abdominal pain, coupled with nausea and vomiting, and at the same time a marked increase in the number of white blood corpuscles.

(2) The surgical is the only rational treatment of perforating typhoid ulcer.

(3) There is no contraindication to the operation, surgically speaking, save a moribund condition of the patient.*

Case I.—Mr. M., aged about fifty-five years, was taken sick about October 15, 1894, complaining of headache, general malaise, pains in limbs and joints, together with irritability of the bladder. Was seen on October 19 by his physician, Dr. Wesley C. Stick, of Glenville, Pa., to whom I am indebted for the notes of the case. "He gave an indefinite history of having felt badly for about ten days. He had at this time a temperature of 102° F., frequent micturition, bowels constipated, pulse 100. Patient up and dressed; was put to bed and bowels opened by enemata. In a few days temperature came down to about 100° F., pulse to 90. Would not stay in bed. Irritation of bladder ceased. Was getting along very nicely until the night of October 26th, when he was suddenly seized with a violent pain in his abdomen while lying in bed. Was seen the next morning. Pain in abdomen very severe, relieved somewhat by emptying the over-distended bladder through a catheter. He had been unable to void urine during the night, although having frequent and urgent desire to do so. Several hypodermics of morphine were necessary, however, before he became easy. An enema was given with little result. His abdomen was moderately distended, and not very tender to the touch. In the evening of the same day he was seen again and found to have considerable pain, which was relieved by a hypodermic. Had vomited some during the day. His pulse was about 90; temperature 99° to 100° F. The following day, October 28, he vomited frequently a coffee-ground-looking fluid. On the fourth day, October 29, his condition remained about the same; he could get in and out of bed by himself (he was a large-framed, heavy man, weighing about 225 pounds); pulse regular and not above 90; cheerful; the constant regurgitation of coffee-ground fluid being the most troublesome symptom. On the next day, October 30, he was able to sit up in bed, but his pulse had risen to 100 and his temperature to 100° F. Abdomen still not much distended nor very tender."

I saw him at eleven o'clock the night of October 30; his condition then was fairly good, temperature and pulse about 100. Abdomen not much distended, rather retracted; muscles, especially the recti, very rigid; tenderness general, but not marked; frequent and copious vomiting of a dark brownish fluid; countenance pallid and anxious. The diagnosis was general peritonitis, cause unknown, probably appendicitis, although Dr. Stick had from the first suspected typhoid fever with a subsequent perforation of the intestine. The patient had been exposed to typhoid contagion during a recent visit.

As his condition was evidently becoming worse, it was thought best to open the abdomen. The operation was accordingly performed, and under most disadvantageous conditions, about midnight, in a small log house, with very poor light. On opening the peritoneum it was found to be everywhere intensely congested, of a dark chocolate color; the coils of intestine distended and covered here and there with flakes of exudate. There was a considerable quantity of turbid feculent fluid everywhere in the abdomen. A perforation was found in the ileum, about six inches from the cæcum, about one and a half centimetres in diameter, with sloughy edges. These were turned in and sutured with Halsted's mattress suture. The peritoneal cavity was cleansed as thoroughly as possible by sponging, the sutured coil irrigated with salt solution and replaced. The appendix was found normal, save the inflammation of its serous covering. The abdominal cavity was thoroughly drained with strips of iodoform gauze, the ends of which were brought out through the wound. The operation took about one hour. His condition at the end was somewhat collapsed, but he rallied under stimulation, administered hypodermically and by rectum. He began to fail, however, and died about seven hours after the operation. No autopsy.

Case II.—J. P. D., aged twenty-six years; single; American; tailor; entered the Medical Ward of Johns Hopkins Hospital, August 3, 1895. Family history is negative, except that his father died of some intestinal trouble, the nature of which was unknown, and one brother died, a year ago, of typhoid fever.

Has had diseases of childhood and several attacks of chills and

* Since the above was written one other case has been reported by Armstrong, of Montreal (Montreal Med. Journal, Vol. XXV, No. 8, 1897). This case recovered from an operation for the relief of first perforation. Twenty-four days later, however, a second, and four days later a third perforation occurred, from the effects of which the patient finally succumbed. Reference is also made to the fact that two other fatal cases had occurred in that vicinity.

fever at varying intervals. With these exceptions has been well. Smokes much, does not drink, denies venereal contagion. Present illness began six days before entrance, with severe frontal headaches and a slight chill followed by fever. These symptoms have persisted, together with anorexia; no nose-bleed. For past two days, diarrhœa; has vomited twice; slight abdominal pain, especially before micturition. Temperature on admission, 103.8° F.; pulse, 92. Blood examination negative as to malarial organism; abdomen generally tender, slightly distended; no rose spots; spleen palpable. Leucocytes 3000 per cubic millimetre.

The patient's disease ran a more or less typical severe typhoid course, up to August 16, a. m., thirteen days after entering the hospital, when the following note appeared in the medical history: "Last night patient began to complain of a sharp pain at base of penis, not relieved by catheterization. Temperature has been rather higher, reaching 105° F., pulse 108, regular, though soft and dicrotic. Very nervous; abdomen very tense, though not greatly distended. Everywhere tympanitic; complains of pain; tenderness marked; tongue coated; sweating profusely, and frequently cries out with pain; baths discontinued and cold sponging substituted." P. M. "Patient has been comparatively quiet since a. m., but at about 4 p. m. began to cry out and complain of intense pain in abdomen. Morphine administered hypodermically. Leucocytes, 16,400 per cubic millimetre."

The patient was seen by me with Dr. Thayer at 9.30 p. m., and operation decided upon.

Operation.—Median incision. Peritoneal cavity filled with cloudy, sero-purulent fluid. Peritoneum dark red and much congested. Coils of intestine distended and covered here and there by flakes of lymph. A single perforation, about one centimetre in diameter, was found in the ileum, about sixteen centimetres from ileo-cæcal valve. It was situated, apparently, in the centre of a thickened Peyer's patch, and had sharply punched-out edges. Numbers of raised, red areas could be seen here and there along the lower few feet of the ileum. The loop containing the perforation was drawn out of the abdomen, carefully cleaned of the exuded lymph and fæcal matter, and the rent closed transversely with eight fine, black-silk mattress sutures (Halsted's). Owing to the rigidity of the abdominal walls and the distension of the bowels, puncture of the intestine in several places was necessary, in order to allow of the escape of gas. The loops of intestine were carefully cleansed by irrigation with hot salt solution, and the entire peritoneal cavity thoroughly wiped out with dry gauze. Iodoform gauze was used for drainage, and the abdominal wound closed except where the gauze drainage was brought out.

At end of operation, which lasted a little over an hour, the patient was somewhat collapsed; temperature 103.3° F.; pulse, 150; respiration, 56. He recovered from this somewhat, under vigorous stimulation, and in four hours his temperature was 101.6° F.; pulse, 130; and respiration, 28. His condition did not change materially, except that he became gradually weaker, and died twenty-six hours after the operation. I regret to say that no bacteriological examination was made, and no autopsy allowed.

Case III.—Charles H., German, aged forty-seven years; married; laborer; admitted to Johns Hopkins Hospital, August 15, 1896. Family history good; no cancer or tuberculosis. Has had the usual diseases of childhood, since which time has been strong and well, except an attack of malaria with chills and fevers eight years ago. This attack lasted four weeks. Denies venereal disease; smokes and drinks in moderation. One week before was taken ill with a headache, general malaise, and loss of appetite, and later in the day had a distinct chill, followed by fever. Next day felt somewhat better, but was weak and unable to work. He kept in bed until his admission to the hospital one week later. During this time had had several chills and more or less fever, appetite fairly good, but had eaten nothing but liquids and soft solids. He had no epistaxis nor vomiting; no pain, no diarrhœa, bowels had been regular. At about 8 o'clock on the evening before admission (August 14), while at stool, he was seized with sharp, stabbing pains in right side of abdomen, with marked tenderness to the touch. Nausea and vomiting were present. His physician was called in and gave him morphine hypodermically, which relieved the pain. He passed a fairly comfortable night and was brought to the hospital early the next a. m., when the following condition was noted:

Face pallid and expression anxious; tongue coated, margin and tip clean and red. Temperature, 101° F.; pulse, 116, regular and of good volume. Lungs and heart negative; abdomen is uniformly distended, no undue prominence in any region noted; skin normal; tympanitic throughout; rigidity of abdominal muscles throughout, especially of the right rectus in its lower part. In iliac region indistinct tumefaction felt; tenderness general, but more marked over right lower quadrant. Rectal examination negative; no eruption on skin; urine showed nothing abnormal.

A diagnosis of beginning general peritonitis, probably due to appendicitis, was made. I confess, at the time, the possibility of perforating typhoid ulcer did not occur to me.

Immediate operation advised and agreed to. After the usual preliminary preparation the abdomen was opened through an incision along outer border of right rectus. Abdominal wall distinctly œdematous. The peritoneum was everywhere intensely congested, roughened and dull, with flakes of plastic lymph. In the pockets between coils of intestine and extending down into the pelvis there was an accumulation of thin, yellowish, turbid fluid, containing flakes of exudate. There was no marked fæcal odor to this fluid. The intestines were distended, congested, and dark colored. In passing towards the median line and hypogastric region the congestion and peritonitis became less marked, and in the upper left quadrant the peritoneum seemed fairly normal. At no place was there the slightest attempt apparent at walling off the inflammatory process. The appendix was found in its normal position, somewhat thickened and congested, and constricted at about its centre, due to old adhesions. It was ligated, excised, and stump covered with peritoneal cuff. About fourteen inches from ileo-cæcal valve, in the ileum on its free border, a small hole, about four millimetres in diameter, was found. It was sharply defined, edges bright red and thickened. It was in the middle of what appeared to be a swollen and enlarged Peyer's patch. Soft yellow fæcal matter was exuding from the opening. Opposite the ulcer was a mesenteric gland enlarged to the size of an olive, soft and of a bright red color. The loop of ileum was brought out through the wound and packed about with gauze. The edges of the ulcer were turned in and sutured with eight mattress sutures of fine black silk. The edges of the ulcer were not excised. After suturing, the loop was thoroughly cleansed with salt solution and dry gauze and returned, the peritoneal cavity thoroughly and systematically wiped out with pledgets of dry gauze. Some distance below in the ileum a second swollen Peyer's patch could be made out. Bismuth gauze in strips was packed loosely about the sutured portion, and the ends brought out through the lower end of the incision. The rest of it was closed with buried sutures of silver wire. The wound was dressed with silver foil and sterile gauze. His condition at the end of the operation was good. Time of operation one and a half hours. Pulse, 120, and of good volume; respiration, 20 to 25, regular; color good; no sweating or coldness of extremities. Shortly after operation an enema of several ounces of black coffee and peptonized milk given.

August 16. Patient passed a fairly comfortable night. Pain not so severe as before operation; very little distension; says he feels better. Temperature and pulse still somewhat elevated, 102° F. and 110 respectively. His general condition improved steadily for about a week, when his temperature and pulse began to go up a little. His tongue became more coated, but abdomen not distended nor tender. Spleen not palpable; no rose spots. An offensive discharge

of pus from the right ear indicated an otitis media. About this time a severe pain in the lower part of left thorax developed. Auscultation detected a slight friction rub beginning just below the nipple and running into axillary line.

Blood cultures aspirated from spleen were negative. His temperature and pulse almost reached the normal on August 28, and remained there for a week, when a sharp rise, accompanied by a chill, occurred. His second relapse was quite a severe and prolonged one, so much so that he was transferred to Dr. Osler's ward, where he could be given the cold-bath treatment more conveniently. On September 14 the following note was made by Dr. Osler: "Tongue a little dry; temperature has been continuously elevated since September 5. Between 6th and 9th not above 100° F. Since 9th above 101° F. On the 12th and 13th, 104°, and on 14th, 105° F.; pulse, 128. Complains of pain in abdomen, which is flat and natural looking. Respiratory movements well marked; no tension; everywhere soft. Pain referred to hypogastric region and about navel. Edge of spleen not palpable." During the ten days, from September 17 to 27, his temperature ranged about 103° F., occasionally going above 104° F. He was given thirty-eight tub-baths during this period. It reached the normal on October 6, and remained there.

During this time he developed great tenderness in the toes of both feet, and extending up the front of right leg to the knee was some redness and stiffness. This gradually subsided. Several small furuncles on buttocks and sacrum appeared, which were opened. On October 23 he was well enough to be up for the first time. Improved steadily up to November 2, when a phlebitis of right femoral vein with pain and swelling of leg developed. This gradually subsided, and he eventually made a perfect recovery.

Cultures taken at the time of operation from the peritoneal cavity and edges of ulcer showed pure culture of bacillus coli communis.

Dr. OSLER.—It may interest you to know of the number of cases of perforation in our series. Since the hospital opened we have had about 530 cases (I have not the exact figures for this year) of typhoid fever, with 48 deaths, of which 16 occurred from perforation. The percentage of death from this cause is unusually high, for I think Dr. Finney mentioned it was the cause of death only in about six per cent. of the fatal cases.

That two of Dr. Finney's cases were supposed to be appendicitis is a point of great interest. It is not the first nor will it be the last time that this mistake has been made. There are instances in which patients with typhoid fever without perforation have been operated upon for appendicitis with a fever of five or six days' duration and a swelling in the right iliac fossa. Patient has been admitted to the hospital, operated upon for appendicitis, no perforation found, but an enlarged ileum and swollen mesenteric glands. It is to be borne in mind, however, how frequent is perforation of the appendix among cases of perforation in typhoid. We have had at least four or five in our cases. There have been two cases of recovery in which symptoms of appendicitis in typhoid seemed very clear.

One word as to the time of the operation. This case was unusually favorable inasmuch as it was seen early and the perforation occurred before the 8th day, which is, perhaps, as soon as ever it occurs in typhoid fever. I think the very early and the very late cases will probably be the most favorable for operation. The statistics that Dr. Finney gives are certainly most encouraging.

NOTES ON NEW BOOKS.

Transactions of the American Pediatric Society, held at Virginia Hot Springs, May 27, 28, 29, 1895. Edited by FLOYD M. CRANDALL. (Philadelphia, 1896. Reprinted from the Archives of Pediatrics.)

The meetings of this society are characterized by the practical papers presented and the general discussion of them by the members present.

The present report of its seventh session contains a number of articles relative to the more important diseases of infancy and childhood, with discussion of many of the newer remedies. The list of contributors includes many of the best-known writers on the subjects mentioned.

The treatment of diphtheria with antitoxin as an immunizing agent, and its toxic effects, are especially dwelt upon. A resolution was finally adopted that in the opinion of the society the evidences thus far produced of the beneficial action of this remedy justify its further and extensive trial.

Several papers on anomalous forms of scarlet fever and eruptions simulating this disease, and one on the use of icthyol ointment for the local treatment of the eruption of scarlet fever, are worthy of special notice.

With regard to the use of the antitoxin of tetanus in tetanus of the newborn, the evidence seems to show that up to this time it is uncertain in its action, and that chloral hydrate with one of the bromides is to be preferred.

The antitoxin of erysipelas seems to have had no influence in treatment of sarcoma of the kidney, but the author of the paper is inclined to the view that any foreign substance injected into or near the substance of a sarcoma tends to effect a cure, by setting up degenerative changes in the neoplasm, hence the apparent favorable action of erysipelas antitoxin in sarcomata which are external and accessible, and its failure in visceral sarcomata.

There are also papers on purulent otitis media, "inanition" fever in the newly born, the frequency of typhoid fever in children under three or four years, hyperpyrexia, pygopagus, the neuroses of childhood, tetany, symmetrical gangrene following scarlet fever, angina resembling diphtheria with absence of the bacillus, cardiac anomaly, and the association of enormous heart hypertrophy, chronic proliferative peritonitis and recurring ascites with adherent pericardium, in which the view is expressed of the probable progress of the chronic proliferative process along the veins, through the diaphragm, until it involves the peritoneum.

The report is in good type, well edited and arranged.

BOOKS RECEIVED.

A Collection of the Published Writings of William Withey Gull, Bart., M. D., F. R. S. Edited by Theodore Dyke Acland, M. D. Memoir and Addresses. 1896. 8vo. 184 pages. The New Sydenham Society, London.

Proceedings of the American Medico-Psychological Association, at the Fifty-Second Annual Meeting, held in Boston, May 26-29, 1896. 8vo. 332 pages. Published by American Medico-Psychological Association.

Saint Thomas's Hospital Reports. New Series. Edited by Dr. T. D. Acland and Mr. Bernard Pitts. Vol. XXIV. 1897. 8vo. 510+118 pages. J. and A. Churchill, London.

Archives of Clinical Skiagraphy. Edited by Sydney Rowland, B. A. Camb. Vol. I, No. 3, December, 1896. Fol. The Rebman Pub. Co., Limited, London.

Pathological Report Illinois Eastern Hospital for the Insane. 1896. 8vo. 236 pages. The Blakely Printing Co., Chicago.

Twentieth Century Practice. An international encyclopedia of modern medical science by leading authorities of Europe and America. Edited by T. L. Stedman, M. D. Vol. IX. Diseases of the Digestive Organs. 1897. 8vo. 820 pages. William Wood & Co., New York.

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A Case of Blastomycetic Dermatitis in Man; Comparisons of the Two Varieties of Protozoa, and the Blastomyces found in the preceding Cases, with the so-called Parasites found in Various Lesions of the Skin, etc.; Two Cases of Molluscum Fibrosum; The Pathology of a Case of Dermatitis Herpetiformis (Duhring). By T. C. GILCHRIST, M. D.

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BULLETIN

OF

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CONTENTS.

REPORT OF A CASE OF POLYBACTERIAL INFECTION IN TYPHOID FEVER, WITH ESPECIAL REFERENCE TO CERTAIN INVOLUTIONS EXHIBITED BY THE BACILLUS TYPHOSUS.

By Edward Perkins Carter, M. D., *Fellow in Pathology.*

[*From the Pathological Laboratory of the Johns Hopkins University and Hospital.*]

The following case seems worthy of publication in view of the opportunity it afforded to study an unusual variation in morphology of the bacillus typhosus isolated from it, and because of the interesting poly-infection with bacteria which existed at autopsy.

The patient, G. C., was admitted to the Johns Hopkins Hospital on October 11, 1896, complaining of fever, weakness and loss of appetite. He had not been feeling well for three weeks, and had been unable to work for the past seven days.

Family history negative. Personal history negative. For the past four years he had led an active out-of-door life, and had up to the onset of present illness enjoyed "good health."

His illness began with a general feeling of weakness, which increased until on Monday, October 5th, 1896, he was unable to go to work, and complained of fever, loss of appetite and pains in the back and legs. He kept up until October 9th, and on October 11th, 1896, when admitted to the ward, he had a temperature of 102.5°, pulse 100 to the minute, and respirations 20. Examination of the blood at this time and at all subsequent examinations was negative for malarial organisms. Examinations of the thorax and heart were negative. Abdomen was not distended. No tenderness and no gurgling in right iliac fossa. Several suggestive rose spots. Spleen was just palpable. Liver dulness normal. The diagnosis of typhoid fever was made and the patient put upon a strictly typhoid treatment.

I have abstracted the following notes from the history of the case, omitting the treatment as being foreign to our purpose.

October 12th, '96, at 7 a. m. The patient had a large semi-liquid stool, containing some formed particles, and a considerable amount of blood fairly bright red in color. At 8.30 a. m. a second hemorrhage, rather brighter red than preceding. Both considerable in amount. Temperature 103.5°, pulse 102.

October 14th. Patient flushed, looks well. Tongue furred,

not tremulous, pulse good. Two fresh rose spots. Abdomen flat, no distension.

October 16th, 1.40 p. m. Hemorrhage, somewhat thick tarry consistence, with some blood clots. Amount of movement about 400–500 cc. 5.30–6.30 p. m., patient had two movements like preceding, quantity same, about 400–500 cc. Pulse very running and feeble. Temperature at 8 a. m. 101.5°, pulse 124.

October 17th. This a. m. condition is distinctly better. Pulse at visit 29 to the quarter. Abdomen not distended and nowhere tender. 11.30 p. m. the patient had a stool of about 250 cc. in amount, which contained blood dark in color.

October 18th, 10 p. m. A stool, about 200 cc., containing blood, no clots. The patient's condition did not show any material change. Temperature at a. m. 102.8°, pulse 120.

October 25th, 2 p. m. The patient had a large movement, 1000 cc. Total amount of blood estimated 500 cc. Temperature at 8 p. m. 101.5°, pulse 148.

From this time, though he had no subsequent hemorrhages, the patient's condition remained critical until his death.

On October 28th he developed well marked signs of consolidation in the lower left back over a small area, and on November 1st the same signs were found in the lower right back.

November 9th. Breath sounds at left base seem almost clear. Percussion at right base impaired, breath sounds distant. Temperature at 8 a. m. 103°, pulse 124.

November 11th. This a. m. pulse 32 to the quarter. The patient passed a restless night, complaining considerably of pain in the left side. Lying on left side, skin moist. Tongue dry and tremulous. Respirations 13 to the quarter. Profuse sweating. Respiration on left side is enfeebled. Back not examined.

The patient's general condition gradually grew weaker and he died at 12.30 a. m., November 12th, 1896. The temperature just before death touched 105°; the pulse was 160.

The autopsy was held 34 hours after death, and the body, apart from slight post-mortem gas development, showed no other distinctive signs of decomposition.

Anatomical Diagnosis. Typhoid fever. Small number of healing ulcers in the ileum; little glandular enlargement. Subacute spleen tumor, parenchymatous degeneration of the viscera, abscess of prostate gland, necrosis of the cricoid cartilage, pneumonia, fibrino-serous pleurisy.

Body 170 cm. long, pale, no œdema. Moderate emaciation. Rigor mortis in both extremities. Abdomen greatly distended, tympanitic and greenish in color.

The spleen weighed 210 grams. It was free from adhesions. On section moderately firm, pale grayish red in color. Malpighian bodies not prominent. Several phleboliths of the size of bird-shot in cut surface.

The small intestine was moderately distended, the mucosa opaque, containing soft fæces. No ulceration until within 100 cm. of the valve, where a small, clear, punched-out ulcer 1 cm. in diameter existed. The surrounding mucosa was congested. No more ulcers found for the next 50 cm., where a large group of coalescent clean ulcers with united edges occurred, which were shallow and rapidly skinning over. These measured 3 x 5 cm. in extent, and the individuals composing the group were hardly larger than the above single one. The most important group of ulcers was located a hand's breadth above the valve; these numbered nine (2.5 cm. in diameter), the largest not much exceeding a silver twenty-five cent piece in size. They were perfectly clean and rapidly healing, judging from the manner in which their bases were filled up; and they appeared to be skinning over at the same time from the edges. The cæcum and appendix vermiformis were free from ulceration.

The larynx on the left side shows a small aperture measuring 1 cm. in diameter, which leads into a cavity in relation to the cricoid cartilage. On dissection a cavity the size of the little finger, lined by granulation tissue, is found, and into the cavity the upper and eroded end of the cricoid cartilage projects. The upper surface gives the impression of being calcified; it is eroded and hard. The contents of the cavity are semi-fluid pus of rather dark color.

In the right lobe of the prostate gland there existed a small abscess the size of a hazel-nut, containing creamy pus. The walls of the cavity are thin and ill-formed. No communication existed with the bladder.

The mesenteric and retroperitoneal glands were little if at all enlarged.

Bacteriological Examination.

Cover-slip preparations made at the time of the autopsy showed from the *pleura* large numbers of streptococci, which occurred in threads of 6–8 segments, and a few long evenly staining straight bacilli.

From the abscess in *prostate gland* great numbers of small thin straight bacilli, which looked not unlike the bacillus of typhoid fever; also numbers of cocci, appearing chiefly in pairs (diplococci).

From the *heart's blood* a number of long straight bacilli resembling closely those seen in the cover-slips from the pleura; also a few single cocci were seen.

Cultures.

Pleura. The agar-agar plate was studded with minute pin-point, finely granular colonies.

Microscopically these proved to be streptococci, which were identified as the streptococcus pyogenes.

Lung. The plate on the same medium resembled identically that from the pleura and contained the same micro-organism in pure culture.

Larynx. The agar-agar plate showed superficially many round grayish brown pin-head colonies, limited to one-half of surface, the remaining area being overgrown with colonies which exhibited a bluish green color. In the substance of the medium were great numbers of small, finely granular pin-point colonies and smaller numbers of large whetstone and irregularly round colonies. This plate being so crowded, a series of plates was made, and from the third dilution the following micro-organisms were isolated and identified: streptococcus pyogenes, bacillus lactis aerogenes and bacillus pyocyaneus.

Kidney. The agar-agar plate was studded with small

round dark granular colonies, much larger than the usual streptococcus colonies. In the substance of the medium there were also a number of whetstone and irregularly round colonies, and on the surface two grayish white spreading colonies and five slightly smaller grayish white more translucent ones. The small granular colonies were composed of the streptococcus pyogenes. From the other colonies two bacilli were isolated and identified as the bacillus coli communis and the bacillus typhosus. (See notes below.)

Liver. The agar-agar plate presented practically the same appearance as that from the kidney, and the same microorganisms were isolated from it.

Heart. The agar-agar plate showed two sets of colonies. The substance of the medium was studded with small finely granular colonies, and here and there a few scattered grayish white whetstone forms occurred, while on the surface there were a number of grayish white, small, fairly round and slightly elevated forms. From the small granular colonies the streptococcus pyogenes was isolated, and from the whetstone colonies in the depth and the round colonies on the surface of the medium a bacillus was isolated which was identified as the bacillus typhosus.

Mesenteric gland. The agar-agar plate showed two superficial, spreading, grayish white irregular colonies, and numbers of whetstone colonies in the substance of the medium. From the plate two bacilli were isolated and identified as the bacillus coli communis and the bacillus typhosus.

Abscess in the prostate gland. The agar-agar plate was studded with small finely granular colonies, and in addition showed a few scattered whetstone colonies in the substance, and several small, reddish brown, irregular, spreading forms on the surface of the medium. From the finely granular colonies the streptococcus pyogenes was isolated. From the superficial colonies a bacillus was isolated which was identified as the proteus vulgaris.

Spleen. The agar-agar plate from the spleen remained sterile after 48 hours in the thermostat.

The bacillus which is, however, of greatest interest in this case is that which was isolated from the heart, liver, kidney, mesenteric gland, and by Mr. Potter from the bile by means of Elsner's method, and which, though it shows great variation upon certain media, must, we think, be considered the true bacillus of Eberth.

Culturally and morphologically this bacillus was proven identical, from all of the above given sources, and our study of it has therefore been made with the cultures obtained from the kidney and bile. At the same time there was carried along with these for control a culture of an established typhoid bacillus. The bacillus isolated from the case under consideration, taken from a 24-hour growth upon agar-agar, is of medium size, straight and thin, with slightly rounded ends, taking the stain deeply and uniformly. It stains with all the ordinary aniline dyes, though most satisfactorily with gentian violet.

The Elsner plates made by Mr. Potter directly from the bile gave what has been and is considered the typical reaction for a mixture of typhoid and colon colonies. The colon colonies were larger, more coarsely granular and more numerous than the small, very pale, transparent and faintly granular colonies from which the typhoid bacillus was isolated in pure culture.

Upon agar-agar plates the colonies of the bacillus under study are small, grayish white in color, slightly elevated and irregularly round upon the surface of the medium, while in its substance they presented the common small whetstone or irregularly round outline. By transmitted light under low power they are of a reddish brown color and faintly granular structure. Upon gelatine plates the colonies are, after 24 hours, small, very finely granular, irregular in outline, and tend to increase in size very slightly during the second 48 hours, thus appearing as typical typhoid colonies.

Agar slant. The growth upon a moderately dry agar tube was, after 24 hours, of a slight, narrow, rail-like character along the track of the needle, being slightly elevated and of a grayish white color. On the moist agar slant it grows somewhat more profusely, covering the surface of the medium more irregularly. This was equally true of the control typhoid culture.

Bouillon at the end of 24 hours is clouded and somewhat opaque. The reaction for indol was negative. In order to establish the certainty of the negative indol reaction beyond a doubt, a culture in bouillon, together with a culture of the control typhoid, and an uninoculated tube of bouillon were placed in the thermostat for three days and then tested for indol, adding at the same time the H_2SO_4 and $NaNO_2$ to the uninoculated tube of bouillon and watching these three carefully for a few hours, and then replacing them in the thermostat over night. When examined the following day all three tubes presented the same appearance, and it could not be said that a true indol reaction was obtained. The test for indol was made again and again without obtaining a positive reaction.

Litmus milk after 24 hours was only faintly acidulated, and reached apparently its greatest degree of acidulation, which is very slight, on the third day. At the end of a month there was no increase of acidulation, as evidenced by the pale pink color which remained quite as noted on the third day following inoculation. Coagulation of the milk did not ensue.

Upon potato the growth bears an extremely close resemblance to the control typhoid. It shows at the same time under the microscope the most remarkable involution forms, which begin to appear upon the third day after inoculation.

If the potato is strongly acid the growth after 24 hours is just visible as a delicate white membrane over the surface of the potato extending from the track of the needle. The macroscopic appearance of the growth remains unaltered, being only just visible after thirty days, while the potato remained undiscolored.

Upon a neutral potato, on the other hand, the growth after 24 hours appears as a slightly yellowish white line along the track of the needle, spreading out somewhat at the base of the potato, being plainly visible and much more luxuriant than is ordinarily true of the bacillus of typhoid fever. After five days the potato itself becomes a very little discolored, while the growth remains unaltered after the third day. At the end of three weeks no further change was noted.

Under the microscope this bacillus shows the greatest variation in morphology, and apparently without relation to the reaction of the potato. After the third day involution forms appear, first as long rods with unstained bulbous ends, and these are quickly followed by the most extraordinary forms, such as long threads, irregular rods with unstained poles closely resembling spores, and shorter oval forms, a picture unlike anything one finds in cultures of the true bacillus typhosus.

Glucose agar. In a deep stab this organism again agrees well with the control typhoid. After 24 hours there is a delicate, small, nail-head growth upon the surface of the medium, while along the line of puncture the growth extends downwards for one-half the distance. This appearance remains in general the same, the growth increasing very gradually until at the end of thirty days there is only a more irregular nail-head appearance upon the surface with a slight growth along the line of the needle stab, thus bearing a striking similarity to the control culture. At no time was there gas formation. Here again under the microscope the cover-glasses made after the third day show the same remarkable involution forms seen in the growth upon the potato.

In a gelatine stab there is a slight nail-head growth on the surface of the medium after 24 hours, extending along the course of the needle for a short distance as a delicate linear growth, and giving identically the same picture as that seen in the control. Liquefaction of 5 per cent. or 10 per cent. gelatine does not occur, and the growth increases very slowly, showing after three weeks a surface growth of the size of the head of a small tack. Microscopically, after the fifth day, we find involution forms in the shape of straight and slightly curved threads, longer by at least twelve times than the bacillus as it appears after 24 hours. The very unusual forms seen in the growth upon potato and sugar agar are not present.

Motility. Hanging drops made from an agar-agar culture of any age always showed great numbers of the bacilli in the field in active motion, but the greatest motility was seen when examined from agar-agar slants of from eight to ten hours' growth; at this age all the bacilli in the field appeared to be in active motion.

It decolorizes by Gram's stain.

Fermentation tubes of glucose, lactose and saccharose bouillon failed to show any development of gas after eighteen days in the thermostat.

The thermal death-point of this bacillus as established by means of Sternberg's bulbs is between 53° and 55° C. at an exposure of ten minutes.

By means of Pittfield's stain the presence of flagella can be demonstrated extending around the entire organism.

Widal's test. Upon adding from $\frac{1}{2}$ to $\frac{1}{12}$ the volume of blood serum obtained from a case of typhoid fever to a 24-hours-old bouillon culture of this organism, a control typhoid bacillus culture and a culture of the bacillus coli communis according to the method of Widal, the following results were obtained:

The control culture and the culture of the organism under study gave characteristic precipitates in the same time, while that of the bacillus coli communis remained unaffected.

A number of tests for agglutination were made by the Wyatt Johnston method, using blood of known activity. The control typhoid bacillus gave immediate clumping, and the organism under study showed a similar reaction in from twenty minutes to one hour.

It is interesting to note that cultures made from potato, sugar agar and gelatine, which showed the involution forms in great numbers, always grew upon re-transplantation as the normal-sized, straight bacilli which were originally met with.

Upon plain agar-agar in bouillon and in milk the growth varied but slightly from what seemed to be the normal.

Animal Experiments.

A mouse inoculated subcutaneously with two loops from a 24-hour agar growth died in less than 48 hours.

The autopsy showed no excess of fluid in the abdominal cavity and no focal visceral lesions. The lymphatic glands were nowhere enlarged. The spleen, liver and kidneys appeared normal. At the seat of inoculation the skin was bound down by quite firm fibrinous adhesions. In the cover-slips from the seat of inoculation great numbers of bacteria were seen. Cover-slips from heart and spleen were negative. Cultures from heart and spleen remained sterile after 48 hours.

A guinea-pig inoculated with 1 cc. of a 24-hours bouillon culture intraperitoneally died after thirty days. The autopsy showed the lymphatic glands somewhat swollen and injected. No excess of fluid in abdominal cavity. Peritoneum perhaps reddened and vessels somewhat congested, but no peritonitis present. Liver, spleen and kidneys appeared normal. Cover-slips from peritoneum and from all the organs negative. Cultures from same sources remained sterile.

A rabbit inoculated with 1 cc. of a 24-hours bouillon culture intravenously was still alive after two months.

We have then a bacillus which agrees culturally with the typhoid organism, which reacts to all the known tests for the true bacillus of typhoid fever, and yet which, after the third day, upon certain media, potato, sugar agar, and gelatine, shows very unusual involution forms; forms so remarkable that were it not for the evidence given by the fulfilment of every test, it would seem impossible to consider this the true bacillus of Eberth.

During the past few years a number of bacilli, found under conditions which would seem to exclude the presence of the true bacillus of typhoid fever, have been isolated and studied by Lösener,* Babes,† Fülles‡ and Cassedebat.§ These bacilli resembled the true typhoid organism so closely in cultural and morphological properties, with the exception of a slight variation in the organisms reported by Cassedebat and by Babes, that it has thus far been very difficult, if not impossible, to distinguish between them and the bacillus typhosus.

* Lösener, Arbeiten aus dem Kaiserl. Gesundheitsamte, XI.

† Babes, Variabilität und Varietäten des Typhus-bacillus. Zeitschrift für Hygiene, IX, 1890, p. 323.

‡ Fülles, Bacteriologische Untersuchung des Bodens in der Umgebung von Freiburg i. B. Zeitschrift für Hygiene, X, 1890, p. 225.

§ Cassedebat, Sur un bacille pseudo-typhique trouve dans les eaux de rivière. Compt. rend. de l'Académie de Paris, CX, No. 15, 1890, p. 798.

Fig. I.

Fig. II.

Fig. III.

Fig. IV.

the Fr[illegible] Co., Engravers and Printers.

These forms have therefore been designated pseudo-typhoid bacilli.

In addition to the irregular forms described by Babes as seen in growths upon agar-agar, and those in the bacillus studied by Cassedebat, Chantemesse and Widal* have noted certain variations from the normal which appeared as longer thread-like forms upon gelatine, and as straight rods containing irregular vacuoles and unstained poles upon potato. Vilchur† further, in a study made of some 200 cultures from the organs of four typhoid patients, describes variations in form, particularly on old gelatine cultures and upon potato. These occurred as vacuoles which after 72 hours took the stain and then more intensely than the rest of the organism. Aside from these irregular forms I have been unable to find in the literature any reference to such involution forms as are noted in this case.

The growth upon agar-agar in bouillon and in milk showed no variation from the normal, the irregular forms being seen only upon potato, sugar agar and gelatine, as noted above.

*Chantemesse et Widal, Recherches sur le bacille typhique et l'etiologie de la fièvre typhoïde. Archives de Physiologie, I, 1887.

†Vilchur, Cultivation of Typhoid Bacillus from Organs and Evacuations of Typhoid Patients. Vrach, St. Petersburg, 1886, VII, pp. 456–458. Ref. Lancet, London, 1886, II, p. 137.

The control culture used in the study of this case did not at any time show such involution forms as the bacillus under consideration, while culturally the two organisms appeared identical.

It seems therefore unavoidable to consider that this bacillus, which was found in a patient dead of typhoid fever, being isolated from five different sources, and reacting to every test in the manner of the true bacillus of typhoid fever, is, in spite of the peculiar involutions it undergoes, no other than the bacillus typhosus.

In conclusion I wish to express my appreciation to Dr. Simon Flexner for his kindness and interest in the study of this case, and also to Dr. Gray of the Army Medical Museum, Washington, for his kindness in taking the photographs which illustrate this report.

DESCRIPTION OF PLATE.

Figs. I and II. Bacillus typhosus obtained from this case as it appears after a growth of 24 hours upon agar-agar. Zeiss II mm. apochromatic objective, No. IV projection ocular. Gentian violet staining.

Figs. III and IV. The same organism as it appears after a growth of two weeks upon glucose agar-agar. Same magnification. Gentian violet staining.

A CASE OF TYPHOID FEVER IN WHICH THE TYPHOID BACILLUS WAS OBTAINED TWICE FROM THE BLOOD DURING LIFE.

BY E. BATES BLOCK, M. D., *Assistant Resident Physician, The Johns Hopkins Hospital.*

Evidence is strongly in favor of the fact that, at some period of the disease, the typhoid bacillus is present in the blood in nearly all patients suffering from typhoid fever, gaining entrance from time to time at the site of the intestinal lesions. It is the rule for the typhoid bacillus to be cultivated from the internal organs (spleen, mesenteric glands, etc.) after death, and sections of these organs usually show bacilli which resemble the bacillus typhosus, in clumps or masses in the capillary vessels. The early experiments of Wyssokowitsch* show that these organs are principally concerned in removing from the blood introduced bacteria. It was shown by Welch and Nuttall† in 1891 that human blood serum is capable of destroying many typhoid bacilli, and later by other observers that the blood serum from typhoid patients also possesses this power, so that the peculiar conditions which allow these organisms to live in the capillary vessels of the organs cannot, at least in the majority of cases, depend upon a simple loss of this power of the blood serum. That the invasion of the blood or organs by other micro-organisms, more particularly the streptococcus pyogenes, modifies the relation of the patient to the typhoid bacillus, has been clearly shown by Vincent‡ in experiments upon animals and by cultures made at autopsy in human cases. In six out of 31 such autopsies he found the streptococcus associated with the typhoid bacillus. In one case a typhoid patient whose temperature had become normal developed a streptococcus angina, the temperature rose and on the fourth day the patient died. At autopsy the typhoid bacillus and streptococcus were obtained from the organs and the latter from the blood. The streptococcus pyogenes has also been found in association with typhoid bacillus post mortem by Flexner* in 5 out of 6 cases reported, by Wright and Stokes† in 2 out of 9 autopsies, by Klein‡ in the blood, once in association with B. typhosus, by Netter, E. Fraenkel, and others. Karlinski§ has found streptococci in the pulmonary complications of typhoid fever in six out of nine cases, some of them being associated with the typhoid bacillus in the lungs. A similar case is reported by Flexner (*op. cit.*) In forty-one abscesses in typhoid cases examined by Vincent (*op. cit.*) the staph. pyogenes aureus was present thirty-two times, all of these patients recovering. In eight cases streptococcus alone or associated with the bacillus typhosus was met with, and of these, five died. Assuming that in these instances the typhoid bacillus was increased in virulence, it may be said that

*Zeitschrift für Hygiene, 1886.

†Verbal communication.

‡Annales de l'Inst. Pasteur, 1883.

*Johns Hopkins Hospital Reports, Vol. V.

†Boston Med. and Surg. Jour., March–April, 1895.

‡Baumgarten's Jahresb., 1894, Vol. 10.

§See Vincent, *op. cit.*

a similar modification of the physiological characters of the typhoid bacillus infection is produced (Sanarelli*) by inoculating cultures together with the soluble products of the bacillus coli communis and the bacillus proteus.

The clinical history of this case presents points of interest in connection with the bacteriological investigations both before and after death.

M. Z., female, age 30, born in Poland, was admitted to Professor Osler's wards on Saturday the 4th of July, 1896. She could not speak English, so no history could be obtained. Upon admission she was restless, listless, weak, and gave evidence of shortness of breath and abdominal pain, frequently passing her hand over the abdomen. Soon after admission she became delirious. The examination of the thorax was negative. The abdomen was tender upon pressure, and resistant, especially in the splenic area. The pharynx was somewhat reddened and its vessels were injected.

On the 5th of July Dr. Thayer made the following note: Respirations 44 to the minute, pulse 104; patient looks dull and a little confused; the tongue has a thick pasty coat; the lungs are clear on auscultation and percussion; the heart sounds are feeble but clear; the abdomen is full, generally tympanitic, does not seem tender—it is held very tense so that palpation of the spleen is impossible. A number of small spots are seen on the abdomen, some of them apparently ecchymotic, others not unlike rose spots. There is slight cyanosis of the face and lips, which in connection with the rapidity of respiration suggests some pulmonary affection. The patient has had one liquid stool.

On the 8th of July Dr. Thayer noted further: The general condition of the patient is about the same; she is still dull, drowsy, delirious, and quite irresponsive when questioned. There is marked muscular resistance in the splenic region, and pressure here causes the patient to wince. There are no definite rose spots to-day.

The urine did not give the diazo reaction.

The temperature upon admission was 101.2°, respirations 44, and the pulse 120. Three hours later the temperature was 104.6°, and during the fourth, fifth and sixth of July ranged between 101° F. and 104.3° F., the low temperature being due to cold baths, to which she reacted well. From then on the temperature gradually declined and reached normal on the 8th of July. It remained practically normal for about 18 hours. On the following day it rose gradually, the highest point reached being 102.6°.

The respirations during her illness remained rapid and on the 9th of July became more labored, the pulse became more rapid and feeble, and the patient died at 12.45 a. m. on the 10th of July.

On the 5th of July a culture was taken from the stool of the patient, by Elsner's method, with a negative result.

On the 6th of July a hypodermic syringeful of blood was taken from a vein of the forearm with due antiseptic precautions. A few drops were allowed to fall on an agar slant, and the rest of the blood was mixed with melted gelatine and placed in a Buchner jar in the thermostat. The agar slant subsequently showed one colony, while the gelatine tube which contained a greater volume of blood showed about a dozen colonies identical in appearance. Several of these colonies were grown on the usual culture media. They did not coagulate milk, grew characteristically on Elsner's medium; inconspicuous growth on potato with increase of moisture; did not form gas in glucose agar; were actively motile; did not liquefy gelatine, and morphologically resembled the typhoid bacillus.

On the 9th of July a second culture was taken by the same method. The volume of blood obtained was smaller than in the former culture and was allowed to fall on the surface of an agar slant, which 20 hours later showed one colony. Inoculations of other media from this showed the same reactions as in the previous instance. In addition these bacilli did not produce indol; grew anaërobically; did not change the color of Wurtz's medium; gave the agglutinative reaction with over 40 specimens of typhoid blood, and morphologically was identical with the bacillus obtained three days before.

A culture from the throat on the same day did not show diphtheria bacilli; the chief organism found was the streptococcus.

I am indebted to Dr. Flexner for the privilege of making an abstract of the post-mortem examination.

The autopsy was held at 2 p. m. on the 11th of July, 37 hours after death.

Anatomical diagnosis: Typhoid fever; ulceration of small intestine; acute spleen tumor; swelling of the mesenteric glands; parenchymatous degeneration of the viscera; post-mortem invasion of a gas-forming bacillus; œdema of the lungs.

Body cold, has been on ice. No odor of decomposition.

The upper portion of the body shows dark spots and splotches. The face is discolored and swollen. The greatest discoloration is over the back.

Crepitation is present over the face, the neck, the upper portion of the thorax and over the back. The neck is much swollen, thick and discolored.

No œdema and no crepitation of lower extremities.

The abdomen is distended and contains gas which has a somewhat putrefactive odor. The intestines are distended, but not discolored.

The tissues about the kidneys, pancreas, cæcum and the root of the mesentery are emphysematous. The mesenteric and cæcal glands are enlarged, softened and reddened.

The spleen is enlarged and softened, and on section appears dark in color, almost diffluent.

The liver shows many gas bubbles under the capsule, and on section it is found to be penetrated throughout by small gas vesicles, and the blood which escapes from the cut ends of the portal veins is frothy. The organ is pale, homogeneous, and cloudy yellow in color.

Both kidneys are emphysematous, the capsules adherent, the cortex increased, and the striæ coarse.

The duodenum shows many gas cysts. The small intestine shows swollen patches of Peyer; lower down the patches exhibit small erosions. As the valve is approached the enlarge-

* Ann. de l'Inst. Pasteur, 1892.

ment of the patches increases, as does the extent of erosion. Occasionally these patches show hemorrhagic infiltration. At the valve nearly the whole of the intestine is involved in deep ulceration which presents a sloughy and necrotic appearance and is nearly black from imbibition of blood.

The lungs are deep in color, crepitate throughout, and almost sink in water. The cut surface is smooth and dark. The bronchi are dark in color from imbibed blood. The blood in the vessels is frothy. The right side of the heart is enormously distended. On incision there is escape of gas and collapse. The intima of the vessels, and endocardium, are deeply blood stained.

In the right upper angle of the cavity of the uterus is a portion of placenta the size of a walnut, apparently the remains of a recent abortion. It is oval in shape, firmly attached, dark in color, porous in consistence, and has a deep red color. The mucosa is congested.

Cover-slips from the heart's blood, liver, spleen and intestinal ulcer showed, along with other bacterial forms, a large capsulated bacillus resembling closely the bacillus aerogenes capsulatus. These were not seen upon cover-slips from the bile and placenta. Anaërobic cultures were taken from all of the organs, but the large bacillus failed to grow.

Cultures upon agar plates yielded the following results: Bacillus typhosus in placenta, spleen, liver and kidney. Bacillus coli communis in the kidney and heart's blood. Bacillus pyocyaneus in the heart's blood. Bacillus proteus in the bile.

Some of the appearances found at the autopsy must be regarded as due to post-mortem changes, so that the invasion of the bacillus coli communis and the bacillus proteus after death cannot be entirely excluded. It is not improbable, however, that they may have been present in the organs or body fluids during life. The bacillus pyocyaneus is not a common post-mortem invader.

In reading over the available literature I find that the typhoid bacillus has been obtained during life from the blood of patients suffering from typhoid fever by three other writers. Thiemich* found it once in blood taken from a vein of the forearm. Ettlinger* obtained it twice by the same method, and Stern twice.†

Other writers report a negative result. Neuhaus‡ failed in twelve cases from blood taken from a vein of the forearm, and twenty-four cultures§ from blood obtained by pricking the skin of the forearm; Fränkel and Simmonds‖ in six cases. Ettlinger** reports eight negative results with blood taken from the forearm, and Klein ten.†† Failures are also reported by Gaffky, Rütimeyer, Chantemesse and Widal, v. Jaksch, and Vaquez.

In six other cases I failed to obtain the typhoid bacillus, although a syringeful (1.5 cc.) of blood was employed in each instance.

The typhoid bacillus has been obtained from the blood after death by several observers: Vincent,‡‡ Fränkel and Simmonds,§§ Flexner,‖‖ Klein,*** and by Wright and Stokes.†††

Heretofore not much importance has been attached to the work of Letzerich,‡‡‡ Almquist,‡‡‡ Maragliano,‡‡‡ Rütimeyer,§§§ Pasquale,§§§ Guarnierl,§§§ and Karlinski,§§§ because their examinations were made at a time when the differentiation of the typhoid bacillus from other micro-organisms closely resembling it in morphological and biological characters, was not so clearly understood as it is at present. However, it is probable now, that since definite proofs exist of the not very infrequent occurrence of the bacillus typhosus in the blood, either before or after death, their work may come to have more significance.

* Baumgarten's Jahresbericht, Vol. 10, 1894, p. 266.

* Wirtz, Précis de Bacteriologie Clinique.
† Centralb. f. innere Med. 1896, No. 49, p. 1249.
‡ See Wurtz.
§ Berliner klin. Wochenschr., No. 6, 1886.
‖ Sternberg, Text-book of Bacteriology, p. 352.
** Loc. cit.
†† Baumgarten, Vol. 10, 1894, p. 266.
‡‡ Ann. d. l'Inst. Pasteur, 1893; Le Mercredi médical, 17 fev. 1892.
§§ Sternberg, Text-book of Bacteriology, 1896, p. 352.
‖‖ Op. cit.
*** Baumgarten, 1894, Vol. 10.
††† Op. cit.
‡‡‡ Sternberg, op. cit.
§§§ See Flexner, op. cit.

SUCCESSFUL CULTIVATION OF GONOCOCCUS IN TWO CASES OF GONORRHEAL ARTHRITIS AND ONE OF TÆNOSYNOVITIS, WITH REMARKS ON A NEW MEDIUM.

BY FRANCIS R. HAGNER, M. D., *Assistant Resident Surgeon, Johns Hopkins Hospital.*

The more successful attempts to cultivate the gonococcus from pathological conditions other than urethritis and conjunctivitis, have widened our view concerning the part played by this organism in human pathology.

Even now it would take much space to enumerate all the different lesions and parts of the body in which this organism has been found. The gonococcus, as is well known, cannot be cultivated with the facility of the other pyogenic cocci, and it has for this reason not lent itself so readily as an aid to diagnosis in obscure cases, unless perchance it could be found in cover-slips, where its peculiar form and definite staining reaction might suffice for its identification.

Greater experience, on the other hand, has shown that, although this organism does not grow at all, or at least most feebly and unsatisfactorily, upon the ordinary culture media, its choice of substance is still not a small one.

Since Steinschneider's observation of the great value of urine in the composition of a culture medium for the gonococcus, no really easy practicable method of preparing a medium containing this fluid has been devised.

We offer in the accompanying paper a simple method which, in the limited number of cases at our disposal, has proven successful.

It is in part my object in presenting these cases to draw attention to the ease with which, by the use of this medium, the gonococcus may be cultivated.

I must state that the value of the medium was further tested and proven by cultivating this micro-organism from urethral pus. The cases themselves are of interest from their clinical aspects, and as illustrating the good results which surgical interference gives when undertaken in time.

The possibility of making a positive diagnosis before opening the infected joint enhances the likelihood of good which may be confidently expected from these measures.

No question is likely to arise as to the identity of the cocci isolated in these cases, even in view of the fact that in one case the organism did not completely decolorize when treated according to Gram's method.

The later writers on the subject, among whom I shall only mention Caplewski,* concede great difference in the behavior of cocci from different sources.

Most samples of gonococci are quickly and readily decolorized; some few are more refractory and may retain the stain in part. On the other hand, the ordinary pyogenic cocci which resist Gram's method sometimes become decolorized.

No small part in this procedure is played by the composition of the stain and decolorizing agents.

But when all the facts are gathered, namely, the source of the organisms, their morphological properties, their difficulty of culture, and slight viability, together with their staining reaction, no doubt is likely to be entertained concerning their nature.

Case I.

B. B., æt. 21, female, colored. Domestic. Admitted December 5, 1896.

Previous History. Patient has never been very healthy. One year ago she had an attack of rheumatism; at this time the right knee was swollen and painful. The patient was confined to bed for one month, and has never had any trouble with the joint since. There was no history of any vaginal discharge at this time.

Present Illness. Patient acknowledges exposure within the last month. Has had vaginal discharge for three weeks. Six days before entrance to the hospital she noticed pain and swelling of the left knee. Pain more marked at night and increased by motion.

Examination. The patient is a rather poorly nourished, unintelligent woman, with a slight blowing murmur over the apex of the heart, transmitted to axilla. The joint is quite tense, painful on palpation and motion. Patella floats. There is marked induration and thickening of the peri-articular tissues, which are boggy. Distinct fluctuation over the joint. A purulent discharge observed to be present in vagina and urethra. The examination of cover-slips was negative for typical gonococcus-like organisms.

December 5th. Knee aspirated with sterile syringe and a straw-colored fluid obtained; this showed under the microscope a great many polymorphonuclear leucocytes, and a few large diplococci which were not contained in the pus cells. Cultures made on agar-agar, gelatin, potato and bouillon were negative after forty-eight hours in the thermostat. Cultures made at the same time on albuminous urine agar in twenty-four hours showed no perceptible growth, but at the end of forty-eight hours in the thermostat about a dozen isolated colonies, a little larger than ordinary streptococcus colonies, elevated above the surface of the medium, presenting an opaque white color, but still translucent, were easily seen.

Cover-slips were made, stained with Sterling's gentian violet, mounted in water. The examination showed diplococci morphologically identical with the gonococcus. The same specimens were then stained by Gram's method and almost completely decolorized, a faint outline still being visible here and there. The ordinary media (mentioned previously) were inoculated from the cultures with negative results; but another albuminous urine agar tube, inoculated, gave a similar growth to the first after forty-eight hours in the thermostat, and this showed the same morphological characteristics.

Another generation, third in succession, was obtained on the albuminous urine agar medium; this one was feebler than the preceding ones, and no further growth was obtainable.

December 8th. Knee again aspirated, the fluid giving the same growth when inoculated on the albuminous urine agar tube.

The same negative results as described previously were obtained on the ordinary media. The growth mentioned was carried through three generations, but again would not grow on the fourth transplantation.

December 17th. The knee joint was opened and cultures taken, two tubes of the albuminous urine agar being inoculated. One of these became contaminated; in the other the growth was very slight and did not survive for a second transplantation.

The following is a brief description of the mode of preparation of the albuminous urine agar, which was prepared by Dr. Hugh Young and myself.

Acid urine containing 0.05 albumen or more should be collected and allowed to stand for twenty-four hours, no effort being made to prevent decomposition. The urine is boiled until a large albuminous precipitate is formed; it is filtered through paper, when the resulting fluid will be clear. The filtered urine is boiled, and agar-agar, peptone, beef extract and sodium chloride are added in the same proportion as making ordinary agar.

The other steps are the same as in making ordinary agar, except that filtered albuminous urine instead of water is used throughout the preparation of the medium. It is important to see that the medium before being placed in tubes has a neutral or slightly acid reaction.

The advantages of using albuminous urine are, first, that in such urine albumens are always present, which are not coagulated by heat, and second, the albumen that is coagulated acts as a clarifying agent in the removal of the salts that usually cause the cloudiness of urine agar-agar as prepared by

*Hygienische Rundschau, Vol. 6, No. 21, p. 1029.

mixing the urine agar separately and sterilizing by discontinuous heating below the point of coagulation. It is important to have the medium very moist when inoculated.

The operation consisted of opening and irrigating with bichloride of mercury 1 to 1000, followed by salt solution, an Esmarch bandage being applied above the joint to prevent absorption of the bichloride solution.

The wound was approximated with subcutaneous silver wire sutures, silver foil dressing applied, and the leg put up in plaster. Of course very strict cleanliness is necessary in these operations—in all cases the operator and assistants wearing rubber gloves. The wound healed *per primam.*

At the time of operation the subcutaneous tissues were found very œdematous and thickened, and minute hemorrhagic areas were seen in the tissues near the joint. The fluid within the joint was serous in character, although flakes of fibrin were contained in it. The synovial membrane was thickened and its surface covered with hemorrhagic material that in places had a plush-like appearance, having lost its gloss. At the junctions of the cartilages and synovial membrane there were a number of tessellated, very vascular fringes of fibrinous material 3 to 5 mm. in length.

The cartilages showed no change.

The patient is at present more comfortable, but has not entirely recovered.

Case II.

A. D., female, æt. 20 years, colored, domestic. Admitted August 25, 1895.

No history of rheumatism.

Has had vaginal discharge for two weeks. (Patient acknowledges exposure several days before the discharge was noted.)

Three days before entrance left knee joint became painful and swollen, pain being more marked at night; fever was present, the highest temperature recorded being 103° F.

Examination. Large, well nourished woman.

Left knee slightly flexed, and warmer than adjacent parts. Slight fluctuation on inner side of patella; movement of the affected joint caused great pain.

The peri-articular tissues were indurated and boggy.

There was a purulent discharge from the vagina and urethra that contained diplococci. These were in a manner suggestive of the gonococcus and occurred within the pus cells; they completely decolorized when stained according to Gram's method.

The operation was done on the fifth day of the disease, and consisted in the application of an Esmarch bandage, incision of the joint, irrigation with 1 to 1000 bichloride of mercury followed by salt solution, and closure of wound with silver wire. Silver foil dressing and plaster cast applied.

Patient made good recovery.

The examination of joint at time of operation showed the peri-articular tissues to be in an œdematous and hemorrhagic condition.

The joint contained about 25 cc. of blood-stained fluid in which floated small pieces of a fibrinous material.

The synovial membrane was roughened, thickened and had the same appearance described in the preceding case.

Larger tessellated masses of fibrin adhered to synovial membrane wherever it came in contact with the cartilage.

Bacteriological Examination.

The fluid for culture was removed from the joint with a sterile Volkman spoon, and placed in sterile test tube. A small quantity of blood was obtained by allowing a stream from a small artery to spurt into a sterile test tube.

The tube containing the blood was allowed to stand for two hours, during which time the serum had separated from the clot and could be pipetted off. An ordinary agar tube was melted and cooled to 46° C., so as to prevent the blood serum from coagulating when added. About 5 cc. of the human blood serum was added, making the proportion one-third human blood serum and two-thirds nutrient agar-agar; the resulting medium was perfectly clear. The fluid medium was then mixed thoroughly, and inoculated with three loops of fluid obtained from the joint, great care being taken not to add the fluid until the medium was observed to be on the point of solidifying, so as to prevent all chances of destruction of the organism by heat.

The inoculated medium was poured into a Petri's dish and placed in thermostat at 37° C. No growth was visible at the end of the first twenty-four hours, but at the expiration of forty-eight hours five or six small colonies could be seen. These were isolated and about the size of the ordinary streptococcus colonies, but they were more elevated when they appeared on the surface of the medium, and of a more opaque white color; they were, however, slightly translucent.

Cover-slips prepared from such a colony and stained with Sterling's gentian violet, mounted in water, showed numerous diplococci somewhat larger than the ordinary pyogenic cocci, composed of two hemispheres separated by a narrow unstained interval; a few tetrad forms were also seen. The same preparation treated by Gram's method was completely decolorized.

Agar-agar, bouillon, potato, gelatin, and glycerine-agar were then inoculated from one of the colonies.

At the same time another culture was made on the serum agar. No growth could be seen after forty-eight hours on any of the tubes except the one containing the human serum agar, and on this a growth similar in appearance to the ones described before, consisting of cocci with the same morphological properties, was found; further transplantation was not successful on this medium.

As no perceptible growth occurred on any of the ordinary cultural media, and cover-slips taken from their surfaces were negative, the conclusion that the organism was the gonococcus was considered justified.

It is interesting to note that although numerous cover-slips were made from the fluid at the time of operation, and numbers of polymorphonuclear leucocytes were found, no micro-organisms could be discovered.

Case III.

A. F., male, white, single, 39 years. Admitted May 20, 1896.

Denied any venereal disease. (Very questionable.)

Patient felt, without any premonitory symptoms, great pain

in the left ankle joint, and at the same time noticed that there was considerable swelling and redness of the skin over the joint.

The pain was more marked at night, and increased with movement.

The condition mentioned gradually grew worse until the twenty-fourth day after the beginning of the disease, when patient was transferred to the surgical ward.

Examination. Patient was a well nourished man. Temperature on entrance 100° F. There was a fluctuating swelling extending from the juncture of middle and lower third of tibia, following the sheaths of extensor muscles, to a point on the dorsum of foot 3 cm. below the ankle joint.

May 21st, Operation. Same operation as described previously.

Incision of abscess and excision of fibrinous material from tendon sheaths. Irrigation of bichloride of mercury 1 to 1000, wounds closed with silver wire and dressed with silver foil, and leg put up in plaster. Patient made good recovery in three weeks, wound healing *per primam.* On incision the subcutaneous tissues were œdematous and slightly hemorrhagic. The tendon sheaths were thickened and covered with hemorrhagic fibrinous material.

The pus was confined principally to the sheaths of tibialis anticus and extensor proprius pollicis, chiefly about the annular ligament, but followed the pollicis to a distance of 3 cm. below. The sheaths were opened and about 100 cc. of blood-stained fluid escaped, which was placed by means of a Volkman spoon in a sterile test tube.

The internal portions of the sheaths were covered with a hemorrhagic fibrinous material and some granulation tissue.

I am indebted to Dr. Flexner for the privilege of reporting his successful cultivation of the gonococcus in this case. The pus collected at operation in a sterile manner was sent to the Pathological Laboratory.

Cover-slips when stained with Sterling's gentian violet showed polymorphonuclear leucocytes filled with diplococci morphologically resembling the gonococcus; a few of the organisms seen were extra-cellular.

When stained according to Gram's method the organisms were completely decolorized. Inoculations of the pus were made on the mixture of Steinschneider,* on a mixture composed of human ascitic fluid and agar-agar,† on a mixture of human blood serum and urine,‡ on an infusion of pig-fœtuses and nutrient agar,§ and also upon ordinary agar slants. The cultures were placed in a thermostat at 37° C., and at end of twenty-four hours a scarcely perceptible growth was found on all the inoculated tubes except the agar slants, which last remained sterile, whereas the growth on the other tubes increased somewhat during the next twenty-four hours.

The appearance of the growth was the same as that described in previous cases.

Growth on pig-fœtus agar was more abundant and apparently more vigorous than on the other media.

Cover-slips from the cultures showed the same diplococcus as was found in the pus, and it became decolorized completely by Gram's method.

Transplantations at intervals of forty-eight hours were made on pig-fœtus medium mentioned and growth obtained for four generations, but from the fifth inoculation no growth resulted.

It is interesting to note that the condition of synovial membranes and peri-articular tissues in these cases was practically the same, namely subcutaneous œdema, thickening and induration of peri-articular tissues, with small hemorrhagic areas.

The synovial membrane was thickened, very hemorrhagic and had the appearance of plush, having lost the glossy condition.

The fringe-like pieces of fibrin were very hemorrhagic. In neither case was the cartilaginous portion of joint affected.

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*Steinschneider's medium consists of a mixture of bullock's serum, urine, and agar-agar.

†The mixture of ascitic fluid ½ and agar-agar ½, which after being placed in tubes is sterilized and slanted. An albuminous flaky precipitate collects at the bottom of the medium, leaving surface clear.

‡Human blood serum and urine medium is composed of ½ urine, ½ human blood serum sterilized in autoclave at 220° F. (Human serum derived from placenta.)

§ *Preparation of pig-fœtus agar:* Fresh pig-fœtuses not exceeding 5 cm. in length separated from placenta and membranes are minced in a sausage machine. An equal volume of distilled water is added to the finely divided fœtuses, and after thoroughly stirring, the mixture is allowed to macerate in a cool place for from six to twelve hours. The fluid is then freed from contamination by filtration through a Chamberland filter under a pressure of 150 to 200 lbs.

Two per cent. sterilized nutrient agar is then melted and cooled to 40° C. and to it ½ of its volume of the infusion of fœtuses is added. The tubes are then slanted.

A NEW ÆSTHESIOMETER.

By Lewellys F. Barker, M. B.

[*Exhibited to the Johns Hopkins Hospital Medical Society, January 18th*, 1897.]

I exhibited at this Society some time ago the test hairs employed by Professor von Frey in studying pain and pressure sense. These consisted, it may be recalled, of short wooden handles of suitable length, to which finer and coarser hairs were fastened at one end at right angles with sealing wax. The most suitable form is perhaps a four-sided wooden handle measuring 4 mm. on each side and 80 mm. in length. Hairs of different strength are obtained from the scalp of men, women and children; hairs from the beard, from the horse's tail and hog bristles are also of service where stronger stimuli are required. The advantage of these test hairs consisted, it will be remembered, (1) in the very small surface of skin acted upon, and (2) in the possibility of grading accurately the intensity of the stimulus applied. In order to test the stimulus-value of the hair, its area in cross section must be determined, as well as the weight which can be lifted by the hair when it is pressed with its cross section against one of the scale pans of a delicate balance. I described on the former occasion the methods of determining these two constants and shall not now repeat the details. Suffice it to say that with time and patience a set of such test hairs can be prepared varying in stimulus-value from 0.1 gr./mm² to 300 gr./mm², though, as Professor von Frey says, the preparation of them is "nicht jedermanns Sache."

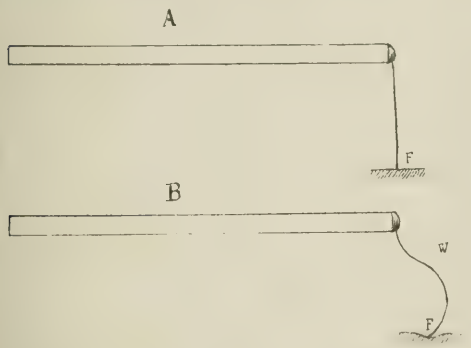

Fig. 1.

The form of the hair and its mode of action are shown in Fig. 1. A represents the test hair when it is placed upon the skin at the point F, though as yet no pressure has been exerted. In B the handle is nearer the skin, through pressure made parallel to the surface of the skin, and the hair is bent into an S-shaped curve, the turning point of which is at W. If W is perpendicularly above the point F, then the hair exerts exclusively an influence of pressure upon the skin; but if W be directed to one side, there arises along with the pressure a "shoving" component. The latter appears, as one finds on bending the hair, as soon as it begins to twist out of one plane; that is, a space-curve arises instead of the plane-curves.

The set of hairs which I pass around were prepared under Professor von Frey's direction in Leipzig in the spring of 1895. I have tested them at intervals since that time and find that they have undergone very little variation. For accurate testing of pressure and pain sense some such delicate testing mechanism is indispensable. Such hairs, however, are not in the market, and I fear if one wished a set of them he would have to prepare them for himself.

Recently, however, Prof. von Frey, with the aid of the mechanician Zimmermann, has prepared a simple instrument which, for purposes of clinical examination at least, will take the place of the set of test hairs. This æsthesiometer, which depends upon the same principle as that involved in the construction of the test hairs, has the advantage that with a single hair one can obtain a large series of pressure-values at will. It consists of a long hair pushed through a capillary tube of very narrow lumen, much like that of a thermometer tube; the hair can be shoved through the lumen easily, but on pressure only the part of the hair outside the capillary tube can bend, and the force exerted is always greater the less the amount of hair outside the tube, and feebler the greater the length of hair not inside the capillary tube. In Fig. 2 the mechanism is shown, though the sample which I pass around has some improvements not illustrated in the figure. The capillary tube consists of a brass tube, S, of very narrow bore, over which a sheath H glides with slight friction. In the axis of the sheath, and of the same length as this, runs a wire, which fits in the bore of the tube S, and at the end of which the test hair is fastened. If the sheath be shoved entirely over the scale the hair projects in its greatest length, and has accordingly only very slight force. On the other hand, if the sheath be drawn back as far as possible the greatest part of the hair

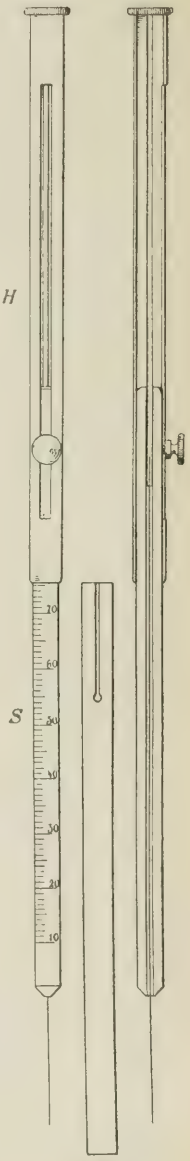

Fig. 2.

disappears within the bore, and the short still projecting part is capable of exercising very considerable pressure force. By means of a screw the sheath can be held firmly in any position corresponding to a test hair of any desired length. There is a millimetre scale on the tube, by the help of which a given length of test hair can always be found again, together with a protecting tube for the free end of the hair to complete the instrument.

The testing of the hair for its pressure values at different lengths can be carried out with the aid of a delicate balance, and if one makes determinations for every fifth or tenth line of the millimetre scale he can easily calculate the values for the intervening lines. With this instrument it is easy to pass from very low pressure values, even below the threshold for the most delicate pressure points, to pressure values above the pain threshold in parts of the body where the pain threshold is high.

The value of this instrument was demonstrated with Dr. Cushing in the ward the other day. In a case in which ordinary slight stimuli appeared to call forth pain constantly, the idea had arisen that pressure sense was absent, the pain sense being very much exaggerated. It was easy with this instrument to show that the pressure sense was not abolished, though the threshold for pain was almost at the same level as the threshold for touch. With care, however, the pressure points could easily be made out. The significance of careful examinations in such cases is obvious, for it would be easy for the clinician to make the statement that tactile sense was destroyed in a given case in which in reality it was unaffected or but little affected. If such a case should come to autopsy, one might be entirely misled in interpreting the lesions found.

The æsthesiometer is not expensive, costing I believe five marks, when purchased from E. Zimmermann of Leipzig. I cannot recommend it too highly for use in clinical examinations.

EDINGER ON "THE DEVELOPMENT OF BRAIN PATHS IN THE ANIMAL SERIES."*

[Abstract of a Report made by C. R. Bardeen, M. D., before the Journal Club of the Johns Hopkins Hospital.]

In this address Edinger speaks in a most interesting way of the value and possibilities of a comparative psychology based on careful biological and morphological study. He himself, he says, was led to undertake this line of research by the knowledge that the lowest vertebrates have no cerebral cortex. In man and in the higher vertebrates the finer conscious activities take place in this part of the brain, and in the ascending vertebrate series there is a gradual development of the cerebral cortex up to man. "Indeed, in man," says Edinger, "the evolution of the brain cortex is still under way." The interesting questions arose, What nervous activities are possible in animals without a cerebral cortex? and What nervous and mental activities have been added as the cortex has been evolved in the animal series? The solution of these questions involved the broader task of studying the finer structure of the nervous system of the lower vertebrates. It was found on investigation that those parts of the brain which, as opposed to the cortex, are designated as the "lower parts" are essentially similar in all vertebrates. The spinal cord and medulla of the fish and of man do not differ fundamentally.

"So far as we know to-day," says Edinger, "we may ascribe to similar structure similar function." If this be true we may hope by careful study of the morphology of the nervous system to have opened up new points of view for physiology and psychology. If to the spinal cord, for example, the functions of which are well known, comparative anatomical study shows that other structures are added little by little, we may suppose corresponding additions in functional capacity.

Edinger lays special stress on the need of care in forming our conceptions of the operations of the nervous system of the simpler animals. We must carefully rid ourselves of all preconceived notions of perception and desire as the necessary accompaniments of complex reactions to stimuli. We have, he says, no grounds for belief that such states of consciousness arise outside the higher centres of the cerebrum. We have no right to assume that in the lower animals the simpler nervous system performs functions like those performed by the higher centres of the nervous system in the higher vertebrates. "I trust I may be able to prove," says Edinger, "that the latter assumption, so commonly made, cannot be maintained."

To show how easily one might falsely attribute a conscious origin to complex movements, two or three examples are given from the invertebrate kingdom. Loeb's interesting experiments with the actinia are quoted. If a bit of fish be placed on the tentacle ring of one of these animals the tentacles close in and force the food into the mouth between the tentacles. But a piece of white paper put in the same situation is left undisturbed. This at first sight might seem a voluntary choice between the food and the paper, involving a conscious perception of taste. But if the mouth be destroyed and the bit of fish be again put on the tentacle ring the actinian will double itself up trying vainly to force the morsel into the closed mouth. The definite activity caused by the meat is, roughly speaking, a direct reaction of the tissues to a chemical stimulus. The actinian has no very definite nervous system, though certain of its cells are taken to represent nerve cells.

Edinger also refers to the recent studies on the nervous

*"Die Entwickelung der Gehirnbahnen in der Thiereihe," delivered before the medical section of the "Gesellschaft deutscher Naturforscher und Aerzte," in Frankfurt a. M., Sept. 23, 1896, and reported in the Deutsche medicinische Wochenschrift, Sept. 24, 1896, Vol. XXII, No. 39. [Prof. L Edinger of Frankfort is well known in America as the author of a very lucid text-book on the structure of the brain, "Der Bau des Gehirns." He is perhaps the foremost worker in the line of research of which he speaks in his address.]

system of the earth-worm. Thanks to the work of Loeb and Friedlaender on the living earth-worm, and that of Retzius and von Lenhossék on the morphology of its nervous system, the task of comparing its structure with its psycho-physiological activity has been greatly lightened. If the earth-worm be cut into pieces not too short, and one of the pieces is stimulated to move, it will continue creeping. The movement is produced as follows: from large epithelial cells in the external skin the earth-worm's sensory fibres pass into the central ganglia situated in the ventral band; here the process divides into at least two parts. These lie in contact with the dendrites of large ganglion cells lying in this ganglion and in those immediately adjoining. These large cells send processes to the muscles. Each ganglion sends motor fibres, not only to the muscles of the segment within which it lies, but also to those of the neighboring segments. Some of the fibres cross the median line. A third set of cells have processes which run up and down the ventral band connecting different ganglia. Thus a sensory impulse started in a large epithelial cell is carried to the neighboring ganglion. Here the motor and associative cells are called into activity, and the muscles in the vicinity of the segment whose surface has been stimulated contract. This throws increased tension on the surface of the neighboring segments and they in turn are stimulated to contraction. A contraction wave is thus started along the worm, called forth by simple reflex action. This scheme is not diagramatic; it is based on the actual observations of trained observers.

The mechanism which controls intestinal contraction in the higher animals is very similar.

The nervous mechanism found in the vertebrate spinal cord is fundamentally the same. Here again we find motor cells sending processes to the muscles; here again processes from sensory cells terminating in gray matter; here again, but in a far more developed degree, association neurones. That the spinal cord is capable, unassisted by the higher centres, of carrying out very complex movements is shown by the complex activity of the frog deprived of a cerebrum, the jumping of the brainless rabbit and the swimming of the brainless goose.

The morphological structure on which the functions of the spinal cord depend has now been fairly well determined. Beside the factors already mentioned there enter into its structure paths connecting it with the brain. In the fish paths connect mid-brain and cerebellum with the spinal cord. Connections between the cerebrum and the spinal cord first appear in mammals. "The direct influence of the cerebrum on the activities controlled by the spinal cord varies, therefore, according to the class of animal, and it does not even exist among the lower vertebrates." The pyramidal tract is not found in birds.

The medulla, while, like the cord, serving as a primary centre for the reception of sensory and the origin of motor fibres, has a much more highly developed associative mechanism than the cord. Yet the development of these paths of association varies greatly in different animals. In the carps and many other fishes it has a more complex development than in man. The complexity of development of the medulla depends chiefly on the uses to which the cranial nerves are put. The terminal area of the fifth nerve, so well developed in the sensitive-faced mammals, is but slightly developed in the snakes, but the motor area of the fifth nerve in snakes is relatively more developed than in the mammals, owing to the snake's powerful jaw muscles.

The cerebellum varies greatly in development, even among the fishes. Those that swim actively have it more highly developed than the mud-seeking varieties. Birds being animals of delicate sense of balance have it well developed. In snakes it is very rudimentary. Whatever the functions of the cerebellum may be, this organ is well developed in all animals executing carefully poised movements. The hemispheres of the cerebellum first appear in the mammals.

The connections of the cerebellum with other parts of the central nervous system are interesting. The pons fibres first appear in the mammals, and it is probable that the olivary paths do not occur in the lower forms. On the other hand the connections with the spinal cord through the corpus restiforme and with the thalamus through the superior cerebellar peduncle are primordially old. The latter are more highly developed in fishes than in man.

Next to the spinal cord the mid-brain is that part of the central nervous system most alike in all vertebrates. It is the primary terminus for the optic fibres, and in it end a large part of the secondary sensory fibres transmitting impulses from the other sense organs. It is the great centre for the association of sensory impulses in the animals without a well developed cerebrum.

The cerebrum in all vertebrates is composed of olfactory apparatus, basal ganglia and cortex.

The olfactory region varies greatly in development. In reptiles and in fishes it makes up half the brain mass. In birds it is scarcely to be traced.

The corpus striatum, which lies just behind the olfactory apparatus, appears developed throughout the vertebrates. It plays a chief part in connecting thalamus and fore-brain, but in large part its functions are ill understood. The optic thalamus is likewise complexly developed throughout the vertebrates. The cortex stands in marked contrast to the lower parts of the central nervous system which are so much alike among all the vertebrates. In fishes the cortex consists of a thin epithelial plate. In the amphibia it contains a simple nervous apparatus. In reptiles a true cortex appears for the first time.

Within the last twenty-five years it has been definitely shown that the cortex performs the highest functions of the nervous system. On the existence of a normal cortex depend all those functions which may be learned, almost all which are carried out by memory pictures, and, above all, those complex conscious processes designated "associative." The silver stain has shown into what a complexity of relations each nerve cell is brought by its processes. From the reptiles to man this associative complexity increases.

It seems probable that various sensory areas in the cortex have been added as the need has arisen for more highly developed associative processes connected with the special senses.

The earliest cortical relations are with the sense of smell

only. Reptiles, we may assume, differ from fishes in that they can "retain their smell impressions, associate them and choose." For the reptile the cortex is an olfactory centre and out little more.

"This first inheritance of the cortex, the olfactory centre, remains throughout the entire series; in birds alone is it somewhat uncertain. There is no difficulty in following the cortex of the reptiles into the Ammon's horn and the uncinate gyrus of mammals and man."

But in the course of evolutionary development other brain centres have been added to this; the cortex has been built up piece by piece. Unfortunately most of the steps are still uncertain. Something is, however, known of the optic paths. In fishes the optic nerve ends in the mid-brain. And so too in man at birth the only functional fibres end there. The babe is not blind, but it has no association centres for sight impressions. During the second month of life paths are developed from mid-brain to occipital lobe, the cortical sight-centre is called into activity, and association paths are formed between it and the rest of the cortex. The child only then begins to perceive what it sees.

It is because the fish has no cortical centre for sight that it can be hooked. To a similar reason is due the fact that reptiles and amphibia often go hungry when they do not smell their prey and it does not move. Snakes which do not eat dead mice will seize and devour, without a trace of dislike, dead mice artificially made to move.

Birds have a well marked cortical area for sight, and hence they exhibit many phenomena which indicate reason and memory founded on sight impressions.

It is clear, however, that in the lower animals many functions are performed without the influence or control of a cortex, and the question naturally arises as to the real nature of the functions of the lower centres. It is well known that man and the higher mammals are more injured in normal activity by loss of the cortex than are the lower vertebrates; that the cortex becomes indispensable in proportion as it becomes well developed and is brought into close association with the lower centres. This has been shown by the study of the diseased human brain and by experiments on animals. But nature offers us animals with no cortices and with cortices variously developed along special lines. We have here a beautiful opportunity to study the functions of the cortex in the animal economy. Most interesting points of view might be obtained by excitation of the olfactory nerves of fishes which have no cortical centres, and of snakes which have cortical centres for smell; or by comparing the effects of visible objects on snakes which have no developed associative centre for sight, and on birds which have them well developed.

And this same sort of study carried to man will also prove productive. The great man need not necessarily have a heavier brain than the average man, but we should expect that part of his brain which he had occasion to use to be better developed than the average. The great painter should have a well developed occipital lobe; the great musician a well developed temporal lobe. Gambetta's brain was not above the average in size and weight, but the speech area was very greatly developed. For the present, Edinger points out, we may willingly refrain from speculating about convolution anomalies and criminal types. More fruitful fields of investigation are offered the scientist. The field of comparative psycho-physiology and comparative morphology gives every promise of being most fertile. One thing seems sure, "there is no boundary to be established between the conscious activities of the lowest and those of the highest vertebrates."

PSEUDO-TUBERCULOSIS HOMINIS STREPTOTRICHA.

[A PRELIMINARY NOTE.]

By Simon Flexner, M. D.

[*From the Pathological Laboratory of the Johns Hopkins University and Hospital.*]

At the meeting of the Johns Hopkins Hospital Medical Society held on October 19th, 1896, I presented specimens from the lungs and peritoneum of a man who had succumbed to a disease characterized by symptoms which resembled those of phthisis pulmonum, but in the lesions of which, instead of the bacillus tuberculosis, another and probably entirely distinct micro-organism was discovered, for which I have proposed the name of streptothrix pseudo-tuberculosa. As the publication of the full report of the case and the complete description of the micro-organism has been somewhat delayed, a brief outline of the case may be of interest at the present time.

The patient was a male, colored, aged 70 years, in whom extensive consolidation was made out in both lungs. The symptoms were generally those of pulmonary tuberculosis. Sputum was carefully watched for during his stay in the Hospital (Dr. Osler's clinic), but none was obtained. No microscopical examination could therefore be made.

Autopsy. The body was that of a slightly built, somewhat emaciated man. The abdomen was moderately distended. The autopsy was made 19 hours after death, the body having in the meantime been kept on ice. No evidences of post-mortem decomposition were noticeable. The description of the viscera is limited here to the organs especially affected.

The *Lungs* are voluminous and meet in the middle line anteriorly. They are not bound to the chest wall. *Left.* The entire lung, except the anterior edge of the upper lobe, which is insufflated, is consolidated more or less perfectly. Where the consolidation is frank the lung presents an opaque appearance, is gray in color, and beginning softening (disintegration with early cavity formation) is going on. The cavities often

still contain the products of disintegration, and all appearances of reactive encapsulation are wanting. Where the hepatization is less complete the lung tissue is œdematous and swollen, although perhaps not completely airless, and discrete tubercle-like nodules may be seen. The pleura over the hepatized areas is covered with a fibrinous exudate. *Right.* The consolidation is less extensive and more focal in character, but occupies in places areas as large in extent as 4x5 cm. The pleural cavity contains a small quantity of fluid, pink in color, in which flakes of fibrin occur.

The intestines are moderately distended. The omentum is rolled up; it occupies a position beneath the transverse colon and extends across the abdominal cavity. The pelvis contains about 15 cc. of fluid of brownish color and mucilaginous consistence. Between the intestinal loops delicate shreds of fibrin exist. In addition smaller and larger nodules resembling tubercles, usually translucent, are scattered irregularly over all the exposed peritoneal surfaces, and occur more uniformly upon and within the thickened, rolled-up omentum. The liver and spleen on section show similar nodules.

The bacteriological examination consisted in the study of cover-slips from the fresh lungs, the inoculation of glycerine-agar tubes, and the injection of a suspension from the consolidated lung subcutaneously into a guinea-pig. The histological study embraced all the organs of the body. Cover-slips from the lungs, stained by Gabbett's method, showed no micro-organisms which resembled the bacillus tuberculosis in their morphology. There remained faintly stained in carbol-fuchsin upon the cover-slips numerous examples of a branching organism, occurring often in clumps or convoluted masses, among which no ordinary bacillary forms were discovered. From the history of the case, the character of the lesions and the known variation in morphology of the bacillus tuberculosis, it was, for the time, assumed that the organism was a streptothrix form of the former bacillus. Its subsequent study has rendered this assumption highly improbable.

The cultures from the left pleural cavity and the peritoneum remained sterile. Three separate sets of cultures were prepared from the lungs. In all these, at the end of 24 hours, a vigorous growth of a bacillus, identified as belonging to the group of B. coli communis, had taken place. The streptothrix did not grow. The guinea-pig showed no reaction to speak of at the site of inoculation, the adjacent lymph glands could not at any time be felt; the animal, however, lost in weight and died at the end of the 7th week, at the autopsy showing great emaciation. None of the lymphatic glands were found enlarged; there were no lesions resembling tubercles in these and other organs, and cultures upon glycerine agar, made from several sources, remained sterile. Cover-slips from the serous cavities, blood and viscera were negative for any kind of bacteria.

The further study of the staining properties of this organism in cover-slips, made from the lungs at the time of the autopsy, shows that as stained by the ordinary methods employed for tubercle bacilli, and decolorized by means of acids, the dye is held very loosely and quite readily given up. The best method of staining is either Gram's or Weigert's modified fibrin stain. The same holds true for its demonstration in the tissues.

The lesions in the tissues are of two kinds, depending in part upon their situation. In the peritoneal cavity tubercle-like nodules are formed, consisting of epithelioid and lymphoid cells with an occasional giant cell. Necrosis by fragmentation is not unusual in the centers of the tubercles, and fibrin, either before or coincident with the necrosis, is commonly observed in the nodules. In the lungs tubercles also exist, but they are less striking than a diffuse exudation of leucocytes, plasma and fibrin which fills the air cells, infiltrates the stroma and tends to undergo necrosis, producing larger and smaller spreading caseous foci of degeneration. The number of masses of the streptothrix is very great indeed and they are in intimate relation to the pathological process.

From these and some other considerations which will appear in the full report, it is believed that the organism is probably a new species, for which the name *streptothrix pseudo-tuberculosa* is proposed, and, further, that it is capable of causing in human beings a rapidly spreading and destructive disease resembling phthisis florida, for which the appellation of pseudo-tuberculosis hominis streptotricha seems warranted.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of December 7, 1896.

Dr. Thayer in the Chair.

Discussion of Dr. Friedenwald's Paper on Congenital Motor Defects of the Eyeballs. See p. 202, Nov.-Dec. Bulletin, 1896.

Dr. Paton.—This case is of very great interest, and so unique that I feel interested from an anatomical standpoint. Cases of unilateral paralysis are easily explained, but for cases of double paralysis of the 6th nerve there is no anatomical explanation. As yet there has been no demonstration of the crossing of the 6th nerve in man. It has been demonstrated in monkeys. The crossing of the 4th nerve has been demonstrated in man. The further interesting fact that this case brings forward is the relation of the 6th nerve to the oculomotor. There are two possible ways in which these nerves can be related. If you take a section of medulla at the level of the 6th nerve and look at the right side, the fibres are seen to pass across to the left side, and then upward in the posterior longitudinal bundle as far as the nucleus of the third nerve. The main function of that bundle is to connect the nuclei of the cranial nerves, and there you find the connection between the 6th and 3rd. Recently another path has been marked out. The 6th on the right side may pass up on the same side as the right nucleus, and join the fibres of the 3rd nerve from the other side; so you have two possible connections. Either the

6th nerve crosses or the third nerve crosses, and the probability is the latter, because the crossing higher up of the 3rd nerve fibres is the simplest physiological explanation.

Dr. THEOBALD.—Dr. Friedenwald has had an exceptional experience in meeting with so many of these very interesting cases. It would seem that in this case there is a marked want of power of the internal rectus of the left eye as well as of the external rectus. This suggests the related cases of congenital ptosis sometimes accompanied by inability to turn the eyes upwards, that one meets with. It is well known that in this case the defect is not central, but is due to absence of or faulty development of the levator muscle of the upper lid and of the rectus superior. Such cases are not so rare as the one shown. I have met with several of quite marked degree. Frequently they are associated with epicanthus. It seems to me that the most probable explanation of this case is that we have here a similar want of development of the external recti. Indeed all the eye muscles here appear to be more or less faulty or weak, for it is difficult to induce the patient to turn his eyes in any direction, all of the movements being defective. We not unfrequently meet with cases of pronounced weakness of the recti muscles, particularly of the external recti, but such cases as the one shown are rare and extremely interesting.

Congenital Facial Diplegia.—Dr. THOMAS.

In connection with the case which Dr. Friedenwald has exhibited, Dr. Thayer thought it might be interesting to have this rather unusual case presented to the Society. He has asked me to bring it before you.

The patient, a youth of 19, came to the Hospital from a neighboring State, in the hope that something might be done to improve his unfortunate appearance. Dr. Halsted has admitted him to his wards, and it is through his kindness that I have had the opportunity of examining him.

The family history is important. Father and mother are healthy and there is no history of any hereditary taint in either of their families. Patient is the third child of a family of nine. Three children died young, one of these having a misformed foot. The eldest child, a girl, is perfectly healthy; the second child, a boy, now twenty-one years old, was born in a condition similar to that of our patient. The patient's birth was not particularly difficult and was non-instrumental. It was noticed soon after he was born that he was unable to close his eyes and that his underlip dropped while nursing. In crying his face remained motionless and he was unable to smile. He learned to speak at the usual time but was never able to pronounce certain letters. His general development was good except that he had some glandular trouble. He played with other boys and was able to do everything they did.

You see what a remarkable appearance the patient has; the face is mask-like and expressionless, the mouth open, the lower lip pendulous, and the lower jaw protruded. He is absolutely unable to move the muscles of his forehead, and when told to close his eyes he simply rolls the eyeballs up and relaxes the upper lid. He is unable to elevate or pucker his lips, but can move the angles of the mouth out and down; in doing this, you see, he brings into play the platysmata. In speaking he cannot pronounce the sounds which require the use of the lips, viz. b, f, m, p, v. His eyes are prominent; the pupils are equal and react normally to light and during accommodation; all movements of eyeballs are normal. He complains of being somewhat near-sighted; there is no disturbance of the visual field. Muscles of mastication unaffected. There is no disturbance of sensation and taste is normal. Tongue is well developed and freely movable, indeed he makes his tongue take the place of his lips as much as possible, drinks and smokes by its aid. I have been unable to discover any abnormality in the muscular development of his trunk or limbs. Stimulating the facial nerves by electricity causes contraction in the muscles back of the ear and of the platysma. By direct stimulation the platysma can be made to contract.

Before leaving the patient I should like to call your attention to the congenital defect in the right lobe of his ear. You will see that it is notched.

This, then, is a case of congenital facial diplegia. Dr. Friedenwald has told you that certain of the cases of congenital defect of the ocular movements have been associated with a similar condition in the facial muscles, and it is on account of this association that I have brought the case before you at this time.

Dr. Chisolm, of this city, reported one of the very first examples of this condition. In his case there was bilateral paralysis of the sixth and seventh nerves, a combination of the symptoms seen in Dr. Friedenwald's case and of those in the boy whom I have just shown you.

Moebius had a somewhat similar case, which he described in 1888, after which he made a fairly complete collection of all like and analogous cases. These he published in 1892. In this article he expresses the view to which, as Dr. Friedenwald has said, Kühn takes exception, that the disease depends upon an atrophy of the nuclei, and he proposes the name "Infantiler Kernschwund."

Moebius was unable to find the record of any case in which congenital facial paralysis was unassociated with any defect of the eye muscles. Since then, however, two or three such cases have been described, but these cases were all unilateral, and, as far as I have been able to discover, the case which I have shown you to-night is the first one of its kind to be reported, although I have no doubt that others have been observed.

As to the anatomical condition which underlies these cases not much is known, and it seems scarcely worth while, at this time, to examine the theories which have been advanced.

The aspect and condition of the face in the patient whom we have seen suggest strongly the myopathic face which occurs in certain forms of progressive muscular dystrophy. We have examined the patient thoroughly with this point in view and have been unable to discover any other muscular abnormality, either hypertrophy or atrophy.

It therefore seems to me that the case cannot be classed with the progressive muscular dystrophies, although it might be considered as an abortive form of this disease, an explanation which has been given of a somewhat similar condition. As we do not understand the pathology of the muscular dystrophies, such an explanation helps but little. In this connection the condition of the patient's brother is of

importance, for if, as we are told, his symptoms are quite similar to those of our patient, and no other muscles are involved, it will make the classing of the case with the muscular dystrophies still more far-fetched.*

Dr. Osler.—I do not think there are any muscular dystrophies of this kind that have that extreme atrophy without any involvement of other muscles. None that I have seen presented that appearance. You will probably find the brother the same as this patient.

Dr. Halsted.—Is the jaw of the brother the same?

Dr. Thomas.—The patient tells me that it is not quite so much so.

Dr. Theobald.—Were there any cases in the family previous to this?

Dr. Thomas.—Not as far as I can find out, not even an ocular palsy.

Dr. Barker.—The absence of ocular paralysis in Dr. Thomas's case is an interesting feature. In consideration of the anatomical relations of the sixth and seventh nuclei, the occurrence of paralysis of the abducens along with paralysis of the seventh nerve is rather to be expected, if the lesions be in the region of the nucleus and due to pressure or hemorrhage. One of the most curious facts with which the anatomist has to deal is the relation of the fibres of the seventh nerve to the sixth nucleus after they leave the facial nucleus. Why these fibres should run up toward the middle line, turn and run along the floor of the fourth ventricle and then turn again ventrally and laterally has never been satisfactorily explained. Such an out-of-the-way course seems unnecessary.

During the development of the motor nerves whose nuclei of origin are situated in the medulla and pons, the motor fibres belonging to the N. accessorius, N. hypoglossus, N. vagus, N. glossopharyngeus, N. abducens, etc., pass directly toward the periphery of the medullary tube and pass through the marginal veil to form the peripheral cranial nerves. The fibres of the N. facialis alone show the well known remarkable discursion. Whatever be the factors which determine the course of these fibres, they are active at a very early period of development, for the relations mentioned are visible in very young embryos. In his lectures on vertebrate embryology last year, Professor His of Leipzig made the ingenious suggestion that the cause of the deviation of the fibres of the N. facialis from the course we would expect them to take may possibly depend upon mechanical factors associated with the development of the auditory vesicle, since the ear vesicle is laid down laterally exactly in the region of the sixth and seventh nuclei.

It would be easy to speculate further and to think of such cases as the one before us as instances of congenital nuclear destruction from disturbances of the relations which ordinarily exist between the auditory apparatus and the neural tube, due either to an unfortunate variation or to early intra-uterine pathological lesions. That the affection is bilateral and that more than one member of the same family is diseased would favor rather than oppose such an hypothesis. It is surprising, considering the extremely complex character of the developmental relations of the internal, middle and external ear, that vicious developments of these parts are not more common than they are. It is interesting to note that, as Dr. Thomas has pointed out in this individual, there is faulty development of a portion of the external ear. Should this man or his brother be the father of children it would be important to determine the presence or absence in them of similar lesions, since, as is well known, variations favorable or unfavorable show a marked tendency to become inherited. That instances of extremely unfavorable variation persisting through many generations are comparatively rare need not surprise us, inasmuch as in the progress of the race, in the course of a very few generations, individuals bearing such peculiarities, owing to their unattractiveness and unfitness, are, as a rule, gently killed out without offspring.

While modern embryology permits the formation of hypotheses such as those here hinted at, it is to be remembered that for any real explanation we must await the results of pathological findings in actual cases. In view, however, of what has recently been done, the problem might perhaps be advantageously approached from the side of teratological experiment.

*The elder brother was seen at his house and was found to be in an almost exactly similar condition to that described above in the case of his brother. Both cases will be reported more fully at a later date.

Meeting of December 21, 1896.

Dr. Thayer in the Chair.

A Case of Acquired Paralysis of both External Recti Muscles, with Unilateral Facial Paralysis.—Dr. S. Theobald.

I thought this case would be of interest to show as supplementary to the one exhibited by Dr. Friedenwald several weeks ago. His was a case of congenital paralysis, or perhaps defective development, of the external recti muscles. He pointed out, as one of the interesting features of that form of paralysis, that there was no squint, and explained that in cases of congenital paralysis secondary squint does not usually occur. In the case which I exhibit we have the usual secondary squint found in acquired paralysis of the ocular muscles, and as both external recti are involved, it is of high degree.

This patient is 33 years of age and until August last was employed as a laboring man. His history shows that ten years ago he had a facial paralysis of the left side, and at the same time a paralysis of the right external rectus. There has been little or no change in his condition, so far as we can judge, in all that time. During August last he first developed a paralysis of the left external rectus. As to the cause of these paralyses the history is rather indefinite. It is more than probable, I think, that they are of syphilitic origin. He admits having once had gonorrhœa, and I think there must have been specific trouble also, though the history as to this is not clear. The points of interest are that so many years ago he should have had paralysis of the facial nerve occurring at the same time as the ocular paralysis. If the two had been on the same side it would not be so difficult to explain their co-existence, for we know that the nuclei of the 4th and 6th nerves lie close together in the floor of the fourth ventricle, and it is not uncommon to find both these nerves involved in the same case. It is of great interest, too, that after so long a

lapse of time the external rectus of the other eye should have become involved. The paralyses are evidently nuclear, and it would seem that some central change, either inflammatory or degenerative, involved the nucleus of left 7th nerve and the nucleus, which is quite close to it but on the other side of the brain, of the right external rectus, and that after a long lapse of time the left external rectus also became involved.

Paralyses of the ocular muscles are not uncommon. Their origin may be cortical, fascicular, nuclear, basilar, or orbital. Probably the commonest cause of paralysis of the ocular muscles is syphilis. We also often have a paralysis of the ocular muscles in tabes which is quite marked and yet which may in time entirely disappear. Paralysis of the ocular muscles may also be caused by diphtheria, disseminated sclerosis, poisoning by alcohol, nicotine, etc., and a certain class of cases certainly are due to cold. I have seen recently four cases of paresis of the external rectus due to cold or exposure. Such cases frequently occur in rheumatic subjects and are usually due to inflammation in the orbital portion of the nerve, and the prognosis is good.

The most marked symptom in cases of acute paralysis of ths eye muscles is diplopia, which is very annoying. In squint due to hypermetropia there is no complaint of diplopia, possibly because it usually develops in childhood; but in paralytic squint, which oftener occurs in adults, diplopia is the most common symptom complained of.

There is one point in regard to this case which I have neglected to mention: this patient has well advanced atrophy of both optic nerves. The discs are decidedly white and the vision greatly impaired, in one eye being only $\frac{2}{200}$, in the other $\frac{7}{200}$. The treatment has been the administration of large doses of potassium iodide, and I think there is some slight improvement, but an operation will probably be necessary. It will not be sufficient to perform a tenotomy of the internal recti, but it will be necessary to combine with this an advancement of the externi.

Dr. Thomas.—There is the history of a decided facial paralysis ten years ago, and at present there is contracture of the muscles of the right side of the face. We know that in cases of severe facial paralysis there is very generally developed a secondary contracture of the paralyzed muscles. After a hurried examination it seems to me that upon voluntary effort the patient does move the left side of his face more than the right. An electrical examination would determine the point, but even now I am strongly inclined to the belief that it was the right side that was paralyzed. If this is found to be the case we can easily understand how a single lesion could cause a paralysis of the right 6th and 7th nerves; in fact there are many such cases reported. But on the other hand it is difficult to imagine a lesion involving the right 6th and the left 7th nerves.

Dr. Osler.—One other point is of interest in this case: whether this may not be a facial paralysis and external rectus paralysis occurring with the secondary symptoms of syphilis, and whether his present paralysis and atrophy may not be the signs of tabes. The fact that he has the knee jerk is somewhat against this, but the persistence of these ocular paralyses is occasionally seen as an initial symptom of tabes.

Dr. Theobald.—I would only say in closing that the knee jerk was examined and found to be up to the usual normal standard. The suggestion of Dr. Osler is well worth considering, whether we are dealing with a greatly different state of affairs now from what originally existed; whether this present paralysis is a tertiary, while the other was a secondary symptom.

I will be glad to have the patient come to Dr. Thomas's clinic and have the electrical examination made. My diagnosis of left facial paralysis was made simply on the drawing of the face to the right side and the fact that there is a certain blank expression about the left side of the face.

Exhibition of Ophthalmological Cases.—Dr. R. L. Randolph.

Bilateral Dacryo-adenitis.

Dr. Randolph reported a case of bilateral dacryo-adenitis (mumps of the lachrymal glands, Hirschberg) in a negro woman thirty-nine years old. He spoke of the case as being one of the few cases reported in this country, the disease being very rare. Both lachrymal glands were so swollen that the upper lids had been pressed down at the outer canthus to such an extent as to hide the outer half of the eyeball. In the case of the left eye the hypertrophied gland had pressed the eyeball inward and slightly downward. The tumors were exceedingly painful to pressure, but at other times she suffered no local pain, the pain then being referred to the sides of the face. There was nothing in her history that would give one a clue as to the origin of her trouble. She was put on small doses of bichloride of mercury and ten grains of iodide of potash three times daily, and frequent hot applications were made to the tumors, and after a month there was a noticeable diminution in their size. Six months after the beginning of the trouble there remained only a slight enlargement of the left gland.

The trouble having passed away it is no longer interesting to show the patient, so she is not here this evening. It is the first case reported in the city, and certainly less than a dozen have been reported in this country.

Dr. Thayer.—In connection with Dr. Randolph's case I should like to say a word with regard to a somewhat similar instance which has been under our observation in the hospital. In 1894 a little girl, 10 years of age, was admitted to the hospital with bilateral hard enlargement of the lachrymal, parotid and salivary glands, for which we were unable to find any cause. The lachrymal glands were to be felt on either side as two small hard shot-like bodies. The child stayed in the wards for many months, and while there developed an ozœna and caries of the nasal bones which was clearly syphilitic in nature. Under treatment with mercury and iodide of potassium the glandular swellings slowly but completely disappeared. While in the hospital, however, some of the cervical and lymphatic glands became enlarged and remained so after treatment with mercury and iodide of potassium, and the child has since showed evidences of a tuberculous peritonitis. The enlargement of the lachrymal glands was very striking, though never as marked as in Dr. Randolph's case; it has entirely disappeared.

Operations for Cataract.

The other cases which I have to exhibit are some of the cataract cases upon which I have operated in this Hospital during the last summer. There are 12 or 13 here to-night. Some of them have interesting histories. One, an old man, 88 years of age, was operated upon early in September, and on the night of the operation had an attack of acute mania. He tore the bandage off several times, and finally had to be tied in bed, but in spite of that has a good result. When we consider how slight a disturbance may sometimes cause the operation to go to the bad this is rather a remarkable recovery. The bandage was disarranged at least three times. After the atropia was withdrawn he regained his senses and was rational for three days. One night after that he had another attack, jumped from his window, scaled the fence and was making his way homeward when found. Strange to say it had no effect upon the ultimate result.

The next case is a rare one. I operated for cataract early in June and the anterior chamber remained open after the operation for 17 days. At the last meeting of the American Ophthalmological Society I asked several of the members what was the longest time they had ever seen the anterior chamber remain open, and the longest period given in reply was 11 days. Four weeks after the operation when this patient left the hospital he had $\frac{2}{200}$ vision, which is very good practical vision.

Very frequently in cataracts there seems to be a stage where they make no progress toward maturity. That was the case with this woman, aged 63, who, while having sight enough to get about, was unable to do work. Here I performed the maturing operation. This consists in doing an iridectomy and practicing massage upon the lens through the cornea. The cataract was ripened, then extracted. With the exception of that case I have performed the simple extraction, and in several of them there is no objective evidence of an operation having been performed.

Demonstration of Florence's Iodine Test for Seminal Stains. —Dr. LEWELLYS F. BARKER.

Professor Florence of Lyon has recently published in the Archiv d'Anthropologie a very delicate test for human seminal stains. He uses a mixture of iodine, iodide of potash and water not unlike the ordinary Lugol's solution.

To apply the test, if the seminal stain be upon linen, a small piece of the stained fabric is moistened with water, placed upon a glass slide and a drop of the reagent added beneath the cover-glass. If the stain be due to semen a very distinct precipitate of crystals results. The form of crystals is not unlike that of ordinary haemin.

We have used the test in the course in normal histology and find it very easy to apply and extremely delicate. The reaction is not yielded by blood, saliva, nasal mucus, vaginal mucus, urethral mucus, nor by the semen of other animals. I have placed under the microscope one specimen in which the seminal reaction is apparent, and under the other microscopes a number of other fluids mentioned in which no reaction has taken place. Urine sometimes throws down yellow-brown globules, but as far as we have been able to make tests, definite crystals, likely to be confused with those of the reaction, are never deposited. Whether or not urine containing semen would yield the reaction I have not yet had the opportunity of testing; but inasmuch as minute quantities of the seminal fluid on linen will afford the reaction, it is very probable that urine containing this substance would also yield it. Some alkaloids are capable of yielding similar precipitates, a fact which must be borne in mind in medico-legal cases. Just what portion of the semen is concerned in the reaction has not yet been made out; it would be easy to ascertain this by testing the individual constituents of the seminal fluid obtained, say from the vas deferens, vesiculæ seminales, prostate and Cowper's glands at autopsy. Urethral mucus, as will be seen under one of the microscopes, does not yield the reaction. In case no single one of these constituents afforded the reaction, the latter must be due to some substance produced on their admixture.

NOTES ON NEW BOOKS.

The Practice of Medicine. A Text-book for Practitioners and Students, with special reference to Diagnosis and Treatment. By JAMES TYSON, M. D., Professor of Clinical Medicine in the University of Pennsylvania, etc. Illustrated. (*Philadelphia: P. Blakiston, Son & Co.*, 1896.)

This is in every respect an admirable book. The author's statement that it has taken several years of labor is borne out by the careful and thoroughly conscientious way in which the subject has been treated. It is a work of nearly 1200 pages, larger than the recent text-books issued in this country, containing on the whole rather more matter even than *Flint's*, which is a very closely printed book.

The author's method of dealing with a subject is well illustrated in the consideration of the important subject of myxœdema. Following the definition—and by the way the text-book is quite strong in clear, practical paragraphs defining diseases—the history of our knowledge of the affection is considered in nearly three-fourths of a page. Dr. Tyson has in nearly every section dealt in a most instructive way with the historical development of the knowledge of the different diseases, and in myxœdema it is of course particularly interesting. I do not think that the statement is altogether clear about the dispute between Reverdin and Kocher as to the discovery of operative myxœdema. Unquestionably Reverdin published the first note in October, 1882, but he did not at that time appreciate fully the remarkable character of the changes following thyroidectomy. Kocher distinctly states that in the autumn of 1882, in Geneva, he spoke to Professor Reverdin of the remarkable sequences of the operation, and that Reverdin six days later read a paper on the subject. In Kocher's paper, which appeared in the spring of 1883, the description of operative myxœdema as we know it now, and which he called *cachexia strumipriva*, was fully and clearly drawn, and he certainly appreciated at that time, as Reverdin did not, the serious effects which might follow total extirpation. In the succeeding paper by the brothers Reverdin they recognized the condition as identical with myxœdema and called it *myxœdeme operatoire*. Three forms of myxœdema are recognized: pure myxœdema, myxœdema associated with congenital or sporadic cretinism, and operative myxœdema. There is in addition a full description of cretinism. On the subject of exophthalmic goitre, though the disease is placed under diseases of the thyroid gland, Dr. Tyson states that the neurotic nature of the disease is now generally admitted. He holds that the sympathetic neurosis theory

explains the symptoms rather more satisfactorily than any other. His practice is better than his precept in this respect, since he places the disease where it probably belongs, among those of the thyroid gland. We are glad to notice that he insists upon the priority of the description by Graves. Of this, of course, there can be no doubt, though Parry and others published individual cases. Graves' clinical lecture in 1835 gave the first good description of the affection.

Naturally in a new text-book one turns to certain of the diseases about which there is still a good deal of difference of opinion. Appendicitis receives a very thorough and satisfactory treatment. There is no work in English which gives so good an account of the history of the affection. We are glad to see that Dr. Tyson does not consider it necessary to speak of a typhlitis, stercoral or otherwise. It is satisfactory to see that the name even does not occur in the index. He describes catarrhal, ulcerative and interstitial forms of appendicitis. The clinical description of the different varieties is admirable. On the all-important matter of treatment the author takes rather advanced ground, stating that "the diagnosis being established, operative treatment should be recommended, except in those cases where the disease is so far advanced as to make it unlikely that the patient will be saved by operation." He thinks that the operation after the first attack is safer than during the first attack. On the much debated point of purgatives he leaves the matter to the circumstances of the case and the good judgment of the attendant, as the results may be either very happy or very mischievous. He believes that if there is doubt it is best not to purge.

The article on typhoid fever, with which the book opens, is in every way worthy of the great importance of the subject. The author is a strong believer in the use of the cold bath, and on the question of treatment he everywhere displays sound judgment.

We have said enough to indicate the importance of the work, its thoroughness, and its reliability in all practical details. The publishers are to be congratulated on the appearance of the volume. It is one of the handsomest works issued of late years in this country, and the type and paper are very much above the average. Altogether Tyson's Practice forms a very welcome addition to our text-books, and we predict for it a most successful career.

An American Text-book of Applied Therapeutics, for the use of Practitioners and Students. Edited by J. C. Wilson, M. D., assisted by Augustus A. Eshner, M. D. Pp. 1–1326. (*Philadelphia: W. B. Saunders*, 1896.)

Since the main object of medical studies must always be the formulation of methods for the prevention and cure or alleviation of disease, it necessarily results that laboratory researches and clinical observations must ultimately be valued in proportion as they have brought us nearer to the attainment of these aims—in other words, according to the advances which have been derived from them in the establishment of a rational system of therapeutics. The world at large is apt to look at results rather than methods, and the busy practitioner may justly demand that the previous studies and experience of others should be presented to him in a concrete form. For these reasons the status of medicine at any particular period will, to a great extent, be gauged by the therapeutic measures which prevail at that time, and of which the text-books dealing with the subject are the exponents.

Graduates of twenty years ago will probably remember a time in the first few years of their practice during which they were tempted to become adherents of the doctrines of therapeutic nihilism. They had gone forth armed, they had been taught and for a time had firmly believed, with agents with which they could infallibly combat each and every untoward symptom. Is it to be wondered at that many of them in a short time exchanged their early therapeutic optimism for a hopeless therapeutic pessimism? Could they not justly reproach for this the faulty teaching which had been accorded to them?

Medicine is still to a great extent an empirical art, but although we can hardly hope that it will ever be numbered among the exact sciences, there are signs which indicate that by slow degrees we are attaining to a therapeusis which may always be at least rational.

The book before us shows a decided advance, not only because it registers real progress made in our knowledge of disease processes and in our methods of treatment, but because it shows that the difficult subject of therapeutics is now being attacked in a frank and true scientific spirit. The writers have been chosen from among men who have brought to bear upon the subjects allotted to them not not only the results of a profound study of the existing literature, but also those which can be obtained only by a wide personal experience. They are not mere compilers; they know whereof they speak. If not all of them have added much that is new, they have at least accepted the dicta of others only after a painstaking proving of their statements. They have chosen the middle ground, and while confident that much can be accomplished by the use of the various therapeutic measures which they recommend, they do not by the employment of specious generalities attempt to conceal those points upon which our present knowledge is still defective. They hold a strong position midway between therapeutic optimism and therapeutic nihilism. Above all and first of all they preach the doctrine of prophylaxis.

In many of the articles a short account of the more prominent manifestations of the disease under discussion will be found, which, although adding considerably to the bulk of the book, will assist the reader materially in better appreciating the treatment recommended later. It is impossible to speak here in detail of all or of any of the various contributions. In his article on tuberculosis, Whittaker summarizes our present knowledge upon prophylaxis in general, hygiene and climatology, and has ably marshaled all the recent experience, upon which he formulates a treatment which, if it contains little that is really new, is perhaps the best at hand. If his conclusions as to the advantages to be obtained by the use of tuberculin are not in accordance with those of other authors, his results certainly deserve the most respectful consideration. Tyson's article upon the diseases of the kidney is brief but admirably comprehensive. In speaking of typhoid fever, Wilson, after a careful consideration of other methods, not only endorses the cold bath treatment but repudiates the notion that it is cruel. This latter view will certainly not be conceded by many even of the most enthusiastic supporters of the procedure. Serum therapy receives a full share of attention, and the subject has been treated, by the writers upon the conditions for which it has been advised, with a full appreciation of its importance. Whatever may be the opinion with respect to Laveran's view as to the identity of the parasite for the different forms of malarial fever, the careful and precise treatment which he lays down will not easily be improved upon.

Another point to be noted is the comparative simplicity of the prescriptions which are given; we are grateful for further evidence of the decline of polypharmacy. It would seem that we are beginning to appreciate Huxham's advice, "The physician should select a few (drugs) of the most effectual for his use of each sort and stick to them and not run into an immense *farrago* which some are so fond of." Many of the illustrations are good, but not a few are superfluous. As might be expected, the book lays no claim to perfection. The student who looks to it for infallible remedies for every disease will naturally be disappointed; the man of more moderate demands will find in it much that will help him in his daily work, and much that will stimulate him to the observation of disease processes and of the way in which they may best be met.

Frank R. Smith.

Die Färbetechnik des Nervensystems. By Dr. B. Pollack. (*Published by S. Karger, Berlin*, 1897.) Pp. 1–130.

This little book will be welcomed by neuro-histologists everywhere. It gives briefly the important steps in all the more impor-

tant methods used in microscopic examination of the nervous system, including those of recent date. In the first section the technique of cutting up the brain at autopsy is described, together with the methods for preserving the brain whole and for reproducing plastically the specimens found at autopsy. In section two the general technique of hardening, staining, embedding and sectioning is discussed. The methods of making serial sections, including the recent method of Flatau for making serial longitudinal sections of the whole spinal cord, are considered. We are glad to find mention made in section three of the work of Donaldson and others concerning the alteration in weight of the brain and cord after preservation in different hardening fluids. Too little attention has been paid to such alterations in previous books on technique. Apparatus for drawing and photography are described in section four. In the next section the methods of staining and impregnation are taken up. The various ways of demonstrating nerve cells and their axones and myelin sheaths are outlined. Golgi's method, Ehrlich's method and the new stains for neuroglia have been carefully considered. Nissl's method is given, and also Held's modification of it. The differentiation with alum solution is simple, easy to manage, very inexpensive, and yields in the reviewer's experience results fully as satisfactory as those afforded by the method with anilin oil and alcohol. In the sixth section certain general points to be borne in mind in the examination of normal and pathological cases are emphasized. It is particularly gratifying to find epitomized at the end of this section the *routine* methods employed in Waldeyer's laboratory for the study of the central and peripheral nervous systems. A brief bibliography is appended as well as an index. The book costs only two marks, and will probably find its way into many laboratories, where it will prove a safe and convenient guide. L. F. B.

Arbeiten aus dem Institut für Anatomie und Physiologie des Centralnervensystems an der Wiener Universität. Herausgegeben von Professor Dr. HEINRICH OBERSTEINER. V. Heft, mit 5 Tafeln und 46 Abbildungen im Texte. (*Leipzig und Wien: Franz Deuticke*, 1897.)

The most recent number of the fasciculi which are appearing at intervals from Obersteiner's laboratory is fully up to the general standard set by the preceding numbers. It contains seven articles, one of which, on the innervation of the blood-vessels of the brain, is by Obersteiner himself. In this article Obersteiner discusses the work of previous investigators and describes and pictures a small artery of the pia mater stained with gold, in which he brings the direct anatomical proof that the finer intra-cranial vessels, at least within the pia mater, possess their own nerves. He refers briefly to the physiological and pathological significance of such innervation.

Schlagenhaufer contributes an article on the course of the fibres in the optic paths, in which is discussed also the tabetic atrophy of the optic nerve. He believes that there exists sometimes, at any rate, a compact uncrossed optic bundle which, however, forms only a part of the uncrossed bundle, and probably corresponds to the inferior (external) fibres. The direction of the course of this bundle gives, he thinks, in all probability, the anatomical course of the uncrossed bundle. The question of the total or partial crossing of the optic nerves in man must, therefore, be regarded as decided in favor of the latter through anatomical investigation. He thinks that by means of a scheme constructed accordingly it is possible to explain all the hemianopsias. As regards Gudden's commissure, he makes out that a part of the fibres stream into the ansa lenticularis to become connected with both lenticular nuclei. Some of the fibres run in the peduncle of the hypophysis. In front of Meynert's commissure in the upper anterior part of the chiasm there is a small system of fibres which remains intact when the optic nerves and chiasm atrophy. He thinks it possible that the tabetic atrophy of the optic nerves may be due to pressure at the foramen opticum.

F. Rezek describes and pictures a primary polymorphous sarcoma of the brain.

Pflegler and Pilcz contribute a long article entitled "Beiträge zur Lehre von der Mikrocephalie." They describe twelve cases of their own, with consideration of no less than 365 bibliographic references.

An interesting study of the histology of the ganglion cells of the horse in normal conditions and after arsenic poisoning is given by H. Dexler. Two beautiful plates accompany his article. The same writer publishes also a short note on the course of the fibres in the optic chiasm of the horse.

Julius Zappert, in an article on degenerations in the spinal cord and medulla oblongata in the child, embodies the results of his studies on the spinal cord and medulla of children who have died during the first three years of life. He has used Marchi's method and describes his findings with especial reference to the changes in the various nerve roots. L. F. B.

BOOKS RECEIVED.

Tuberculosis. By William Osler, M. D. 8vo. 1897. Reprinted from "Loomis' System of the Practice of Medicine," New York and Philadelphia, I, pp. 731-848.

Diseases of the Ear, Nose and Throat and their Accessory Cavities. A condensed text-book. By Seth Scott Bishop, M. D., LL. D. 1897. 8vo, 496 pp. The F. A. Davis Co., Philadelphia, New York, Chicago.

Annual Report of the Trustees of the State Hospital for the Insane, at Warren, Pennsylvania, for the year ending November 30, 1896, *to the Board of Commissioners of Public Charities.* 1897. 120 pp. Herald Printing and Publishing Co., Erie, Pa.

Medical and Surgical Report of the Presbyterian Hospital in the City of New York. Edited by A. J. McCosh, M. D., and W. B. James, M. D. Vol. II, Jan., 1897. 8vo, 272 pp. Trow Directory Printing and Bookbinding Co., New York.

Guy's Hospital Reports. Edited by E. C. Perry, M. A., M. D., and W. H. A. Jacobson, M. A., M. Ch. Vol. LI, being Vol. XXXVI of the third series. 1895. 8vo, 272 pp. J. & A. Churchill, London.

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Lectures on Pharmacology for Practitioners and Students. By Dr. C. Binz. Translated from the second German edition by Peter W. Latham, M. A., M. D. Vol. II, 1897. 451 pp. 8vo. New Sydenham Society, London.

A Pictorial Atlas of Skin Diseases and Syphilitic Affections, in Photolithochromes from Models in the Museum of the St. Louis Hospital, Paris. With explanatory woodcuts and text. By E. Besnier, A. Founier, et al. Edited and annotated by J. J. Pringle, M. B., F. R. C. P. Fol. 1897. Part IX. W. B. Saunders, Philadelphia.

Transactions of the Indiana State Medical Society, 1895. Forty-sixth annual session held in Indianapolis, Ind., June 6th and 7th, 1895. 8vo, 534 pp. Carlon & Hollenbeck, Indianapolis.

Hysteria and Certain Allied Conditions. By George J. Preston, M. D. 1897. 8vo, 298 pp. P. Blakiston, Son & Co., Philadelphia.

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BULLETIN

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CONTENTS.

STUDIES ON THE LESIONS INDUCED BY THE ACTION OF CERTAIN POISONS ON THE CORTICAL NERVE CELL.

STUDY VII.

POISONING WITH PREPARATIONS OF THE THYROID GLAND.

By Henry J. Berkley, M. D., *Associate in Neuro-Pathology, The Johns Hopkins University.*

The favorable side of the administration of the thyroid extracts is shown in the very numerous articles in current medical literature published both in this country and in Europe. Comparatively few of these papers treat of other than the bare clinical results from the most auspicious standpoint, and it is quite safe to say, after a review of some of them, that the results would have been as brilliant had no medicament been administered.

It is nevertheless true that the extract, when administered to either man or the lower animals, will occasion very grave symptoms of a toxæmic nature, symptoms that involve the cerebral, the vaso-motor and digestive functions, and perhaps also the normal action of those ductless glands that throw into the circulation a potent though unknown substance; and when this administration is pushed even to a moderate degree death is almost invariably the result, either through the advent of convulsions, or extensive loss of weight with indications of profound poisoning of the central nervous system, shown by the change in the heart's action and in the respiratory movements.

A medicament having these qualities cannot, therefore, be administered with impunity to every sane or insane patient, and it was therefore directly for the purpose of ascertaining the toxicity of one of the best known varieties of the thyroid extract that the following series of experiments was undertaken.

The first portion of the investigation was made upon eight patients at the City Asylum, who, with one exception (No. 1), had either passed or were about to pass the limit of time in which recovery could be confidently expected. To these patients the thyroid tablets, each pill representing five grains of the fresh sheep's gland, were administered, the dosage beginning always with a single pill daily for a period of three days, then, after a certain tolerance had been established the dosage was increased to two tablets daily, and, unless the symptoms induced became grave, the number of pills was increased to three daily, the length of continuance depending upon the results.

Loss of weight always attended the administration of the tablets, as did disturbances of the circulation in the form of tachycardia and enfeeblement of the cardiac action. Digestive disturbances and slight pyrexia were present in more than half the cases. A peculiar odorous sweating was noticed with two patients, and increase of the cutaneous transpiration in

all. Irritability and a greater or less degree of mental and motor excitement were remarked in all cases, no matter how depressed or demented they had been previous to the administrations. Two patients became frenzied, and of these one died before the excitement had subsided, the immediate cause of the exitus being an acute disseminated tuberculosis. A peculiar gelatinous feel to the integument of the forehead and cheeks, precisely similar to that in myxœdema, combined with puffiness of the skin about the malar prominences, was very noticeable in those cases in which the administration of the extract was continued for any length of time. Urinary examinations were made several times before the commencement of the administration of the thyroid, and several times during its administration, but only for the purpose of noting the presence or absence of albumen and sugar. In the abstracts this analysis is mentioned only when there is evidence of the presence of these abnormal constituents.

Abstracts of Histories of Insane Patients Treated with Thyroid Extract.

I. *Adolescent insanity.* Martha H., æt. 17. Sister insane. Admitted with melancholic symptoms accompanied by considerable mental confusion. Occasionally had to be fed with stomach tube. Could not speak, and it was impossible to determine what delusions were present. After being several weeks in the Asylum she partly recovered, and then relapsed, and there appeared to be considerable mental reduction after the lapse of several months. Then began to brighten, and take more interest in her surroundings, also to gain flesh. The thyroid gland was, apparently, small on palpation. Weight at beginning of the thyroid administration 115 pounds. A single thyroid tablet was administered for ten consecutive days, at the end of which time there was slight febrile reaction, with a pulse ranging from 100 to 110 (normal 78). The mental change was very slight, patient exhibiting some irritability, but nothing more. The weight is now 109 pounds.

On the fourteenth day, the thyroid being continued, the first signs of improvement were noticed. Patient became brighter, ate food without compulsion, and on the twentieth day volunteered to do work about the ward and conversed rationally. The thyroid extract was discontinued on the twenty-second day, and patient was discharged one week later, six months after her admission, and did not relapse.

II. *Melancholia followed by deep dementia.* Olivia P., æt. 27. Education fair. No heredity. Married. Nutrition poor. Thyroid fairly well developed. Weight 100 pounds. On admission refused to speak, and would not take food.

Patient was deeply demented, and quiet for several months before the thyroid treatment was begun. She lost flesh very rapidly, and on the eleventh day of the treatment showed pronounced mental and motor excitement. Slight febrile reaction, accompanied by a pulse rate of 120 beats. On the twelfth day she passed into a state of frenzy, the motor excitement being more pronounced than the mental symptoms. The thyroid extract was now discontinued, but the excitement kept up, despite numerous attempts, with narcotics, baths, and systematic exercise, to allay it, for seven weeks, at the end of which time she died with the clinical evidences of acute miliary tuberculosis. An autopsy was not permitted.

III. *Beginning dementia.* Frank G., æt. 20, well educated, was admitted to the asylum suffering from an attack of acute mania. There he improved, but was taken out too soon, relapsed, was readmitted, and then gradually demented. Thyroid of normal size. Is good tempered. Weight at beginning of thyroid administration 125 pounds. On the seventh day of the treatment became quite irritable and impatient. By the fifteenth day he was so quarrelsome that it was necessary to restrain him. During these 15 days he lost five pounds, and there was considerable tachycardia and sweating. The myxœdematous symptoms were not so pronounced as in some of the other cases. The administration of the extract now being discontinued, he regained weight, became more quiet, and after the lapse of several weeks he was sent to his friends somewhat improved.

IV. *Dementia.* John B., æt. 21, admitted as a case of acute mania, and after a period of four months gradually demented, became quiet, and not at all irritable. Thyroid gland normal. Treatment was now begun, and within a week there was pronounced febrile reaction, with tachycardia and sweating. There is a marked difference in the aspect of the face, which now appears puffed and rounded, in contrast to the former rather emaciated appearance. The facial expression also became anxious, but there was no pronounced excitement. The treatment was continued three weeks longer, without producing other change than an increase of the myxœdematous characteristics, and was then discontinued. From a mental standpoint, the course of the patient's disease was now rapidly downward, and he became absolutely demented and degraded.

V. *Chronic melancholia.* Marcus Z., æt. 30, Russian Jew, admitted to the asylum with alternating melancholia and mania. Thyroid normal. Much emaciated from chronic diarrhœa. Refused food at first. Has been quiet for some months, suffering from well marked delusions of persecution. Under enforced feeding became well nourished, but not less melancholic. Six months after admission treatment with thyroid extract begun. One tablet for ten days, two for four days, and three daily for two weeks longer. On the 11th day became much excited, complaining that his countrymen wished to kill him. There was slight febrile reaction and increase in the pulse rate to 120 (normal 75). The cheeks soon began to assume a marked puffiness, and on palpation had a jelly-like feel. No other phenomena were noticed, except that at the end of the month's treatment he had lost eight pounds, which he rapidly regained after it was discontinued. Then he also became quiet, and at the date of writing still remains an inmate of the institution, retaining his old-time delusions.

VI. *Dementia following puerperal melancholia.* Katie S., æt. 25, was admitted in 1893, four weeks after confinement. Recovered in about six weeks, was taken home, and there relapsed and became permanently demented. Is untidy, mischievous, but never excited. Pulse rate normally 85 to 90. Thyroid normal. Was placed on thyroid extract, one pill, then two pills daily. In second week marked febrile reaction,

pulse 120 to 130, very weak. There is considerable sweating. Facial puffiness well marked. Has become very irritable, restless, and difficult to control. Thyroid extract discontinued after three weeks' administration, after which she gradually returned to her usual condition.

VII. *Deep dementia following confusional melancholia.* Maggie E., æt. 25, was admitted in December, 1893. Thyroid normal. When treatment with the thyroid extract was commenced was untidy and deeply demented. On the tenth day there was slight febrile reaction accompanied by slight motor excitement. These symptoms abated in the course of a few days, though the administration of the thyroid extract was continued, and, after three weeks, no improvement having been noticed, it was discontinued.

VIII. *Imbecility with recurrent mania, followed by apparent dementia.* C. B., æt. 21, admitted with second attack of excitement in December, 1895, and within a few weeks became apparently deeply demented. Thyroid gland very small. Administration of the extract was begun, and after a few days there was febrile reaction, considerable sweating, and a myxœdematous appearance of the integument of the face. The pulse rate altered from 72 to 110, and the patient lost weight rapidly. There were also considerable motor and mental excitement, with the febrile symptoms, all of which gradually abated, though the treatment was faithfully kept up for a considerably longer time. The patient has had several lucid intervals during the fall of 1896, but now seems completely demented.

The above experiment upon eight human subjects points out conclusively that the administration of even the very best and purest of the commercial desiccated thyroid tablets is not unattended by danger to the health and life of the patient, and that at times the administration of very limited amounts of the gland may be followed by symptoms not only difficult to control, but of very marked influence upon the future mental powers of the subject.*

These results obtained, we then decided to further pursue our experiments upon the lower animals, to determine the amount necessary per kilo of weight to cause death, the immediate cause of the dissolution, and the lesions, both macroscopic and microscopic, present at death, especially those pertaining to the cerebrum.

Through the kindness of Dr. Crawford of the Pharmacological Laboratory, who undertook the ordering of the administration to the animals, we obtained material from five mice and three guinea-pigs, to which the same desiccated sheep's thyroid tablets used in the first part of the investigation had been fed; also the cerebrum from one guinea-pig to which had been administered thyroid extract, and the cerebrum of a dog from which the thyroid had been extirpated about one year previous to its death, but in which, at the autopsy, supernumerary thyroids were discovered, though the animal during life had exhibited minor symptoms of a cachexia.

A portion of the material for microscopic examination was hardened in Muller's fluid for after-treatment according to the silver-phospho-molybdate formula, and another portion in alcohol, for staining with the anilines, hematoxylin, and more particularly to examine into the lesions of the blood-vessels, both in the abdominal viscera and cerebrum.

The five mice were first fed with the tablets. All of them ate the pills readily to obtain the sugar coating them. For a few days there was no appreciable effect. Then they grew dull, the cheeks became puffy, there was trembling and increase of the frequency of the respiratory movements, and death rather suddenly.

Abstract of the Histories of the Thyroid Mice.

No. I. Administration of the tablets commenced Aug. 22, '96. One pill 22nd; three, 24th. Animal remains bright and eats other food; 25th, two tablets. On 26th, it seems frightened and the face appears swollen; on the 27th instant, it is still trembling very greatly, and no pill was given. On the 28th, it is very much brighter and the trembling has almost ceased. On the 29th, is bright, and feeding of the thyroid was again begun. Sept. 1st, three pills were fed, the animal eating nearly the whole quantity. The 2nd instant, the face is again swollen, and on the 3rd, refused to eat a portion of the tablets, and has become quite dull. On the 4th and 5th instant, the animal continued dull, trembling, and looks weak and sick. On the 7th, the eyes are very bright, and there is slight emaciation. Five pills were given, but not all were eaten. On the 8th, only two pills were taken; there is much trembling. Died during the night of the 9th instant, having eaten a portion of the tablets left in the cage.

The autopsy showed congestion of all the viscera, but without hemorrhage. The brain was soft.

No. II. On the 22nd August, one pill administered, on the 23rd and 24th, the same quantity, but little not being eaten. On the 25th, two pills were eaten, the animal still remaining bright. On the 26th, two tablets were eaten, and the face shows signs of swelling. On the 27th, the testes have become swollen, in addition to the face, but the appetite is still retained. On the 28th, the eyes are partly closed, and on the 29th, the animal is trembling, the legs are dragged, but it still takes care of its coat.

September 1st, the animal is dull, the face much swollen. Three pills were eaten. On the 3rd, is much brighter, sleeps well, but has not taken all the pills during the last two days. On the 5th instant, will hardly touch the sugar-coated tablet. On the 7th, the face is markedly swollen, the animal is dull, the hair less sleek, and the eyes almost closed. Respiration 134 per minute. Died in convulsions at 2.30 P. M.

The autopsy was performed immediately. Besides some unimportant congestion of the abdominal viscera there were no ascertainable lesions.

No. III. Commenced feeding on 22nd August, but no symptoms were noticed until the 26th, when the face became slightly swollen and the animal declined to eat the pill. On the 28th, there is slight trembling. On the 30th, the trembling continues. On Sept. 2nd and 3rd, took daily three pills. On the 5th, is dull, tottering, very weak. On the 7th instant, the hair is rough, and it seems weak, but eats the pills

*I do not take into consideration the possible presence of putrefactive products in the tablets, as they were perfectly free from all evidences of decomposition.

well. On the 8th, is trembling very much, but eats the pills. Died during night.

Autopsy showed congestion of the abdominal viscera. Brain rather soft.

No. IV. Feeding commenced on August 22nd, but does not eat the tablet well, hardly averaging ¾ of a pill daily. On the 26th, the animal is bright, but the face is slightly swollen. On the 29th, refused to eat pill, but remained dull until September 2nd, and thereafter refused to eat pill at all. On the 12th instant, had apparently fully recovered.

No. V. Administration commenced on the 22nd August, and the dried gland was all eaten. On the 26th instant, the face is swollen. On the 28th, there is much trembling, but three pills were eaten. On the 29th, would not eat pill, but on Sept. 1st ate four pills. On the 5th instant, is trembling considerably, but ate two pills. On 8th instant, was bright, though trembling. On morning of 9th instant, found dead in cage. The autopsy showed the usual congestion.

Abstract of the Histories of the Thyroid Guinea-Pigs.

No. I. Fed with thyroid extract, 20 mg. daily, from Oct. 21st until Oct. 30th, on which day it died. Weight at beginning of experiment, 620 grammes. The animal became dull and gradually emaciated. Weight at autopsy, 380 grammes. All internal organs very much congested. The animal received a total of 180 mg. of extract.

No. II. Pig fed on the same desiccated thyroid as in the former experiments. Weight, 810 grammes. On Oct. 21st, one and a half pills administered; on 22nd, four pills; on the 23rd, the same quantity. The respiration had now reached 144 per minute. On the 24th, 25th and 26th, four tablets were fed daily, and during the night of the 26th, the animal died. At the autopsy the abdominal organs were found to be much congested. Weight, 620 grammes (loss 190 grammes). This animal received about seven grammes of the dried thyroid gland, or less than one per cent. (.864) of its bodily weight to produce a lethal effect.

No. III. Fed on desiccated thyroid tablets. Weight, 580 grammes. Oct. 21st, one pill; on 22nd, three tablets; on the 23rd instant, four; on the 24th, 25th and 26th, the same; on the 27th instant, six pills; on the 28th, four tablets; on the 29th, five; on the 30th, five. The animal had been for several days very dull and had rapidly emaciated. The exitus took place on the morning of the 30th instant. At the autopsy the viscera were found to be much congested. The weight was 320 grammes. Loss of weight during the nine days of the experiment, 260 grammes. The animal received more than 2 per cent. of its weight in the dried gland to produce dissolution.

No. IV. The same thyroid preparation fed. Weight at beginning of the administration, 610 grammes. On Oct. 22nd, two tablets were fed to the animal; on the 23rd, three; on the 4th, four pills; on the 26th, six pills; on the 27th, four pills; on the 28th, five pills. The pig has become very dull and does not take care of its fur. Died Oct. 30th. At the autopsy the animal weighed 370 grammes (loss, 240 grammes) and the viscera were much congested. This animal received 1.30 per cent. of its bodily weight of the gland to cause death.

No. V. Thyroid dog (Dr. Abel). Thyroid gland extirpated *in toto* in Oct. 1895; died one year later, after showing profound emaciation and a dermatitis suggestive of myxœdema. At the autopsy several parathyroid bodies the size of a small pea were discovered. This animal was fed for several months on thyroids and thyroid extracts, seemingly without benefit. The autopsy showed no demonstrable lesions.

The guinea-pig series may be looked upon as an example of the acute type of poisoning by the administration of thyroid gland, while the mice are of a more chronic order. It is impossible to estimate the exact percentage necessary to produce lethal results with the mice, for the reason that these small animals always left some crumbs of the tablets on the floor of their cages which it was not practicable to collect. The guinea-pigs on the other hand were fed with the entire pill without loss, and but in one case was less than about one per cent. of desiccated gland found to produce lethal results, the administration being distributed over five days.

The microscopic examination of the cerebra of the eight mice and guinea-pigs showed, both with the silver phosphomolybdate, and aniline and hematoxylin stains, an absolutely normal condition of the nerve elements and neuroglia; none of the varicose and atrophied dendrites, with loss of the gemmulæ, of the former studies being discovered. The corpora retain their angularity and sharp outlines, and the axôns with their appendages, the collaterals, retaining their natural appearances. The sections stained with anilines and hematoxylin showed the normal appearances of the nucleus and nucleolus, and not even in the tunics of the blood-vessels, where pathological changes were most carefully sought for, could any demonstrable lesion be discovered.

The nearest approach to any pathological condition found was in the cerebrum of the dog that had had its thyroid gland extirpated a number of months before death, though even here the lesions were confined to a very few tumefied dendrites, a condition that was most probably caused by the long continued state of mal-nutrition into which the animal had fallen.

More particular attention was paid to the examination of the liver than to the other organs of the abdominal cavity, but here again we failed to find more than a turgescence of the blood-vessels, the liver cells retaining their natural characteristics.

It is obvious from these results that the death of the various animals was induced by an entirely different kind of intoxication than that causing the lesions of the nerve elements in ricin and alcohol toxæmias, and it is therefore a poison that does not induce degenerative alterations in the sheaths of the arteries, and the consequent disturbance of the nutritive supply, followed by pronounced changes in the neurôns, dependent to a certain degree upon the intensity of the vascular lesions; but acts upon the general system in an entirely different manner, and is essentially more subtle in its effects upon the nerve tissues, corresponding more to the action of a group of chemical poisons that leave no trace of their effect after death upon the nerve cell, but during life inducing symptoms directly referable to the central nervous system. The tissue metabolism induced by the action of these poisons upon the nerve cell we can only at present conjecture.

FIVE SUCCESSFUL CASES OF GENERAL SUPPURATIVE PERITONITIS TREATED BY A NEW METHOD.*

By J. M. T. Finney, M. D., *Associate Professor of Surgery, The Johns Hopkins University.*

Recovery following laparotomy for purulent peritonitis is unfortunately of sufficient rarity to excite interest whenever it occurs. My object in making this report to the Society is two-fold; first, to record five successful cases of laparotomy for general suppurative peritonitis, all treated by the same method; and second, to describe briefly the method itself. The principle involved is not a new one; only in the manner of carrying it out is there any originality claimed.

Since the appearance in 1877 of the classical work of Wegner, and later that of Grawitz and others, it has been known that the healthy peritoneum is capable of disposing of a considerable amount of infectious material. J. G. Clark, in a recent article,† reviews the literature of the subject and gives the conclusions reached by the experimenters in this direction. All agree that the peritoneum is able under favorable conditions to take up a relatively large amount of infectious material and dispose of it effectually. These observers were dealing with a more or less healthy peritoneum. On opening the abdomen of a patient suffering from general suppurative peritonitis, however, we have very different conditions with which to deal. The observations of Pawlowsky would indicate that the lymph channels leading from the peritoneal cavity are choked with infectious bacteria and inflammatory products in purulent peritonitis, and that thus the efficiency of the peritoneum would be greatly impaired. Our observations clinically seemed hardly to bear this out.

The question that suggested itself to our mind was this, whether or not the peritoneum, even under these most unfavorable conditions, still retained its absorptive power. It seemed to us, from our experience in operating upon such cases by the methods heretofore employed, that they were inadequate and did not remove a sufficient quantity of the exudate, but left the peritoneum little better off than before. With this idea in mind we devised a plan of treatment which, so far as we know, has not been employed elsewhere.

The steps of the operation are as follows: Make a sufficiently long incision to admit of easy access to all parts of the peritoneal cavity. Quickly withdraw the coils of small intestine from the peritoneal cavity, beginning with the worst coils first. Remove all, or as much as is necessary of the small intestine and place it outside the abdomen, covered with warm gauze or towels, thus practically disemboweling the patient for the time being. Then thoroughly and systematically wipe out the peritoneal cavity with large pledgets of gauze wrung out of hot salt solution, paying particular attention to the pelvic portion. In some cases it may be well in addition to flush out the cavity with warm salt solution, but this is rarely necessary.

Next the small intestine should be systematically examined loop by loop while still outside the abdomen, and rendered macroscopically clean by wiping with gauze compresses wrung out of hot salt solution. It is necessary to wipe with considerable force at times, in order to remove adherent flakes of partly organized lymph. It should be done thoroughly and conscientiously, however, as upon this depends, we believe, in great measure, the success of the operation. It facilitates the cleansing process, as well as lessens the shock of the operation, if the wiping of the intestinal coils is carried on under a constant irrigation of warm salt solution.

After being cleansed macroscopically of all foreign material, pus, feces, lymph, etc., the intestine should be replaced in the abdomen—the worst or sutured coil being the last, or most superficial, in order that it may be the better drained by being packed about with gauze, if necessary.

The abdominal wound is then tightly closed, leaving just room enough between two sutures for the gauze drain. If there are any evidences of distension or pain the abdomen should have the Paquelin cautery thoroughly applied, and the bowels moved early by calomel in broken doses, followed by salts and a turpentine enema.

It is not claimed for this method that it will cure every case of general suppurative peritonitis. We believe, however, that a larger percentage of cases will recover after this method than any other with which we are familiar.

To insure success with any method it is essential that the operation should be performed within a few hours after the perforation has taken place. This is well brought out in the very interesting series of experiments on dogs made for me by Messrs. Elting and Calvert of the Johns Hopkins Medical School, a report of which is subjoined.

Five cases have been operated upon by this method up to date, all of which have recovered. The first case, a case of perforating typhoid ulcer, has already been published,* and hence only a very brief abstract of the history will be given here.

Case I.—Male, aged 47, on about eighth day of mild attack of typhoid developed symptoms of perforation. Entered hospital 14 hours later and was operated upon immediately. Peritoneum everywhere intensely congested, roughened and dull, and covered with flakes of plastic lymph. Considerable amount of turbid purulent fluid in abdominal cavity. Perforation in ileum about 14 inches from ileo-cæcal valve. Fecal matter exuding from opening. Peritoneum cleansed in the manner described, gauze drainage. Recovery.

Case II.—G. W., male, aged 20. Saw patient for the first time, November 24, 1896, in consultation with Dr. Barringer in Charlottesville, Va. Patient gave history of four previous mild attacks of appendicitis, from which he had promptly

*Read before the Medical and Chirurgical Faculty of the State of Maryland at its Annual Meeting in Baltimore, April 27, 1897.

†Bulletin of the Johns Hopkins Hospital, April, 1897.

*Annals of Surgery, March, 1897.

recovered. The night before he had eaten very heartily of apples. He was awakened about 3 a. m. with severe abdominal pain, cramp-like in character. At about 6 a. m. Dr. Barringer was called. He stated that at this time, three hours after the beginning of the attack, the patient presented the classical symptoms of peritonitis. When I saw him, 24 hours later, he had a temperature of 102° and a pulse of over 100, and from the first had suffered intense pain, which was controlled only by morphia hypodermically. He had had nausea and vomiting all day. Examination of the abdomen showed slight distension and great rigidity of the abdominal muscles. A slight tumefaction could be made out just to the inner side of the anterior superior spine of the ilium on the right side. Tenderness very marked. Immediate operation advised and agreed to. Incision 5 inches long in right linea semilunaris. On opening the peritoneal cavity the intestinal coils in the right lower quadrant of the abdomen were found to be congested and dull and covered with flakes of adherent lymph. Elsewhere the intestinal coils were found to be congested, but not otherwise much changed in appearance. The pus, of which there was perhaps 200 cc., was not walled off, but everywhere present in pockets between the adherent intestinal coils. The appendix was readily found. It was closely adherent to the pelvic brim on the one side and the cæcum on the other. Its distal end was swollen and distended to the size of my thumb, perforated and gangrenous over an area about as large as a five-cent piece. Appendix was ligated and excised, and stump covered with peritoneal cuff and suture. The peritoneum was treated in the manner above described. Recovery.

Case III.—This patient was seen first on December 14, 1896. His history is in brief as follows: R. S., male, aged 33 years. Has had no previous similar attack. The night before he was taken sick he attended a banquet and ate heartily of solid indigestible food. He was attacked with severe abdominal pain about 3 o'clock the next afternoon. The pain at first was general and cramp-like; nausea and light vomiting during the night. Morphia was necessary to relieve him. The next day he was unable to get up. Toward evening his physician gave him a cathartic, after which the bowels moved 8 or 10 times in quick succession. The next morning the pain had shifted to the right side and was severe. He received a hypodermic of morphia and got on fairly well until about 6 p. m., about 60 hours after the onset of the attack, when he was taken with a sudden severe pain in the lower right side of the abdomen. The pain for a time was excruciating at the base of the penis. Vesical and rectal tenesmus marked. When I saw him, about 4 hours later, in consultation with Dr. Reiche, he had a temperature of 105° and pulse of 150, profoundly collapsed. I have never seen such a hard and retracted abdomen as he presented. His condition appeared grave. Immediate operation advised and consented to.

Incision about 5 inches long, in right linea semilunaris. On opening abdomen the intestinal coils were found not to be distended but considerably congested. Beginning in the right lower quadrant there was found a considerable amount of thin pus containing flakes of lymph. This condition extended over into the left side, down into the pelvis and up into the hypogastric region. The appendix was found to be gangrenous and perforated, and was removed. The toilet of the peritoneum was made in the manner already described, by disemboweling and vigorously scrubbing the parietal and visceral peritoneum until macroscopically clean. The intestinal coils were then replaced, a gauze drain inserted, and the abdominal wound closed except a small opening for the drain. He made an uninterrupted recovery.

Case IV.—M. B., boy, aged 10. Operation by Dr. J. C. Bloodgood, January 7, 1897. Five days before admission to the hospital was struck in the abdomen by the fist of a playmate. Next day felt severe pain in the right iliac region. This progressively increased for three days, when vomiting began and the pain became general. Two days later was brought to the hospital, when his condition was found to be in brief as follows: Temperature 101°, pulse 128 and fairly good. Slight abdominal distension. Muscular spasm marked on right side, present but less marked on the left. General abdominal tenderness. Under ether a definite tumefaction could be made out in the region of the right kidney. This proved to be an abscess behind the cæcum, extending from the iliac fossa below to the liver above, and in this cavity was the diseased appendix. There was found no walling off of this from the general peritoneal cavity. The entire pelvis was filled with yellow pus and all the intestinal coils were covered with flakes of fibrin. The stomach and spleen were not seen, but the surface of the liver looked exactly as if it had been covered with yellowish-white paint. The appendix was removed and the entire abdominal cavity thoroughly wiped out with gauze pledgets wrung out of salt solution. The exudate was scrubbed off the liver's surface, after which it looked simply congested. A gauze drain was inserted and the abdominal wound partly closed. He made an uninterrupted recovery. Cultures and cover-slips from the peritoneum showed colon bacillus and a coccus (not differentiated).

Case V.—R. S. P., aged 9, a schoolboy, entered the Johns Hopkins Hospital, Feb. 26, 1897. He had always been healthy except for measles, whooping cough and chicken-pox.

Family history good except remote cases of tuberculosis on both sides.

Just 48 hours before entering the hospital first complained of pain in abdomen. Three hours later had an attack of vomiting. Pain in abdomen was at first general, but in a few hours became localized in the right iliac and lumbar regions. After about 24 hours the pain lessened somewhat, and he sat up for a little while, but shortly after pain and vomiting returned with increased severity. A physician saw him after about 36 hours and gave him calomel in broken doses. His bowels moved twice. His condition did not improve, and by advice of his physician was brought to the hospital at 8 p. m., 48 hours after the onset of the attack. His condition then was as follows: Face flushed and anxious. Pulse 126; temp. 102.8°; resp. 56, and entirely thoracic; abdomen generally distended and tender, especially in right iliac fossa, where the tenderness is extreme and muscle spasm very marked. Pain is most marked here also. Liver and spleen not palpable. Liver dullness on right corresponds about to costal border.

Percussion over right iliac and lumbar regions shows dullness; tympanitic over left side. Heart normal. Fine moist râles over bases of both lungs. No history of any similar previous attack.

Diagnosis.—Perforating appendicitis with beginning general peritonitis. Immediate laparotomy advised and agreed to. Ether. When thoroughly anæsthetized, a small, hard mass, somewhat movable, could be felt just over the middle of Poupart's ligament. An incision about 15 cm. long was made parallel to and over the right linea semilunaris. After exposing the peritoneum and before opening it several bubbles of gas could be seen free in the peritoneal cavity. On opening the peritoneum a considerable amount of thin, cloudy seropurulent fluid escaped and some gas. The mass felt before was found to be the appendix with a roll of omentum adherent. The intestines, especially the cæcum, were distended and congested, and covered with flakes of fresh fibrinous exudate. The congestion was most marked in the immediate vicinity of the appendix.

The appendix itself was superficially placed and freely movable, not walled off, but had a portion of omentum adherent. It was rather long, and curled upon itself, with a constriction at about the junction of its proximal and middle thirds. It contained two concretions, the larger of which was engaged tightly in the constriction, and from this point to the tip the appendix was gangrenous and softened. A small perforation was present at the distal end of the date-seed like concretion. There had been an apparent attempt of the omentum to surround the entire gangrenous end of the appendix, but it had not quite succeeded. The appendix together with the adherent omentum was ligated and excised.

Pelvis was found to be full of pus, and the peritoneum treated as above. He made a rapid and complete recovery.

Bacteriological examination of the peritoneal exudate showed the presence of streptococcus, staphylococcus, and bacillus coli communis.

Note.—Since reading the above article, I have operated upon one additional case of general peritonitis. The patient, a young woman, was *in extremis* at the time of the operation, which was undertaken simply as a forlorn hope. This operation was secondary to one performed several days previously by another surgeon for appendicular abscess. There was found present a general peritonitis, with much plastic lymph covering the greatly distended and adherent coils of intestine. There was very little purulent fluid in the abdomen. Her pulse was very rapid and thready, and her temperature had risen several degrees. After the operation she was placed in a continuous bath, which added greatly to her comfort. The operation seemed to prolong her life, as she lived about thirty-six hours following it.

AN EXPERIMENTAL STUDY OF THE TREATMENT OF PERFORATIVE PERITONITIS IN DOGS BY A NEW METHOD OF OPERATION.

By Arthur W. Elting and William J. Calvert.

[*From the Anatomical Laboratory of the Johns Hopkins University.*]

At the suggestion of Dr. Finney and with the permission of Prof. Mall, the writers have undertaken an experimental study of perforative peritonitis in dogs, with especial reference to the method of treatment of this disease in human beings, introduced by Dr. Finney. Inasmuch as this is a preliminary report, the literature upon the subject will not be considered. It may be mentioned, however, that so far as we know no previous work of this nature has been done from a surgical standpoint. It was decided to divide the series of experiments into four groups:

1. To scrub the intestines of a series of normal dogs and study the condition of the abdominal cavity at varying lengths of time after the operation, in order to determine the results of the mechanical irritation.

2. To determine how long it takes a perforative peritonitis to destroy life.

3. To perforate the intestines of a series of dogs, and after varying lengths of time to operate upon them again, closing in the perforation and cleansing the abdominal cavity and the surface of the intestine and mesentery, and after variable periods of time to kill the dogs which recovered, and study the condition of the abdominal cavity.

4. To perforate the intestines of a series of dogs, and after varying lengths of time to close in these perforations without removing from the abdominal cavity any of the exudate or foreign matter present, and to study the results of this operation.

The dogs used in these experiments varied in weight between 18 and 52 pounds, most of them weighing about 25 pounds.

For the first group of experiments four dogs were used. By a median incision the abdominal cavity was opened, the intestine and parietal peritoneum were vigorously scrubbed with gauze sponges wrung out in warm normal salt solution, and kept covered with warm towels. After this treatment numerous minute hemorrhages caused by the scrubbing were noticed over the peritoneal surfaces, and the intestine presented an extremely congested appearance. It was then thoroughly irrigated with warm normal salt solution, which had a marked effect in reducing the congestion. The intestine was then replaced in the abdominal cavity and the wound closed. The process of scrubbing as performed by the operator and an assistant required from 8 to 12 minutes. In every case the dog appeared ill for about 24 hours after the operation, after

which a marked improvement in the condition was noticeable. Usually by the end of the second day the animal seemed quite well.

Of these four dogs one was killed by an accident one day after the operation. Autopsy showed a very small amount of blood-tinged serum in the abdominal cavity. The surface of the intestine and parietal peritoneum presented numerous hemorrhagic areas caused by the scrubbing at the time of operation. The surface of the intestine was roughened, though not adherent. Cultures from the abdominal cavity were sterile.

A second dog was killed at the end of three days. At autopsy no appreciable amount of fluid was found in the abdominal cavity. Numerous fibrinous adhesions of the coils of intestine to each other, to the inner surface of the abdominal wound and to the omentum were found. The surface of the intestine was slightly roughened and presented numerous hemorrhagic areas. Similar areas were also seen upon the mesentery near its attachment to the intestine and upon the parietal peritoneum. These were likewise caused by the scrubbing at the time of operation. Cultures from the abdominal cavity were sterile.

A third dog which was in excellent health and condition was autopsied at the end of five weeks. No appreciable amount of fluid was found in the abdominal cavity. The appearance of the organs was everywhere normal except for numerous adhesions of coils of the intestine to each other, to the omentum, to the inner surface of the abdominal wound and to the stomach. These adhesions were of a firm character, being apparently composed of fully developed connective tissue. Cultures from the abdominal cavity were sterile. The fourth dog is still alive and will be autopsied later. From this group of experiments we conclude that mere mechanical irritation may cause the formation of extensive adhesions in the abdominal cavity of the dog, but these seem in no way to seriously interfere with the animal's general health.

For the second group of experiments four dogs were used. Because of its accessibility and the comparative ease with which the perforation could be closed, it was decided to perforate the cæcum. By the use of a stick of caustic potash a perforation 1½ cm. in diameter was made in the end of the cæcum, after which it was replaced in the abdominal cavity and the abdominal wound closed. These dogs showed symptoms of a severe peritonitis and died in from 12 to 20 hours from the time the perforation was produced. Autopsy showed practically the same pathological condition in each case. From 150 to 250 cc. of a turbid bloody fluid were found in the abdominal cavity. The surface of the intestine presented a marked hemorrhagic condition, both diffuse and petechial in character. The omentum, mesentery and parietal peritoneum presented a similar appearance. Flakes of reddish yellow lymph were deposited over the surface of the viscera, particularly in the region of the liver, diaphragm and lesser omentum. Slight fibrinous adhesions between the coils of intestine were noted. The mucosa of the intestine presented more or less of a hemorrhagic appearance, and in some of the cases bloody contents were found in the lumen of the gut. In short, the pathological condition was one of an intense hemorrhagic peritonitis associated with a more or less extensive hemorrhagic enteritis. The bacteriology of each of these cases was carefully worked out and will be referred to later.

For the third group of experiments twelve dogs were used. The method of operation was as follows: An incision was made on the right side just outside the rectus muscle, the cæcum brought out and perforated in the same manner as practiced in the experiments already described. The cæcum was then replaced in the abdominal cavity and the abdominal wound closed. From five to seven hours after the perforation was produced these dogs were again opened by an incision in the median abdominal line. The perforated end of the cæcum was brought out and the perforation closed by means of a row of mattress sutures, after the necrotic tissue at the seat of the opening had been resected. The abdominal cavity was then opened, and the intestines being lifted out, were kept carefully covered with towels wet in warm normal salt solution. With gauze sponges wrung out in this solution the surface of the intestine and mesentery was carefully wiped till it appeared macroscopically clean. The abdominal cavity was next wiped out and rendered macroscopically clean, the intestine in the meantime being frequently irrigated with warm salt solution and kept covered with warm towels. After another thorough irrigation of the intestine with the warm salt solution it was replaced in the abdominal cavity and the wound closed in the usual manner. We cannot emphasize too strongly, in doing these experiments, the advisability of thorough and constant irrigation of the intestine while it is outside the abdominal cavity, for in every case it seemed to reduce the congestion and in some cases the distension. The cleansing process required from 10 to 20 minutes according to the amount of exudate and foreign matter present.

Of these 12 dogs one was operated on at 5 hours after the perforation was produced, one at 5¼ hours, one at 5½ hours, one at 6 hours, two at 6¼ hours, three at 6½ hours, one at 6¾ hours, one at 7 hours, and one at 7¼ hours.

In every case the dog showed marked symptoms of peritonitis and evidences of pain. When lying down the legs were drawn toward the abdomen, which was held very tense. Any attempt to straighten out the legs seemed to cause great pain. In some cases the dog vomited a somewhat bile-stained fluid. In every case the abdominal cavity at the time of the second operation contained from 100 to 250 cc. of a turbid bloody fluid. The intestine, mesentery and omentum in nine of these cases presented a generalized hemorrhagic condition. In the remaining three cases this condition seemed more confined to the coils of intestine in the region of the cæcum, though all the peritoneal surfaces seemed more injected than normally. In nine of the cases more or less numerous flakes of yellowish red lymph were found adherent to the gut, mesentery, greater and lesser omentum and other abdominal viscera. In eight of the cases the intestines seemed more or less distended when replaced in the abdominal cavity, Immediately after the cleansing of the surface of the intestine and the abdominal cavity the animals seemed to be much more comfortable, and in the case of every dog which recovered there was a progressive improvement in the condition.

In no instance did a dog which recovered show signs of

pain after the cleansing operation was performed, and usually in from two to three days the dog seemed to have recovered completely from the peritonitis, so far as external symptoms would indicate. Of course the abdominal wound made at the second operation was infected, and this in nearly every case failed to heal by first intention, which delayed somewhat the complete recovery of the animal. Of the 12 dogs thus treated three died without any apparent beneficial effect of the operation, death ensuing within 20 hours from the time the perforation was produced. These three dogs were operated upon 6¼, 7 and 7¼ hours respectively after the perforation was produced. A fourth dog operated upon 6½ hours after the perforation died 30 hours later; the operation apparently prolonged its life about 20 hours. In three of these cases the peritonitis was the most severe we met with in our experimentation, and the dogs in a weak condition at the time of operation, which was done comparatively late in the disease. In each of these four cases the intense hemorrhagic peritonitis described under the second group of experiments was found at autopsy.

The remaining eight dogs were apparently cured of the peritonitis. Of these eight, one died from the protrusion of the intestine, due to the breaking down of the abdominal wound on the fifth day after the operation. In a second case death resulted on the eighth day from a localized peritonitis due to the extension of the suppurative process from the abdominal wall. A third dog which appeared quite well 2½ days after the operation died rather suddenly on the fourth day from a perforation in another portion of the intestine which had come into contact with the caustic potash upon the end of the perforated cæcum at the time the first perforation was produced. A fourth dog appeared quite well at the end of twelve days after the operation, having an excellent appetite and seeming very lively. On the 13th day the dog seemed sick, and gradually grew worse till its death, on the 17th day after the perforation was produced. At autopsy small abscesses were found extending along each stitch in the abdominal wall down to the inner surface of the wound, where the intestines and omentum were adherent. No distinct sinus leading into the abdominal cavity could be demonstrated. The abdominal cavity contained about 100 cc. of yellow pus, collected for the most part in the pelvis and also extending up toward the diaphragm. The coils of intestine and omentum were firmly adherent in a mass in the upper part of the abdominal cavity. The intestine was also adherent to the liver and gall bladder. The parietal and visceral peritoneum were intensely hemorrhagic in places. No apparent walling off of the pus existed. An extension of the suppurative process along the stitches was supposed to have been the source of the infectious material. A fifth dog also apparently made a complete recovery, both wounds healing with the exception of a small sinus in one of them. This dog seemed quite well for nearly three weeks, when it became ill and died three weeks and two days from the time it was operated upon. At autopsy the abdominal cavity presented a perfectly normal appearance, with the exception of numerous adhesions of coils of the intestine to each other, to the omentum, liver and parietal peritoneum. These adhesions were not very firm in character. The sinus mentioned above was found to lead to an abscess cavity about the size of a hen's egg, situated in the pelvis to the right of the uterus. This abscess was completely shut off from the rest of the abdominal cavity and was the undoubted cause of death.

All of these dogs which died as a result of the suppurative process following the operation would probably have recovered could they have been subjected to the same treatment human beings would receive in a similar condition, for it must be remembered that it is practically impossible to drain or treat suppurating wounds in dogs. A sixth dog, apparently in the best of health and condition, was killed and autopsied four weeks after operation. Both wounds had healed with the exception of a small sinus leading to a stitch abscess, which, however, did not penetrate the abdominal wall. On examining the abdominal cavity the only abnormalities noted were seven or eight slight, loose adhesions between coils of the intestine, three or four loose adhesions of the omentum to the intestine, and some rather firm adhesions of intestine to the inner surface of the abdominal wound over an area 3x6 cm. The condition of the viscera seemed everywhere normal. All of the adhesions, except perhaps those uniting the intestine to the inner surface of the abdominal wound, were of such a slender character that they would in all probability have disappeared entirely in a few months. The remaining two animals are apparently perfectly well, one of them being a bitch which was in a moderately advanced state of pregnancy when operated upon. Cultures and cover-slips were made from the exudate in each case of peritonitis. The bacteriology was carefully worked out and will be referred to later. From this group of experiments we conclude that up to 6 hours after perforation the generalized peritonitis in dogs can be cured by this operation in practically every case. The prognosis of operation upon these animals at 6½ hours after perforation is exceedingly favorable, but from that time on rapidly becomes less favorable.

For the fourth group of experiments six dogs were used. The method of procedure in this group was to perforate the cæcum in the usual manner. From 6 to 6½ hours later the abdominal cavity was again opened, the cæcum brought out and the perforation closed in the way before described. After the replacement of the cæcum the abdominal cavity was closed without in any way attempting to cleanse it. At the second operation four of these dogs presented a generalized peritonitis with the characteristics before described, though in no case did the condition seem as bad as in the cases of two dogs in Group 3 cured by the cleansing of the surface of the intestine and the abdominal cavity. Of these four dogs one died about 20 hours after the perforation was produced. The other three failed to rally after the second operation, as the dogs in Group 3 did, and appeared ill till their death two to three and one-half days from the time the intestine was perforated. Autopsy upon two of these animals showed an intense hemorrhagic peritonitis, while in the case of the third the intestine and omentum were closely adherent in a mass, which when pulled apart disclosed numerous pockets of pus, presenting the condition of multiple abscess formation. The remaining two dogs of this series presented only a localized

peritonitis. There was not more than half as much of the turbid bloody fluid in the abdominal cavity as found in the other four cases, and only those coils of intestine in the vicinity of the cæcum presented a hemorrhagic appearance. These were the most favorable cases we met with in all our experimentation. These two dogs are still alive, though their recovery has been slow.

In connection with the last two cases it is interesting to note that in two of the cases of Group 3 some exudate had collected in the abdominal cavity between the time the intestine was replaced and the abdominal wound closed, thus making it evident that the abdominal cavity possessed the power of caring for a considerable amount of the exudate. The bacteriology of this group of experiments was also carefully worked out and will be referred to along with the reports of the other cases of peritonitis.

This group of experiments seems to demonstrate that the mere closure of the perforation, though it may in some cases prolong life slightly, is not sufficient to cure a case of generalized peritonitis in dogs, and makes it very evident that without a careful cleansing of the surface of the intestines and the abdominal cavity recovery in such cases will be exceedingly rare. It must be borne in mind that the length of time which had elapsed since the perforation was produced and the condition of the abdominal cavity would have afforded a most favorable prognosis in these cases had the cleansing operation been performed.

Cultures were made from the 4 cases of Group 2, 12 cases of Group 3, and 6 cases of Group 4. In one case of Group 3 the cultures failed to grow, although cover-slips showed a few cocci and bacilli. Also in one case of Group 4, in which the peritonitis was not yet generalized, the cultures were negative. In the twenty cases in which bacteria developed in the cultures, from one to three species of microorganisms were found in each case. Members of the colon group were found 18 times, 4 times alone and 14 times in association. Streptococcus pyogenes was found 8 times, once alone and 7 times in association. Staphylococcus albus was found 5 times, in each case in association. Staphylococcus aureus was found 4 times, once alone and 3 times in association, and staphylococcus citreus was found 4 times, in each case in association. Cultures were also made from the heart blood at several of the autopsies, but in each case were sterile. Cover-slips from the exudate in the abdominal cavity were examined in each case and more or less numerous bacteria were seen. An abundance of leucocytes was found in nearly every cover-slip. The bacteria in general were outside the cells.

From our experimental work we feel justified in stating the following conclusions:

1. That mere mechanical irritation of the peritoneal surfaces will lead to the formation of adhesions.

2. That peritonitis in dogs caused by a perforation of the intestine is of an intensely hemorrhagic character, and if left to itself rapidly proves fatal.

3. That generalized peritonitis of this character, in dogs, can be cured as late as 6½ hours after the perforation, by the cleansing operation introduced by Dr. Finney.

4. That mere closure of the perforation without this cleansing operation will rarely, if ever, cure a case of generalized peritonitis in dogs.

SQUAMOUS EPITHELIOMA AND EPITHELIAL HYPERPLASIA IN SINUSES AND BONE FOLLOWING OSTEOMYELITIS.

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In view of the interest manifested in the pathology of bone, the two cases about to be reported seem to be of value. They are striking examples of malignant and benign epithelial growth into old sinuses and medulla of bone.

Case I.—John H., colored, æt. 45, laborer, was admitted to Dr. Halsted's wards, January 2, 1897.

Patient gives a history of injury to his left tibia 19 years ago, with subsequent formation of a sinus and discharge of sequestra. One month before entering the hospital the patient began to feel pain in the leg, and the odor of the discharge became foul. No sequestra have come away for eight months. There is pulsation of discharging material synchronous with the radial pulse.

Upon Jan. 4, Dr. Bloodgood excised the sinus and chiseled and curetted the bone. The bone was fractured 10 cm. below the knee, where the cavity was largest. The operator's note estimates the cavity communicating with the sinus as 3 cm. deep, 2 to 3 cm. wide, and 14 cm. long. The diagnosis, squamous epithelioma, being confirmed, and the growth recurring within two weeks, the leg was amputated above the knee, and glands of the groin excised by Dr. Finney on Jan. 29th. On Feb. 25th patient was discharged, the wounds having healed *per primam*.

Pathological report of the first operation.—The specimen consists of the skin, sinus, eburnated bone, and soft material filling the cavity in the bone. The edges of the sinus are dense and pearly in appearance. The skin within ½ cm. of the sinus edge has lost its dark pigmentation. The bone next to the soft central mass is soft and crumbly, but outside of this is eburnated. It appears directly continuous with the skin at the orifice of the sinus. The sinus is lined by the same papillary growth that fills the cavity in the bone, and this same growth projects between the periosteum and eburnated bone, indenting it, causing a jagged appearance. The medullary cavity is filled with a soft, necrotic-looking material, made up of soft yellowish white masses, and with white papillary granular projections from a rather dense translucent pink ground substance looking like granulation tissue. The papil-

lary projections average 2 mm. diameter, and are of varying length up to 4 mm. The growth within the cavity erodes the bone, leaving small spicules and granules in the soft necrotic mass. In places the dense bone has become granular and crumbles readily. There is no sequestrum nor cancellous bone. The periosteum is very much thickened and not to be well differentiated from the subcutaneous tissue; it is invaded by the epithelial growth. The microscopical description of the original sections is the same as of the recurrent growth, so they will be included together.

The leg and lower third of the thigh removed at the second operation present no abnormal appearance outside of the gaping granulating wound in the tibia, the seat of an osteotomy performed January 4th. The wound, measuring 16x 4x4 cm., is surrounded by edges of skin inverted over the bone, which for the most part is covered by apparently healthy granulations. Only at one place is the bone exposed; this is at the upper angle of the wound, where an edge of eburnated bone is left uncovered. At the outer rim of the excavated tibia, 4 cm. from the upper angle of the wound, is a projecting mass of papillary excrescences 4 cm. in diameter, whose surface is covered by a dry blood-stained crust. Scraping the upper layer away leaves the deeper papillæ, pearly in appearance, closely aggregated and more or less intimately connected with the velvety granulations about them. Some of these epithelial nests are so closely packed without any apparent stroma that at first glance they give the appearance, on section, of a cheesy mass. Careful observation shows this to be made up of individual nests. This mass is at the seat of fracture alluded to. Similar nests of cells are seen in smaller discrete masses over the whole surface in the granulations.

One area on the inner wall of the excavated tibia, 5 cm. from the upper angle of the wound and 2 cm. from the fracture, can be made out as a mass sharply defined from the surrounding granulations. The bone here seems excavated to fit the growth which is eroding it. Spicules of bone project into the growth between the epithelial plugs at the periphery. Between the ends of the fracture the new growth projects, invading muscle and adjacent tissues. The ends of the bone are rough, and the papillary masses are seen indenting the ivory-like bone to a depth of 1 to 3 mm., giving it a worm-eaten appearance on removing the growth. The granulations, 2 to 4 mm. thick, covering the surface of the bone also groove it and cause a rough and gnawed appearance.

The bone sawn through at several places is dense and eburnated and shows no evidence of tumor formation which is not directly connected with the surface growth. The heads of femur, tibia and fibula and the astragalus are normal. The tibia and fibula are anchylosed by bony union at the interosseous ligament. No tumor can be traced from the bone along the vessels. The muscles and soft parts, except at the seat of fracture and ulcer edge, appear normal. The cartilage of the patella is softened, that over the outer head of the femur is depressed and soft. The synovial membrane is hemorrhagic where it envelops the crucial ligaments at their insertion into the head of the tibia.

The popliteal and inguinal glands are firm, enlarged and harder than normal, but do not show any areas of metastasis.

Microscopical Description.

Tumor invading muscle at the seat of fracture. The tumor mass is sharply circumscribed. At that part nearest the invaded tissue the tumor is made up of single cells and small masses of cells in a fine reticulum; this passes, further away, into small non-cornified, non-cystic masses of cells, then larger alveoli with cornified epithelium in the centre of the stratum mucosum layers. Furthest away from the muscle and nearest the periphery of the tumor mass are seen cystic dilatations with anastomosing alveoli lined by a few layers of columnar cells and containing scales of cornified epithelium and fatty detritus. The invaded fibrous tissue shows no change. The muscle fibres are granular and fragmented; the fragments and individual fibres contain many nuclei, giving the appearance of elongated giant cells. The vessel walls show round cell infiltration. There are newly formed capillaries among the degenerating fibres. There is evidence of endothelial proliferation in the capillaries.

Tumor mass and skin, the mass projecting between the fractured ends of the tibia. Where skin and tumor pass over into one another the regular papillæ of the skin cease, as does the deep pigmentation. The pigment is no longer seen between the stratum mucosum cells as in the skin, and is much less developed in the stratum granulosum and deepest columnar epithelium of the Malpighean layer.

It looks as if the stratum mucosum and granulosum were continuous with like layers of cells lining the stroma of the tumor, keeping on over the tortuous papillary bulgings and corresponding depressions of the tumor mass. Similarly can the stratum corneum be followed, but it changes its appearance over the tumor, becoming less compact and scattered in flakes on the surface, or loosely filling cystic cavities along with cellular detritus, or it may be lacking on some of the plugs.

In the cornified layers over the tumor are masses of brown granular pigment containing crystals of hæmatoidin. The tumor growth is divided by deep grooves caused by keratinizing and fatty degeneration of epithelial down-growths. This causes the follicular appearance described macroscopically.

Papillæ, or stroma strands, better named, push the epithelium up into bulging papillary masses. These stroma strands vary in size, as do the corresponding cylinders and plugs of epithelium lining them. The plugs and cylinders anastomose freely at the surface. One cyst thus caused measures $1 \times \frac{1}{2}$ cm. and is made up of numerous small plugs containing keratinized epithelium and detritus around the margin. The contents must have fallen out in great part. The surface is covered with epithelial cells, polymorpho-nuclear leucocytes, and keratinized epithelium in a mass of coagulation necrosis.

The stroma varies in different parts, from œdematous young granulation tissue with stellate, epithelioid and giant cells at the surface under the coagulation necrosis, to a very cellular fibrous tissue, with numerous capillaries and spindle-shaped long nuclei deeper down. In places the stroma is homogeneous and stains pink with eosin, like hyaline. There are areas of round cell infiltration in the stroma. The included plugs

and cylinders of epithelium comprise all the epidermis layers arranged in the same order as in the skin—a cylindrical or cuboidal layer next to the stroma, then polyhedral cells of the stratum mucosum showing prickles most distinctly with Van Giesen's stain, then two or three layers of spindle cells with pigment which takes the hæmatoxylin stain—the stratum granulosum. The outermost layer lining or filling the cavity of the plugs or cylinders is of loose keratinized epithelium, sometimes arranged compactly,

Where the centres are cystic we find besides the keratinized epithelial flakes, fat cells, cells which have undergone fatty degeneration, leucocytes and salts, granular and deeply stained with hæmatoxylin. Cell multiplication is very active, as evidenced by the many divided and dividing nuclei; 2 to 5 nuclei are contained in some cells, connected as if budding.

Into the basal layer of these cylinders there may be ingrowths of papillæ, explaining an unusual appearance, namely, a mass of fibres and connective tissue cells cut across in the centre of one of the above described plugs of epithelial cells. In the deepest part of the invading tumor the cylinders become very small, even narrowed to single cells separated by the same cellular stroma. Anastomosis is very free, many branches spreading throughout a loose stroma. The arteries included in the section show marked endarteritis and round cell infiltration of the adventitia also.

In staining the sections the Van Giesen method was found valuable in staining the stroma and the prickle cells. The keratinized cells stain yellow, the young stroma stains dull red. Gram's stain used for keratohyalin by Ernst[7] shows it well, staining these cells deep blue.

Sections of the pink granulations over the surface of the bone show granulation tissue without evidence of tumor.

The lymph glands of the popliteal space and groin show fatty atrophy and connective tissue formation, thickened capsules and endothelial hyperplasia. There are no metastases.

The popliteal artery and vein with surrounding tissue show no evidence of tumor growth about them. They are united by dense fibrous tissue. There is evidence of endarteritis.

The synovial membrane described as hemorrhagic shows round cell infiltration and vessels filled with blood, which also suffuses the surrounding tissue.

The bone cut across near the knee shows no microscopic evidence of carcinoma; it appears normal.

Section of fragments of bone with tumor and granulations mixed in an irregular friable mass. The tumor alveoli and stroma are as described above. Adjoining whorls are seen to become conglomerate, mixing together their contents of keratinized epithelium and fatty necrotic substances and bounding this by their several epidermis layers. Secondary papillæ project into the primary alveoli, giving a complicated appearance on section. In the proximity of the bone the cellular stroma is strewn with giant cells with centrally massed large oval vesicular nuclei containing big nucleoli. These are osteoclasts, for wherever the bone is seen undergoing absorption it is lacunar in nature and the Howship's lacunæ contain osteoclasts to fit them. The tumor cells do not come in direct contact with the bone, being separated by stroma and osteoclasts.

The bone is very dense, with narrow compact lamellæ containing few corpuscles, and these are small and far apart. The Haversian canals are filled with cellular connective tissue, vessels, old bone fragments looking as if shelled off, and osteoclasts in lacunæ. Branching canaliculi are distinctly seen. There is new formation of bone going on. The new lamellæ are arranged at an angle to the old ones, they take the eosin stain deeper and are lined by osteoblasts, cuboidal and spindle-shaped. There is a granular line stained with hæmatoxylin between old and new bone.

Section of bone with invading tumor at the seat of fracture. The lamellæ are narrow and closely packed and enclose bone corpuscles at rather wide intervals. Some of the corpuscles nearest the invading tumor are enlarged and the cells are deeply stained. The Haversian canals are irregular in contour, of various sizes, and filled with granular detritus and fragments of bone. About their rim there is lacunar absorption, the grooves being small. The bone, where invaded, is being absorbed by the osteoclasts, for in every Howship's lacuna can be seen a giant cell such as Kölliker[8] describes, or large osteoblasts which here take on the function of osteoclasts and are such.

These osteoclasts vary in size and shape, each fitting exactly a groove in the bone hollowed out to fit the absorbing agent. Some of the cells are seen completely surrounded by bone, others have only one-third of their body enclosed by the lacuna. The shape varies from oval, round, oblong, large cells to elongated flat cells lining quite a large part of the bone surface, looking almost as if one of the outer lamellæ had broken off abruptly and taken in many large nuclei. The size varies from an osteoblast to cells five or six times as big.

The nuclei are either massed in the centre or arranged around the periphery; they are large, round or oval, and vesicular. The protoplasm of these osteoclasts is granular and stains deeply with eosin, especially at the centre. The edge of the cell next the bone is rough; the other borders of some cells seem of double contour and quite smooth.

No foreign bodies were detected in any of these bodies next the bone, yet some of the giant cells near by included epithelial debris.

The protoplasm of some osteoclasts is drawn out like a pseudopod and pushes in between the connective tissue cells. Where granulations seem to fill the lacunæ one finds osteoclasts between them and the bone wall.

There is evidence of new bone formation. To the characteristics of newly deposited bone already mentioned can be added the closer approximation of bone cells—there being more of them than in the older adjacent bone. The medullary spaces between the cancelli of bone are filled with newly formed fibrous tissue and granulation tissue containing giant cells and all the cells usually found in embryonal tissue. There are also numerous capillaries and larger vessels in the spaces. The bone cells vary in size and appearance, as do the bone corpuscles, some being round and spindle-shaped, others stellate. They can be best studied in the newly deposited bone or in bone undergoing absorption. It would seem as if when about to be freed from their imprisonment they take on active functions again and are stained more readily.

As in other sections of bone, no tumor cells come in direct contact with the bone. The tumor advances as described above. There are small fragments of bone in the granulations, which look as if they had been eaten off and left. There is a deposit of new bone in the vicinity of the tumor and evidence of absorption going on in the same microscopic field.

Case II.—W. J. R., white, æt. 54, admitted June 26, '95.

For 49 years the patient has had discharging sinuses in the thigh communicating with necrotic bone.

Operation, June 28th, by Dr. Bloodgood. Amputation of thigh at the upper third. Notes made at the operation refer to the great friability of the bone, the thickened periosteum, thin shaft and presence of a sequestrum.

Nov. '96. Patient reports himself well.

The pathological report is as follows: The diseased condition of the bone begins 26 cm. above the condyles and involves the shaft for 16 cm. The last piece of bone removed, 3 cm. below the trochanter, appears healthy. The periosteum is thickened, the shaft, stripped of periosteum, is rough and presents minute spicules. The shaft varies in thickness from 3 to 6 mm., and there is very little cancellous bone. It is brittle, fracturing easily. The medulla above seat of disease contains much fat and oily material. At the seat of disease there is no involucrum. In the sinus leading from the diseased bone there is a sequestrum 6 cm. long and 1½ cm. wide. The periosteum about the necrotic portion is 5 to 6 mm. thick, and on section is pearly white and appears striated at right angles to the long axis of the bone. On the surface next to the shaft it is covered with a yellow necrotic friable tissue covering a leathery surface. Fine spicules of bone are imbedded in this. The odor is foul. The surface of the shaft is rough and hard. The medullary cavity is filled with hard bone mixed with thick leathery tissue, and is riddled with small cavities containing the same material as covers the shaft. The only attempt at new bone formation is in the medullary cavity. No attempt at formation of healthy granulations is evident. About the area of disease the shaft exhibits exostoses 1 to 1½ cm. in length. The knee joint is normal in appearance.

Microscopical examination of the tissue between the periosteum and bone described as striated and friable with necrotic border next to the shaft, shows it to be made up in the main of large swollen polygonal cells with oval vesicular nuclei. The arrangement is such as one sees in the stratum mucosum of the skin. There are papillæ projecting into the mass from the periosteum, which is thickened and infiltrated with small round cells. The cells next the papillæ are prickle cells; those nearer the shaft do not show the prickles. The cells are massed in varying density. According to the location of the papillæ we get lighter and darker stained masses, the darker being more compact and approaching the cancroid pearl in appearance, but there is no cornified nor degenerated centre. Toward the bone the cells are flat and the nuclei lose the ability to stain. A thin layer of cornification covers their surface. Many of the nuclei are vacuolated. The papillæ are very cellular. There is an absence of the stratum granulosum and lucidum; simply a uniform growth of the mucosum and corneum. There is considerable endo- and periarteritis. The muscle and connective tissue show no tumor invasion. The leathery material described in the medulla is like that just described.

Examination of the cortical bone from the shaft shows no tumor growth into it. The dense bone presents a feathery appearance commonly seen in eburnated bone. The edges show lacunar absorption.

A number of cases of squamous epithelioma developing in sinuses and old scars which would come under the grouping I have purposely omitted, since the pathological description of the tumor is in every case essentially the same as in Case I. Two of the cases might be considered carcinoma developing in osteomyelitic sinuses, but the history does not fully substantiate this. In these cases the sinuses were lined by the tubules and plugs of epithelial cells continuous with the tumor mass in the bone itself. The invasion of the bone resembled that described in Case I.

The cases reported bring to mind several most interesting subjects in pathological histology: the development of carcinoma in sinuses, scars and ulcers, its invasion of bone, the peculiar character of epithelial growth, and the bone formation and absorption due to the invading tumor. They are interesting especially because they show side by side the picture of a typical squamous epithelioma and a mere enormous hyperplasia of the epithelial elements of the stratum mucosum in bone. The one is evidently quite malignant; the other does not appear to be very destructive in its growth, but merely a filling in of the space made void by the osteomyelitic process. The two tumors have their homologues in the epithelial growths in sinuses, ulcers and scars, some being typical epitheliomata, others simply hyperplastic growths of epithelium lining the sinus walls.

There is this point to be noted in Case II differing from any yet described—the great development of the cells of the stratum mucosum to the exclusion of the granulosum and lucidum. There is simply a single layer of cuboidal cells covering the papillæ, then 10 to 15 layers of large swollen polygonal cells covered by a thin layer of cornified epithelium. This not only fills the sinus and medullary cavity, but pushes in between the periosteum and the shaft, nowhere penetrating the bone itself. It may be compared in a way with a case of great epithelial cell hyperplasia of the outermost layers of the epidermis described by Busch[18] in a case of lupus. Here there was an epithelial papillary growth covered by thickened, horny epithelium spread over the surface, finally breaking into the connective tissue and forming carcinoma.

Typical squamous epitheliomata in scars, ulcers and sinuses are not uncommon. There are only twenty-eight cases reported in which the epithelioma developed in the sinus following osteomyelitis. From the histories of many cases of epithelioma in ulcers I infer that a few if more accurately described would come under the heading of carcinoma in sinuses following osteomyelitis. Some give a history of osteomyelitis. See Van Hook,[1] Schindler,[2] Boegehold.[4] Borchers[5] in 1891 collected all the cases up to his time, numbering twenty-five. He records cases of König, Dittrich,[10] Nicoladoni,[11] Esmarch,[12] Fischer,[13] Bartens, Cornil and Ranvier,[6]

Winiwarter,[14] Hannover[16] and Volkmann.[15] Another case is recorded by Feigel.[5] One of Van Hook's[1] two cases was undoubtedly carcinoma developed in an old fistula communicating with necrotic bone. Von Friedlander's[17] three cases, reported in 1894, are the last recorded. All of the cases described have many points in common with our first case.

Clinically, the development of the disease in those beyond 40 years of age, the common involvement of the lower extremities, the uncertainty of fixing the exact time of development, its slow growth, the foul odor, the long existence of the fistulæ, the absence of pain until the carcinoma begins to develop, the ease with which the bone is broken, the fixation of the neighboring joints and ankylosis of adjoining bones, the infrequent involvement of lymphatic glands or other organs, and its almost sure recurrence unless the limb be amputated, are all most noteworthy points.

Volkmann[15] says that recurrence occurs in a few weeks or months after the operation, if at all; if not within 1 to 1½ years, it seldom occurs.

The pathological picture is not to be confused with any known disease of bone or sinus. The crater-like ulcer or cauliflower excrescences made up of individual oval yellowish white masses, are enough to make the diagnosis. Finding the same papillary growths in the medullary cavity is not calculated to make one think of simple osteomyelitis. The bone next the tumor is either soft and spongy or denser than normal bone. It is increased in circumference and the medullary canal may be smaller than normal. Osteophytes may form on the surface and the bone may rarely present the appearance of spina ventosa. Fracture is common.

The microscopical picture is that of squamous epithelioma modified in appearance according to the amount of degeneration and bone absorption and the greater or less development of tubules, alveoli or cysts. The tumor cells nowhere come in direct contact with the bone, being separated by connective tissue and giant cells or osteoblasts. The thickness of the growth varies, but it is thickest in the cloaca, and in places looking like granulation tissue. The sequestra in Nicoladoni's[11] cases were not invaded by epithelial cells.

Borchers[3] refers to the advance of the tumor into the Haversian canals. Our cases do not substantiate this, the epithelial cells never being found separate from the main growth.

In none of the cases were metastases found in the internal organs and rarely even in the lymph glands. The swollen glands usually became of normal size after amputation of the limb. The reason of the infrequent metastases is found in the sclerosis and condensation of tissues about the tumor and its very slow growth.

Thinking of the etiology and histogenesis of the tumors, one would naturally class those described with tumors developing in ulcers, fistulæ and old scars. Many theories have been advanced to explain them: Virchow's[19] idea of chronic irritation, mechanical and chemical, being most naturally first alluded to. The question whether the connective tissue growth or epithelial proliferation be the primary factor has been most actively debated since Ribbert's[9] so strongly advocated the former view. Boegehold,[4] who reported several cases like my first one, believes in their connective tissue origin, and says that the epithelium is lost over scars and ulcers. He says: "If the surface epithelium cannot cover over the granulation surface, one cannot see why it shall grow into the depths of the granulation tissue."

Langenbeck,[20] in discussing the development of carcinoma in lupus, expresses the view that the cause of development is like that in traumatic scars, a continuous irritation and the carcinoma develops from remaining epithelial cells. It is distinct from the lupus growth. "It is difficult to reconcile the notion of lupus—a granulation tissue—passing directly into carcinoma, because of our view that epithelioma must come from pre-existing epithelial cells."

Wenk,[21] who believes in this direct transition, concedes that the epidermis projections have not been entirely destroyed. Langenbeck[20] attributes its formation to development of epithelium in the outlying scar. Schindler[2] cites cases to prove the development from the scars—either from the covering epithelium or glandular organs of the skin left intact by the lupus process. He answers Boegehold's[4] argument cited above, by explaining that the surface epithelium is prevented from spreading superficially by continual irritation (pressure or secretion) and therefore it dips down deeply where not exposed to these influences. Hulke,[22] in describing two cases of carcinoma in old scars, ascribes them to purely local causes. Pedraglia[23] refers to old age and periodic irritation as predisposing causes. This view that old age influences the growth corresponds with that of Verneuil referred to by Marcuse:[24] "Ein locus minoris resistentiae" of the connective tissues, the epithelium retaining and increasing its activity. Marcuse uses this theory in explaining the growths in the granulations covering ulcers—the granulation tissue, when not going on to scar formation, being not so resistant to epithelial hyperplasia as normal tissues. Here the epithelium grows into the tissues as stated by Thiersch[26] in his most valuable contribution to the etiology of epithelioma of the skin.

It is not much disputed now that epithelium only forms from preformed epithelium and not from leucocytes or connective tissue cells. This materially aids the histogenetic study of these tumors. Whatever the cause, the practical lessons obtained from them are of much value to the surgeon, and one is not tempted to use tentative measures to stop a growth which he knows by experience and microscopical study to go steadily onward in its course until it is excised radically.

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ON THE BLOOD-PRESSURE-RAISING CONSTITUENT OF THE SUPRARENAL CAPSULE.*

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Both clinical experience and laboratory research have shown that the suprarenal capsule is an organ of vital importance.

Physiologists† have proved that a very small quantity of an aqueous extract of the medullary substance raises the blood pressure to a great height above the normal. It has also unequaled power in reviving a poisoned heart. Gottlieb,‡ for example, has shown that it will revive the heart of a rabbit which has practically stopped beating in consequence of an intravenous injection of chloral hydrate.

Bates§ applied an aqueous solution to the eye and found that it exerted a marked vaso-constricting action. In numerous cases of congestion a small quantity dropped into the conjunctival sac brought about an immediate pallor, lasting for some time. According to this writer the extract is very useful in prolonged operations, for, when repeatedly applied, hæmorrhage is prevented and cocaine anæsthesia is in consequence indefinitely prolonged. As the result of his two years' use of the extract Bates concludes "that within the limits of its sphere of activity there is absolutely no other substance which can take its place."

Other experiments‖ go to show that the aqueous extract is a powerful poison when injected directly into the circulation and may lead to fatal results.

The various extracts that have been used in these experiments were mixtures of unknown substances, and it is as yet an unsolved question whether the various actions at present ascribed to the gland are due to one and the same substance.

We are at present interested in the isolation of the blood-pressure-raising constituent, for in a purified state, separated from all other constituents, it might become a therapeutic agent of great importance.

On the chemical side but little advance has been made over Vulpian's* striking original contribution more than forty years ago. Vulpian observed that the juice expressed from the suprarenal capsule of many different animals behaved in a striking manner toward ferric chloride and toward solutions of iodine, giving with the former reagent an emerald green color, and with the latter a beautiful rose carmine tint. No other tissue of the body, so far as investigated by Vulpian, gave these reactions.

Virchow† substantiated Vulpian's statements, but added nothing new. A year after Vulpian's first announcement his second paper appeared in conjunction with Cloëz,‡ verifying and extending his first observations and stating his failure to isolate the chromogenic substance or substances to which the above reactions are due.

Equally unsuccessful were Arnold§ and Holm.‖ Kruken-

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*Read before the Association of American Physicians, May 6, 1897.

†Schäfer and Oliver, Journal of Physiology, xvi (1894) and xvii (1895); Szymonowicz and Cybulski, Wien. med. Wochenschrift, 1896, No. 6.

‡Arch. f. exp. Pathol. u. Pharmakol., xxxviii, 106.

§New York Medical Journal, lxiii (1896), 647.

‖Foa and Pellacani, cited in Maly's Jahresb. d. Thier-Chemie, xiii, 129; Marino-Zuco, ibid., xviii, 231; Gourfein, Rev. Méd. de la Suisse Romande, Oct. 20, 1895; Compt. rend., cxxi (1895), 311–314.

*Note sur quelques reactions propres à la substance des capsules surrénales, Compt. rend., xliii (1856), 663–665.

†Virchow's Archiv, xii (1857), 481–483.

‡Compt. rend., xlv (1857), 340–343.

§Virchow's Archiv, xxxv (1866), 64–107.

‖Journ. f. prakt. Chemie, c (1867), 150.

berg,* years after, repeated the work of Arnold and came to the conclusion that the chromogen of the suprarenal capsule is a non-volatile, nitrogenous and ferruginous organic acid which is probably related to the turacin of the musophagidæ and to chlorophyll. He assumed that the substance giving the green color with ferric chloride is not the chromogenic substance of Vulpian, but more likely pyrocatechin accompanying the chromogen. Attention being thus attracted to the possible occurrence of pyrocatechin in the suprarenal capsule, others took up the subject.

Brunner† found that an alcoholic extract can be made to give nearly all of the reactions of pyrocatechin; thus, it gives the well-known green color with ferric chloride, passing into a fine red on the addition of ammonium tartrate and a few drops of an alkali; it reduces silver nitrate at room temperature, and Fehling's solution on boiling. The addition of an alkali soon causes it to take on a dark brown color, lead acetate gives a precipitate, sodium nitroprusside and very dilute ammonia give a wine-red color. All of the above reactions being given also by pyrocatechin, Brunner concluded that Krukenberg was right in his belief that pyrocatechin is present in the suprarenal gland.

After the discovery of the blood-pressure-raising property of the suprarenal gland, B. Moore,‡ working in Schäfer's laboratory, came to the conclusion that Vulpian's chromogen and the blood-pressure-raising constituent are identical. He based his opinion on the fact that chemical operations which destroy the color reactions by oxidizing the reducing agent appear also to destroy the blood-pressure-raising constituent. That the solubilities of the active principle are the same as those of the reducing agent appears also to support this opinion.

Fraenkel§ worked with residues obtained with the help of alcohol and acetone as solvents. These residues raise the blood pressure and do not contain pyrocatechin, and on the strength of the ferric chloride reaction and its reducing power he concludes that the essential principle of the residue is a nitrogenous derivative of the *ortho*dihydroxy-benzene series.

According to Fraenkel both Krukenberg and Brunner are wrong in their opinion that the suprarenal gland contains pyrocatechin. Fraenkel concludes, like Moore, that the blood-pressure-raising constituent and Vulpian's chromogen are one and the same substance.

More recently still, Mühlmann‖ has attempted to prove that the blood-pressure-raising constituent is a pyrocatechin derivative. He asserts that on boiling fresh suprarenal capsules with dilute hydrochloric acid the active principle is decomposed and the pyrocatechin which is split off may be taken up with ether. Mühlmann has not, however, furnished conclusive chemical proofs for his assertion. Both Mühlmann and Brunner might have settled this point by precipitating the supposed pyrocatechin with lead acetate and analyzing the lead salt thus obtained. Pyrocatechin may be present in small amounts in the gland, but no proof of this has yet been furnished.

There is therefore at present great diversity of opinion as to the chemical character of the blood-pressure-raising constituent of the gland.

Whatever the probability may be of the correctness of this or that view, it is to be noted that all of the above-named investigators have based their conclusions on reactions made with aqueous, alcoholic or acetonic extracts; none of them have even roughly isolated a definite chemical compound. The subject is one of great difficulty, and our own work is at present merely preliminary, but we have arrived at the following conclusions which we believe to be borne out by our experiments.

First, we have found by isolating the blood-pressure-raising constituent in the form of a benzoyl compound and decomposing it, that the active principle is a substance with basic characteristics and that it must in all probability be classed with the pyrrol compounds or with the pyridine bases or alkaloids.

Second, that pyrocatechin cannot be split off from the isolated active compound by boiling with acids, as has been asserted.

Third, we have found that a carmine-red pigment can be separated from the sulphate of the active principle without destroying its power to raise the blood pressure.

Fourth, in addition to this, we have isolated from the crude benzoyl product a volatile basic body which fumes in the air and which emits an odor very much like that of coniine.

Method of Isolating the Active Principle in the Form of a Benzoyl Compound.

We have used sheep's glands in large quantity. The medullary substance of the fresh glands was scraped out, dried on the water-bath at 60° C., ground up finely, and extracted with ether for several days until the fats and the substance known as Manasse's jecorin were removed. In this way a fine dry powder of a grayish white appearance is obtained, the aqueous extract of which is very active in raising the blood pressure.

With 100 grammes or more of this powder, representing one kg. in weight or about 1000 fresh glands, we proceeded as follows: The powder is repeatedly extracted with warm water acidulated with a few drops of dilute sulphuric acid until the gland has yielded up all of its chromogenic substances, as tested by Vulpian's reactions. This aqueous extract is evaporated on the water-bath to a small bulk, a large excess of strong alcohol is then added and the whole allowed to stand 24 hours, by which time the proteids have all settled out. The alcoholic fluid is then filtered and the greater part of the alcohol removed by distillation; the remainder is driven off on the water-bath. The entire removal of the alcohol is necessary, and in order to avoid too great concentration of the acid fluid, which seems to destroy some of the active principle, water has now and then to be added. The brownish fluid when filtered gives all the well-known reactions characteristic of Vulpian's chromogen, and on neutralizing the sulphuric acid we found the filtrate to be physiologically very active.

* Virchow's Archiv, ci (1885), 542–591.
† Schweizer. Wochenschr. f. Pharmacie, xxx (1892), 121–123.
‡ Journal of Physiology, xvii (1895), Proc. Physiol. Soc., p. xiv.
§ Wiener med. Blätter, 1896, No. 14–16.
‖ Deutsche med. Wochenschr., 1896, No. 26, 409–411.

This filtered fluid is next treated with the proper quantity of benzoyl chloride and sodium hydrate according to the Baumann–Schotten method of forming a benzoyl compound. There results a tarry substance of a light yellow color which sticks to the sides of the separator funnel and which is collected and washed until the wash fluid no longer gives an alkaline reaction. It is next dissolved as far as possible in alcohol and the alcohol evaporated. The residue is then treated with ether, which takes up the greater part of it, the ethereal solution is filtered and the ether driven off.

The residue, which is of tarry consistence and amber color, is taken up in strong alcohol from which all basic substances have been removed by distilling from tartaric acid. It is then boiled for two hours with animal charcoal previously well washed with purified alcohol. After filtration and the evaporation of the alcohol a considerable quantity of crystalline residue is obtained which is found to consist of the benzoyl compound of the active principle contaminated with other benzoyl derivatives and which we may call the crude benzoyl product. It is insoluble in water, alkalies or acids of ordinary strength, is soluble in alcohol, ether, glacial acetic acid and concentrated sulphuric acid.

It is of interest in this connection to note that benzoyl chloride effects the complete removal of the blood-pressure-raising constituent from an aqueous solution. This is proved by the fact that the filtrate from the insoluble benzoate no longer gives the characteristic chemical reactions of the active principle, and that chemical manipulations no longer yield a blood-pressure-raising constituent. Indeed, an injection of a sufficient amount of the material left after the sodium benzoate and the excess of alkali have been removed, causes a sharp and sudden fall of pressure instead of a rise.

It was not until long after we had made use of benzoyl chloride as a precipitant of the active principle that we obtained access to Fraenkel's* paper. From it we learned that a syrupy substance is thrown out when benzoyl chloride is shaken up with a pyridine solution of an extract of the gland. Fraenkel did not succeed in crystallizing this benzoyl compound, nor did he attempt to decompose it in order to ascertain whether it was in reality a benzoate of the blood-pressure-raising principle.

Methods of Decomposing the Benzoyl Compound.

A quick method always used by us as a qualitative test is as follows: The compound is dissolved in as little concentrated sulphuric acid as possible, crushed ice is slowly added, and the benzoic acid which has been split off is shaken out with ether. On neutralizing the solution we found it to give the reactions characteristic of aqueous solutions of the medullary substance. We have not considered this method adapted to the decomposition of large quantities of the product.

Decomposition of this benzoyl product was effected by means of an alcoholic solution of sodium alcoholate, and also with strong hydrochloric acid and alcohol, but these methods were found to be less satisfactory in practice than the following, which is the method on which we now rely. The benzoyl compound is dissolved in glacial acetic acid, the solution heated to near the boiling point, and an equal volume of a 25 per cent. solution of sulphuric acid actively boiling is slowly poured into the hot acetic acid solution, the whole being shaken meanwhile. The flask is now attached to a back-flow condenser and heated on a small flame for about ten minutes.

The solution is next diluted with water and allowed to cool, the benzoic acid, which has been thrown out, is filtered off and the rest is removed with the help of ether.

Mixed with the benzoic acid which has been removed by filtration is found a dark brittle substance which softens on the water-bath, and which we assume to be a benzoyl compound of unknown composition which was apparently unaffected by the dilute sulphuric acid. On dissolving it in concentrated sulphuric acid and diluting with crushed ice, the resulting fluid gives none of the reactions characteristic of suprarenal extracts.

After decomposing the benzoyl product with hot dilute sulphuric acid and removing the benzoic acid thus split off, we next get rid of the acetic acid by repeated partial evaporations, taking care not to let the solution become too concentrated and thus perhaps injure the active principle. After the removal of the acetic acid the sulphuric acid is precipitated with the help of lead carbonate. The lead sulphate is removed and the filtrate is allowed to stand *in vacuo* over sulphuric acid until it has become of tarry consistency. It is then exhausted with ether, acetone and absolute alcohol in succession.

The residue is physiologically very active, and it gives all the reactions characteristic of an aqueous solution of the gland—a beautiful rose color on the addition of an alkali, a green color with ferric chloride, reducing silver nitrate, etc.

However, we are not yet dealing with a pure substance. If we neutralize an aqueous solution of the product thus obtained with a free alkali or with a carbonate of the alkalies, an overpowering odor much like that of coniine is perceived. As this odor passes that of pyridine seems to take its place. The basic substance thus liberated fumes in the air or when a glass rod moistened with hydrochloric acid is brought into its neighborhood. To remove this basic substance we made an aqueous solution of the active principle as above isolated, rendered it faintly alkaline with sodium carbonate and shook out with ether several times in succession. But this method does not remove all of the coniine-like substance. To effect this we were obliged to make the active principle strongly alkaline with sodium hydrate before shaking out with ether. The aqueous solution, in consequence of the addition of the free alkali, takes on a deep red color, and carmine red flocks are thrown out. After the removal of the coniine-like substance with ether, the fluid containing the red flocks was acidulated with sulphuric acid and the carmine-red substance was filtered off. The clear filtrate, which was a pale straw color, was concentrated *in vacuo*, and the active principle taken up in weak alcohol. On account of the insolubility of the sulphate of the active principle in absolute alcohol it is difficult to obtain this entirely free of sodium sulphate. We hope in future to remove both the coniine-like substance and the pigment with the help of ammonia. The presence of pyridine in our ammonia prevented our using it for this purpose.

* Wien. med. Blätter, 1896, No. 14–16.

This volatile base of a coniine-like odor has not hitherto been described as a constituent of the suprarenal capsule. The beautiful carmine-red pigment we take to be identical with the red substance which many other observers have found to be thrown out as a precipitate when ammonia is added to a concentrated aqueous solution of the gland, or when a solution is evaporated in the presence of lead acetate.* Others have believed this red precipitate to be the oxidation product of the active principle of the gland, but we shall presently see that the active principle is still present in the filtrate from the carmine-red body. We have as yet made no experiments with this pigment except to note that it is but slightly soluble in dilute alkalies and insoluble in dilute acids, and that iodine destroys the color. Our method appears to make the further study of this substance possible.

The coniine-like substance we have secured in the form of its hydrochlorate, and with it we have made certain studies which will be published at a later date.

Characteristics of the Blood-Pressure-Raising Constituent as obtained by decomposing its Benzoyl Compound.

We have now obtained the active principle in the form of a sulphate. As thus far isolated it is a hygroscopic, straw-colored residue which tends to crystallize on standing over sulphuric acid, agglomerates of small crystals forming on the edge of the bowl and the entire residue taking on a semi-crystalline appearance. This sulphate does not contain the volatile coniine-like substance, nor do we find the carmine-red pigment which falls out on the addition of an alkali. Alkalies no longer liberate the coniine-like substance, nor do they throw out the red pigment, but they cause a brownish discoloration, and on heating, alkaline vapors, probably ammonia, are given off.

Our sulphate is very active physiologically. A small quantity suffices to raise the blood-pressure as seen in Fig. 1, and it is therefore evident that we have isolated the active principle but slightly contaminated with other substances.

A final product even more active in small quantities is that whose action is shown in Fig. 2, where the mercury is driven out of the manometer. This more active compound still contains much of the coniine-like substance, and at once throws out the carmine-red pigment on the addition of alkalies. The sulphate of the coniine-like substance does not, as we have seen, raise the blood pressure; it therefore remains for us to consider whether the carmine-red substance which is precipitated on the addition of alkalies, either alone or in conjunction with small quantities of oxidizing agents, has any physiological significance or stands in any chemical relation to the blood-pressure-raising constituent. We incline to the opinion that this substance, which in the original aqueous solution of the gland gives with iodine water the "teinte rose-carmin tout à fait remarquable" of Vulpian, is in nowise connected with the blood-pressure-raising constituent. We have repeatedly removed or destroyed this substance by boiling solutions containing it with strong ammonia or with sodium hydrate, and have always been able to separate subsequently an active material. In proof of this we append Fig. 3, showing a great rise of blood pressure, although the material from which this active principle was obtained had been boiled for one hour with a 5 per cent. solution of sodium hydrate. After such treatment with alkalies, care must be taken in the subsequent evaporation of the alcohol with which the active principle is removed, to keep an acid reaction, as otherwise the greater part, if not all of it, will be destroyed by oxidation. And unless all evaporations are carried on under reduced pressure, much material will be lost, even with the above precaution.

Although somewhat contaminated with its own decomposition products, this final sulphate has all the characteristics of an active substance. As shown by repeated experiments, it promptly raises the blood pressure, it constricts the vessels of an inflamed eye, and when injected into the dorsal lymph sac of the frog it acts like a narcotic or cerebro-spinal poison.

As freed of the red substance the sulphate of the active principle behaves as follows: It is very soluble in water, fairly soluble in weak alcohol (50 per cent.), almost insoluble in absolute alcohol, and quite insoluble in ether, acetone, ligroine and chloroform. Its aqueous solution, even when freed from adherent sulphuric acid, has a slightly acid reaction. The addition of iodine water to a neutral solution does not give a rose-red color. Alkalies added to a strong solution give a brown color which deepens on heating. Ferric chloride gives a purplish brown, almost black in concentrated solution, which on the addition of tartaric acid and an alkali passes into a deep red color. Before the removal of the carmine-red substance the addition of ferric chloride gives the well-known emerald green color, which passes into red on the addition of an alkali.

It is evident that our sulphate gives Vulpian's ferric chloride reaction, though somewhat changed by the removal of what we take to be the chromogenic substance which gave his iodine reaction. It also promptly reduces silver nitrate in alkaline solution, but does not reduce Fehling's solution even on boiling.

Probable Relation to the Alkaloids.

More than a year ago, during our first studies with suprarenal extract, we were struck with the fact that every extract entirely free of proteids and physiologically active gave a fine pyrrol reaction when subjected to dry distillation. This is evidenced both by the odor and by the pine sliver reaction. A small quantity of the isolated sulphate also gives the pyrrol reaction when heated either alone or with zinc dust.

We attach considerable importance to this reaction. As is well known, alkaloids in general give pyrrol on dry distillation; morphine, for instance, on being heated with 10 parts of zinc dust gives off pyrrol, ammonia, trimethylamine, pyridine, phenanthrene, etc.* During the past winter we made

* Holm, Journ. f. prakt. Chemie, c (1867), 150.

* We are well aware that certain salts of glutaminic, pyromucic and its related acids also yield pyrrol on dry distillation. These compounds, however, like the proteids and their allies, appear to us to be excluded.

several attempts to prove the presence of pyridine among the products of dry distillation of the active principle as above isolated, as its detection would prove that our principle was to be classed among the alkaloids.

In attempting to show the presence of pyridine we heated the active principle with zinc dust in a current of dry hydrogen and passed the distillation products through a test tube and two small flasks, the tube being placed in a cooling mixture, the first flask being partly filled with dilute sodium hydrate, and the second with dilute hydrochloric acid.

At the close of the experiment the test tube gave off alkaline vapors that smelled strongly of trimethylamine and had in addition a peculiar sweetish odor. The contents of the test tube diluted with water gave a precipitate with bromine water and with copper sulphate, but with the latter reagent the fine blue color characteristic of pyridine did not appear. The presence of amines seems to render difficult the detection of small quantities of pyridine. The contents of the third flask on exposure to the air took on a rose-red color and after a time threw out a precipitate of the same tint. Both flasks gave off the odor of benzaldehyde.

The following experiment was also made with a little of the sulphate, which no longer gave the rose-red reaction with iodine but which still contained a little of the coniine-like substance. For two hours it was kept at 150° C. in a sealed tube with 25 per cent. hydrochloric acid. On shaking out with ether a considerable crystalline residue was obtained which, without much purification, melted sharply at 120° C. and had all the properties of benzoic acid.

In the above decomposition experiments the quantity of material at command was small, perhaps not more than one-fifth of a gramme at a time, and not entirely pure. We do not, therefore, lay much stress on our failure to detect pyridine.

The fact that the nitrogen of our compound is given off in the form of amines and pyrrol gives strong ground to believe that our substance is to be classed with the pyridine bases, using this term in a broad way. Its basic character, its ability to take up acid radicles, as illustrated by the formation of a benzoyl product, its reducing power and its color reaction with ferric chloride are all points which can be urged in support of this view. Furthermore, cupric acetate, the serviceableness of which as a precipitant of carbo-pyridine bases has been shown by Gautier and Landi,* also precipitates our active principle; and iodine chloride, which Dittmar† found to give brown or yellow halogen addition-derivatives with a large number of the alkaloids, gives with a neutral or slightly acid solution of our active sulphate a brownish flocculent precipitate.

Of less weight in this connection, but nevertheless of some value, is the fact that its physiological action and its power in small doses is again in accord with what is known of alkaloids. Strychnine, thebaine and other alkaloids are readily called to mind as able to raise the blood pressure, and recently Tunnicliffe‡ has placed piperidine in the same list. The pyrrol* bases are also physiologically active, although less attention has been paid to them.

*Compt. rend., cxiv (1892), 1154–1159.

†Berichte d. deutsch. chem. Gesellsch., xviii, 1612.

‡Centralbl. f. Physiol., x, No. 25, 777.

Pyrocatechin cannot be split off from the Blood-Pressure-Raising Constituent.

As already said, Mühlmann has stated with great positiveness that the blood-pressure-raising constituent is pyrocatechin joined to some other substance, probably an acid. Mühlmann does not offer sufficient proof for his conclusion; and even had he proved the presence of pyrocatechin in the gland itself, this is a very different thing from showing that it enters into the chemical constitution of the blood-pressure-raising constituent.

We have repeated Mühlmann's work and have found that after boiling the medullary substance with hydrochloric acid, the ether takes up a trace of Vulpian's substance, as well as a substance that reduces Fehling's solution.

The ether residue also gives a precipitate with neutral lead acetate which, on decomposition with dilute sulphuric acid, sets free a compound that gives with ferric chloride the reaction so characteristic of pyrocatechin. Our blood-pressure-raising constituent is not precipitated by lead acetate and could not, therefore, have been responsible for this result.

Furthermore, on decomposing a fairly large quantity of the crude benzoyl product before referred to and shaking out the resulting benzoic acid with ether, we have twice found that the ether has taken up in addition to the benzoic acid a small quantity of a substance which reduces Fehling's solution and gives a precipitate with neutral lead acetate. On decomposing the resulting lead compound with dilute sulphuric acid and neutralizing the filtrate, we obtained a solution which behaved with ferric chloride in the way characteristic of pyrocatechin. The quantity of this lead compound obtained has been too small for analytical purposes.

We consider it, therefore, still uncertain whether or not a little pyrocatechin is present in the gland.

That the blood-pressure-raising constituent is, however, not a pyrocatechin derivative seems to us certain. To prove this we used, not the entire gland nor the medullary substance, but the active principle itself, as isolated by us by decomposing the benzoyl compound.

We have used large quantities of material representing in each experiment the active principle of several thousand glands. We have boiled this with hydrochloric acid of varying strength and for varying lengths of time, and in no case have we been able to find in the ether used as a solvent any trace of a substance that would reduce Fehling's solution or give a precipitate with lead acetate. Inasmuch as some of the chromogenic substance always passes into the ether from acid solutions, these two reactions are both necessary to establish the presence of pyrocatechin. In other words, we have failed to split off pyrocatechin from the active principle as isolated by us. If present, it could hardly have eluded our search, for even a minute quantity may be made to give a precipitate with neutral lead acetate.

*Jac. Ginzberg, Ueber das Verhalten des Pyrrols, etc., Inaug. Diss., Königsberg, 1890.

We propose during the coming autumn to continue this work. Having made arrangements for the use of a large amount of material, we hope to secure both the benzoate and the sulphate in a form pure enough for analysis and for further chemical study.

Summary.

We may summarize the results of our work as follows:

The blood-pressure-raising constituent of the suprarenal capsule may be completely precipitated from an aqueous extract by treatment with benzoyl chloride and sodium hydrate, according to the Schotten-Baumann method.

On decomposing the resulting benzoyl products, a residue is obtained which possesses great physiological activity. It gives the color reactions of Vulpian, reduces silver nitrate and possesses the other specific qualities of suprarenal extracts.

With the help of alkalies a carmine-red pigment may also be separated from these decomposition products. We take this pigment to be that one of the chromogenic substances of Vulpian which gives the rose-carmine color when suprarenal extracts are treated with oxidizing agents or alkalies.

A volatile, basic substance of a coniine-like odor is always found to accompany the crude benzoate. When these substances are removed the active principle is left as a highly active sulphate or hydrochlorate, as the case may be. It is therefore a basic substance. Its salts give a color reaction with ferric chloride; they also reduce silver nitrate, but not Fehling's solution.

It is not possible to split off pyrocatechin from this isolated active principle. The fact that dry distillation causes the appearance of amines and pyrrol in abundance, taken in connection with its ability to take up acid radicles, its reducing power, its precipitability by cupric acetate and iodine chloride, and its physiological action, lead us to conclude that our active principle is to be classed with the pyridine bases or alkaloids.

Addendum, June 15, 1897.

Since the foregoing paper was read before the Association of American Physicians on May 6, 1897, B. Moore has published a paper in the *Journal of Physiology*, vol. xxi, Nos. 4 and 5, May 12, 1897, entitled, "On the Chromogen and on the active Physiological Substance of the Suprarenal Gland." In this paper it is suggested that the active principle may be a pyridine derivative. Moore's conjecture is based, first, on a formula calculated by him from a combustion analysis of Krukenberg, made with an impure, hygroscopic, noncrystalline residue obtained by merely decomposing and drying a precipitate secured out of an alcoholic extract of the gland with the help of basic lead acetate. The calculated formula, the carbon content of which differs by 1.33 per cent. from that actually found by Krukenberg, is $C_5H_{14}NO_4$, and Moore points out that in it the ratio in which the elements carbon and nitrogen stand to each other is the same as in pyridine, C_5H_5N. Now such a calculation, though suggestive to the investigator, furnishes no proof of the presence of pyridine, for Krukenberg could not possibly have had in hand a chemical individual uncontaminated with other constituents of the gland. Krukenberg himself admits that his material was a mixture of unaltered pigment and its decomposition products. It is also certain that it was contaminated with other constituents of the gland. This is proved by the fact that basic lead acetate precipitates several of the constituents of the gland which pass into alcohol, and also by the fact that the analysed material contained 0.068 per cent. of sulphur and from 1.18 per cent. to 1.44 per cent. of ash.

A second reason given by Moore in support of his conjecture is that when "some suprarenal extract was cautiously fused with caustic potash so as to avoid charring, the peculiar odor of pyridine was at once obtained." He admits that proteids were present in this extract, and that pyridine and its homologues are formed in the destructive distillation of proteids, but states that the experiment was "conducted so as to avoid charring," and considers this a sufficient safeguard. This experiment has also no value, for the odor of pyridine can always be obtained when a mixture of dry, powdered proteid and powdered caustic potash are fused together so as to avoid charring. This experiment, therefore, must be made with material entirely free of proteids. Since reading Moore's paper we have fused a little of our active principle with caustic potash, but have failed to detect pyridine. If present in the molecule of the active principle, it is evident that larger quantities of the material must be used to prove it. Only indisputable chemical proofs can establish the presence of pyridine; the odor is not enough. We have frequently in various manipulations with the active substance met with what we took to be the odor of pyridine, but on shaking out with ether and adding an ethereal solution of hydrochloric acid and evaporating the ether we have been unable to detect pyridine in the residue.

Description of the Tracings.

Fig. 1. Tracing. Dog anæsthetized with morphine; curare and artificial respiration, both vagi cut. Injection of the active sulphate, freed from the carmine substance and coniine-like body, at ×.

A = running base line.
B = time record.
C = curve of the blood pressure, canula in the right carotid artery.

Fig. 2. Tracing. Conditions of the experiment as in Fig. 1. Injection at × of a highly active sulphate which still gives the rose-carmine color with iodine water and still contains some of the coniine-like substance which does not raise the blood pressure. The blood pressure is so high that the mercury is driven out of the manometer.

Fig. 3. Tracing. Conditions as in 1. Injection at × of a material which is still highly active although it had been boiled with 5 per cent. sodium hydrate for one hour. In this experiment a number of injections had already been made; the pressure had fallen to the normal before the injection indicated at × was made.

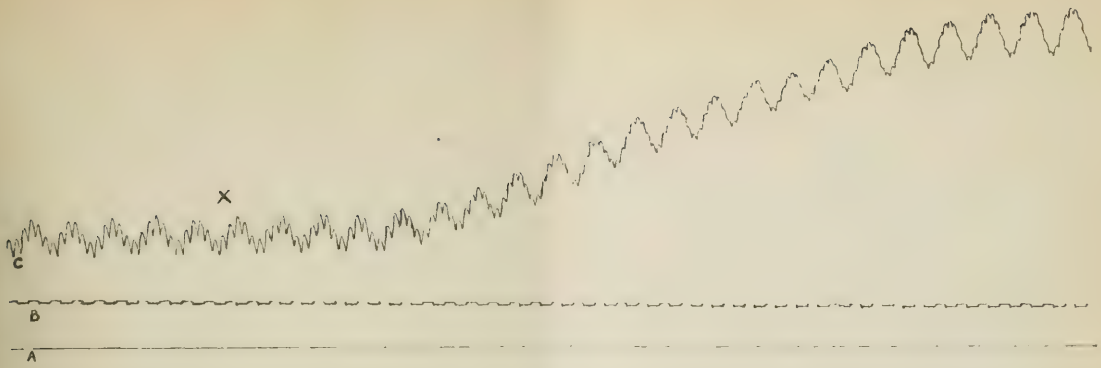

Fig. 1.

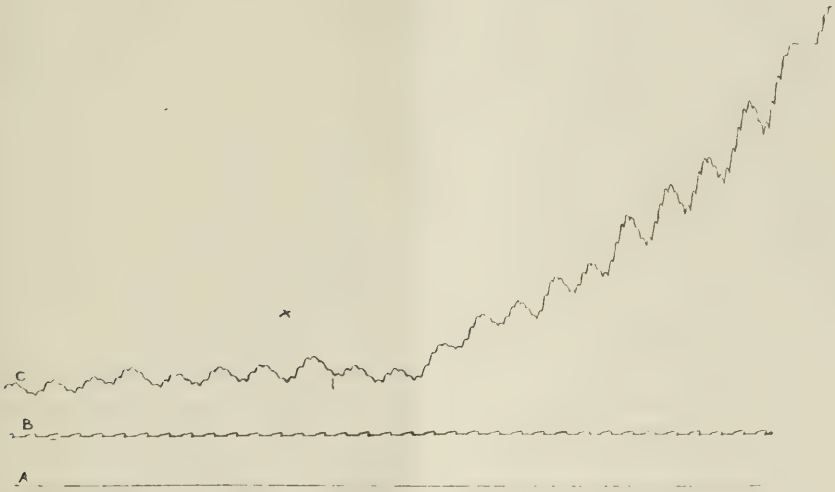

Fig. 2.

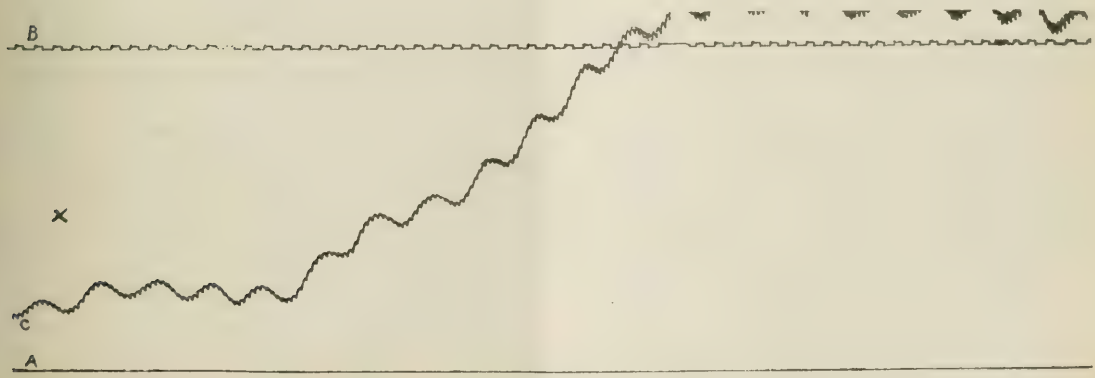

Fig. 3.

NOTES ON NEW BOOKS.

Anomalies and Curiosities of Medicine, being an encyclopedic collection of rare and extraordinary cases, and of the most striking instances of abnormality in all branches of Medicine and Surgery, derived from an exhaustive research of medical literature from its origin to the present day, abstracted, classified and indexed. By GEORGE M. GOULD, A. M., M. D., and WALTER L. PYLE, A. M., M. D. With 295 illustrations and 12 half-tone and colored plates. 968 pp. (*Philadelphia: W. B. Saunders*, 1897.)

The statement of Gibbon that objects which are only singular without being pleasing may excite surprise but soon lead to satiety and disgust, does not apply to this volume, which is thoroughly interesting from beginning to end. The attempt of the authors "to briefly epitomize and to arrange in order the records of the most curious, bizarre and abnormal cases that are found in medical literature of all ages and all languages," has been most successful. The book is thoroughly scientific in its treatment of the varied material which has been gathered with an industry which calls forth admiration. The first six chapters will probably be read most generally and relate to anomalies of conception, birth and development, and are of special interest to the gynecologist, obstetrician and student of legal medicine. Chapter seven relates to gigantism, dwarfishness, obesity and abnormal leanness, and the accompanying illustrations form a curious collection of anomalies suggestive of a dime museum.

The chapter on longevity taxes one's faith rather more than any other. Think of Henry Jenkins dying at the age of 169 years; Thomas Parr at 152; Jean Korin at 172 and his wife at 164, and a son left an orphan by their untimely death at the tender age of 116; Petretsh Zartan at 185 or 187 (authorities differing), who walked a mile to the post office a few days before his death to ask for alms; and many other well-authenticated instances of nearly equal age.

The chapter on anomalous mental and nervous diseases is so complete it is a matter of surprise that it does not include the history of the young man in Ohio who became totally blind at the age of seven months, and who, while receiving an education at the school for the blind, in consequence of a fall, lost both hearing and speech. After a time, his eyesight being restored by the fall, he was transferred to an establishment for the education of deaf mutes. Here eventually his hearing was suddenly restored, but epileptic attacks developed which required hospital treatment, this time in an institution for the insane. This well-authenticated tale was published in considerable detail in one of the State reports and deserves a place in these annals. The chapter on Historic Epidemics is timely, especially the full account of the bubonic plagues of the middle ages.

An excellent feature of the book is the judicial spirit shown by the authors. Facts are weighed and reasons are advanced for the conclusions which are reached. The book is well printed and finely illustrated and is worthy of a large success. Every chapter is of interest to every physician.

Text-Book of Materia Medica, Therapeutics and Pharmacology. By G. F. BUTLER, M. D. (*Philadelphia: W. B. Saunders*, 1896.)

This work is dedicated to the "Medical Students of the United States," and we have no doubt that many of them who enjoy buying the latest work on this branch of medicine will find it serviceable. It cannot be said to replace the older works of Wood, Hare and others. There is very little true original thought in it, which should be the the real reason for the publication of any new book, especially to-day, when there is altogether too much production of simply transient works. As the author states in the preface: "From the U. S. Pharmacopeia chiefly, and from the National Dispensatory, have been adopted almost verbatim, the 'origin' and 'description and properties' of the various drugs under consideration," so it is more in his arrangement of his material that we must look for originality. He classifies the drugs by their properties, rather than alphabetically, as is done by Hare. Both methods have their advocates, and personally, as it is much the most rapid way to look up any given drug, we prefer the latter method. Butler still further classifies the drugs into so called "Disease-Medicines," a very unscientific term, as he himself recognizes, and "Symptom-Medicines." In such a classification no two persons will agree as to the class to which certain medicines will belong most properly, and thus it becomes confusing and time-consuming to search for the drug wanted. The author says: "A genuine specific is tolerated only by the system in which it antagonizes some disease. For instance, A and B are put under a prolonged course of mercury; A is salivated beyond recognition, while B's health improves—simply for the reason that B had syphilis, which A had not." Such general remarks are often not true, and the example given is a very poor one, for we all know that syphilitic patients may be salivated, and sometimes as severely as those who are not syphilitic. Also many patients who have not syphilis may take mercury in large doses for long periods of time without becoming salivated. We do not understand the following sentence: "Quinine was formerly considered a specific in malaria, until the fact was recognized that the drug is analogous to a normal constituent of healthy bile in its action upon plasmodia malariae." We believe that by most authorities quinine is still considered to be a specific in malaria, whatever the action of bile may be. In a work which covers so much ground as this text-book, the value depends on an equal balancing of the different parts, and especially, in the description of the drugs, of careful omission of all unnecessary parts, and still more exact and concise information on all important points. Each author naturally finds special interest in certain parts of his work, and so not knowing these it is hard to criticise the book justly. But in the 650 pages given to drugs and their actions we feel that much improvement could have been made with careful revision—some parts omitted, and other information of more importance added. We think it quite out of place to introduce in such a work declensions of simple Latin words and other rules of Latin grammar, which should be known by every student before he begins the study of medicine, and if he does not know them, he should not be helped to the knowledge in this superficial manner.

Diseases of the Ear, Nose and Throat. By S. S. BISHOP, M. D. (*Philadelphia: F. A. Davis Co.*, 1897.)

This book, we think, fulfills pretty satisfactorily the object of the author, as expressed in the preface; he says: "This work was designed, first to help students in preparing for their degree; second, for those progressive practitioners who wish to acquire the proficiency necessary to properly treat those patients who are unable to visit specialists; and third, for those who are gradually exchanging their general practice for special work in these branches." The chapter on blood-serum therapy in diphtheria seems out of place; it is merely an abstract of a few of the articles which have appeared on this subject during the past two years, and we see no good reason for introducing it here. The work on the whole is a fair presentation of our knowledge in these diseases, without any attempt to take up any of them at length. The treatment as given is generally satisfactory and simple. We do not agree with the author in considering hay-fever, or "nervous catarrh," as he prefers to call it, a result of uric acid diathesis. There are many questions in the study of this disease which are as yet quite inexplicable, and this theory of its causation is insufficient to explain them all; the neurotic character of the disease is well established, and that uric acid may in some cases play an important rôle in this nervous affection is undoubted, but it is also equally certain that other important causes play their rôle too in determining this malady.

This book is cheaply gotten up and the cuts are of poor quality; the colored illustrations also seem very unsatisfactory. Many of

the cuts are reproductions of instruments which by this time should be known to all practitioners and to every student graduating from a medical college. These simply add to the expense of the book without adding to its intrinsic value.

Essentials of Physical Diagnosis of the Thorax. Second Edition. By ARTHUR M. CORWIN, M. D. (*Philadelphia: W. B. Saunders*, 1896.)

That there is a demand for such a quiz-compend or aid in cramming for an examination is shown by the fact that a second edition of this small book has been called for. We cannot recommend it, however, for like other similar works it fails in attempting to condense much knowledge in a very limited space and although tolerably well arranged, there are numerous statements of fact with which we cannot agree. The varieties of tympany (p. 69) are confusing and not generally used and were better omitted in such a work. In the discussion of heart murmurs there is much needless repetition, and on p. 176 the mitral systolic murmur described as occurring in aortic insufficiency, otherwise known as Flint's murmur, is presystolic in time. The chapter on congenital lesions of the heart is treated too briefly to be of service, as is also the one on hydatid cyst of the lung, which, when primary, is not a condition easy to diagnose, nor could the signs of it as given by the author differentiate it from pleurisy. Spasm of the columnæ carneæ is a condition which may occur, but it is hardly one of which a diagnosis could be made. Acute endocarditis without valvular lesion is not a condition which can be recognized clinically, and inorganic aortic systolic murmurs should usually be doubted. The ratio of the inspiratory sound to the expiratory is not as three to one, nor in asthma is the dyspnœa (orthopnœa) chiefly expiratory. Cheyne-Stokes respiration does not ordinarily accompany opium poisoning. No worse instrument for clinical instruction could well be devised than the multiplex stethoscope, of which there is an illustration in the beginning of this work.

Pathological Report of the Illinois Eastern Hospital for the Insane. (*Chicago: Blakely Printing Co.*, 1896.)

This is an excellent report, full of much valuable material, and Dr. Adolf Meyer deserves much credit for it, considering the difficulties under which the work was prosecuted, due to a lack of general facilities for carrying it on. We cannot criticise any shortcomings when we read his closing remarks. He says: "It may justly be said that the publication of so much raw material is of little use. To polish the report, away from the records and the material, did not seem to be in the interest of the accuracy of a picture of the working of the laboratory which had barely come into existence at the end of the period covered. The work was planned on a broader basis than it was feasible to carry out in the short period. The idea was that the plan of publishing 'interesting' cases only was not in the interest of sober study of the daily experience, that selecting cases might lead to illustration of preconceived ideas instead of the facts as they present themselves in reality, and that at the present stage of psychiatry a consideration of all the things seen would be less dangerous than arbitrary selection. The same principle should be carried out in the clinical side as well." Although much of the material is raw, yet many facts of interest are to be found—perhaps the most interesting being that 32 per cent. out of 49 cases of terminal dementia, and 27 per cent. of 192 cases of mental diseases, including the first series, died of florid tuberculosis. Of course without fuller statistics as to the class of patients in the hospital, too much stress should not be laid on these figures, but nevertheless the percentage is high. A case of acute mania, dying presumably of sulphonal poisoning, shows the necessity of the utmost care being used in the administration of drugs to patients with mental diseases to avoid accidents of this sort. We shall await with pleasure successive reports from Dr. Meyer, who has now transferred his work to the Worcester State Hospital and Clark University, and trust he will be able to describe some of the finer microscopical findings in brain and cord lesions from the interesting material at his disposal.

St. Thomas's Hospital Reports. New Series. Vol. XXIV. (*London*, 1895.)

The first half only of this volume is taken up with detailed papers, and the second half with statistics of the different departments of the hospital, and brief abstracts of cases, medical and surgical. Among the papers here presented, two are worthy of special note. The article on "Osteo-arthropathy and its Relationships," with report of a case of pulmonary hypertrophic osteo-arthropathy, both by Dr. Walters, is a very valuable contribution to our knowledge of this curious condition and its relationship to akromegaly. It is an exhaustive study, with a brief abstract of all the cases reported of this bone-disease up to the time of the publication of this volume. The other paper is on "Enteric Fever and Sewage Gas," in which 11 cases of typhoid fever are described as resulting from poisoning with sewer gas in one hospital within a short space of time. Here milk, water and food as possible sources of the contagion could apparently be eliminated without doubt, and the only other discoverable source was a water-closet into which typhoid organisms had probably been discharged but a few weeks before the outbreak of this small epidemic, which ceased as soon as the sewage pipes were overhauled and modified. With the modern belief that typhoid fever in nearly every case results from milk, water or food contaminated by the typhoid organism, this epidemic raises the most interesting question as to whether or not typhoid bacilli may enter the body through the lungs and thus cause the fever. There are other articles on tuberculous disease in the knee-joint, and relapse in the specific fevers, which will repay careful reading.

Feeding in Early Infancy. By ARTHUR V. MEIGS, M. D. (*Philadelphia: W. B. Saunders*, 1896.)

In this paper Dr. Meigs emphasizes the results of his milk analyses as expressed in his earlier publication, and describes in detail the preparation of his food, based on these results.

He finds that human milk never contains more than one per cent. casein, cow's milk three times this amount, other constituents being present in about equal quantities. In his preparation cow's milk is therefore diluted with lime water, and cream and sugar added in definite proportions. The food, prepared after this manner, has been used for a number of years by the author, with satisfactory results.

He thinks that subjecting milk to high temperatures detracts from its usefulness as an infant food; therefore it is better to be assured of its source and avoid sterilization.

This course seems hardly practicable, and the injurious effect accredited to sterilization is not sustained by most writers on the subject.

Proceedings of the American Medico-Psychological Association at the 52d Annual Meeting, held in Boston, May 26–29, 1896. (*American Medico-Psychological Association*, 1896.)

The proceedings of this society occupy nearly 300 large papers, pretty closely printed; but all the papers are good, while some are of especial value. There is an interesting address on psychological education by Stanley Hall, a leading authority on such a subject; and there are important contributions by Brush, Worcester, Hoch, and Berkley. The paper by Hoch, on "General Paralysis in Two Sisters," is perhaps, while one of the most thorough articles, the one of most general interest. To students who have given much time to the study of the blood, the paper on "Leucocytosis Associated with Convulsions," by Burrows, will open up a point of much interest as to the cause of leucocytosis, whether or not it be due to a form of auto-intoxication.

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CONTENTS.

INFLUENCE OF LOUIS ON AMERICAN MEDICINE.*

By William Osler, M. D.

Harvey and Sydenham, types of the scientific and the practical physician, though contemporaries, were uninfluenced, so far as we know, by the other's work or method. Harvey had little reputation as a practical physician, and Sydenham cared little for theories or experiment. Modern scientific medicine, in which these two great types meet, had its rise in France in the early days of this century. True, there had lived and worked in England the greatest anatomist and medical thinker of modern times; but John Hunter, to whose broad vision disease was but one of the processes of nature to be studied, was as a voice crying in the wilderness to the speculative, theoretical physicians of his day.

Bichat's *Anatomie Générale* laid the foundation of the positive or modern method of the study of medicine, in which theory and reasoning were replaced by observation and analysis. Laennec, with the stethoscope, and with an accurate study of disease at the bedside and in the post-mortem room, almost created clinical medicine as we know it to-day.

The study of fevers occupied the attention of all the great physicians of the time. Fever—what it was, how it should be treated. What a vast literature exists between Sydenham and Broussais! What a desolate sea of theory and speculation!

No one had been more influenced by Bichat's brilliant teachings than Broussais, who ruled supreme in the medical world of Paris in the early decades of this century. A strong believer in careful observations at the bedside and in the post-mortem room, he was led into hopeless error in attributing fevers and many other disorders to irritation in the stomach and intestines—his gastro-enteritis.

Writing in the American Medical Recorder, July, 1821, an American student, Dr. F. J. Didier, says of the Paris professors of that date, "They were always talking of Hippocrates, Galen, Celsus, etc., as if not a particle had been added to the stock of knowledge since their time." And again, "The doctrines of John Brown, mixed up with the remnants of humoral pathology, form the basis of the present system."

The same mixture prevailed early in the fourth decade, as you may see from Broussais' Pathology, the American edition of which was issued in 1832, and from Jackson's (Samuel) Principles of Medicine, published in the same year.

Upon this scene, when Broussais was at the height of his fame, came Louis. He, with his friends Andral and Chomel, were very important factors in substituting finally in the study of medicine, for speculation and theory, observation and method.

The chief facts in Louis' life may be thus briefly stated. He was born in 1787 at Aï. He began the study of law, but abandoned it for that of medicine. He seems not to have

*Read before the Stillé Society of the Medical Department of the University of Pennsylvania.

been of a very strong constitution, as he did not pass the inspection for military service. He began the study of medicine at Rheims, and completed his course in Paris, where he graduated in 1813, in the twenty-seventh year of his age. While waiting at home, hesitating what he should do, M. le comte de Saint-Priest, who occupied an official position in Russia, happened to stay for a few hours in the town of Aï to see Louis' family, and it was suggested that the young physician should accompany him to Russia. He consented and in St. Petersburg obtained a diploma to practice. For three years he seems to have had no settled abode, but wandered about with his friend, who was Governor of one of the provinces. He then settled in Odessa, where he remained for four years and practiced with great success. In the last year of his stay in Odessa he was very much disturbed by the high rate of mortality in children with diphtheria, and this appears to have determined him to abandon for a time the practice of medicine and to devote himself to study. With this object in view he returned to Paris and for six months attended the practice at the Children's Hospital. Among the younger physicians in Paris he found an old fellow-pupil, Chomel, physician to La Charité, who offered him opportunities for work in his wards. Louis at this time was thirty-four years of age. Here for six years uninterruptedly he set himself to work to study disease in the wards and in the post-mortem room. At first he appears to have occupied the position simply as a voluntary assistant and friend of Chomel, but subsequently he became his *chef-de-clinique*, and during this period he occupied a room in the entresol of the hospital. He was a voluminous note-taker and collected in this time an enormous number of important facts.

This remarkable feature in Louis' life has scarcely been dwelt upon sufficiently. I know of no other parallel instance in the history of medicine. It is worth while reading the brief extract from Dr. Cowan's introduction to his translation of the work on Phthisis. "He entered the hospital of La Charité as a *clinical clerk*, under his friend, Professor Chomel. For nearly *seven years*, including the flower of his bodily and mental powers (from the age of thirty-three to forty), he consecrated the whole of his time and talents *to rigorous, impartial observation*. All private practice was relinquished, and he allowed no considerations of personal emolument to interfere with the resolution he had formed. For some time his extreme minuteness of inquiry and accuracy of description were the subjects of sneering and ridicule, and *cui bono?* was not infrequently and tauntingly asked. The absence of any immediate result seemed for a time to justify their contempt of a method involving too much labor and personal sacrifice to be generally popular or easily imitated; and M. Louis himself, at moments, almost yielded to the increasing difficulties of the task he had undertaken. No sooner, however, were his facts sufficiently numerous to admit of numerical analysis than all doubt and hesitation were dissipated, and the conviction that the path he was pursuing could alone conduct him to the discovery of truth became the animating motive for future perseverance. Many of the results to which he arrived soon attracted general attention, and among those who had formerly derided his method while they admired his zeal, he found many to applaud and a few to imitate. From this moment may be dated the presence of that strong impression of the necessity of exact observation by which the school of Paris has been since so distinguished, and which is now gradually pervading the medical institutions of the continent and our own country; it is undoubtedly to the author of the present volume that we ought to ascribe the practical revival of that system, which had for ages been verbally recognized but never before rigorously exemplified."

The following works appeared as a direct result of his studies during these six years:*

"In 1823, a memoir on perforation of the small intestines, in acute diseases; a second, on croup in the adult; a third, on the communications between the right and left cavities of the heart (Archives de médecine).

"In 1824, two memoirs on the pathological anatomy of the mucous membrane of the stomach; another on pericarditis.

"In 1826, a memoir on abscess of the liver; another on the condition of the spinal marrow in Pott's disease; a third on sudden and unforeseen deaths; a fourth upon slow but anticipated deaths, but which anatomy will not explain; a fifth on the treatment of tænia by the Darbon potion (Archives de médecine).

"In 1825, his Anatomical Researches, etc., on Phthisis (1 vol. 8vo); reprinted with many additions in 1843.

"In 1828, Researches on the Typhoid Affection or Fever (2 vols. 8vo); reprinted with many additions in 1841."

Louis introduced what is known as the Numerical Method, a plan which we use every day, though the phrase is not now very often on our lips. The guiding motto of his life was "Ars medica tota in observationibus," in carefully observing facts, carefully collating them, carefully analyzing them. To get an accurate knowledge of any disease it is necessary to study a large series of cases and to go into all the particulars —the conditions under which it is met, the subjects specially liable, the various symptoms, the pathological changes, the effects of drugs. This method, so simple, so self-evident, we owe largely to Louis, in whose hands it proved an invaluable instrument of research. He remarks in one place that the edifice of medicine reposes entirely upon facts, and that truth cannot be elicited but from those which have been well and completely observed.

American medicine felt the influence of Louis through two channels, his books and his pupils. Let us speak first of the former. No French writer of the century has had such a large audience in this country; all of his important works were translated and widely read. The work on phthisis, the first important outcome of five years' hard work at La Charité in Chomel's wards, was published in 1825. Much had already been done by physicians of the French school on this subject. Bayle's important *Recherches* had been issued in 1810, and Laennec had revolutionized the study of phthisis by the publication of his treatise on auscultation. I cannot enter into any detailed analysis of the work, but it is one which I can commend to your notice as still of great value, particularly as

* Brief Memories of Louis and some of his Contemporaries. H. I. Bowditch, Boston, 1872.

a model of careful observation. The work was based upon the study of 123 cases observed in Chomel's clinic. The lesions observed at autopsy are first described under the different organs, with great accuracy and detail, and then summarized, following which is an elaborate description of the symptomatology. I do not know of any single work on pulmonary tuberculosis which can be studied with greater profit to-day by the young physician. The fifty years which have elapsed since its publication, and the changes which have taken place in our ideas of tuberculosis, diminish naught from the value of his careful anatomical and clinical presentation of the subject.

In 1829 appeared his second great work, *Anatomical, Pathological and Therapeutical Researches upon the disease known under the name of gastro-enterite, putrid, adynamic, ataxic, typhoid fever, etc., compared with the most common acute diseases.* It was based upon 138 observations made between 1822 and 1827. He analyzed and determined the lesions found in fifty patients who had died of the typhus fever, and compared these with alterations found in other acute diseases. Altogether for this work he states that he analyzed the changes in the viscera of 133 subjects and the symptoms of nearly 900. In his introduction to this work he quotes a sentence from Rousseau which is always to be kept in mind: "I know that truth lies in the facts, and not in the mind that judges of them, and that the less I introduce what is merely my own into the deductions I make from them, the more certain I shall be of approaching the truth." This work was translated by Dr. H. I. Bowditch in 1836. At the time of Louis' observations, although differences were recognized between the various forms of continued fevers, the profession had no accurate knowledge of the subject. It so happened that at this period the disease prevailing at Paris known as typhus was almost entirely what we now call typhoid fever, so that the anatomical lesions found by Louis in his fifty autopsies were chiefly in the intestines; in all the Peyer's glands were diseased. His method was to analyze carefully the appearances found in the different organs in the series of fever cases, and compare them with patients who had died of other acute diseases; thus of course the contrast was striking in the very matter of involvement of Peyer's glands, which were more or less seriously changed in structure in all of the patients with the fever, while in the persons dead of other acute diseases the elliptical patches had no special redness or softening.

The symptomatology was also given in great detail, and the same painstaking comparisons were instituted between the subjects of the typhoid affection and those of other acute diseases. Louis' work convinced a majority of the members of the Paris school that the essential lesions in continued fevers were in the intestines, and Louis himself appears not to have had any idea whatever that the disease which he was studying was in any way different from the disease prevailing in other parts of Europe and which we now know as typhus fever.

The next important memoir, the essay on Blood-letting, had a very potent influence on professional opinion in this country. It appeared in Paris in 1835 and was translated by G. C. Putnam, with an introduction and appendix by Dr. James Jackson. As this learned physician remarks in his preface, "If anything may be regarded as settled in the treatment of disease, it is that blood-letting is useful in the class of diseases called inflammatory, and especially in inflammations of the thoracic viscera." When one reads the reports of the treatment by bleeding up to about the year 1840, one is almost forced to ask the question, are the diseases the same? or surely the patients must have possessed much more powerful constitutions than those which we are called upon to treat at the end of the century.

At the time of Louis' return to Paris, under the influence of Broussais' doctrine of irritation, local and general blood-letting was practised more extensively than at any previous period in the history of medicine. As an interesting illustration it may be mentioned that the trade in France and Spain in leeches had developed to proportions which assumed really those of a national industry, and even in this country I believe one of the medical societies offered a prize for the best demonstration of the practical method of cultivating leeches for medicinal purposes.

It must have been a terrible shock to Broussais and his adherents when Louis attacked the subject of blood-letting in pneumonia with his numerical method. For this purpose he analyzed 78 cases, 28 of which proved fatal, and in a second series 29 cases with 4 deaths. Among his conclusions were that pneumonitis is never arrested at once by blood-letting, and that the supposed happy effect on the progress of the disease was very much less than was commonly believed. Incidentally he remarks with reference to the practice of blistering which was in vogue at the time, that he had rejected the practice after the treatment of 140 cases of pleurisy without losing a case. I would refer you particularly to Putnam's translation of this article, which you can obtain in any of the libraries, not only for Louis' work, but for the excellent introduction by Dr. Jackson on the value of the numerical method in medicine, and also for the appendices, analyzing the pneumonia cases of the Massachusetts General Hospital from 1824 to 1834 (inclusive).

To American students one of Louis' most valuable works is his Research on the Yellow Fever in 1828. On the 1st of November, 1828, Louis, with Chervin and Trousseau, left for Gibraltar, where the disease prevailed. They made a very careful study of the symptoms and morbid anatomy, and on their return to Paris made a report to the Academy of Medicine, but the work remained in manuscript until Dr. Geo. C. Shattuck translated it into English and it was published by the Massachusetts Medical Society as Vol. X of their Library of Practical Medicine. The work did not appear in French until 1844. It is chiefly valuable as a very accurate and careful record of a series of cases studied clinically and anatomically.

Powerful as was the effect of Louis' writings on American medicine, it cannot compare with the influence which he exerted through his pupils, who "caught his clear accents, learned his great language, made him their model." Of the great triumvirate of the French school of the fourth decade, Louis possessed a singular power of attracting hard-working, capable men, and this in spite of the fact that his rivals and friends, Chomel and Andral, possessed more brilliant gifts of

a certain kind. As a writer in the Lancet said (1872, II), "Year by year fresh bands of students came to imbibe from his lips the instruction which their predecessors had abandoned with reluctance, till his academic progeny knew no distinction of race or even color, but coalesced into a noble band of enthusiasts in the cause of medicine, of science and of humanity." In this academic progeny Louis' American pupils take a very unusual position. Among the thousands in the profession of this country who have during this century sought light and learning in the older lands, the group of young men who studied in Paris, between 1830 and 1840, had no predecessors and have had no successors. Partly because the time was ripe and they were active agents in bringing the new art and science to the New World, partly owing to inherent capabilities, etc., but not a little because the brightest minds among them fell under the influence of Louis—they more than any others gave an impetus, which it still feels, to the scientific study of medicine in the United States.

There had been, of course, in Paris many students from this country prior to 1830, but they do not form a school, recognizable to us at present. One name comes to my mind, that of the Rhode Island philosopher, Elisha Bartlett, a peripatetic of the peripatetics, in the days when men moved from city to city, like the Sophists of ancient Greece. I do not know whether when in Paris in 1828 he came personally under Louis' influence—probably not, as Louis spent part of that year in Spain—but he brought back recent French methods, with Gallic lucidity and a keen appreciation of the value of the numerical method. His well known work on Typhus and Typhoid Fever, issued in 1842, is in itself a lasting witness to the intelligence and progressive character of the younger teachers of that day. With a clear separation of Typhus, Typhoid, the Periodic and Yellow Fevers, it had at the date of its publication no counterpart in European literature, and is in remarkable contrast to the chaotic treatises of Armstrong, Fordyce, Tweedie, Southwood Smith and others.

Without attempting to give a complete list, the following were among the American students in Paris between 1830 and 1840:

From Boston, James Jackson, Jr., H. I. Bowditch, Oliver Wendell Holmes, Geo. C. Shattuck, Jr., John D. Fisher, J. C. Warren (then past middle age), and J. Mason Warren.

From New York, John A. Swett, Abraham Dubois, Alonzo Clark, Charles L. Mitchell, Charles D. Smith, Valentine Mott, Sr., and John T. Metcalf.

From Philadelphia, Geo. W. Norris, W. W. Gerhard, Casper W. Pennock, Thomas Stewardson, Alfred Stillé, Thomas D. Muter, J. Campbell Stewart, Charles Bell Gibson, John B. Biddle, David H. Tucker, Meredith Clymer, Wm. P. Johnston, W. S. W. Rushenberger, Edward Peace, William Pepper, Sr.

From Baltimore, William Power.

From the South, Peter C. Gaillard, Gibbs, and Peyre Porcher of Charleston; J. L. Cabell, L. S. Joynes, Selden and Randolph of Virginia.

"And many more whose names on earth are dark"—men of the stamp of Dr. Bassett of Alabama, who felt the strong impulsion to know the best that the world offered, every one of whom has left a deep and enduring impression in his sphere of work.

It would be impossible to tell in detail how Louis' students brought back his spirit and his methods to their daily work, and of the revolution which they gradually effected in the study and in the treatment of disease. I can best, perhaps, fulfill my object by referring somewhat fully to two of the most distinguished among them, James Jackson, Jr., and W. W. Gerhard.

James Jackson, Jr., is the young Marcellus among the physicians of this country, "the young Marcellus, young, but great and good." I do not know in our profession of a man who died so young who has left so touching a memory. He was the son of Dr. James Jackson, of Harvard, one of the most distinguished of New England's physicians, a man to whom our generation owes a heavy debt, since he, with Jacob Bigelow, was mainly instrumental in bringing about more rational ideas on the treatment of disease. Of Louis' pupils from this side of the water, young Jackson seems to have been his special favorite. After taking the B. A. degree at Cambridge in 1828, Jackson attended the medical lectures at Harvard, and in the spring of 1831 went to Paris, where he remained until the summer of 1832. Returning home in 1833, he graduated in medicine at Harvard in 1834. In the two years and a half of his studies in this country before going abroad he had had exceptional opportunities with his father at the Massachusetts General Hospital, and showed his early industry and ability by taking one of the Boylston Prize Essays before the completion of his second year of study.

In Paris he attended the practice of La Pitié and St. Louis. He soon became devoted to Louis, and by him was utilized to the full in the cholera epidemic in 1832. Two letters from Louis to James Jackson, Sr., show how important he thought a prolonged period of study was for a young man. He says: "I pointed out to him (James Jackson, Jr.) the advantage it would be for science and for himself if he would devote several years exclusively to the observation of diseases. I now retain the same opinion and am strengthened in it; for the more I become acquainted with, and the more I notice him applying himself to observation, the more I am persuaded that he is fitted to render real service to science, to promote its progress. I find that he would be well pleased to follow for a certain period the vocation for which nature has fitted him; but he has stated to me that there are many difficulties which would prevent his devoting himself exclusively to observation for several years. But can these difficulties be insurmountable?"

And again: "Let us suppose that he should pass four more years without engaging in the practice of medicine, what a mass of positive knowledge will he have acquired! How many important results will he have been able to publish to the world during that period! After that he must necessarily become one of the bright lights of his country; others will resort to him for instruction, and he will be able to impart it with distinguished honor to himself. If all things be duly weighed, it will appear that he will soon redeem the four years, which men of superficial views will believe him to have lost." In another letter, the following year, just before young

Jackson's departure from Paris, he refers again to this question and urges Dr. Jackson to allow his son to devote himself exclusively to observation for several years in Boston. The extract from this letter is worth quoting. "Think for a moment, sir, of the situation in which we physicians are placed. We have no legislative chambers to enact laws for us. We are our own lawgivers; or rather we must discover the laws on which our profession rests. We must *discover* them and not invent them; for the laws of nature are not to be invented. And who is to discover these laws? Who should be a diligent observer of nature for this purpose, if not the son of a physician, who has himself experienced the difficulties of the observation of disease, who knows how few minds are fitted for it, and how few have at once the talents and inclination requisite for the task? The inclination especially, for this requires that the observer should possess a thorough regard for truth, and a certain elevation of mind, or rather of character, which we rarely meet with. All this is united in your son. You ought—for in my opinion it is a duty—you ought to consecrate him for a few years to science. This, sir, is my conviction, and I hope it will be yours also. I know very well that every one will not be of the same opinion; but what matters it, if it be yours?—if you look upon a physician, as I do, as holding a sacred office, which demands greater sacrifices than are to be made in any other profession."

Young Jackson's letter to his father, just as he was quitting Paris, indicates on what affectionate terms he had lived with Louis. "In two hours I am out of Paris. I will not attempt to describe to you the agony it gives me to quit Louis. He is my second father, and God knows that is a name I of all men cannot use lightly. I may not persuade you to look upon him with my eyes exactly as a scientific man; but in your heart he must have the share of a brother; for he almost shares my affection with you. From one upon whom I had no claims but those which my life and mind and habits gave me, I have experienced a care, an affection which I never could dare expect from any but my dear father, and which I shall ever feel to be the most honorable and truly worthy prize of my life."

He seems to have inspired the same tender feelings in all his American students. In the *Memoir* of Dr. Bowditch, to which I have already referred, he speaks of Louis' fatherly kindness to him during a prolonged attack of rheumatic fever lasting for many weeks.

Young Jackson was one of the founders, in 1832, of the Society for Medical Observation, which consisted of the ablest of the students of Louis, Chomel and Andral. During his stay in Paris he made an important study of cholera, which was published in this country in 1832. It was most timely, as it gave the profession here a very clear and accurate description of the disease, of which up to that time they had had no experience. Jackson's name, too, will always be associated with the studies upon emphysema, and he is the discoverer of the prolonged expiration in early pulmonary tuberculosis.

Returning to Boston in the autumn of 1833, he spent the winter preparing for his degree and elaborating the notes which he had taken in Paris. In March he fell ill with a dysentery, which proved fatal on the 27th of the month, in the twenty-fifth year of his age. I know of no young man in the profession who had given pledges of such exceptional eminence. His influence in extending Louis' methods and views throughout New England was chiefly through his father, who, though a man approaching his sixtieth year, became an ardent follower of Louis and the numerical method.

In Oliver Wendell Holmes' recently issued Biography you will find a delightful description of life at the Medical School of Paris at this period. He bears witness to the good effect which Jackson's warm friendship with Louis had had in promoting the interests of American students. I may conclude with a quotation from Dr. Jackson's, Sr., memoir: "At the suggestion and request of one of my most judicious brethren I shall add that my son's influence on the profession here, in the short time he was with us, was of a very salutary description. This gentleman states that my son not only caused others, who had not yet read the works of M. Louis, to study them with care, but that he induced among the rising members of the profession in our own city the habits of thorough observation of the phenomena of disease in the living and in the dead, which he had learned from the same great pathologist. He also taught us much in respect to the physical signs of disease in the thorax, with which we were imperfectly acquainted before; at least I may say this was true as to myself. Indeed I ought to say more, for he aided me very much in regard to the diagnosis of the more obscure diseases of that region, derived from the combination of the physical and rational signs. On emphysema of the lungs he threw, for me, quite a new light."

Wm. W. Gerhard was the most distinguished of the American pupils in Paris between 1830 and 1840. When you call to mind the men whom I have mentioned, this may seem a strong statement, but I feel certain that could we take their suffrages they would accord him the place of merit in consequence of the character of his work. Dr. Gerhard was born in Philadelphia, in 1809, and was graduated from the University of Pennsylvania in 1831. Early in the year he went to Paris and attached himself to Louis at La Pitié. In one of his letters* to his brother, dated January 18, 1832, he says: "Dr. Louis is delivering an interesting clinic at La Pitié; he is a remarkable man, very different from the physicians of England or America, and remarkable even at Paris by the strict mathematical accuracy with which he arrives at his results; he is not a brilliant man, not of the same grade of intellect as his colleague at La Pitié, Andral." In another letter he gives an account of his day's work. "The morning from seven to ten is occupied with the visit and clinic at the hospital; there are several distinct clinics now in actual progress; each of them has its advantages. I shall vary my attendance at the different hospitals and select those lecturers who are of real merit. At this moment we are following Piorry at the Salpetrière, a very distant hospital, two or three miles from our lodgings; his patients are all old women, and not interesting. My object in following his course is to obtain some interesting information on the best mode of

*I am indebted to members of Dr. Gerhard's family for the letters from which these extracts are taken.

investigating the diseases of the chest. M. Piorry has devoted special attention to this subject. From Salpetrière we hurry to La Pitié; we hear a surgical lecture, reach home to breakfast, and then to the school of medicine. The lectures at the school, with a private course of anatomy during the hour of intermission, fill up the remainder of the day until four. Fortunately a private clinic at La Charité introduces me to a set of very interesting cases, especially on pectoral cases. Dr. Dagneau has a class who pay him ten francs a month and enjoy the privilege of examining the patients much more conveniently than is practicable during the morning visit in the midst of a crowd of students. We dine at five-thirty and then lectures again until eight o'clock. Imagine the facilities, the delightful advantage of acquiring positive information, and what is at least as important, of learning the mode of obtaining these positive results. We see and hear the men who are so well known to us in America, learn to form a correct estimate of their relative worth—in short, one of the most striking advantages of a medical visit to Europe is to acquire the sort of liberal professional feeling which is rarely secured by the continued intercourse with the same men, and the unpleasant medical politics which divide the profession in America."

Evidently Broussais made no special impression on Dr. Gerhard. He says, "Broussais is the best known, his reputation is universal, and the benefits he has conferred on medicine are immense, but unfortunately he is a wretched lecturer. His own opinions are given in the most awkward, clumsy manner; the manner and style of lecturing are coarse and vulgar."

In another letter of February 3, 1832, he tells how he induced Louis to give them private instruction. To his brother he writes: "I must write you at least a few days before the excitement has passed off: can you imagine how fortunate I am—devinez si vous pouvez—two or three days ago, Jackson, Pennock and myself were talking of hospitals and morbid anatomy, when the idea occurred of attempting the study of pathology in a particular manner. It was this: to obtain the specimens and study them, the authors in our hand, exactly and carefully comparing authorities with the subject before us. We addressed ourselves to two of the *internes* at La Pitié attached to the *salles* of Louis and Andral, and they agree to procure all facilities in their power and communicate their own information for the compensation of 60 francs from each of us; we accordingly visit La Pitié on three afternoons of the week and examine the parts at the hospital, afterwards carrying home such portions as require minute investigation. Our first success in this opening of new sources of instruction emboldened us to attempt something of higher importance. We were all desirous of studying auscultation, of studying it in such a manner as to be sure of our ground on our return, and to be capable of appreciating the advantages of the art. Louis' public instructions were valuable, but his private lessons upon a subject demanding minute and patient inquiry we knew would be infinitely more so. I therefore in the name of my friends addressed him a polite note, accompanied by a handsome pecuniary offer; we did this with little hopes of success, but happily for us he accepted our proposition, and next week we are his private pupils at La Pitié. We are, I believe, the first who have made this arrangement with M. Louis, and you may estimate its importance when I tell you that he is considered in excellence of diagnosis the successor of Laennec. Our advantages for the study of pathology and the diagnosis of diseases of the chest are now superior; they are indeed the very best in the world, and our eagerness to embrace them will, I hope, render them of real utility; of course they involve an additional expenditure of 400 or 500 fr., but I should be happy to shorten my stay at Paris a month to improve the remainder of my time in this manner, if such were necessary for me. Pennock and myself are very happy to have become intimate with Jackson; he has superior talents, and his excellent education, conducted by his father, unquestionably the first physician in America, has cultivated his mind and developed an ardent attachment to medicine."

Few American students have occupied their time abroad to greater purpose than Dr. Gerhard. He appears to have been an indefatigable worker, and the papers which he published based upon material collected in Paris are among the most important which we have from his pen. Thus with Pennock he described Asiatic cholera in 1832. Devoting himself particularly to the study of diseases of children, he issued a very interesting paper on small-pox, and two papers of very special value, the first on tuberculous meningitis and the other upon pneumonia in children. Both of these papers mark a distinct point in our knowledge of these two diseases. He is usually accorded the credit of the first accurate clinical study of tuberculous meningitis.

Late in the year 1833 he returned to Philadelphia, and at his suggestion his friends had secured him the appointment as resident physician at the Pennsylvania Hospital, which he took early in 1834. This step indicated how carefully he had weighed the important influence in Louis' career of the years of quiet work at La Charité. At the Pennsylvania Hospital he had an opportunity to study the common continued fever of the country, and determined that it was identical, clinically and anatomically, with the typhoid fever of Louis, and characterized by a special lesion in the glands of Peyer. I do not know exactly how long he remained resident physician at the Pennsylvania Hospital, but he was soon after appointed one of the physicians at Blockley, and here in 1836 he was able to carry out his most important piece of work. The general opinion prevailed that the fever which Louis described and which had the lesions in the small bowel was only a modification of the ordinary typhus fever which at that time prevailed so extensively, particularly in Great Britain and Ireland. In London, Edinburgh and Dublin the intestinal lesions were regarded as only accidental, and not indicative of a special affection. Dr. Gerhard knew the typhoid fever of Louis well, and had had an opportunity of studying it again at the Pennsylvania Hospital, so that when the epidemic of typhus fever developed in 1836 he was in a very good position to make an accurate study of the disease. Two hundred and fourteen cases were observed, and as a result of his study he declared positively that the typhus fever, which was similar to the disease which he had also seen in Edinburgh, was a different affection altogether from the typhoid fever with intestinal lesions. These observations, you must remember,

were made in 1836, at a time when the greatest confusion existed as to the forms of fever. It took a great many years in Great Britain before the duality of the prevalent fever was recognized, but owing to the influence of Gerhard's paper, and to the accurate knowledge of fever brought to this country by Louis' pupils, the differentiation of the two diseases was here quickly recognized, since, as already mentioned, Bartlett in 1842 considered them apart.

Gerhard's work influenced his Paris friends greatly, and this was strengthened by the papers read before the Society for Medical Observation by Geo. C. Shattuck and Alfred Stillé, of whom the former had had opportunities of studying typhus fever in Great Britain, while the latter had been one of Gerhard's house physicians in the typhus epidemic at Blockley. Shattuck's paper is published in the Medical Examiner for 1840. I have always regretted that Dr. Stillé's paper has never appeared in print. He was kind enough to let me see it, and, as I have mentioned elsewhere, the differential points between typhus and typhoid fever are nowhere more clearly laid down.

The University of Pennsylvania early took advantage of Gerhard's training and utilized him as clinical lecturer at the Philadelphia Hospital. He soon acquired a special reputation in diseases of the heart and lungs. In 1842 appeared the first edition of his work on Diseases of the Chest, which ran through four editions, and is still a valuable work of reference. One of his fellow-students in Paris, Stewardson, has given a very pleasing picture of him as a clinical teacher: "As a clinical teacher he was remarkably successful and exerted a powerful and commanding influence. Without any pretension to eloquence, he nevertheless riveted the attention of his hearers and stimulated their enthusiasm. Himself deeply interested in his subject, he communicated this interest to his audience by the sheer force of truth. Students saw that truth was his object, not display; the advancement of science, and not the gratification of personal feelings, whether of vanity or ambition; in short, that in his mind, a deep interest in his subject and a thorough conscientiousness in the pursuit of it were the overmastering motives. In an easy and conversational style he presented to his hearers a graphic portraiture of the case before them, bringing into relief its most important symptoms; impressing upon their minds the most striking features in its history; pointing out, by a few clear and practical expressions, the bearing of any particular fact upon interesting medical questions, but avoiding long and labored arguments, or general disquisitions upon the nature of diseased action. He neither stimulated the fancy by the flowers of rhetoric, nor amused the intellect with episodes upon theoretical questions, but confined himself to drawing such practical conclusions as were clearly deducible from the facts presented. No man of his day enjoyed so high a reputation as a clinical teacher, and not only did he succeed in an eminent degree in arousing the enthusiasm of students and putting them in sympathy with himself, by infusing into them his own ardor in his favorite study; but he produced an influence upon the profession here which is felt still, which has fostered the establishment of clinical teaching among us, and done much to give it that rank which it now occupies here as a branch of medical instruction."

Of the work of Louis' other students in this country time would fail me to tell—of the influence of Bowditch, Holmes and Shattuck in Boston, of Swett, Clark and others in New York, of Pennock, Stewardson, Stillé in Philadelphia, and of Power in Baltimore. To them all we owe a heavy debt of gratitude. They brought from Paris enthusiasm, faith in the future, faith in the profession of their choice, accurate methods and a loyal love of truth. Endowed with the spirit and zeal of their master, they carried his great message to the New World; and more than this, touched with those finer qualities which made Louis so lovable, they have become bright ideals for all future generations of American students.

There remain, so far as I know, three only of the Paris students of whom I have spoken, John T. Metcalf, Meredith Clymer, and your honored patron, Alfred Stillé. They, too, must soon go the way of all the earth; but among the consolations of old age what greater solace can they feel than that the lives of the men whose fathers and grandfathers they taught are still made better by their presence.

WILLIAM HARVEY AS AN EMBRYOLOGIST.*

By William K. Brooks, LL. D., *Professor of Zoology, Johns Hopkins University.*

The immortal discoverer of the circulation of the blood is held to be also the discoverer of the law of embryology—"that all animals are produced out of ova" (Encyc. Brit., 9th ed., art. Embryology, p. 164); and he is also held to have had some vague premonition, scarcely worth mentioning in history, of the great law that the complex animal arises, from a relatively homogeneous germ, by gradual differentiation or epigenesis.

I hope to show, by quotations from his work on embryology (Exercitationes de Generatione Animalium, Amstelodami, 1651, translated into English by Robert Willis, M. D., London, 1848), that both these current impressions are erroneous. He not only formulated but demonstrated epigenesis. His statement of this law is clear, definite and thoroughly modern, and it is based upon actual observations which are fully described.

On the other hand the conception which he sought to express by the dictum "omne vivum ex ovo" is totally foreign to the principles of modern embryology. Harvey was a worker, not a dreamer, and his dictum is no mere guess or happy inspiration. It sums up results reached by laborious research, and as a generalization based on actual study it still has value,

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although its meaning has nothing in common with that which the words have as we now use them. He repudiates in most energetic language the opinions, current at his time, which come nearest to the modern discovery that the physical continuity of living matter is never broken. In fact the chief aim of his treatise is to show that his observations, as he interpreted them, prove that there is no physical or "corporeal" continuity between parent and child.

Embryologists who permit Germans to write the history of their science, and make no protest when the demonstration that the embryo arises from the egg by epigenesis is attributed to Wolff (1759), and to Von Baer (1829), are either ignorant of Harvey's researches (1651) or indifferent to the fame of this great Englishman, who studied the history of the chick as laboriously and faithfully as Von Baer, nearly two hundred years before. While his resources were more limited, his ability to reflect upon the meaning of his observations and to state in clear and energetic words the results of his "Beobachtung und Reflexion," were inferior in no way to those of the justly famous author of the "Entwickelungsgeschichte der Thiere."

Harvey means just what more modern writers mean by "epigenesis," but the strangeness of the views he opposed gives us difficulty. The form of words into which an account of a scientific discovery falls is fixed by the view of the matter which is current at the writer's day, and later generations of readers may be puzzled by inability to occupy his standpoint. Thus it is with Harvey, and we thus explain the prevalence of the opinion that he had no more than a dim adumbration of truths the demonstration of which is generally credited to Wolff and Von Baer.

The evolutionary teachings of Bonnet are quite intelligible to us; and as we easily put ourselves in Von Baer's place, his refutation of Bonnet appeals to us with all its native force; but it is much harder for us to stand where Harvey stood.

So far as I can discover, no notion at all equivalent to Bonnet's conception of germs ever entered Harvey's mind or the mind of any one before his time. He presents the evidence for epigenesis as opposed, not to "evolution," but to "metamorphosis," and his way of using the last word is so unfamiliar to us that we cannot grasp what he has in mind without effort.

They who studied embryology before him held one modification or another of the very ancient belief that embryos arise from "excrement"; that they are products of decomposition.

He gives the evidence for epigenesis as opposed to this opinion which finds no pigeon-hole in the modern mind. Fortunately he is a ready writer. Illustrations and analogies overflow his brain and pen; and patient study enables us to pick out passages which give his views on epigenesis uncomplicated by reference to "metamorphosis." When we have done this we find his reasoning as modern and definite as that of Von Baer, although his resources did not qualify him to sum up the evidence with modern exhaustiveness.

While Harvey does not deny that some "imperfect" animals may be generated "out of a putrescent material, the drying of a moist substance, or the moistening of a dry one," he tells us, clearly and definitely enough, that the generation of all "perfect" animals, such as the lion and the cock, "is the result of epigenesis as the man proceeds from the boy; the edifice of the body, to wit, is raised on the punctum saliens as a foundation; as a ship is made from the keel, and as a potter makes a vessel . . . For out of the same material from which the first part of the chick or its smallest particle springs, from the very same is the whole chick born; whence the first little drop of blood, thence also proceeds its whole mass by means of generation in the egg; nor is there any difference between the elements which constitute and form the limbs or organs of the body, and those out of which all their similar [*i. e.* homogeneous] parts, to wit, the skin, the flesh, veins, membranes, nerves, cartilages, and bones derive their origin. For the part that was at first soft and fleshy, afterwards, without any change in the matter of nutrition, becomes a nerve, a ligament, a tendon; what was a simple membrane becomes an investing tunic; what had been cartilage is afterwards found to be a spinous process of bone, all variously diversified out of the same similar [homogeneous] material." From what "appears to be homogeneous in the beginning and resembles the spermatic jelly" the structure of the body arises; its parts being "at first delineated by an obscure division, and afterwards become separate and distinct organs."

He says the result of the process of development is just as if the chick were created by a command to this effect: "Let there be a similar [homogeneous] colorless mass, and let it be divided into parts and made to increase, and in the meantime, while it is growing, let there be a separation and delineation of parts; and let this part be harder and denser and more glistening, that be softer and more colored."

"Now it is in this very manner that the structure of the chick in the egg goes on from day to day; all its parts are formed, nourished and augmented out of the same material. . . . For there is a greater and more divine mystery in the generation of animals than the simple collecting together, alteration and composition of the whole out of parts would seem to imply; inasmuch as here the whole has a separate constitution and existence before its parts, the mixture before the elements."

These passages summarize conclusions from observations which have been more fully described in forty-four preceding chapters or "exercises," and it would be difficult, even at the present day, to state in more definite language the truth that the developing embryo passes "from indefinite, incoherent homogeneity to definite, coherent heterogeneity by successive integrations and differentiations."

While we have no desire to ignore the merits of Wolff or to belittle the greatness of Von Baer, we find it hard to understand how any one who knows Harvey's works can, without protest, read this assertion or similar ones in the German works from which it is derived:

"It was reserved for Caspar Frederick Wolff, a German by birth . . . to bring forward observations which . . . established the theory of epigenesis upon the secure basis of ascertained facts" (Encyc. Brit., 9th ed., Embryology, 165).

We now know that the germ itself is an organism of wonderful complexity; that its homogeneity is relative, not absolute; but there is great mystery to us as well as to Harvey in the

manner in which "the whole has a separate constitution and existence before its parts," and while the doctrine of "metamorphosis" as held in Harvey's day has vanished from science, I venture to believe that we shall find in his discussion of this doctrine, clear statement of other difficulties which are still as grave as he found them.

It is hard to decide just what his opinion on spontaneous generation was. No less careful a student than Huxley tells us (Encyc. Brit., 9th ed., art. Evolution, p. 746) that "Harvey believed as implicitly as Aristotle did in the equivocal generation of the lower animals." "Harvey shared the belief of Aristotle—whose writings he often quotes, and of whom he speaks as his precursor and model, with the generous respect with which one genuine worker should regard another—that such germs may arise by a process of 'equivocal generation' out of non-living matter."

I am by no means confident that this assertion does justice to Harvey, or that the quotations from Aristotle prove anything except that Harvey was not yet quite prepared to demonstrate their error. I believe there is ample evidence that he had made many observations which, while he never published them, led him to distrust most of the familiar examples of spontaneous generation, although he may not have been fully armed to attack the teachings of "my leader," Aristotle, "one of nature's most diligent inquirers," "whose authority has such weight with me that I never think of differing from him inconsiderately." It is true that he quotes without comment, and occasionally without credit, many passages in which Aristotle affirms spontaneous generation; but as an offset to this he tells us explicitly (Exercise the forty-first) that he shall show in another place "that many animals, especially insects, arise and are propagated from elements and seeds so small as to be invisible (like atoms flying in the air), scattered and dispersed here and there by the winds; and yet these animals are supposed to have arisen spontaneously, or from decomposition, because their ova are nowhere to be found." He was far too cautious to have ventured to criticise "the philosopher," even to this extent, without pretty good evidence; and in Exercise the sixty-ninth he tells us why this evidence was never published. "Let gentle minds forgive me," he asks, "if, recalling the irreparable injuries I have suffered, I here give vent to a sigh. This is the cause of my sorrow:—whilst in attendance on his majesty the king, during our late trouble and more than civil wars, not only with the permission but by the command of the Parliament, certain rapacious hands stripped not only my house of all its furniture, but, what is subject of far greater regret with me, my enemies abstracted from my museum the fruits of many years of toil. Whence it has come to pass that many observations, *particularly on the generation of insects*, have perished, with detriment, I venture to say, to the republic of letters."

Is there not reason to believe that, if they are ever discovered, those lost observations will be found to cover some of the ground which was so successfully explored by Spalanzanni more than a hundred years later?

Harvey's reference (Exercise the twenty-seventh) to "the animalculæ which are engendered in our bodies . . . lumbrici, ascarides, lice, nits, syrones and acari," and to "the worms which are produced from plants and their fruits, as from gall-nuts, the dog-rose, and various others," might be held to imply belief in heterogenesis, if he did not tell us, almost immediately, that: "It certainly cannot be that the living principles of these animals which arise in the gall-nuts existed in the oak, although these animals live attached to the oak and derive their sustenance from its juices."

Notwithstanding Huxley's opinion, Harvey seems to have been nearer than any of his successors for a hundred years to the modern discovery that all living things come from germs, although I shall show soon that he did not intend to imply anything at all like the modern view by his statement that this is true.

In his discussion of epigenesis as contrasted with "metamorphosis," he assumes the reality of "equivocal" generation, as he does in many other places, although, in view of the passages I have quoted, I believe that this is admitted out of courtesy to Aristotle, and for the sake of the argument, as something which he is not yet fully prepared to disprove.

He tells us (Exercise the forty-fifth) that there are two ways in which one thing may be made out of another. When a workman cuts the material already prepared, divides it and rejects what is superfluous, till he leaves it in the desired shape, as in making a statue from a block of stone, the whole material of the future piece of work has already been in existence before it is finished into form or any part of the work is yet begun. When on the other hand a potter educes a form out of clay by the addition of parts, increasing its mass, and giving it a figure, at the same time that he provides the material, which he prepares, adapts and applies to his work, "the form may be said rather to have been *made* than *educed*." "So exactly it is with regard to the generation of animals. Some, out of a material previously concocted and that has already attained its bulk, receive their forms and transfigurations; and all their parts are fashioned simultaneously, each with its distinctive characteristics, by the process called metamorphosis, and in this way a perfect animal is at once born; on the other hand, there are some in which one part is made before another, and these from the same material afterwards receive at once nutrition, bulk and form; that is to say, they have some parts made before, some after others, and these are at the same time increased in size and altered in form. The structure of these animals commences from some one part as its nucleus and origin, by the instrumentality of which the rest of the limbs are joined on, and this we say takes place by the method of epigenesis, namely by degrees, part after part; and this is, in preference to the other mode, generation properly so called. In the former of the ways mentioned, the generation of insects is effected when by metamorphosis a worm is born from an egg; or out of a putrescent material, the drying of a moist substance or the moistening of a dry one, rudiments are created from which, as from a caterpillar grown to its full size, or from an aurelia, springs a butterfly or fly already of a proper size, which never attains to any larger growth after it is first born. But the more perfect animals with red blood are made by epigenesis or the superposition of parts. In the former, chance or hazard seems the principal promoter of gen-

eration, and the form is due to the potency of a pre-existing material; and the first cause of generation is 'matter' rather than an 'external efficient,' while the more perfect animals owe their immortality to one constant source—the perpetuation of the same species . . . Bees, wasps, butterflies, and whatever is generated from caterpillars by metamorphosis, are said to have sprung from chance, and therefore to be not preservative of their own race. . . . The lion and the cock owe their existence, as it were, to nature, or an operative faculty of a divine quality, and require for their propagation an identity of species, rather than any supply of fitting material." "In the generation by metamorphosis forms are created as if by the impression of a seal, or as if they were adjusted in a mould . . . but an animal which is created by epigenesis attracts, prepares, elaborates, and makes use of the material all at the same time. The processes of formation and growth are simultaneous. In generation by metamorphosis the whole is distributed and separated *into* parts, but in that by epigenesis the whole is put together out of parts, in a certain order, and constituted *from* them. In the one case the result is due to matter; in the other the animal makes itself.

"Now it appears clear from my history that the generation of the chick from the egg is the result of epigenesis rather than of metamorphosis, and that all its parts are not fashioned simultaneously, but emerge in their due succession and order; it appears, too, that its form proceeds simultaneously with its growth, and its growth with its form; also that the generation of some parts supervenes on others previously existing, from which they become distinct; lastly, that its origin, growth and consummation are brought about by the method of nutrition.

"The formative faculty of the chick rather acquires and prepares its own material than only finds it when prepared, and the chick seems to receive its growth from no other than itself. And as all things receive their growth from the same power by which they were created, so likewise should we believe that the chick is created by the same power by which it is preserved and caused to grow."

The meaning of this rather puzzling passage will be somewhat clearer after we have examined Harvey's views on generation, but when we omit the complications which come from the reference to "metamorphosis," its meaning as interpreted by the rest of the essay is about as follows:

The substance which composes the body of all "perfect" animals does not exist as such before the body itself is formed; but it consists of unorganized or "homogeneous" food which is changed by nutrition into all the diversified parts of the complicated body, so that nutrition, growth and development go on together. As the organized body is constructed by the assimilation of unorganized food, its structure cannot be the outcome of the ordinary or physical properties of this food. There must be some organizing influence at work making use of these properties to construct out of homogeneous matter a definite organism belonging to the same species with the parents. To the question what this organizing influence is, he answers that this is a "divine mystery," or, in plain English, that he does not know, although he finds clear evidence of its existence. He says in many places that the egg has a "vital principle," but the context shows that he means by this no more than we mean when we say it is "alive," and nothing is farther from his thoughts than recourse to supernatural agencies, for he tells us clearly that while the cause of its development is a "divine mystery," "the egg is a natural body endowed with animal virtues . . . it is moreover a body which under favorable circumstances has the capacity to pass into an animal form; heavy bodies, indeed, do not sink more naturally, nor light ones float, when they are unimpeded, than do seeds and eggs in virtue of their inherent capacity become changed into vegetables and animals." (Exercise the twenty-sixth, p. 272.)

It would be a gross error to infer, from this passage or from others like it, any further similarity between Harvey's opinions and the results of modern microscopic study of ova and male cells. In order to understand the meaning of his celebrated dictum "omne vivum ex ovo" we must undertake more extended analysis of his observations and reflections on generation, and of the opinions of his predecessors.

Aristotle saw nothing strange or exceptional in the generation of animals from decomposing organic matter, for he believed that all generation takes place in essentially the same way; and he regarded the generation of insects from putrescent slime as a simple or typical example, what we should now call a primitive type, of generation in general, in comparison with which more complicated instances are to be interpreted.

As a bloody substance is discharged at intervals from the reproductive organs of woman, during the fertile period of her life, and as its appearance marks the beginning and its cessation the end of fertility, he believed that the mammalian embryo is formed out of this substance just as other animals are generated from decomposing matter of other kinds.

"Milk and the menstrual discharge," he tells us (De Gen. II, 4), "are of the same nature." "When the semen masculinum enters the female uterus it coagulates the purest part of the catamenia," and when this has "set in the uterus" it forms a coagulum like curdled milk. As heat causes milk to curdle, so "the semen or geniture of the male bears the same affinity to the nature of the catamenia" and causes it to "set" without itself contributing any part of the substance of the coagulum. "The female always supplies the matter, the male the power of creation, and this it is which constitutes one male and another female." "The male is the efficient agent, and by the motion of his geniture creates what is intended from the matter contained in the female." "The body and the bulk therefore are necessarily supplied by the female; nothing of the kind is required from the male; for it is not even requisite that the instrument, nor the efficient agent itself, be present in the thing that is produced. The body then proceeds from the female; the life (anima) from the male."

Harvey points out the inconsistency of Aristotle's admission that hybrids "partake of the species of both parents" (De Gen. Anim. II, 2), and his assertion that "the conception or egg receives" "from the female its body solely and its dimensions," and that the mother has no part in the transmission of "form, species and life"; for the study of hybrids shows the error of his opinion that creative force or vital power is

derived exclusively from the male, and proves that both parents must be efficient in determining form or species.

The medical men of Harvey's day held a different opinion, as he tells us in Exercise the thirty-second. Like Aristotle, they held that the embryo arises from "excrement"; but they held, in opposition to his teaching, "that the prime matter of conception is not blood, but the mingled genitures of both sexes." They also held, in opposition to Aristotle, the opinion, which Harvey shares, that the male is no more "the efficient cause of generation" than the female.

"Conception, according to the opinion of medical men, takes place in the following way: during intercourse the male and female dissolve in one voluptuous sensation, and eject their seminal fluids (genituræ) into the cavity of the uterus, where that which each contributes is mingled with that which the other supplies, the mixture having both equally the faculty of action and the force of matter; and according to the predominance of this or that geniture does the progeny turn out male or female. It is further imagined that immediately after the intercourse something of the conception is formed in the uterus."

If the uterus contains a "conception" immediately after a fertile union, in the form of a bloody coagulum, as Aristotle supposes, or in the form of the mingled emissions or genitures of both sexes, as the medical men taught, this ought to be discoverable, and Harvey, a true scientific investigator, set himself to hunt for it without a microscope.

His facilities for making the search, and its results, are best described in his own words. He was the attending physician of the King of England, and he tells us: "It was customary with his Serene Majesty, King Charles, after he had come to man's estate, to take the diversion of hunting almost every week, both for the sake of finding relaxation from grave cares and for his health; the chase was principally the buck and the doe, and no prince in the world had greater herds of deer. This gave me an opportunity of dissecting these animals almost every day during the whole of the season when they were rutting, taking the male and falling with young. I had occasion so often as I desired it to examine and study all their parts, particularly those devoted to the offices of generation."

His studies upon the development of the embryo of the deer are fully described at length in the essay on generation, but only those which relate to the question of conception concern us at present. Here his researches had a very definite result. "Repeated dissections performed in the course of the month of October, both before the rutting season was over and after it had passed, never enabled me to discover any blood or semen or a trace of anything else, either in the body of the uterus or its cornua." Neither the bloody coagulum of Aristotle nor the geniture of the medical men has any existence. The "conception" which should be discoverable in the uterus if their teachings are correct, cannot be found there when a search is made for it, and actual observation shows that their teachings are erroneous and fanciful.

The keepers and huntsmen said "that I was both deceiving myself and had misled the king, and that there must of necessity be something of the conception to be found in the uterus. These men, however, when I got them to bring their own eyes to the inquiry, gave up the point." Harvey tells us that the king fully appreciated the value of the investigation, and in order "that this important question might be the more satisfactorily settled in all time to come," provided means for isolating the does and for proving that there was no error as to the fact of conception; but the physicians were still unconvinced, and "held it among their impossibilities that any conception should ever be formed without the presence of the semen masculinum, or some trace remaining of a fertile intercourse within the cavity of the womb." But the man who had proved the error of their teachings regarding the function of the heart and blood-vessels had little tolerance for their belief in anything which they were unable to demonstrate.

If they had insisted that Harvey's resources were inadequate, that the "conception" for which he sought is too minute to be found by such rough means, we now know they would have been in the right, for even at the present day our knowledge of the essential facts of mammalian conception is, for the most part, a deduction from observations on the eggs of animals which were almost or quite unknown to Harvey, the sea-urchin and ascaris, for example. But his proof of the non-existence, in the uterus of the doe, of anything corresponding to their teachings is conclusive. He did not stop here, however, for he tells us: "In the dog, rabbit and several other animals, I have found nothing in the uterus for several days after intercourse; I therefore regard it as demonstrated that after fertile intercourse among viviparous as well as oviparous animals there are no remains in the uterus either of the semen of the male or of the female emitted in the act; nothing produced by any mixture of these two fluids, as medical writers maintain, nothing of the menstrual blood present as 'matter' in the way Aristotle will have it; in a word, that there is not necessarily even a trace of the conception to be seen immediately after fruitful union of the sexes. It is not true, consequently, that in a prolific connexion there must be any prepared matter in the uterus, which the semen masculinum, acting as a coagulating agent, should congeal, concoct and fashion or bring into a positive generative act."

His study of the generation of birds leads him to the same result. "As the hen does not emit any seminal fluid, and as the seminal fluid of the cock does not reach the uterus of the hen, and as there is no trace of an egg to be found in the uterus immediately after intercourse, it is obvious that it is not engendered" by the mixture of seminal fluid in the way the medical men teach (Exercise the thirty-second). After quoting Aristotle's opinion that the chick is formed out of menstrual blood coagulated by the influence of the cock, he says (Exercise the twenty-first): "The business in the generation of an egg is very different from this; for neither does the semen or rather the 'genitura' proceeding from the male in the act of intercourse, enter the uterus in any way, nor has the hen after she conceives any particle of excrementitious matter, even of the purest kind, or any blood in her uterus which might be fashioned or perfected by the discharge of the male. Neither are the parts of the egg produced by any kind of coagulation; neither is there anything like curdled milk to be discovered in the uterus. The cock, I say, contributes neither form nor

matter to the egg, but that only by which it becomes fertile and fit to engender a chick. And this faculty the cock confers by his semen (genitura) emitted in the act of intercourse, not only on the egg which is already begun, but on the uterus and ovary and even on the body of the fowl herself, in such wise that eggs which have yet to be produced, eggs, none of the matter of which yet exists either in the ovary or in any other part of the body, are thence produced possessed of fecundity." "Inflammable material is not set on fire by the contact of flame more quickly than is the hen made pregnant by intercourse with the cock" (315).

Careful observation on the fowl, the deer, the dog, the rabbit, and on many other animals, proves that none of them are generated out of excrement or decomposing matter. There is no basis in nature for Aristotle's opinion or that of the medical men, and all these teachings break down when brought to the test of actual observation. It is no small thing to prove the error of the belief, which had been current for two thousand years, and is even now embodied, through a quotation from St. Paul, in our burial service, that all forms of reproduction find their type in generation from dead putrescent matter. This Harvey accomplished by methods which are rigorously scientific; and with this accurate but very imperfect knowledge he boldly faced and tried to answer the question, what is it which the cock contributes in virtue of which the egg "becomes fertile and fit to engender a chick"?

He undertakes "to seek the truth regarding the following difficult questions: Which and what principle is it whence motion and generation proceed? By what virtue does the semen act? What is it that renders the semen itself fruitful? Whether is that which in the egg is cause, artificer and principle of generation and of all the vital and vegetative operations—conservation, nutrition, growth—innate or superadded? and whether does it inhere primarily, of itself, and as a kind of nature, or intervene by accident, as the physician in curing disease? Whether is that which transfers the egg into a pullet inherent or acquired, or is it already conceived in the ovary, and does it nourish, augment, and perfect the egg there? What is it besides that preserves the egg sweet after it is laid? What is it that renders an egg fruitful?" (274).

"In truth, there is no proposition more magnificent to investigate or more useful to ascertain than this: How are all things formed by an 'univocal agent'? How does the like ever generate the like? . . . Why may not the thoughts, opinions, and manners now prevalent, many years hence return again, after an intermediate period of neglect?" (582).

As we find the embryologists of the present day vexing themselves over the question, "Whether is that which transfers the egg into a pullet inherent or acquired?" we need not wonder if Harvey's success in the investigation of this magnificent proposition seems small to us. At least we must follow him in order to understand his dictum.

As a starting-point this much seems to be certain. "The egg, even when contained in the ovary, does not live by the vitality of the mother, but is like the youth who comes of age, made independent even from its first appearance; as the acorn taken from the oak, and the seeds of plants in general are no longer to be considered parts of the tree or herb that supported them, but things made in their own right, and which already enjoy life in virtue of a proper and inherent vegetative power" (275).

Furthermore, "although some animals . . . are produced from females alone" (286); "it is manifest that a fruitful [hen's] egg cannot be produced without the concurrence of a cock and a hen; without the hen no egg can be formed; without the cock it cannot become fruitful. But this view is opposed to the opinion of those who derive the origin of animals from the slime of the ground" (284).

"The egg is the terminus from which all fowls, male and female, have sprung, and to which all their lives tend—it is the result which nature has proposed to herself in their being" (271).

"And this is the round that makes the race of the common fowl eternal; now pullet, now egg, the series is continued in perpetuity; from frail and perishing individuals an immortal species is engendered" (285).

"We cannot conceive an egg without the concurrence of a male and female fowl any more than we can conceive fruit to be produced without a tree. We therefore see individuals, males as well as females, existing for the sake of preparing eggs, that the species may be perennial though their authors pass away. And it is indeed obvious that the parents are no longer youthful or beautiful, or lusty, and fitted to enjoy life, than while they possess the power of producing and fecundating eggs, and by the medium of these, of engendering their like. But when they have accomplished this grand purpose of nature, they have already attained to the height, the ἀκμή of their being; the final end of their existence has been accomplished; after this, effete and useless, they begin to wither, and, as if cast off and forsaken of nature and the Deity, they grow old, and, a-weary of their lives, they hasten to the end. How different the males when they make themselves up for intercourse, and swelling with desire are excited by venereal impulse! It is surprising to see with what passion they are inflamed, and then how trimly they are feathered, how vainglorious they show themselves, how proud of their strength, and how pugnacious they prove. But the grand business of life accomplished, how suddenly, and with failing strength and pristine fervor quenched, do they take in their swelling sails, and from late pugnacity, grow timid and desponding. Even during the season of jocund masking in Venus's domains, male animals in general are depressed by intercourse, and become submissive and pusillanimous, as if reminded that in imparting life to others they were contributing to their own destruction. The cock alone, replete with spirit and fecundity, still shows himself alert and gay, clapping his wings and crowing triumphantly he sings the nuptial song at each of his espousals; yet even he after some length of time in Venus's service, begins to fail; like the veteran soldier, he by and by craves discharge from active duty, and the hen, too, like the tree that is past bearing, becomes effete, and is finally exhausted."

Having come to the end of his means of observation, Harvey turns to reflection, the second resource of the man of science, to see how this may help him to discover how "from frail and perishing individuals an immortal species is engen-

dered." As his studies seemed to prove that the contagion which remains in the female "after intercourse, as the efficient of the future offspring, is not of the nature of any corporeal substance," he was unable to escape the admission that it is "incorporeal." Thus driven to the wall, if he had taken refuge in "soul" or "spirit," no one could greatly blame him, for spiritual agents had been the resource of philosophers for many ages before his time. He was a true soldier of science, however, seeing as clearly as we do that this venerable formula can do nothing to help us, and preferring outspoken ignorance to this antiquated and threadbare cloak for intellectual poverty.

"If on further inquiry it should appear that it [the efficient] is neither spirit nor demon, nor soul, nor any part of a soul, as I believe can be proved by various arguments and experiments, what remains, since I am unable myself to conjecture anything beside . . . but to confess myself at a standstill?"

What does the modern man of science in such a case? Does he not search through the whole province of knowledge to see if perchance he may find some other natural phenomenon which bears some resemblance to the subject of his studies? Harvey says he knows well "that some censorious persons will laugh at this . . . Yet this that I do is the practice of philosophers, who when they cannot clearly comprehend how a thing really is brought to pass, devise some mode for it in accordance with the other works of nature, and as near as possible to what is true."

"Since, then, nothing can be apprehended by the senses in the uterus after coition, and since it is necessary that there be something to render the female fruitful, and as this is probably not material, it remains for us to take refuge in a mere conception."

Men of science in all ages, from Aristotle to Tyndall, have believed in the virtues of the provisional hypothesis; and, armed by eminent authority, Harvey undertakes, by comparing a "mere conception" with other things in nature, to frame a provisional hypothesis of generation; but natural science seems to be an uncongenial soil for the nurture of such attempts, and if time has shown that Harvey's hypothesis has little value, he errs in good company, and he also takes pains to say he does not wish it "to be taken as if I thought it a voice from an oracle," although he does hope it may "stir up the intellects of the studious to search more deeply into so obscure a subject."

Starting with the belief that "the semen of the male does not so much as reach the cavity of the uterus . . . and that it carries with it a fecundating power by a kind of contagious property" from which the female "seems to receive influence and to become fecundated without the co-operation of any sensible corporeal agent, in the same way as iron touched by the magnet is endowed with its powers and can attract other iron to itself," he holds that "when this virtue is once received the woman exercises a plastic power and produces a being after her own image."

"Yet it is a matter of wonder where this faculty abides after intercourse is completed. . . . To what is the active power of the male committed? . . . Does the woman conceive in the womb as we see by the eye and think by the brain?" "Since there are no manifest signs of conception before the uterus begins to relax . . . and since the substance of the uterus, when ready to conceive, is very like the structure of the brain, why should we not suppose that the function of both is similar, and that there is excited by coitus within the uterus a something identical with or at least analogous to an imagination or a desire in the brain, whence comes the generation or procreation of the ovum?" "For the functions of both are termed conceptions, and both, although the primary source of every action throughout the body, are immaterial, the one of natural or organic, the other of animal action . . . Just as a desire arises as a conception of the brain, and this conception springs from some external object of desire, so also from the male, as being the more perfect animal, and as it were the most natural object of desire, does the natural (organic) conception arise in the uterus, even as the animal conception does in the brain. From this desire, or conception, it results that the female produces an offspring like the father. For just as we, from the conception of the 'form' or 'idea' in the brain, fashion in our works a form resembling it, so in like manner the 'idea' or 'form' of the father, existing in the uterus, generates an offspring like himself with the help of the formative faculty.

"Whoever has pondered with himself how the brain of the artist, or rather the artist by means of his brain, pictures to the life things which are not present in him, but which he has once seen; also in what manner birds immured in cages recall to mind the spring, and chant exactly the songs they had learned the preceding summer, although meanwhile they had never practiced them; again, and this is more strange, how the bird artistically builds its nest, the copy of which it had never seen, and this not from memory or habit, but by means of an imaginative faculty, and how the spider weaves its web, without either copy or brain, solely by the help of this imaginative power; whoever, I say, ponders these things, will not, I think, regard it as absurd or monstrous, that the woman should be impregnated by the conception of a general immaterial 'idea' and become the artificer of generation."

"For my own part then, when I see nothing left in the uterus after intercourse, to which I can ascribe the principle of generation, any more than there is in the brain anything discoverable after sensation and experience, which are the prime sources of art, and when I find the structure of both alike, I have devised this fable."

Whatever the value of this hypothesis may be, it serves well to emphasize the fact that Harvey's opinions on generation have nothing in common with the modern discovery of the physical continuity of living matter, and it shows that his teaching that all animals come from eggs cannot possibly mean what the words now mean.

He believes the uterus conceives an animal in the same way that the brain conceives an idea; and he also tells us that he agrees with Fabricius that "the egg [of the hen] is in a certain sense an exposed uterus" (290).

Furthermore, "the hen is not the efficient cause of a perfect egg, but that she is made so in virtue of an authority, if I may use the word, or power required of the cock. For the egg, unless prolific, can with no kind of propriety be accounted perfect; it only obtains perfection from the male, or rather

from the female, as it were upon precept from the male, as if the hen received the art and reason, the form and laws of the future embryo from his addresses" (290). So much for the generation of the fowl. In Exercise the sixty-ninth he describes the embryo of the doe at about seven weeks, and the human embryo about the second month after conception, but, following Aristotle, he regards these embryos in their membranes, not as embryos, but as eggs without shells. "In the way above indicated do the hind and doe, affected by a kind of contagion, finally conceive and produce primordia, of the nature of eggs, or the seeds of plants, or the fruit of trees, although for a whole month and more they had exhibited nothing in the uterus."

In this sense, then, he holds that viviparous animals are generated from eggs. He therefore maintains (as contrasted with Fabricius, who held that the greater number of animals are produced from ova) "that all animals, even the vivipara, and man himself not excepted, are produced from ova; that the first conception, from which the foetus proceeds in all, is an ovum of one description or another, as well as the seed of all kinds of plants. Empedocles therefore spoke not improperly of the 'egg-bearing race of trees.' The history of the egg is therefore of the widest scope, as it illustrates generation of every description. . . . Fabricius has these additional words: "The foetus of animals is engendered in one case from an ovum, in another from the seminal fluid, in a third from putrefaction; whence some creatures are oviparous, some viviparous, and yet others born of putrefaction or by the spontaneous act of nature, automatically."

"Such a division as this, however, does not satisfy me, inasmuch as all animals whatsoever may be said in a certain sense to spring from ova, and in another sense from seminal fluid, and they are entitled oviparous, viviparous or vermiparous rather in respect of their mode of bringing forth than of their first formation."

We see then that, unfamiliar as his words often seem, and while he holds that the organizing influence which produces the chick from the egg is a "divine mystery," we owe to Harvey the demonstration and clear formulation of the following truths:

There is no basis for the venerable doctrine that the higher animals are generated from excrement.

The hen's egg, even before it leaves the ovary, is an independent organism, which enjoys life by its own right, and perfects itself by nutrition.

The embryo assimilates homogeneous food, and by means of an inherent organizing power converts it into the structure of the living animal Nutrition, growth and development go on together, and the embryo arises by epigenesis or differentiation.

Many animals which have been held to arise from putrescent slime actually come from microscopic eggs.

"Animals are entitled viviparous or oviparous or vermiparous rather in respect of their mode of bringing forth than of their first formation."

LONG, THE DISCOVERER OF ANÆSTHESIA.

A PRESENTATION OF HIS ORIGINAL DOCUMENTS.

By Hugh H. Young, A. M., M. D., *Assistant Resident Surgeon, Johns Hopkins Hospital, Baltimore.*

[*Being in substance a paper read before the Johns Hopkins Hospital Historical Society, November* 8, 1896, *with additions.*]

It was my good fortune last summer to meet Mrs. Fanny Long Taylor, whose father, Dr. Crawford W. Long, is thought by many to be the original discoverer of anæsthesia.

As she put me in possession of her father's papers, I thought they might prove sufficiently interesting to warrant their presentation to this Society.

During the famous ether controversy which was waged in the forties and fifties the work of Long received little attention. A modest, retiring man, who abhorred public strife and controversy, too honorable to wish pecuniary reward for his discovery, it is not strange that he made no effort to get the reward from Congress, but preferred to let the justice of his claim be judged by an unbiased posterity.

Crawford W. Long was born in Danielsville, Ga., on the first of November, 1815. His grandfather was Capt. Samuel Long of Pennsylvania, who made a brilliant record in the Revolutionary war and was one of Lafayette's captains at Yorktown. Soon after the close of that eventful struggle he left his native State and took his family to Georgia, where they settled along with a large colony of Pennsylvanians.

His son, James Long, received every educational advantage there obtainable, and inheriting his father's executive ability, became one of the prominent men of his State. Although engaged in mercantile pursuits he was a hard student of the law, and so well versed in the principles of jurisprudence that he was often consulted by judges in difficult cases.

He represented his people in the Senate for a number of years and was the intimate friend, adviser and confidant of Wm. H. Crawford, Georgia's greatest statesman, at different times Secretary of State, minister to France and candidate for the Vice-Presidency. As an evidence of attachment he gave his eldest son the name of Crawford. Coming from such ancestry it is not wonderful that young Crawford early showed promise of rare ability. As a boy he was studious and mature beyond his years, and entered Franklin College at so early an age that he was known as "baby." Notwithstanding this fact he graduated as Master of Arts second in his class at the age of nineteen. Alexander H. Stephens was his room-mate, and so much older that he was dubbed "daddy" by the college boys. Though pursuing different paths, Stephens and Long kept up an intimate friendship all their lives. After studying under a preceptor for one year

Long graduated at the University of Pennsylvania in 1839. While there he was recognized as a man of marked ability and fond of experimental work.

After graduation he spent one year in a New York hospital, where, it is said, he made such a reputation for himself as a surgeon that he was urged to apply for the position of surgeon in the U. S. Navy. Obedient to his father's wishes, however, he returned to practice in his native State and located in Jefferson, Jackson Co., Georgia, in 1841, at that time a small country town, far removed from any railroad, in the midst of a farming community whose only factory was the cotton gin.

Here Dr. Long soon acquired an extensive and lucrative practice, and although young was noted for his quiet, dignified bearing, which endeared him to all. His office was a favorite meeting-place for the young men of the town, who would often gather there to pass a merry evening together.

About this time it became fashionable to inhale laughing-gas for its exhilarating effects. Itinerant lecturers on chemistry would conclude an evening's entertainment with a nitrous-oxide party in which the participants would get gloriously drunk from its inspiration.

The practice spread throughout the country, and at Jefferson during the early part of the winter of '41 a coterie of young friends begged Dr. Long to let them indulge in the far-famed luxury.

Dr. Long replied that he had no means of preparing nitrous-oxide gas, but that sulphuric ether would produce similar exhilaration. The company being anxious to try it, the ether was produced, all inhaled of it and soon became hilarious.

The young men were delighted and hastened to tell their friends of Dr. Long's wonderful drug, and thus the inhalation of ether for sport soon became very popular over that section of Georgia, and almost every party ended up with an "ether frolic," as it was called.

During January, 1842, the ether frolics at Dr. Long's office became very frequent and were well attended, and some of the young men probably became pretty thoroughly intoxicated, as Dr. Long discovered that he and others would afterward have considerable bruises about their persons of which they had no knowledge.

Being a thoughtful man, *he at once remarked that ether must have the power of rendering one insensible to pain, and therefore available for preventing pain in surgical operations.*

This was January, 1842, and Dr. Long at once determined to prove his discovery on the first surgical case he should have. That opportunity came on March 30th, when Long administered ether to Mr. James M. Venable till completely anæsthetized, and then excised a small cystic tumor from the back of his neck. Imagine the surprise of the patient when on regaining consciousness he was told that the operation was over, and his amazement when he saw the tumor in the hands of the surgeon and he had not felt a scratch. This was four and one-half years before Morton's earliest claims.

An original paper read by Dr. Long before the Georgia State Medical Society in 1852, describing these events in his own words, is appended to this paper—see Appendix I.

It is worthy of note that two and a half years later Wells of Hartford discovered the anæsthetic powers of nitrous oxide under very similar circumstances. He attended an entertainment given by a popular lecturer on chemistry, inhaled nitrous oxide for its exhilaration, and saw a man under its influence injure his ankle severely without being conscious of it. From this he concluded that nitrous oxide was capable of producing anæsthesia and proved it in extracting a tooth.

Morton, on the other hand, got his suggestion as to the anæsthetic power of ether from Jackson, who, after using ether to relieve the pain and dyspnœa following the accidental inhalation of chlorine gas—an antidote well known in chemistry then—inferred that it might be useful as an anæsthetic. Jackson did not test the correctness of this observation, which he claims to have made about the same time that Long etherized his first case, but left it for Morton to prove practically four and a half years later.

Dr. Long reports the first five cases in which he used ether, being desirous only of establishing priority of use. An examination of the letters and certificates before me, however, shows that he must have operated on at least eight cases before Morton's "discovery." This number seems small, but is not so astonishing when we remember that the country was sparsely settled, that Jefferson was a mere village, and Long had just entered practice.

I will now read in substantiation of these statements a copy of the original account in Dr. Long's journal against Mr. Venable for medical services rendered, certified to by a clerk of the Superior Court.

"James Venable

To Dr. C. W. Long, Dr.

1842.	cts.
January 28th, sulphuric ether,	.25
March 30th, sulphuric ether and exsecting tumor,	2.00
May 13th, sul. ether,	.25
June 6th, exsecting tumor,	2.00

Georgia.
Jackson County. } I, P. F. Hinton, clerk of the superior court of said county, do certify that the above account is a correct copy of an original entry made in his book for medical services for the year 1842.

Given under my name and seal of office this 27th of March, 1854.

[Seal] (Signed) P. F. Hinton, *Clerk S.*"

The following paper relative to the fashion of inhaling ether for its exhilarating effects is interesting as showing how the custom in Georgia started with Dr. Long:

"I certify that on the first of January, 1842, I resided in Jefferson, Jackson Co., Georgia, and that about that time myself with several other young men were in the habit of meeting at Doct. C. W. Long's *shop*, and other rooms in the village, and inhaling ether which *he administered to us*.

On the 20th of January of the same year I removed to Athens, where I introduced the inhalation of ether. I and several of my young associates frequently assembled ourselves together and took it for the excitement it produced. After that I know it became very common to inhale ether in Athens, and that it was frequently taken in the college campus and on the street.

(Signed) R. H. Goodman,

August 4th, 1849. Athens, Georgia."

When we see daily the dreadful distaste patients who have been etherized have for ether, it seems strange that any one could become fond of its use.

I will now read an account of the first operation as given by Mr. James M. Venable:

"I, James M. Venable, of the county of Cobb and State of Georgia, on oath depose and say, that in the year 1842 I resided at my mother's in Jackson County, about two miles from the village of Jefferson, and attended the village academy that year.

In the early part of the year the young men of Jefferson and the country adjoining were in the habit of inhaling ether for its exhilarating powers, and I inhaled it frequently for that purpose, and was very fond of its use.

While attending the academy I was frequently in the office of Dr. C. W. Long, and having two tumors on the back of my neck, I several times spoke to him about the propriety of cutting them out, but postponed the operation from time to time. On one occasion we had some conversation about the probability that the tumors might be cut out while I was under the influence of s. ether, without my experiencing pain, and he proposed operating on me while under its influence.

I agreed to have one tumor cut out and had the operation performed that evening after school was dismissed. This was in the early part of the spring of 1842.

I commenced inhaling the ether before the operation was commenced and continued it until the operation was over. I did not feel the slightest pain from the operation and could not believe the tumor was removed until it was shown to me.

A month or two after this time Dr. C. W. Long cut out the other tumor, situated on the same side of my neck. In this operation I did not feel the least pain until the last cut was made, when I felt a little pain. In this operation I stopped inhaling the ether before the operation was finished.

I inhaled the ether, in both cases, from a towel, which was the common method of taking it.

(Signed) James M. Venable.

Georgia, Cobb Co., July 23rd, 1849. } Sworn to before me.

Alfred Manes, J. P."

This operation was done in the presence of four witnesses, Jas. E. Hayes, A. T. Thurmond, W. H. Thurmond, principal of the academy, and Edmund S. Rawls, the last of whom testifies as follows:

"Georgia, Clarke Co. } I, Edmund S. Rawls, of Rome, Floyd Co., Ga., on oath depose and say that . . . on one occasion during that year (1842) I was present with James M. Venable in the office of Dr. C. W. Long in Jefferson, Jackson Co., Ga., and witnessed Dr. C. W. Long cut out a tumor from the side of neck of J. M. Venable while said Venable was fully under the effects of the vapor of s. ether inhaled from a towel, and without his exhibiting the least symptoms of suffering pain from the operation. J. M. Venable was so unconscious of the operation having been performed that he would not believe the tumor was removed until it was shown him. (Signed) E. S. Rawls.

Sworn to and subscribed before me this 2nd November, 1853.

E. L. Newton, *J. J. C.*"

The patient continued to inhale ether until the operation was over, was entirely unconscious of its performance, and felt no pain. Surely this was complete anæsthesia. This fact has been denied by Dr. Wm. J. Morton, son of the Boston discoverer, who says it was no more than mere exhilaration.

It has been stated that Long kept his discovery secret and that he therefore deserved no credit for it. I present certificates from Drs. Laperriere and Carlton, which show that his work was well known to citizens of the town of Jefferson and neighboring cities, particularly Athens, which was then the centre of learning and culture in Georgia; that it was considered a remarkable discovery by the populace, and that the prominent physicians knew of it and realized its importance. See Appendix II.

Dr. Carlton was then a student under Dr. Moore. One year later (1844) he used ether in extracting a tooth. This was probably the first use of ether in extracting teeth. Dr. James Camak, another student of Moore, was present and assisted in the same operation and corroborates Carlton's statements.

Can Dr. Long be blamed for not publishing at once a report of his first case or two when they were well known to the physicians of that part of the State? He had no Massachusetts General Hospital at his back, and he knew that such startling claims coming from one so young (he had not been practicing one year) would be severely criticised. It is but natural that he should be satisfied for the time being with the local and State publicity which was given to his great discovery, and waited until he could make a comprehensive report embracing all kinds of cases, such as every careful investigator does to-day.

But he kept on with his work, operating on two more cases under ether in 1842, and about three more during the next year, for most of which I find sworn certificates.

I have a letter from his first student, Dr. J. F. Groves, which is of particular interest as giving an insight into the character of Dr. Long and his work at that time. It is quite lengthy and I omit portions of it. The letter is written to Mrs. Taylor, Dr. Long's eldest daughter. See Appendix III.

This letter shows conclusively that Dr. Long was thoroughly convinced of the anæsthetic powers of ether, but was anxious to put it to a severe test in capital surgery. He withheld his cases of minor surgery because he wished to determine accurately the limitations and possibilities of ether.

In his paper Dr. Long does not give the details of the etherization with the minuteness we should desire. For instance, he does not say who gave the ether, the patient or himself, and he does not explain whether the patient was entirely unconscious or not, but simply remarks that he suffered no pain and did not know the tumor had been removed.

These omissions of Dr. Long led Dr. Wm. J. Morton, of New York, to write a forty-eight-page article in the Virginia Medical Monthly, March, 1880, in which by dexterously quibbling with Long's innocent statements he arrives at the conclusion by a skilful process of deduction, that Long never did anything. I will read parts of this article:

"The Invention of Anæsthetic Inhalation.

* * * But we will proceed slowly. We must know who is giving the ether. Of the first operation Venable deposes under oath, 'I commenced inhaling the vapor before the operation was commenced and continued it until the operation was over.'

Thus Venable kept his eye on the whole affair, knew just what was going on, otherwise how could he know and swear to it that he continued the inhalation until the operation was over. Surely *Venable administered the ether to himself and remained conscious all the time.*"

This is erroneous, for according to good legal authority

such a statement as Venable's could be made from a knowledge based on satisfactory hearsay evidence and would be accepted in law.

But he goes on: "But now comes the damnatory point of this second experiment. *The patient felt pain.* This both Long and Venable confess. Here then is positive failure; Dr. Long's anæsthetic state was nothing more nor less than the fleeting peripheral numbness often associated with the first or exhilarating stage of the complete anæsthesia of to-day. But why did Dr. Long not take the towel into his own hand and force the ether? Why not make his patient insensible to pain if he knew this could be done?

"Knowing what medicine knows to-day, how wonderful this halting of Long—this pause at a most critical moment—on the very threshold of discovery! So nicely balanced is the situation that it almost seems as if he would topple over into discovery; but he falls the other way.

"It seems almost inexplicable that he did not seize the towel, force the anæsthesia to the stage of stupor, perform the operation, and proclaim the discovery to the world,"—

and we might add, patent it at once!

It is a fact well known to all surgeons that a patient may be entirely unconscious and still retain sensibility to pain. This is evidenced by the flinching before the knife when in this state. He may give evidence of feeling pain, but have no recollection of it afterward. All witnesses agree that Venable gave no evidence of feeling pain in the first operation. He must have been pretty thoroughly anæsthetized. The second operation was merely a test case to determine the length of the anæsthetic state, and although the ether was discontinued from the beginning of the operation (which Long says was tolerably difficult on account of adhesions), still the anæsthetic state lasted until the last cut was made. We would consider such a patient pretty thoroughly anæsthetized in Baltimore.

I have recently tested a number of patients who were being anæsthetized and found invariably that consciousness was lost before sensibility to pain—as evinced by movement of a member when pricked with a pin.

It was therefore practically certain that no person could administer ether to himself, an act requiring consciousness—and become sufficiently anæsthetized for even very small operations; but in order to settle the question definitely I determined to administer ether to myself, using the same methods as were employed by Long in 1842.

Accordingly, under the direction of Dr. F. R. Hagner of Washington, I placed a folded towel over my face and poured ether upon it from time to time at his bidding, as long as I was conscious. During this time Dr. Hagner pricked me with pins up to the last application that I remember. Toward the last the pin pricks did not produce the usual sensation of pain, but a peculiar disagreeable clanging sound in the ear.

Dr. Hagner thus briefly describes the experiment: "Dr. Young poured ether on the towel when so instructed by me. After a number of such additions the movements of his arm became very unsteady and he would spill some of the ether on his neck. Soon after the last application, made at my request, I pricked him with a pin and he moved his leg. I then instructed him several times to add more, but he made no attempt to do so and seemed unconscious. I then pricked him with pins several times, but received no response for about a minute, when he again responded to a prick of pin and suddenly became conscious. Complete consciousness returned almost immediately.

Dr. CRAWFORD W. LONG.

"I feel certain that he lost consciousness before sensibility to pain, and that if I had attempted to do the smallest surgical operation he would have been conscious of pain before its completion."

It is therefore certain that Venable would have been conscious long before the small tumor was removed and would have suffered considerable pain, if he had conducted his own etherization. Nor is it probable that Long intended to convey that idea. We might with propriety say to-day that our patients "inhale ether until anæsthetized," if we did not care to specify the details of etherization. But in a document quoted above R. H. Goodman says, in speaking of the ether frolics, "We were in the habit of meeting at Dr. Long's shop and *inhaling ether which he administered to us.*" It seems probable therefore that some one administered ether to the persons on whom he operated, too.

Desirous of settling these trivial points on which Morton would have Long deprived of every honor, I addressed a letter a few days ago to Long's first student, Dr. J. F. Groves, whose document I have quoted above. I saw that he would now be about 75 years of age and waited for an answer with considerable anxiety. To my surprise and delight I received a letter from him yesterday which supplies all of Dr. Long's omissions. Dr. Groves did not see the first operations, as he did not enter Dr. Long's office till 1844, but soon after his entrance he assisted in the operation on the negro boy in which two fingers were amputated, early in 1845, and at my request he describes this etherization in detail.

As this case occurred a year and a half before Morton's discovery, it is equally good as the first for my purposes. It is as follows:

A Recent Letter from Long's First Student.

"Cohutta, Ga., Jan. 15th, 1897.

Dr. Hugh H. Young,

Dear Sir: * * * The patient was placed in a recumbent position, on a bed, with hand to be operated on to the front for convenience to the surgeon. Dr. Long poured ether on a towel and held it to the patient's nose and mouth, too, to get the benefit of inhalation from both sources. Dr. Long determined when the patient was sufficiently etherized to begin the operation by pinching or pricking him with a pin. Believing that no harm would come of its use for a reasonable length of time he profoundly anæsthetized the patient, then gave me the towel and I kept up the influence by holding it still to the patient's nose. The patient was entirely unconscious—no struggling—patient passive in the hands of operator. After a lapse of fifty years you would hardly suppose that a man could remember every minute detail, but I have clearly in mind all the facts I have given you.

Your ob't servant,

(Signed) J. F. Groves, M. D."

Long then administered ether as it is done to-day. He did not pause at the threshold of discovery or topple the other way, but kept right ahead and by careful observation, experimentation and reflection discovered that ether was a safe, sure and complete anæsthetic.

Nor did his patients etherize themselves and at the same time superintend the operation, as Dr. Morton would have us believe.

As quoted above, Morton grasps eagerly at the acknowledgment of pain at the end of the second operation, where the ether had been discontinued, and from that isolated instance characterizes all of Dr. Long's cases as failures. But in his eagerness to annihilate Dr. Long he seems to have overlooked the fact that in the first report of anæsthesia with Morton's "Letheon" at the Massachusetts General in 1846, Dr. Bigelow* says, in speaking of the first operation, "During the operation the patient muttered as in a semi-unconscious state, and afterwards stated that the pain was considerable," and in the second, "The operation lasted four or five minutes, during which time the patient betrayed occasional marks of uneasiness." But these certainly were not failures, although the anæsthesia was not as complete as in Dr. Long's previous cases.

In his paper Long speaks of "those high in authority who were advocating the mesmeric state as adequate to prevent pain in surgical operations." Contemporary medical literature furnishes ample verification of these statements, according to Dr. Grandy,† who says:

"The journals were full of discussions upon the phenomena of mesmerism, animal magnetism, etc., and wonderful reports were coming from European hospitals of operations done without pain during the 'magnetic sleep.'

"Jules Cloquet had excised a cancerous breast with the axillary glands and the patient showed no sign of pain. Topham of London, in 1843, had amputated a thigh, and Dr. Dugas of Augusta, Georgia, in 1845, twice extirpated the mamma of a female under the mesmeric sleep.

"We can imagine what effect these cases had on the mind of Long. Need we wonder therefore that he was the more particular in his experiments on etherization. Such were the reasons for his silence, and while the sequel was unfortunate, his course was cautious and commendable."

While thus waiting, his opportunity was lost. A second discovery was made in Boston in 1846, was published immediately, and anæsthesia became the property of the world.

Friends of the other "discoverers" have often stated that as Long made no publication of his work he deserved no credit for it. To this Dr. J. Marion Sims responds very forcibly as follows:*

"Now upon this point Long, Wells, Morton and Jackson stand individually upon the same level.

Long exhibited to medical men and to the community his operations under ether in 1842. Wells exhibited to medical men and to the community his operations of the extraction of teeth under nitrous oxide gas in 1844. Morton exhibited to medical men and the community the use of his secret remedy "Letheon," 1846, as an anæsthetic. But Morton was fortunate in showing his patent remedy to the great surgeons of Boston, and it was not Morton, but it was Warren and Hayward and Bigelow who performed the operations to which the world owes the immediate and universal use of anæsthesia in surgery. If Morton could have had his way he would have deodorized the ether and kept it secret from the world. Neither Wells nor Morton nor Jackson ever published a word on the subject till it burst forth in a blaze from the labors of the hospital surgeons already named. When Warren and Hayward and Bigelow proved the real greatness of the discovery [and published it broadcast], then it was that Wells, Morton and Jackson began the war of pamphlets, and not till then did either of them publish in any scientific journal a line about anæsthesia."

The Famous Ether Controversy.

In 1849 Morton petitioned Congress for a reward for his discovery. He was at once opposed by Jackson and the friends of Wells, who was then dead. The celebrated ether controversy, thus begun, occupied the attention of Congress for many years, and was characterized by the greatest animosity between these former bosom friends and companions.

For five years Long refused to take part in the conflict, but finally in 1854, persuaded by his friends that in that way alone could he obtain recognition of his claims, he wrote to Senator Dawson giving an account of his work. It seems that Dawson was a friend of Jackson, for he wrote to him of this new claimant and requested him to investigate his case. This Jackson did, calling upon Long at his home in Athens on March 8th, 1854.

The Interview between Long and Jackson.

At this interview Hon. C. W. Andrews, a prominent justice,

* Boston Medical and Surgical Journal, Nov. 1846.

† Va. Med. Monthly, Oct. 1893.

*Va. Med. Monthly, May, 1877.

was present, and certifies that after satisfying himself of the genuineness of the claims, Jackson proposed to Long to lay their claims conjointly before Congress—he, Jackson, to claim the discovery, and Long to claim the first practical use,—his object evidently being to get ahead of Morton.

This proposition Dr. Long rejected, being satisfied that he was entitled to both. In a letter to Hon. D. L. Swain, ex-governor of North Carolina, which I have here, he says in regard to this transaction: "The only ground Dr. Jackson urged for his right to the discovery was that while suffering with pain and dyspnœa, in February, 1842, from breathing chlorine gas, he inhaled ether and found that while under its influence he was free from pain. He does not claim that he suggested its use to prevent pain in surgical operations until more than one year after my first operation was performed. I cannot give the exact date when I was first led to believe that ether would prevent pain in surgical operations, but I know it was as early as February, 1842."

Now in 1839 Pereira, in his "Elements of Materia Medica," states: "The vapor of ether is inhaled to relieve the effects caused by accidental inhalation of chlorine gas. If the air be too strongly impregnated with ether, stupefaction ensues."

So there was very little new in Dr. Jackson's "discovery," and a mere untried inference hardly deserves the title of discovery.

Dr. Jackson finally acknowledged the justice of Dr. Long's claims and wrote to Senator Dawson to that effect.

On April 15th, 1854, the appropriation bill was up before the Senate for its final reading. The friends of Wells and Morton, relying on the volumes of manuscript they had presented, were confidently awaiting the result, when Senator Dawson arose and said that he had a letter from Dr. Jackson which acknowledged that a Dr. Long in Georgia had undoubtedly used ether before any of the claimants for the appropriation.

Coming as it did from so prominent a contestant, this announcement fell like a thunderbolt on the rival claimants, and from that time they seem to have lost all hope of gaining the reward and passively allowed the bill to die.

Desirous only of preventing another from being recognized by Congress as the discoverer, and not wishing any pecuniary reward himself, Long never pushed the matter farther, and his documents of proof were never even brought up before Congress.

I have here an interesting memento of that conference between the two discoverers, in a card on which Jackson has written a note to Long. On one side it reads:

"For Dr. C. W. Long,
of Athens, Ga.
C. T. Jackson,
New York Hotel.
(over)"

and on the reverse:

"Telegraph from J. L. Hayes, Washington.
'Assignee struck out by request of Mr. Everett.'
Bill probably will come up in House July next."

Edward Everett was then senator from Massachusetts. In the transactions of the Senate, April 19th, 1854, I find the following explanation of the bill by Senator Walker:

"The bill as amended recites that a discovery of anæsthesia has been made—that it is believed the discovery was made by some one of the following persons, W. T. G. Morton, Chas. T. Jackson and Horace Wells, but it does not appear to the satisfaction of Congress which of those parties was the original, true and first discoverer thereof. It proposes to appropriate $100,000.00 as a recompense for the real discoverer. In order to determine this it shall be the duty of the district attorney of the United States for the Northern District of New York, to file in the circuit court of the United States for that district a bill of interpleader wherein reciting the act or its substance, the Secretary of the Treasury shall be complainant, and W. T. G. Morton, Chas. T. Jackson and the personal representatives of Horace Wells or any other person who may make application to the court for that purpose shall be defendants. The issue is to be which of the parties named was the original, true and first discoverer of anæsthesia, and the court is to decide which one that is and direct that the sum of $100,000 be paid over to him."

At the instance of Senator Dawson Dr. Long's name was also inserted in the bill.

I have carefully searched the Congressional Records and find that this bill never came up before the House for final passage, and consequently never reached the district court of New York. It seems to have been abandoned.

Several years later Dr. Jackson wrote an article in the Boston Medical and Surgical Journal giving Long the credit for the first use of ether in surgery. I have here Dr. Long's copy of that journal. The communication is so important that I will read most of it:

"The Boston Medical and Surgical Journal.
Boston, Thursday, Apr. 11, 1861.

First Practical Use of Ether in Surgical Operations.

Messrs. Editors:—At the request of the Hon. Mr. Dawson, U. S. Senator from Georgia, on March 8th, 1854, I called upon Dr. C. W. Long, of Athens, Georgia, while on my way to the Dahlonega gold mines, and examined Dr. Long's evidence, on which his claims to the first practical operations with ether in surgery were founded, and wrote, as requested, to Mr. Dawson, who was then in the U. S. Senate, all I learned on the subject. From the documents shown me by Dr. Long, it appears that he employed sulphuric ether as an anæsthetic agent:

1st, March 30th, 1842, when he extirpated a small glandular tumor from the neck of James M. Venable, a boy in Jefferson, Georgia, now dead.

2nd, July 3rd, 1842, in the amputation of the toe of a negro boy belonging to Mrs. Hemphill, of Jackson, Ga.

3rd, Sep. 9th, 1843, in extirpation of a tumor from the head of Mary Vincent, of Jackson, Ga.

4th, Jan. 8th, 1845, in the amputation of a finger of a negro boy belonging to Ralph Bailey, of Jackson, Ga.

Copies of the letters and depositions proving these operations with ether were all shown me by Dr. Long. * * *

I then called on Profs. Joseph and John Le Conte, then of the University of Georgia, at Athens, and inquired if they knew Dr. Long, and what his character was for truth and veracity. They both assured me that they knew him well, and that no one who knew him in that town would doubt his word, and that he was an honorable man in all respects.

Subsequently, on revisiting Athens, Dr. Long showed me his folio journal, or account book, in which stand the following entries:

'James Venable
March 30th, 1842, Ether and excising tumor, $2.00
May 13th, Sul. Ether, .25
June 6th, Excising tumor, 2.00'

On the upper half of the same page, several charges for ether sold to the teacher of the Jefferson Academy are recorded, which ether Dr. Long told me was used by the teacher in exhibiting its exhilarating effects, and he said the boys used it for the same purpose in the academy. I observed that all these records bore the appearance of old and original entries in the book.

On asking Dr. Long why he did not write to me or make known what he had done, he said, when he saw my dates he perceived that I made the *discovery* before him, and he did not suppose that anything done after that would be considered of much importance, and that he was awakened to the idea of asserting his claims to the first practical *use* of ether in operations, by learning that such claims were set up by others for this merit, and consequently he wrote to the Georgia delegation at Washington, stating the facts which Senator Dawson had requested me to inquire into.

I have waited expecting Dr. Long to publish his statements and evidence in full, and therefore have not before published what I learned from him. He is a very modest, retiring man and not disposed to bring his claims before any but a medical or scientific tribunal. * * *

Had he written to me in season I would have presented his claims to the Academy of Sciences of France, but he allowed his case to go by default, and the academy knew no more of his claims to the practical use of ether in surgical operations than I did.

Boston, *April* 3, 1861. Charles T. Jackson, M. D."

The list of operations as given by Dr. Jackson is not complete, as he has omitted the second operation on Venable, and a number of the later operations. In a letter to Dr. Sims, which I have, Dr. Long denies absolutely that he ever acknowledged that Dr. Jackson was the prior discoverer. He had been led to infer that ether had anæsthetic powers several months before he got a chance to verify it, and before Jackson claims to have made similar inferences, but he dated his claims of discovery from the time of his first practical demonstration. Before that it was a mere supposition, as was Jackson's also.

But barring these inaccuracies, Dr. Jackson's paper, coming as it does from one who so zealously coveted the title of discoverer, is a remarkable admission.

The interview between Long and Jackson must have been most amicable, and Long evidently felt the greatest respect for Jackson, as shown in the following letter:

"Athens, Ga., Nov. 15th, 1854.

Dr. C. T. Jackson.

Dear Sir:—I design to prepare an article with the proofs of the priority of my claims of the discovery of the anæsthetic powers of ether and of its applicability to surgical operations. I design having this published in pamphlet form for distribution among the members of the medical profession, and I expect to present such proof with the article as will satisfy all that I am entitled to all I claim.

Ours are rival claims, and permit me, sir, to say that although our claims are conflicting, I would not knowingly say anything in the article which would be displeasing to you. I entertain high respect for you as a gentleman and man of science and feel honored by your acquaintance.

Still it becomes each one of us to use all honorable means to advance his own claims, and I know you will not blame me for attending to this matter, which so much concerns my reputation.

Shall it meet with your approbation, I may refer to your admissions to Hon. W. C. Dawson and myself, of the belief of the correctness of my claims. I will, however, make no allusion to your letter to Mr. Dawson or to the conversation held with myself unless it meets with your sanction. . . . .

Your obedient servant, C. W. Long."

Morton's Patent.

It has often been stated by the friends of Morton that he never attempted to enforce his patent. This statement has lately been reiterated by his wife in McClure's Magazine. On this point the following letter from a prominent army surgeon to Long may be of interest:

"U. S. Marine Hospital,
Chelsea, Mass., April, 1859.

Dr. Crawford W. Long, Athens, Ga.

Sir:—Hon. Judge Hyllier, Solicitor of Treasury Department, informed me about a year since, and recently repeated the same, that some years since you used sulph. ether as an anæsthetic and had a record of the same. If it is not asking too much of you, I would be greatly obliged if at your earliest convenience you would forward me a statement of the facts.

I take the liberty to ask this of you because Mr. W. T. G. Morton, to whom in conjunction with Dr. C. T. Jackson a patent was granted in Nov., 1846, for using ether, has brought a suit against me as a government officer for an infringement of his patent.

Judge Hyllier was confident that you could furnish me with proof sufficient to satisfy a jury that you used it way before he or Jackson claimed to have made the discovery. I should have asked for these proofs through my attorney and had them properly witnessed, etc., but the Secretary of the Treasury having decided that I used the article on my own responsibility and therefore the Govt. were not bound to defend me, I wish to save as much expense as possible. Very respectfully,

[Signed] Charles A. Davis, M. D.,
Physician and Superintendent."

In reply Long gives a detailed account of his work, and then adds: "I presume Dr. Jackson is not party to the prosecution, as I know he entertains no good feelings towards W. T. Morton. If you think proper you can see him and ascertain the character of proof I can make. From the little acquaintance formed with him I entertain a high opinion of him as a gentleman and think he will do me justice notwithstanding he himself claims to have made the discovery and has received several awards."

Dr. Davis's letter was written twelve years after Morton's "Letheon" was patented, and many years after ether was the common property of the world. It was probably Morton's last attempt to get money from the U. S. Government.

The ether controversy was never reopened and Long's work was unknown to the world until 1877, when J. Marion Sims learning of him through accident, investigated his claims, was fully convinced of their merit, and vigorously demanded their recognition by the medical profession. His paper appeared in the Virginia Medical Monthly, May, 1877.

The Wilhite Claims.

This article, which obtained for Long the first recognition of any consequence, was the outcome of a conversation which Sims had with a Dr. P. A. Wilhite, of Anderson, S. C. Wilhite told Sims that he had witnessed the first surgical operation ever done under ether, and recounted Dr. Long's

first case, saying that he was one of four students who were then in Dr. Long's office.

He also said that "he presumed that he was the first person who ever profoundly etherized any one," and told how he was at a quilting party in which the boys and girls had concluded the evening by inhaling ether for sport; how they had caught a negro boy, and as he refused to inhale the ether, had firmly held a handkerchief soaked with ether over his face, when to their horror his breathing became stertorous and he could not be aroused. He then vividly pictured their alarm when they realized that they had murdered a fellow-being, and their determination to leave the country, which was prevented by the timely arrival of a physician who restored the boy to consciousness.

Wilhite then related how when the idea of using ether to prevent pain in surgical operations had occurred to Long, *he had encouraged him by relating the story of the negro boy.*

Dr. Sims at once communicated with Dr. Long and soon convinced himself of the truth of his claims, but unfortunately he failed to investigate Wilhite's statements, but embodied them in full in his article, giving to Wilhite the credit of first intentionally producing profound anæsthesia with ether.

Dr. Sims' paper was given great publicity and the Wilhite story has been accepted as true, and copied by many writers on the subject, most notably by Sir Jas. Paget.*

The negro boy story lacks probability, as Wilhite did not enter Long's office until 1844, two years after the first operation, as the following letter from Long to Wilhite shows:

"Athens, Ga., May 20th, 1877.

Dr. P. A. Wilhite.

Dear Sir:—I received Dr. Sims' article on anæsthesia yesterday and find several mistakes. Dr. Sims states that yourself, Dr. Groves, and Drs. J. D. and H. R. J. Long were students of mine and witnessed the operation performed on Venable in 1842. Your recollection failed you at the time. As it was several years, at least two, before either entered my office, you will see that you were mistaken in giving Dr. Sims this information. You also make a mistake in saying that the first inhalation in Jefferson of ether for its exhilarating effects was before the same persons. * * * I wrote to Dr. Sims informing him of the errors and asking him if he considered the mistakes of sufficient importance to be noticed, etc. (Signed) C. W. Long."

Dr. Wilhite replied as follows:

"Anderson, S. C., June 27, '77.

Dr. C. W. Long.

Dear Doctor:—Yours of the 22nd inst. is at hand, and I have also just received a letter from Dr. J. M. Sims, which I will answer to-day. * * *

In my statement I did make a mistake in regard to my being present at the first or second operation, which mistake I will correct. But if you still prefer I will send a certificate. * * *

Let me know and I will give you any information or assistance in this great matter. Yours truly, etc.,

(Signed) P. A. Wilhite."

In the letter to Wilhite, Long makes no comment on the negro-boy incident, but his daughter informs me that he repeatedly told her that he had never heard of it before it appeared in Sims' article.

It is to be regretted that the justification of Long's claims should have been linked so closely with such misstatements.

Sims sailed for Europe soon after the publication of his article, and Long died in a few months, and Wilhite's statements went unchallenged for many years.*

Among Dr. Long's papers are many more documents—affidavits of persons operated on and witnesses to them, and letters to different prominent men—but their recital would take up too much time, so I will close with a few words regarding his after life.

In 1842 Dr. Long was married to Miss Caroline Swain, a niece of Governor Swain of North Carolina, a very handsome and attractive woman, who proved a devoted wife. She survived her husband many years.

Long remained in Jefferson for ten years, when he removed to Athens and there spent the rest of his days. By inheritance and professional labors Dr. Long had amassed a fortune, which was largely swept away by the war of secession, and at its close he found himself reduced to poverty, with a large family to support.

Although he soon regained an extensive practice, the desolation of the country and the general poverty of the people made the remainder of his life a continual struggle against poverty. His life, which, up to the time of Dr. Sims' article, had been one of disappointments, after that suddenly became brighter, for from all parts of the world men prominent in the medical profession hastened to give him the credit which had so long been withheld.

His claims were never investigated by the American Medical Association, as he often desired, but many minor societies and the "Eclectic" Medical Association passed decrees in his favor, and a statue was erected in his honor in Paris, France.

But he was not long to enjoy the praise and long-delayed honors which were now heaped upon him. Within a few months, while laboring at the bedside of a delicate patient, he was stricken with apoplexy and died the next day, June 16th, 1878, at the age of sixty-two, poor in worldly goods but rich in the gratitude of his people. His oft-repeated wish to die in harness had been granted.

A strange fatality seemed to hang over the lives of all connected with the discovery of anæsthesia!

Wells, disappointed and disheartened by the rejection of his claims by the French Academy, became insane and committed suicide in 1848.

Morton gave up a very lucrative practice and vainly spent his life in trying to enforce his patent and get a reward from Congress. He died in 1868 from congestion of the brain, brought on by excitement occasioned by an article attempting to deprive him of the honor he so jealously coveted.

Long died in poverty, from apoplexy brought on by overwork in 1878.

Jackson, like Wells, became insane from the bitter contentions of his life and died in an asylum in 1880.

*The Nineteenth Century, 1880.

*In an article in the Virginia Medical Monthly, 1893, Dr. L. B. Grandy, of Atlanta, showed the error of Wilhite's statements.

Henri L. Stuart, founder of the Woman's Hospital, and a great New York philanthropist, became interested in Long's claims and presented a portrait of him to the University of Georgia. After seeing it unveiled with great ceremony in the capitol in Atlanta, one year after Long's death, he went to Athens as a guest of the Longs, to visit the grave of the discoverer of anæsthesia. Arriving at night, he waited till morning to fulfil his heart's desire. But this was never gratified. During the night he had a paralytic stroke and died at the home of the Longs after lingering several weeks. At his own request his remains were interred next to those of Crawford Long—two great benefactors side by side.

Appendix I.

Dr. Long's Original Paper.*

In the month of Dec., 1841, or Jan., 1842, the subject of the inhalation of nitrous oxide gas was introduced in a company of young men assembled at night in the village of Jefferson, Ga., and the party requested me to prepare them some. I informed them I had not the requisite apparatus for preparing or preserving the gas, but that I had an article (sul. ether) which would produce equally exhilarating effects and was as safe. The company were anxious to witness its effects, the ether was introduced and all present in turn inhaled. They were so much pleased with its effects that they afterwards frequently used it and induced others to do the same, and the practice soon became quite fashionable in the county and some of the contiguous counties.

On numerous occasions I inhaled ether for its exhilarating properties, and would frequently, at some short time subsequent to its inhalation, discover bruised or painful spots on my person which I had no recollection of causing and which I felt satisfied were received while under the influence of ether. I noticed my friends while etherized received falls and blows which I believed were sufficient to produce pain on a person not in a state of anæsthesia, and on questioning them they uniformly assured me that they did not feel the least pain from these accidents. Observing these facts I was led to believe that anæsthesia was produced by the inhalation of ether, and that its use would be applicable in surgical operations.

The first patient to whom I administered ether in a surgical operation was Mr. James M. Venable, who then resided within two miles of Jefferson, and at present lives in Cobb Co., Ga. Mr. Venable consulted me on several occasions in regard to the propriety of removing two small tumors situated on the back part of his neck, but would postpone from time to time having the operation performed, from dread of pain. At length I mentioned to him the fact of my receiving bruises while under the influence of the vapor of ether without suffering, and as I knew him to be fond of and accustomed to inhale ether, I suggested to him the probability that the operations might be performed without pain, and proposed operating on him while under its influence. He consented to have one tumor removed, and the operation was performed the same evening. The ether was given to Mr. Venable on a towel, and when fully under its influence I extirpated the tumor.

It was encysted and about half an inch in diameter. The patient continued to inhale ether during the time of the operation, and when informed it was over, seemed incredulous until the tumor was shown him.

He gave no evidence of suffering during the operation, and assured me, after it was over, that he did not experience the least degree of pain from its performance. This operation was performed on the 30th March, 1842.

The second I performed on a patient etherized was on the 6th June, 1842, and was on the same person, for the removal of the other small tumor. This operation required more time than the first, from the cyst of the tumor having formed adhesions to the adjoining parts.

The patient was insensible to pain during the operation until the last attachment of the cyst was separated, when he exhibited signs of slight suffering, but asserted after the operation was over that the sensation of pain was so slight as scarcely to be perceived. In this operation the inhalation of ether ceased before the first incision was made. Since that time I have invariably desired patients, when practicable, to continue the inhalation during the time of the operation.

Having permitted such a length of time to elapse without making public my experiments in etherization, in order to show the correctness of my statements I procured the certificate of the patient on whom the first operation was performed, the certificate of two who were present at the time of the operation, and also those of his mother, brothers and sisters and a number of his immediate friends who heard him speak of the operations soon after they were performed. The Southern Med. and Surg. Journal* contained but two of the certificates. I have a number of others which can be seen or read if desired by the Society. My third case was a negro boy who had a disease of a toe which rendered amputation necessary, and the operation was performed July 3rd, 1842, without the boy evincing the slightest sign of pain.

These were all the surgical operations performed by me during the year 1842 upon patients etherized, no other case occurring in which I believed the inhalation of ether applicable. Since '42 I have performed one or more surgical operations annually, on patients in a state of etherization.

I procured some certificates in regard to these operations, but not with the same particularity as in regard to the first operations, from the fact of my sole object in the publication being to establish my claim to priority of discovery of power of ether to produce anæsthesia. However, these certificates can be examined.

The reasons which influenced me in not publishing earlier are as follows:

I was anxious, before making my publication, to try etherization in a sufficient number of cases to fully satisfy my mind that anæsthesia was produced by the ether, and was not the effect of the imagination or owing to any peculiar insusceptibility to pain in the persons experimented on.

At the time I was experimenting with ether there were physicians high in authority and of justly distinguished character who were the advocates of mesmerism, and recommended the induction of the *mesmeric state* as adequate to prevent pain in surgical operations. Notwithstanding thus sanctioned I was an unbeliever in the science, and of the opinion that if the mesmeric state could be produced at all it was only on those of strong imaginations and weak minds, and was to be ascribed solely to the workings of the patient's imagination. Entertaining this opinion, I was the more particular in my experiments in etherization.

Surgical operations are not of frequent occurrence in a country practice, and especially in the practice of a young physician, yet I was fortunate enough to meet with two cases in which I could satisfactorily test the anæsthetic power of ether. From one of these patients I removed three tumors the same day; the inhalation of ether was used only in the second operation, and was effectual in preventing pain, while the patient suffered severely from the extirpation of the other tumors. In the other case I amputated two fingers of a negro boy; the boy was etherized during one amputation and not during the other; he suffered from one operation and was insensible during the other.

After fully satisfying myself of the power of ether to produce anæsthesia, I was desirous of administering it in a severer surgical

* Read before Georgia State Medical Society in 1852.

* Dec. 1849.

The first patient to whom I administered
ether in a surgical operation was James Mc
Venable who then resided within two miles of Jefferson
and at present lives in Cobb Co Ga — Mr Venable
consulted me on several occasions in regard to the
propriety of removing two small tumors situated
on the back part of his neck, but would postpone
from time to time having the operation performed
from dread of pain — At length I mentioned
to him the fact of my having inhaled
while under the influence of ether, without suffering
and as I knew him to be fond of and accustomed
to inhale ether, I suggested to him the probability
that the operation might be performed without
pain and proposed operating on him while under
its influence — He consented to have one
tumor removed and the operation was performed
the same evening — The ether was given
to Mr Venable on a towel and when fully under
its influence I excised the tumor —
It was encysted and about half an inch in diameter
The patient continued to inhale ether during
the time of the operation and, when informed
it was over, seemed incredulous, until the
tumor was shown him —
He gave no evidence of suffering during the
operation, and assured me, after it was over,
that he did not experience the least degree of
pain from its performance — The operation
was performed on the 30th March 1842.

operation than any I had performed. In my practice, prior to the published account of the use of ether as an anæsthetic, I had no opportunity of experimenting with it in a capital operation, my cases being confined, with one exception, to the extirpation of small tumors and the amputation of fingers and toes.

While cautiously experimenting with ether, as cases occurred, with the view of fully testing its anæsthetic powers and its applicability to severe as well as minor surgical operations, others more favorably situated engaged in similar experiments, and consequently the publication of etherization did not "bide my time."

I know that I deferred the publication too long to receive any honor from the priority of discovery, but having by the persuasion of my friends presented my claim before the profession, I prefer that its correctness be fully investigated before the Med. Society. Should the society say that the claim, though well founded, is forfeited by not being presented earlier, I will cheerfully respond, so mote it be.

Not wishing to intrude upon the time of the Society, I have made this short compendium of all the material points stated in my article in the Journal, and if the Society wishes any fuller information on the subject I will cheerfully comply with their wishes.

Appendix II.

"Georgia, Jackson County. } I, Ange De Laperriere, M. D., do certify that I resided in Jefferson, Jackson County, Georgia, in the year 1842, and that some time in that year I heard James M. Venable, then of said county, speak of Dr. C. W. Long's cutting out two tumours from his neck while under the influence of the inhalation of sulphuric ether, without pain or being conscious of the performance of the operation.

I do further certify that the fact of Dr. C. W. Long using sulphuric ether by inhalation to prevent pain in surgical operations was frequently spoken of and notorious in the county of Jackson, Georgia, in the year of 1842. A. De Laperriere, M. D.

Sworn to and subscribed before me this 30th of March, 1854.
N. H. Pendegrass, J. P."

"Athens, Clarke Co., Georgia.

I, the undersigned, do certify that in May, 1843, I assisted Dr. R. D. Moore in amputating the leg of a colored boy Augustus, then the property of Mr. Wm. Stroud, who resided in this county; and that I distinctly recollect hearing Dr. R. D. Moore say, If I had thought of it before leaving home I would have tried Dr. C. W. Long's great discovery, namely, the administration of sulphuric ether as an anæsthetic in performing the operation. Having neglected to bring the ether, Dr. Moore finally concluded to influence the patient with morphia; under which influence the operation was performed. Jos. B. Carlton, M. D."

Appendix III.

From Dr. Long's First Student.

"Cohutta, Ga., Dec. 13th, 1894.

Mrs. Frances Long Taylor,

Dear Madam:—* * * In 1844, soon after I attained my majority, I decided to adopt medicine as my profession, and began to think where and under whom I should begin the preparatory study. My father asked me to choose from among the number of physicians whom I knew the one I preferred to act as preceptor to me.

Knowing Dr. Long so well and believing him to be a man of no ordinary ability, I at once fixed upon him as my choice.

I entered Dr. Long's office in May, 1844, as the first student ever under his care. As I progressed with my studies he saw fit to make known to me his discovery, by the use of which he could perform surgical operations without giving any pain to his patient. [Here follows a description of the first cases.]

Not satisfied, however, that there was not more to learn about this great discovery, he proposed that we test it further personally, which we did in his office, where with closed doors we administered it to each other to prove its perfect anæsthetic effect and also to discover any bad effect to the subject etherized. Owing to the prejudice and ignorance of the populace Dr. Long was prevented from using ether in as many cases as he might have.

Thus in the two years preceding my entering Dr. Long's office he had had only about six cases in which to try the anæsthetic effects of ether.

The first case that came under his care where its use was applicable after my going into his office was not till January 8th, 1845, which was the case of a negro boy having two fingers to amputate, caused by neglected burn. I, as the only student still with the doctor, he had me to accompany him to see the operation and assist *in the administration of the ether*. The first finger was removed while under the influence of ether, the little fellow evincing no pain; the second without ether, the child suffered extremely. This was done to prove that insensibility to pain was due to the agent used.

Soon after this, in January, Mr. J. D. Long came into the office as a fellow-student; *later, toward spring, came P. A. Wilhite*, and in August came Dr. Long's brother, H. R. J. Long. We four remained there at Dr. Long's office as students until the opening of the fall term of the medical colleges. * * *

[Signed] J. F. Groves, M. D.

Sworn and subscribed to before me, Dec. 15th, 1894.
Wm. H. Wilson, N. P."

THE EARLY HISTORY OF OPHTHALMOLOGY AND OTOLOGY IN BALTIMORE (1800-1850).*

By Harry Friedenwald, A. B., M. D., *Associate Professor of Ophthalmology and Otology, College of Physicians and Surgeons, Baltimore, Md.*

An old book tells us that each generation may be looked upon as standing on the shoulders of its fathers. If its vision is clearer, its intellectual view less obstructed, its horizon broader, it is in great part due to the height to which others have raised it, to the support others have given. Unmindful of this, it is apt to exaggerate its greatness and the importance of its own work.

In the following narrative I have brought together all that I could find relating to the lives and labors of those who, in the earlier years of this century and in our own city, tilled the soil of ophthalmology and otology. Some have been forgotten, few have been accorded deserved recognition.

Are not many of us as ignorant of their names and works as an old physician from whose memories I had hoped to obtain information, but whose response was, "No work was done in Baltimore in those departments of medicine before 1850"? I must confess that when my attention was first drawn to this

*Read before the Johns Hopkins Hospital Historical Club, April, 1897.

subject I knew of but one work of importance which a Baltimore physician had rendered to ophthalmology.

There is no reference in literature to anything done in Baltimore in the two branches we are considering before the beginning of this century. We must remember that in 1800 the population of Baltimore City was 26,614 and that in 1802 there were but 44 physicians.

It is probable that there were here as elsewhere those who confined themselves to diseases of the eye. This is indicated by a resolution adopted at the convention of the Medical and Chirurgical Faculty of Maryland in 1805.* It was resolved that "the Board of Examiners be authorised to grant special licenses to dentists and occulists to practice in their respective branches, subjecting them to an examination only on the branches they possess; and that such licentiates shall pay ten dollars for each license so obtained; provided it shall be the opinion of the attorney-general that the law authorizes the examiners to grant such licenses. The secretary having submitted the preceding resolution to the then attorney-general, he gave it as his opinion that the law authorized the board to act according to the spirit of the resolution." These "occulists" did not, it appears, stand in very good repute.

In the review in 1825 of an American treatise on diseases of the eye, the writer, who was probably Dr. Isaac Hays, the distinguished editor of the American Journal of Medical Sciences and an ophthalmologist of note, describes the condition of ophthalmology in the early years of this century. He tells us that "the neglect to which disorders of the eye were too long consigned is truly astonishing. Prepossessed with an idea that there was something peculiar in the diseases attacking different parts, physicians entirely abandoned these affections to persons who were exclusively devoted to them and were totally ignorant of the laws which influence diseases of other organs. To this cause is to be attributed the slow progress which the science of ophthalmology made during many centuries. The history of this science shows that while it made most rapid advances in improvement by the investigations of medical men, it invariably, when abandoned to professed oculists, not only ceased to advance but actually retrograded . . . In this country much apathy has existed, and we fear still exists, with regard to these affections. Some of our distinguished surgeons have not, it is true, entirely neglected them; yet the mass of medical practitioners have paid little attention to them, and the science has advanced so rapidly during the few years that we believe few have kept pace with the improvements that have been made. The length of time that generally elapses before opinions of European writers are diffused in this country—the want of regular lectures—and above all, clinical instruction and the opportunities furnished of observing these diseases in institutions established for the reception of these cases, are the cause, no doubt, of the present state of the science among us."

He mentions that the New York Eye Infirmary was established in 1820, the Pennsylvania Infirmary for Diseases of the Eye and Ear in 1822, and "with respect to the institution at Baltimore he has but little information to communicate. It is attached to the Baltimore Dispensary and is committed to the care of the author of this work." [Dr. Geo. Frick.]

*Summary of Proceedings, &c., published in 1817.

Pierre Chatard.

The earliest Baltimore publication having reference to diseases of the eye is found in a paper written by Dr. Pierre Chatard in the Medical Repository, vol. VII, p. 28. Dr. Chatard was born and educated in France, and had settled in Baltimore in 1797. He was a prolific writer, the paper referred to being one of the earliest. It was entitled "An account of a case of Fistula Lachrymalis, with reflections on the different modes of operating in that disease." The paper describes a case of lachrymal fistula relieved by introducing threads of silk after the manner of a seton through the lachrymal duct and gradually increasing their number. He discusses at length the various methods in vogue at that time of treating the disease. It is written in an interesting and elegant manner. None of the other writings of Chatard relate to diseases of the eye.

William Gibson.

During the second decade of this century the celebrated surgeon, Wm. Gibson, practiced in Baltimore. Wm. Gibson was born in 1784 in Baltimore, and was graduated in medicine in Edinburgh in 1809. He was a physician to the Baltimore General Dispensary in 1818–19, and professor of surgery at the University of Maryland from 1812–19, resigning to occupy the same chair at the University of Pennsylvania from 1819–54. He died about 1858 (?).

His numerous publications date mainly from the latter period of his activity, but there are two notable and very interesting references to ophthalmic surgery dating from the Baltimore period.

In Hirsch's History of Ophthalmology* we find the statement that Prof. Gibson of Baltimore had made the experiment of introducing a seton through the cataractous lens, with the view of producing its absorption, so original an experiment that Hirsch cites the description given by Dr. John Revere untranslated. My friend, Dr. O'Connor of Boston, had the kindness of looking up the reference in the New England Journal of Medicine, vol. VIII, p. 119, of 1819, and I will give this account in full because of its intense interest.

Extract of a letter to one of the editors:

"I am desirous of communicating through the medium of the New England Journal a new mode of operating for cataract, which has been projected and practiced recently, *in two cases*, with the most satisfactory success, by my friend, Dr. Gibson, professor of surgery at the University of Maryland.

The operation was performed in the following manner: The iris was in the first place dilated by the application of atropa belladonna. A common sewing needle, slightly curved and armed with a single thread of silk, was then passed through the tunica sclerotica about two lines from the cornea, where the couching needle is usually introduced, through the opaque lens and out of the opposite side of the cornea, at a point corresponding to the one at which it was introduced. The silk being drawn through, and the ends cut off, a single thread was thus left passing through the ball of the eye, and acting on the diseased lens in the manner of a seton. It

*Graefe and Saemisch's Handbuch, Vol. VII, p. 517.

was feared that serious inconvenience might arise from the irritation produced upon the tunica conjunctiva, from the excessive sensibility of this membrane. Fortunately, however, neither this nor any other accident intervened, and at the end of ten days, in both cases the diseased lens had disappeared, and, in its place, the silk was distinctly seen passing like a bar across the pupil of the eye. The silk was withdrawn, and in a few days the vision was restored. In the third and last case in which this operation was performed it failed in consequence of the iris being wounded. This caused such an inflammation of the organ that it was deemed proper to withdraw the seton at a very early period. This accident was attributed to not using the belladonna. One would think that a common sewing needle is not the most convenient instrument that could be devised for this purpose, on account of the dense structure of the part through which it is to pass, and the difficulty of having the perfect command of any instrument without a handle. From the nature of the disease, from the known effects of this remedy when applied to other parts of the body, and from the success which has already been experienced, there seems to be good reason to hope that this will be found an important improvement on the established practice in many forms, if not in every variety of the disease. But the practical benefit to be derived from this operation can only be tested by a more enlarged observation than in this country ever falls to the lot of any individual.

I remain yours, J. Revere.

Balto., Mch. 2nd, 1819."

We learn from Hirsch that Loewenhardt in 1828 operated in a similar manner for secondary cataract with anterior and posterior synechiæ, likewise with good result; it appears that others have not attempted the operation.

In the American Appendix to the second edition of Cooper's Dictionary of Practical Surgery, edited in America in 1844 by David Meredith Reese, who in 1842 and 1843 was professor in Washington University of Baltimore, we find a very curious reference to Professor Gibson under the head of strabismus: "It appears from the Institutes of Surgery that Professor Gibson attempted the cure of strabismus by dividing the recti muscles of the eye, precisely as now practiced, some twenty years since, in Baltimore. Soon after he repeated it unsuccessfully in Philadelphia in several cases, and was induced to abandon it by unfavorable opinions expressed on the operation by Dr. Physick. He, however, inculcated the propriety of the operation upon his class many years since, and Dr. A. E. Hosack, of New York, then one of his pupils, distinctly recollects Dr. Gibson's expressions of confidence that the operation would ultimately succeed."

I had no little difficulty in finding the reference to which Dr. Reese refers. The first five editions of Gibson's Institutes of Surgery (published between 1824 and 1838) contain no chapter devoted to strabismus, and in the seventh edition the long account of strabismus and its treatment consists almost entirely in a paper written by Charles Bell and sent by him to Gibson. In this chapter the above reference is likewise not to be found. It is only in the sixth edition, published in 1841, that we find the reference. It is of such importance that I shall give it in detail. On page 375 Gibson states that:

"In the year 1818, while practising my profession extensively in Baltimore, the late Mr. B. J. consulted me about his daughter, a child of eleven or twelve years of age, both of whose eyes were directed very much inwards, and were thereby greatly deformed by a squint. I advised a pair of goggles, so contrived, by having a small opening in the centre of each, as to oblige the child to direct the cornea to these openings, and by perseverance for several weeks, succeeded in diminishing the deformity but not effecting a cure. In the course of my visits the child remarked at different times that her eyes felt as if tied by a string. Struck with this observation, and conceiving the disease might depend upon shortening of the internal rectus muscle, I determined, the first opportunity, to try the result of divison of that muscle; and as the friends of my young patient were unwilling the experiment should be first tried upon her, I selected a hospital patient, and after some difficulty in fixing the eyeball and in cutting the muscle across, succeeded in restoring the eye partially to its natural situation. Upon two other patients I repeated the experiment, without much better success, but on dividing a muscle in a fourth patient, after my removal to Philadelphia, the eye was so completely turned to the opposite direction as to bury the cornea beneath the lids and create a much greater deformity than had previously existed. Upon showing the patient to Dr. Physick, he advised the experiments to be abandoned, as likely to be followed by very unfavorable results. I mention these circumstances, not from a desire to receive credit as an inventor or to detract from the claims of the distinguished surgeon with whom the modern operation of strabismus originated, but merely as a curious fact, calculating to show the importance of not laying aside processes apparently founded upon correct principles, simply because we are at first foiled in our attempts to execute them. How much benefit would have resulted to the community if I had followed up my operations until I ascertained the proper mode of correcting them, or how much injury I might have inflicted upon individuals by perseverance in the attempt, I shall not stop to inquire. It is sufficient for me to announce the fact—which I have no doubt could be easily substantiated by many pupils who attended my early lectures, some of whom have indeed already proffered their testimony—without being over-solicitous, in setting up a claim as an inventor, of exposing my awkwardness and perhaps want of knowledge of the principles that should have guided me in following out the practice I had attempted to institute."

It may not be out of place to mention that Stromeyer's important monograph, in which he recommended division of the muscle for strabismus appeared in 1838!

The chapters devoted to diseases of the eye in Gibson's Institutes are important, but as the book appeared after the author had left Baltimore, it is not proper to discuss them here.

Another reference which shows Gibson's interest in the eye occurs in the American Medical Recorder (vol. II, p. 283). It is a "Letter of Charles Bell to Professor Gibson, of Baltimore," and its subject is, "The New Coat of the Eye discovered by McCarthy's demonstrator, Jacobs."

George Frick.*

We may next take up the most important name of this narrative, that of Dr. George Frick, the author of a valuable treatise on diseases of the eye, the first work of the kind that appeared in America.

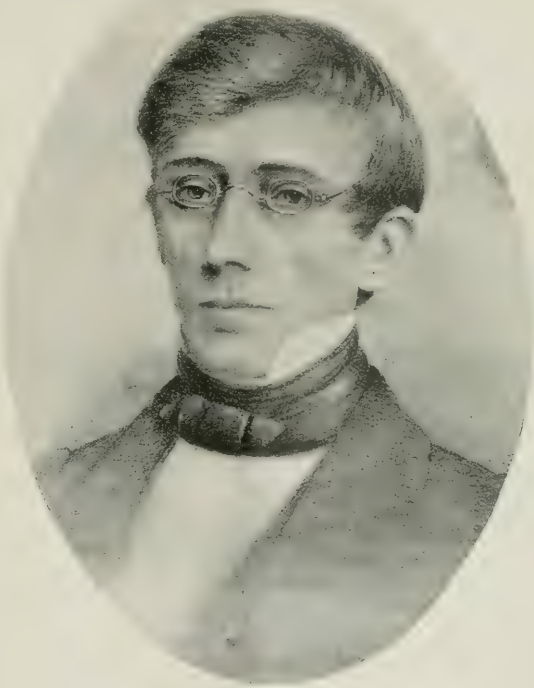
George Frick was born in Baltimore in 1793. After obtaining a broad classical education he entered the University of Pennsylvania, where he obtained the degree of doctor of medi-

*The accompanying portrait of Dr. Frick is copied from one recently presented to the Medical and Chirurgical Faculty, together with a case of instruments which belonged to the doctor, by his niece, Mrs. White and her daughter, Miss Mary White.

cine in 1815, and in 1817 he was admitted as licentiate of medicine into the Medical and Chirurgical Faculty of Maryland. He then spent several years abroad, returning to Baltimore about 1819 to engage in the practice of ophthalmology. He was appointed surgeon to the Baltimore General Dispensary, where he established the first Eye Dispensary in Baltimore, in 1824. In 1822 he delivered clinical lectures at the Maryland Hospital. His name is found on the list of vaccine physicians for 1821.

He was a member of various medical societies; was secretary of the Faculty in 1823, and joined the Maryland Medical Society in 1822. He was much interested in general science, and was one of four physicians to organize a society for promoting science, in 1819. He was likewise a member of the Maryland Academy of Sciences, its librarian in 1824 and curator in 1836.

He devoted himself to the practice of ophthalmology and to the cultivation of general scientific studies, as well as to music for a number of years. He was unfortunate in growing very deaf before middle life, and it is probable that this interfered greatly with his practice of medicine; for somewhere about 1840 he entirely relinquished it and left Baltimore to spend most of his time in Europe, paying occasional visits to this country. He died in Dresden, March 26th, 1870, aged 77 years. Dr. Frick had never married. He was a man of very retiring and modest character and of kind disposition. He was a careful scientific student and his work and writings deserve high praise.



DR. GEORGE FRICK.

His first writing was his thesis for the degree in medicine; its subject was "On the Meloe Vesicatorium" (1815). In 1820–21 his article on "Observations on Cataract and the various modes of operating for its cure" appeared in the American Medical Recorder of Philadelphia. These articles cover over 40 pages. In 1821 an article on "Observation of the various forms of Conjunctivitis" appeared in the same journal, and in 1823 his paper on "Observation on Artificial Pupil and the modes of operating for its cure."* His most important work, however, was "A Treatise on the Diseases of the Eye; including the doctrines and practice of the most eminent modern surgeons and particularly those of Professor Beer," which was published in Baltimore by Fielding Lucas, Jr., in 1823. It was inscribed to his teacher, Dr. Physick of Philadelphia. The articles above referred to, though somewhat more elaborate, were in the main identical with the corresponding chapters of the treatise and do not therefore require special consideration. The treatise is of considerable value.* It is well and clearly written, the system upon which it is classified is excellent, and no greater praise could be given it than stating the fact that it was republished three years later in London by an English surgeon, Richard Welbank, a member of the Royal College of Surgeons and of the Medical and Chirurgical Society of London, and dedicated to the ophthalmologist William Lawrence. Numerous foot-notes were added, but the text suffered no change.

The reviews which the book received were very complimentary. The Philadelphia Journal of Medical and Physical Sciences (probably Dr. Isaac Hays) contains a review covering 18 pages: "The author evidently possesses a cultivated and well disciplined mind; he appears to be intimately familiar with German writers, and we feel much indebted to him for making us acquainted with their writings."

In the American Medical Recorder of 1824 a still longer review is to be found, covering 32 pages. The writer describes the book in terms of high praise. He "offers the humble tribute of (his) thanks to the author for the benefits which he has conferred on the profession generally, by presenting them with a volume of great value and utility, and one which was much

* This curious error is cited as it is found.

* It is interesting to find numerous pencil notes in the articles in the copies of the American Medical Recorder at the library of the Medical and Chirurgical Faculty of Maryland, notes suggesting slight changes in the phraseology, paragraphing, etc., every one of which has been adopted in the treatise. I have been able to trace this copy, which was bought with other books by Dr. John Morris at a public sale of the library of Dr. John Buckler, who was related by marriage to Dr. Frick, and whose library thus passed into Dr. Buckler's. Numerous books at our library contain Dr. Frick's autograph, and one, a copy of Gibson's Institutes of Surgery, has an inscription of the author to his friend Dr. Frick. In Beer's work on ophthalmology there are interesting pencil notes and several pages of written matter which correspond so thoroughly with Dr. Frick's writing that I have no hesitation in stating that they are his.

wanted. As a manual of the diseases of the eye, we believe it to be the best which has been published. It contains all the improvements which have enriched ophthalmic surgery, in such a surprising degree within a few years past," etc.

In 1825 this work was placed on the list of those which the student was required to have read before applying to the Medical and Chirurgical Faculty of Maryland for the examination for licentiate in medicine.

Hirsch in his history of ophthalmology says that "George Frick was the apostle of the ophthalmological school of Vienna in North America; his treatise was next to Saunders's, the first large treatise on ophthalmology in America, and was received by physicians with great praise." Saunders's book was an English work and was republished in Philadelphia in 1821, two years before Frick's. The only other book in the English language of a similar kind was that of Travers, which appeared in London in 1820–21–24.

We thus see that Frick's book was the first American treatise (and for a number of years it remained alone). The work is much quoted in Cooper's Dictionary of Surgery.

In Quinan's Medical Annals of Baltimore I find a reference to a paper of Dr. Frick's "On the Senses," which he tells us was read before the Medical Society of Maryland in 1821. I have been unable to find this paper.

In Cordell's History of the University of Maryland we learn that the foundation of the Infirmary was laid in 1823 and that patients were received in the same year. Of the four wards, "one was reserved for eye cases, instruction in ophthalmic surgery forming a prominent feature in the course. This was during the time of Frick's greatest activity, and it is possible that the prominence given to ophthalmology was through him, and that he delivered the clinical lectures in this branch. I am unable to verify this.

In conclusion it is interesting to call attention to the fact that Dr. George Frick was the uncle of the distinguished clinician, Professor Charles Frick.

Horatio G. Jameson.

Horatio G. Jameson, born in Pennsylvania about 1792, graduated in medicine at the University of Maryland in 1813. He held a number of important public positions, having been consulting surgeon of the Baltimore City Hospital from 1819 to 1835, consulting physician of the board of health of Baltimore City in 1827–35; he was incorporator of the Washington Medical University in 1827, and professor of surgery and surgical anatomy in the same from 1827–35, when he became professor of surgery in the Cincinnati Medical College. He was one of the most prominent surgeons of Baltimore for a number of years, and a very active contributor to medical journals, writing important papers in medicine and in surgery. He was the editor of the Maryland Medical Recorder during its existence of several years (Sept. 1829–Nov. 1832), and a large number of its articles are from his pen.

Jameson appears to have been much interested in diseases of the eye. We find frequent references to publications on these subjects throughout his journal, several of which have remarks added by the editor. In vol. 2 there is an article on the "Pathological Sympathy between Eye and Larynx" (p. 117) This article is without any value, indeed it is difficult to understand the real significance of his report after careful reading. An article on "A case of Enlargement of the Eye following the entrance of steel into the eye" describes the panophthalmitis followed by bursting and shrinking of the eyeball (p. 601).

In another paper he described "two cases of ossification of the lens with luxation through the pupil." These cases are of some interest. He extracted the lenses and the patients did well (p. 608). An article on amaurosis associated with inordinate thirst was probably written by Jameson (p. 664).

In the American Medical Recorder of Philadelphia (vol. XII, p. 340) we find an interesting account of the successful removal of "An encysted tumor of the orbit."

In discussing a letter on "Ophthalmia in the Philadelphia Alms House," written to Dr. Rush, Jameson considers the question of the endemic or contagious character of the ophthalmia, excludes the latter view, and attributes the very severe disease to the vitiated state of the atmosphere. He states that "we do not as a general rule of practice bleed sufficiently in cases of ophthalmia."

John Mason Gibson.

John Mason Gibson in 1832 published in Baltimore (W. R. Lucas) a "Condensation of Matter upon the Anatomy, Surgical Operations and Treatment of Diseases of the Eye, together with remarks. Embellished with twelve lithographic plates, illustrative of the anatomy, operations, and morbid appearance."

I am unable to give any details of this author's life. I find that he was admitted into the Faculty in 1825, and that his name appears as late as 1848 in the list of members with the title of L. M. In the next succeeding list published in 1853 Gibson's name is missing.

In the preface he tells us that his book is an "attempt at collecting the best matter on diseases of the eye." That "diseases casual to vision are many and frequently met with in this country; the curative practice has not been sufficiently inculcated in our universities, by impressing upon the mind of the student where and when the importance and great nicety of judgment are requisite in the treatment of them, and that by inadvertent and mal-practice the victim may grope through his existence here in the valley of darkness."

The work is one of compilation, "being made up of extensive quotations from the classical writers of the day." He claims originality only in the construction of his plates, and so far he is certainly correct, for the drawings are quite unlike anything seen in nature.

The arrangement of the work is very curious. The chapters follow in this order: Anatomy of the eyeball, cataract, ophthalmia, corneitis, iritis, choroiditis, retinitis, inflammation of the lens and its capsule, ulcers of the cornea, opacities of the cornea, ptergium, prolapse of the iris, extirpation of the eyeball, extraneous bodies, diseases of the lachrymal apparatus, under which is included entropium, ectropium, epiphora, encanthus, injury of lids, ophthalmia tarsi and fistula lachry-

malis, looking very much as though the subjects had been drawn haphazard from a grab-bag.*

At the end of several chapters the author adds original remarks. When we consider the very excellent and systematic work which Frick had published, nine years previously, as well as such other works from which copious quotations are made, it is quite inexplicable why Gibson showed such disregard of systematic classification, or indeed what purpose he had in publishing the work at all.

Dr. John Harper.

Dr. David Meredith Reese, in his American edition of Cooper's Dictionary of Practical Surgery, first published in 1832, tells us, under the section of cataract, that "one of the most successful operators in this country is Dr. John Harper, of Baltimore, and he seldom adopts any other operation than this (laceration of the capsule and lens substance), which he repeats as often as necessary on the same eye." I have given myself great pains to obtain some information concerning this "successful operator," but his memories appear to have been completely effaced. One single reference is to be found, a short obituary notice. In the Maryland Medical Recorder (vol. II, 179) there is a notice of the death of four members of the Medical and Chirurgical Faculty of the State of Maryland. One of these reads as follows: "Died in the month of January, 1831, Doctor John Harper. Doctor Harper was a native of Ireland, and graduated at Glasgow. He was well-known as an oculist." The title of oculist appears to have been elevated to the dignity of a special practice of medicine within a few years. For Harper was a member of the Faculty, and not of the despised class of oculists mentioned in the beginning of this paper.

William Alexander Clendinen.

Wm. A. Clendinen graduated in the medical department of the University of Maryland in 1840, a classmate of Dr. G. W. Miltenberger. He died of cholera at New Orleans in 1849, having been seized with the disease while dissecting a victim of the epidemic. After his graduation he traveled extensively, devoting his time to the study of medicine. In the Boston Medical and Surgical Journal in 1847 we find several papers which were translations from the work of Prof. Desmarres. In his letter to the editors he tells us that the extracts are part of a "translation upon which he is now engaged"; he expresses his gratitude to Prof. Desmarres, who "has entrusted to him an onerous but useful task, one which from (his) connection with him (he) may be able to perform advantageously to readers of the English language." In the second article, published in the same journal, we find after the name of the author, "Chef de la clinique oculaire." There were in all but three articles, and the promised book never made its appearance, perhaps on account of the untimely death of the author.

* Not a few important subjects are entirely ignored, viz. errors of refraction, strabismus, etc.

OTOLOGY.

The early contributions to Otology in Baltimore were very few. Two names deserve recognition; the first of these is that of the renowned surgeon,

Nathan Rhyno Smith.

It is beyond the province of this paper to give a biographical sketch of Dr. Smith. A very complete sketch can be found in Dr. Cordell's History of the University of Maryland. He was born in 1797 in New Hampshire, graduated as A. M. in 1817, and as M. D. in 1823 in Yale College. He was professor of anatomy and surgery in the University of Vermont in 1825, soon leaving to occupy the chair of anatomy in the newly organized Jefferson Medical College of Philadelphia. From 1827–29 he was professor of anatomy in the University of Maryland, and from 1829–38 he occupied the chair of surgery at the same university, leaving this for three years to occupy the chair of theory and practice in the Transylvania University. He resumed it again in 1841 and held it until 1869.

One of the earliest writings of this prolific worker was the translation of a treatise on the ear from the French of Saissy,* with additions by the translator on diseases of the external ear. This book was published in Baltimore in 1829, and was, so far as I can learn, the second book on diseases of the ear printed in America, the first having been an American edition of Saunders on the eye and ear in 1821.

Saissy's work was "highly esteemed in France," and was one of the important factors in the revival of modern otology. In his preface Dr. Smith tells us that "a concise manual on the diseases of the ear is an acknowledged desideratum in our medical literature. No sufficient work on the subject has ever been issued from the American press. With a view to supply this deficiency (he has) translated the following pages from the French of Saissy . . . corrected and enlarged by its author, and after his death published in 1827 by his friend Montaion, etc.

"It embodies the excellencies of Saunders, Cooper, Leschevin, Maunoir, Itard and Alard . . .

"The attention of the reader will be particularly occupied with Saissy's excellent method of injecting the ear through the eustachian tube. We very well know how frequently the external ear is obstructed by its own secretions, free as is their egress from this cavity. The internal ear is also lined with a membrane which furnishes an excrementitious fluid. It can escape only by the narrow channel of the eustachian tube. How frequently then must it be delayed in the cavity of the tympanum and mastoid cells, giving rise to any degree of mischief."

To render "the work more complete and useful to the medical pupil (he has) added a brief supplement on diseases of the external ear. On this score, however, (he) claims nothing, as (his) addition is made up of commonplace principles and

*An Essay on the Diseases of the Internal Ear, by J. A. Saissy, M. D., translated from the French by Nathan Rhyno Smith, M. D., Professor of Surgery in the University of Maryland, with a supplement on Diseases of the External Ear, by the translator. Published by Hatch & Dunning, Baltimore, 1829.

precepts subjoined merely for the purpose named above." He concludes: "I have, it is true, for perforating the tympanum devised a new instrument which I trust will be useful."

The part of the book most interesting to us is the supplement on diseases of the external ear, covering about twenty pages. These chapters are written in the most concise and simple manner and cover most of the inflammatory affections of the auditory canal, congenital deformities, injuries as well as the treatment of foreign bodies, insects and indurated wax in the auditory canal.

He describes his method of inspecting the canal as being "best accomplished by placing the head in such an attitude as to suffer the sun's rays to enter the meatus and impinge upon the tympanum. To effect this, the operator must seize the external ear, and drawing it outward from the head, extend and straighten the cartilaginous part of the meatus. I have been able to inspect the ear more perfectly by introducing, at the same moment, a steel director, with its groove toward the meatus and its convex side pressed firmly against the anterior walls. The passage is thereby straightened and expanded. If there be no wax present the tympanum will be seen of a pearly white color and concave."

The little instrument which he devised for perforating the membrani tympani is a minute trephine, by revolving which a circular piece of the drum was excised. His object in constructing this instrument was to obtain a larger opening, for he tells us that in two instances in which he had occasion to perforate the membrani tympani he found the beneficial effects of the operation soon to cease in consequence of the speedy closure of the artificial opening. The Maryland Medical Recorder of 1829 reviews the work extensively, the review covering twenty pages. The review is by no means flattering.

It is very apparent that Dr. Nathan R. Smith must have been deeply interested in the subject of the diseases of the ear. He had an extensive practice in diseases of the ear, and also of the eye, though none of his publications deal with the latter organ. Dr. Theobald has recently found a drawing of a knife designed by Dr. Smith to slit the lachrymal canal.

Dr. Joshua I. Cohen.

Dr. Cohen, born in Maryland in 1800, graduated at the University of Maryland in 1823, having been a student in Dr. Nathaniel Potter's office, and soon after devoted himself to the study of diseases of the ear. He was an intimate friend of Dr. George Frick, the oculist, and, like his friend, had wide interest in science beyond the domain of medicine. He thus for a time became professor of mineralogy in the academic department of the University of Maryland. He was much interested in the Medical and Chirurgical Faculty of Maryland, was its treasurer from 1839 to 1856 and president from 57–58. He was also much interested in the Maryland Academy of Sciences.

He practiced until about 1851, devoting himself almost exclusively to otology. His reputation as an aurist must have been quite great, for we read in Reese's American edition of Cooper's Dictionary of Practical Surgery (2nd ed., vol. 2, p. 73, under the heading "Ear"): "In the United States there have been a few surgeons who have distinguished themselves by their success in the treatment of diseases of the ear.

"Dr. Cohen of Baltimore and Dr. Dix of Boston have for several years directed their particular attention to diseases of the internal ear, and to the investigation of the abnormal condition of the tympanum and eustachian tube in cases of deafness. These gentlemen have employed condensing apparatus for administering the air douche through the eustachian tube after the plan of Kramer and others. By the air and also by the water douche, these gentlemen have acquired great tact in the diagnosis and treatment of obstructions in the tube and upon the tympanum."

In 1840 he established, in connection with his friend, Dr. Samuel Chew, an eye and ear institute in Baltimore, in which Dr. Chew had charge of the eye department. Dr. S. C. Chew has had the kindness to inform me that this association between Dr. Cohen and his father lasted for a short time, as his father's appointment to a chair in the University of Maryland compelled him to withdraw from it.

Dr. Cohen was one of the earliest, perhaps the first, aurist in this country. He has left us, however, but one publication which pertains to diseases of the ear. It is entitled "Post-mortem Appearances in a Case of Deafness."* The paper is very short, but is written in the most scientific manner.

In a note written by the editor of the Journal we read that this "valuable communication was read before the American Philosophical Society, at a recent meeting, and is noticed in the proceedings of that body. It has rarely happened that opportunities have been embraced for examining into the condition of the organ of hearing in cases of deafness, or that they have fallen within the observation of an investigator so competent as the author of this paper." The case was that of a patient who died of phthisis. The brain and seventh pair of nerves were examined carefully, but no changes observed. The lower part of the skull was then removed and the ear examined in minute detail.

In the right ear he found the drum-head dull and dark in appearance, irregularly thickened and retracted as a whole, thus diminishing the cavity of the tympanum. The tympanum itself was filled with muco-fibrous membranes passing from the membrani tympani to the posterior walls, presenting a cellular structure. These were carefully divided, exposing the tensor tympani muscle, the tendon of which was found to be of unusual shortness and attached to the handle of the hammer throughout its whole length, thus drawing the bone and the membrani tympani to within a line of cochlear process. Interesting irregularities in the ossicula were noted. The malleus was normal. The incus was undeveloped, diminutive in size. The stapes was wanting with the exception of the base, which was held in place by the circular ligament. The depression of the oval window was filled with membranous tissue, which likewise covered the fenestra rotunda. The tensor tympani muscle was strongly developed, its tendon short and thick as mentioned above. The stapedius muscle existed, but there was no tendon.

In the left ear the membrana tympani was found to have been entirely destroyed, with the exception of a very thin slip at the anterior inferior edge. The tympanum contained a

*Amer. Med. Intelligencer, July 1841 to July 1842, p. 226 (Vol.1).

quantity of yellowish fetid matter, and its lining membrane was completely disorganized. The union between the ossicula was slight, owing to the general disorganization of the ligamentous and muco-fibrous connections. The incus was in place, but the handle of the malleus was depressed. The stapes was not bound down in the oval window, for the annular ligament was entirely destroyed. The tendon of the tensor tympani was disorganized and that of the stapedius destroyed; the whole condition of the tympanum showed a recent active suppuration which did not confine itself to this part; the vestibule was penetrated as well as the mastoid cells; the latter were covered with pus. The cochlea and one of the semicircular canals were examined a day or two subsequently, but there was nothing remarkable about them at this time worthy of note.

Inquiry about the patient led the author to conclude that the faculty of hearing in the right ear had been entirely wanting or was very much impaired for many years.

Though he seems to regard the condition of the right ear to have been congenital, his critical analysis is as acute as the observations themselves are accurate. He cites cases of Morgagni in which membranes filled the cavity of the tympanum, and another in which there was immobility or contracture of the muscles. At the conclusion of his paper he says: "In the case described in this paper, does not the absence of every part of the stapes, with the exception of the base, liken it to the osseous operculum found in the bombinatores, land salamander, and cæciliæ; of the effect of which, in the communication of sonorous undulations, I have already spoken?" I am unable to find any other reference to this paper on undulations and do not know whether it was ever published.

This sketch must be brought to a close. Is it necessary to remark what any careful reader must have observed, that there were physicians in Baltimore in the first half of this century who labored faithfully and well in Ophthalmology and Otology? Their contributions were among the earliest and most important in this country.

In conclusion I desire to express my thanks to Dr. G. W. Miltenberger, to Dr. John Morris and to Dr. Eugene F. Cordell, who furnished me with important notes, as well as my indebtedness to Dr. John R. Quinan's "Medical Annals of Baltimore," and Dr. Cordell's "History of the University of Maryland."

JOSEPH FRIEDERICH PIRINGER: HIS METHODS AND INVESTIGATIONS.*

By Harry Friedenwald, A. B., M. D., *Baltimore.*

"Joseph Freiderich Piringer was born, March 31st, 1800, in Klein-Zell in Upper Austria. He studied medicine in Vienna; he afterwards turned his attention to ophthalmology in 1824. He was at first an assistant of Jaeger, then for three years of Rosas (beginning in 1825). He next obtained the extraordinary professorship of ophthalmology in the medical school at Gratz. Here he founded a much-needed eye hospital, an institution out of which the ophthalmic department of the Allgemeines Krankenhaus gradually developed through his energy. Here he held a high position and was active as a teacher until 1860. His clinical and experimental studies on blennorrhœa were made at this hospital. He wrote a work on blennorrhœa which was awarded a prize by the German Society of Physicians in St. Petersburg. Piringer has the merit of having shown that intentional infection of blennorrhœic secretion in pannus leads to clearing of the cornea. He founded a reputation upon this which extended far beyond the boundaries of Germany. He was for many years attached, as visiting physician, to the Elizabeth Hospital and to the City Asylum for the Aged, and published several other articles up to the time of his death, Sept. 22nd, 1879, including: Ueber Veratrinbehandlung des acuten Gelenk-Rheumatismus; Die Behandlung der Variola mittelst Iodtinctur; Die richtige Pflege der neugebornen und kleinen Kinder; Studien ueber die Mortalitäts-Statistik in Graz."†—(From Hirsch's Biographisches Lexikon, 1886, vol. IV, p. 575.)

Piringer's work on blennorrhœa‡ was awarded a prize, and the earlier works in ophthalmology refer to his studies, especially to his investigations in the treatment of pannus.§ Arlt devotes some space to a summary of the work on blennorrhœa.* But more recent works in ophthalmology make no mention of these important studies and their no less important results; in works on bacteriology I do not find his name, nor even in works on gonorrhœa, such as that of Finger. Piringer's work was of such importance that it does not deserve to be thus forgotten.

The absence of any other references in ophthalmic literature leads me to believe that Piringer's studies in ophthalmology were confined to the subject of inquiry contained in the work above mentioned. This is the more readily understood when we read in his preface "that his untiring efforts during fifteen years were given up to the solution of the natural laws governing blennorrhœas of the eye, as far as this lay in the limited powers of a single individual." We may aptly apply to Piringer the words, "therefore by their fruits ye shall know them." Judged by this standard, Piringer stands out boldly as one of the greater luminaries of medical science in the first half of this century.

In order to properly estimate the importance of his investigations it will be necessary to examine into the state of knowledge of the subject previous to 1840.

In 1780 a treatise on diseases of the eye appeared, written by George Chandler, surgeon, of London, in which he gives this account of "venereal ophthalmy." He divides it into two varieties, the translative and the symptomatic.

"The translative ophthalmy begins with a copious discharge of a sebaceous humor of a yellowish white color, and is known by the tumor, lividness, sharp and lancing pain of the sclerotica, the

* Read before the Johns Hopkins Hospital Historical Club.

† I am indebted to Professor Wm. H. Welch for having called my attention to this account of Piringer's life.

‡ Die Blennorrhoe am Menschenauge. Graz, 1841.

§ Oest. Med. Jahrb., 1838, and chapter 8 of the monograph.

* Klin. Darstellung d. Krankheiten d. Auges. Vienna, 1881, pp. 35–37.

cornea at the same time being as it were depressed within a pit. It frequently follows soon after an injudicious stoppage of a gonorrhœa, the venereal virus being translated into the eye. It has also been observed that a gonorrhœa which before seemed incurable has, upon the coming on of this ophthalmy, suddenly vanished; and in like manner the ophthalmy has gone off upon the return of the gonorrhœa . . . The symptomatic remits towards morning, never turns into a chemosis, the morbid matter does not change place, the pains are milder, it is removed when the lues is cured, and is also attended with less danger."

He admits that "sometimes a venereal ophthalmy has been produced by the immediate application of the virus to the eyes."

Concerning the treatment he tells us that—

"The venereal ophthalmy in general is subdued and its poison extinguished by mercury, but it should never be applied to the eyes. The patient should be bled and purged, and his eye washed continually with brandy and water, etc. It is necessary also to evacuate the virulent matter collected in the cellular texture of the sclerotica and eyelids by slight incisions of each membrane; an ichor, very like that of gonorrhœa, will be discharged."

This was the older view.

About the beginning of this century a remarkable development occurred in ophthalmology. Beer and Schmidt in Vienna, and Himly, Langenbeck, Graefe the elder, and others gave a new impetus to the scientific study of this branch of medicine. This was followed by the publication of a number of important treatises and monographs in ophthalmology, principally in Austria and Germany, but also in France, England and our own country. I shall pass these by and take up the subject as we find it in the third edition of one of the most important and valuable treatises on "Diseases of the Eye" written in the first half of this century, that of William Mackenzie of Glasgow. I take the third edition as it appeared in 1840, one year before Piringer's work. Here we find under the section of ophthalmia in new-born children, that "there is reason to suspect that this disease is not unfrequently an inoculation of the conjunctiva," etc., and "that therefore it may often be prevented by carefully washing the eyes of the infant with tepid water," etc.; secondly, "that the purulent ophthalmia of infants in its worst form is the result of the application of gonorrhœal matter, is generally admitted."

Concerning gonorrhœal ophthalmia he tells us that—

"Different views have been entertained of the purulent inflammation of the conjunctiva which is frequently found to attend or succeed gonorrhœa. First, this ophthalmia has been ascribed to inoculation with matter from the urethra; secondly, it has been supposed to be metastatic; and thirdly, it has been considered, at least in certain cases, as an effect owing to irritation merely, without either inoculation or metastasis. It is quite possible that there may be three such varieties of this ophthalmia. The existence of the first I consider beyond all doubt; but the second and third are somewhat problematical."

His description of the first form is quite clear, and in several cases which he reports the infection is definitely proved. He did not succeed in separating gonorrhœal from what was called Egyptian ophthalmia, excepting as differing in degree. This distinction was not definitely made until about ten years later (by Bendz). Mackenzie's criticism of the views entertained by some eminent ophthalmologists is so interesting that I shall quote the entire paragraph:

"Dr. Vetch tells us that in a soldier in a very advanced stage of Egyptian ophthalmia he attempted to divert the disease from the eyes to the urethra, by applying some of the matter taken from the eyes to the orifice of the urethra. No effect followed this trial. It was repeated in some other patients, all laboring under the most virulent state of the Egyptian disease; and in all the application was perfectly innocuous. But in another case, where the matter was taken from the eye of one man laboring under purulent ophthalmia, and applied to the urethra of another, the purulent inflammation commenced in 36 hours afterwards and became a very severe attack of gonorrhœa. From the result of these experiments, Dr. Vetch, while he admits that gonorrhœal matter taken from one person and applied to the conjunctiva of another will excite a highly purulent ophthalmia, regards himself justified in no longer admitting the possibility of infection being conveyed to the eyes from the gonorrhœal discharge of the same person. He adds that the impossibility of this effect was rendered decisive by an hospital assistant who, with more faith than prudence, conveyed the matter of a gonorrhœa into his eyes without any affection of the conjunctiva being the consequence. It is remarkable that Dr. Guillie has fallen into the same error of reasoning as Dr. Vetch, only that his negative experiments have led him to the very opposite conclusion. He applied the matter taken from the conjunctiva of one patient to the urethra of another; no effect followed, and hence he concludes that the notion of some regarding the propagation of puro-mucous inflammation from one mucous membrane to another in different individuals, is unfounded."

Mackenzie, however, devotes considerable space to the discussion of gonorrhœal ophthalmia from metastasis, though nothing could be better than his statement that writers had adopted these views "with too little hesitation and appear not to have sufficiently investigated the probability of the ophthalmia arising rather from inoculation than from metastasis." He goes on to enumerate "the causes of the suppression of the gonorrhœa, to which the rise of metastatic gonorrhœal ophthalmia is attributed," and cites an illustrative case from a French writer. It is evident that Mackenzie had little confidence in the existence of this form of gonorrhœal ophthalmia.

A third form of gonorrhœal ophthalmia without inoculation or metastasis is described: "an alternation has been observed between the two diseases; that is to say, when the gonorrhœa came, the ophthalmia went, and *vice versa*." Mackenzie says that the cases reported "show the diversity which exists in opinions entertained regarding the ophthalmiæ which in some individuals are found to attend gonorrhœa, or to alternate with this disease"; and that "it is quite evident that the ophthalmiæ which have been observed to do so are far from being uniform," that some are probably ophthalmia tarsi, others catarrhal ophthalmia. What is most important is his statement that "it may fairly be doubted whether there is any connexion between diseases of urethra and that of the eye, farther than that they occurred in the same individuals, while the occurrence of both might be attributed to a susceptibility for disease arising from peculiar or debilitated constitutions." We are somewhat surprised to see this statement followed by such a one as this, that "Swediar's hint to employ the bougie in cases of ophthalmia alternating with gonorrhœa may probably be found of use; it is evident, however, that this remedy cannot be trusted alone, but that the ophthalmia must be treated according to

the particular symptoms it presents, not according to the conjectural notions entertained regarding its origin."

Concerning Egyptian ophthalmia Mackenzie says:

"I think it probable that the ophthalmia which attacked the British and the French armies in Egypt was an atmospheric puro-mucous conjunctivitis [described at another place as "excited by exposure to atmospheric alternations"], but that it afterwards degenerated into a contagious, perhaps infectious disease; that is to say, that it was propagated by actual contact of the discharge, and perhaps by miasmata from the eyes floating through the air."

Mackenzie's views may fairly be taken as the most advanced of this period and will serve as the proper point from which to view the investigations of Piringer.

It should be mentioned here that many subsequent writers held on tenaciously to these and older views for many years after Piringer's discovery had been made.

We may first direct our attention to Piringer's experiments in curing pannus by producing acute purulent ophthalmia. This method, we are told, was first suggested by Friederich Jäger* some time during the second decade of this century, but little or no attention had been given it before Piringer's experiments were made. He tried the method in more than sixty cases, using the pus of various kinds and stages of purulent ophthalmia of both adult and new-born. All of his cases were improved and not one was injured by the treatment. In the great majority of cases the cure was complete, so that no sign of the former disease could be discovered, and permanent. He therefore recommends this method of curing pannus in these words: "After so many highly successful experiments and observations, the inoculation of the blennorrhœa for the cure of pannus is no longer a doubtful measure which requires great courage, but an excellent method (ein grossartiges Mittel)." This method remained in use for many years and is still being applied in a modified manner. The modification consists in the use of jequirity to produce a purulent ophthalmia instead of blennorrhœic matter.

It was in the study of this method of treatment that Piringer made his investigations as to the nature of blennorrhœa and the contagious property of the secretion. For this purpose his experiments were varied in every conceivable manner. Most of the experiments were made upon eyes which were already diseased, but these were controlled by other experiments upon amaurotic eyes with perfectly healthy conjunctiva, or by the accidental infection of normal eyes.

After describing the various forms of purulent inflammation of the conjunctiva he takes up the causes. Under this head he discusses the question as to the production of gonorrhœal ophthalmia by metastasis. In the course of fifteen years he had never seen a case of suppression of a gonorrhœa with an outbreak at another point, excepting in the neighboring tissues. Many physicians of great practice had likewise never seen true metatastic gonorrhœal ophthalmia. He denies the occurrence of such a form of disease, and characterizes it as a very pretty fable which one after the other has been telling in the best of faith. Gonorrhœal ophthalmia is always due to the transference of infectious material directly into the conjunctiva!

In a similar manner he disproves the existence of a consensual form of gonorrhœal ophthalmia, supposed to be due to a sympathetic connection between the affected parts.

Gonorrhœal ophthalmia is known to be more common toward the end of the primary affection than during the period of its greatest virulence. He explains this very properly on the ground that when the discharge is great much care is used in cleansing the fingers. It is after the discharge has become scant that patients become careless. The right eye is usually the one first affected, because most patients are right-handed.

His experiments proved that the generally accepted view that the transference to the eye of gonorrhœal pus results in a simple conjunctivitis or a mild purulent ophthalmia, and only rarely in a severe inflammation, is false. On the contrary, he asserts that the result is always a purulent ophthalmia of a severe degree. The only exception occurs in those cases in which early treatment is successfully applied.

The contagious character of the secretion of ophthalmia neonatorum had been looked upon as ridiculous;* when Juengken stated that a nurse had developed severe purulent ophthalmia during the night of the same day when she had infected them with a sponge that had been used to cleanse the eyes of an infant with ophthalmia, it was laughed at. No one can deny the infection in his own cases, because the material was carried across the street into another house and yet the result was always the same.

His experiments on the production of purulent ophthalmia embrace almost one hundred eyes, and this does not include a number of accidental infections which were observed with the same care. The matter with which infection was produced was obtained from eyes affected with different forms of purulent ophthalmia as well as from genital blennorrhœa. All ages and both sexes were found to be equally predisposed.

One of the most interesting chapters is the one on the character of the blennorrhœic contagion. Though the pus from the conjunctiva causes infection when applied to the eyes of human beings, he was unable to produce any result when he applied it to the eyes of such animals as dogs, cats, hogs, and various birds. Others had claimed that they had produced effects in such cases. Our present knowledge of the immunity of animals to gonorrhœa shows that Piringer was not deceived.

The granulation from which the pus is secreted carries the contagious property with it, as was shown in 1823 by Werwick, who experimented upon two nurses. Piringer never made any experiments with granulations because it lacked any practical bearing.

*In Hirsch's History of Ophthalmology, p. 441, we read that Ludwig reported the successful use of this method at the hands of a friend, probably Friederich Jäger.

Wharton Jones (in a manual on Ophth. Med. and Surg. published in 1847) states that Dr. Henry Walker was the first to suggest the method (Edinburgh Medical and Surgical Recorder) in 1811. I am unable to verify this citation.

*The faith with which this opinion has been held can be measured by the much-quoted citation of Dr. Vetch, referred to above. Piringer likewise quotes Adams, who rubbed his eyes with a finger smeared with purulent matter without producing ill results, as did Van Sevenoeck and Kriebel. Morburgo smeared the eyes of 300 soldiers without effect.

The pure lachrymal fluid of a blennorrhœic eye was found not to possess contagious properties. An experiment is related in which lachrymal fluid collected upon a camel-hair brush did not produce infection, while the purulent secretion gathered a few days later did.

The question of contagion *par distance* (per miasma) was studied in his hospital, where numerous blennorrhœic patients were placed beside those unaffected, in small wards. He was able to prove definitely that such contagion does not occur and that the cases in which it is suspected can always be traced to direct infection.

The vapor of drying secretion has no power of infection. Even those secretions which are perfectly serous leave a residue when evaporated, and it is this which still retains the contagious properties.

The fluid secretion when kept for three or four days, even without evaporation, is no longer contagious.

If a finger is covered with blennorrhœic secretion and washed immediately in clear fresh water and well dried, it will cause no infection if rubbed over the conjunctiva.

Blennorrhœic matter may be smeared over the eyelids if the palpebral fissure is kept firmly closed by adhesive plaster, and no infection will occur. In order to produce infection the secretion must reach the conjunctiva.

The secretion of acute blennorrhœa of a moderate degree is just as contagious as that of the most severe. Such pus is capable of producing infection even when diluted with 50 or 100 parts of water. The pus of a very mild purulent ophthalmia and of chronic ophthalmia has much less power of infection.

As long as there is any secretion in any case of purulent ophthalmia, whether mild or severe, so long the case is contagious. When the secretion ceases, though there may be considerable congestion and photophobia, the infectious properties are lost.

The properties of infection inherent in the secretion do not vary in different seasons of the year nor under changed atmospheric condition, whether exposed to the glare of the sun or to the cold of the winter. Experiments to determine this may appear meaningless to us, but we must not forget the opinions prevalent in Piringer's time.

Numerous experiments were made to determine the effect upon the contagious properties of the pus when separated for varying intervals of time from the human body. Thus the secretion was collected upon a camel-hair brush and allowed to become as dry as possible ("dry as glass") in from three to six hours. If then applied to the conjunctival sac, but not allowed to soften in the tears, no infection occurred; if softened in the tears, or previously in water, infection was sure to occur.

In seven cases the secretion which had been allowed to dry for thirty-six or forty hours in the open air had lost all contagious property, but in two in which the secretion had been allowed to get dry thirty-three or thirty-four hours in the room and was then softened it produced very severe ophthalmia blennorrhœa. Pieces of linen smeared with fresh blennorrhœic matter and given to a pannus patient to wipe his eyes produced infection, but if the cloth had been dried in the air for several days, the patient could use it about the eyes without harm, and the secretion when scraped off the cloth and inserted into the conjunctival sac produced infection only when it was less than thirty-six hours old. On the other hand, if the secretion was placed in a vaccine case and hermetically sealed it retained its contagious property for forty-eight hours, but lost it entirely when kept for three days. The pus from a case of ophthalmia neonatorum produced infection when kept in this way for two and a half days. Piringer therefore concludes that "*blennorrhœic pus loses its contagious properties as it becomes older, and gradually dies in from twenty-six to forty-eight hours, possessing no more organic life when three days have passed.*" It is upon the discovery of this fact that Piringer bases important rules of prophylaxis, and explains the relative infrequency of gonorrhœal ophthalmia among the common people.

Piringer studied carefully the length of time intervening between the entrance of the infectious material and the first signs of the developing disease, the period of incubation. This he found to vary according to the manner and the amount of the infection, as well as according to the individual peculiarity of the patient. The higher the degree of inflammation, the more rapidly did its pus infect. Thus the pus from a very severe ophthalmia produced infection in from six to twelve hours, or at most in thirty-six hours; while that of very mild blennorrhœa might require sixty to seventy hours, and that of a case of chronic blennorrhœa seventy-two to ninety-six hours.

The secretion of the second stage of acute ophthalmia acts more slowly than that of the first; thus the pus from a case of very acute blennorrhœa in which the secretion was markedly diminishing may take sixty hours to produce the first symptoms.

If the secretion while still warm is immediately transferred from an acute blennorrhœa, but six or eight hours are required for the first signs to show themselves, and in twelve or eighteen hours the disease is fully developed. In this respect the conjunctiva responds more rapidly than the genital mucous membrane. The longer the secretion is kept before it is placed in the conjunctiva, the less rapidly does it act. The rapidity likewise varies with the amount of secretion brought into the eye.

Piringer gave the prophylaxis of gonorrhœal ophthalmia his careful attention and the results were very important. Can the inflammation be aborted after the infectious material has once reached the conjunctiva? Several cases in which the very early and continued application of ice compresses produces this effect are described. In order to determine whether the infectious material can be removed and the outbreak of the disease prevented, several series of experiments were made. The method which required the application of very strong solutions of bichloride of mercury, concentrated acetic acid, etc., appeared to him too severe, and in the few cases in which it was tried the desired result was not obtained.

On the other hand he found that washing out the eye with water after the contagious material had been inserted prevented the development of the disease, provided that it is done sufficiently early. These experiments were made on three patients. In the first case he touched the eye with a large quantity of matter from a newborn babe, cleaned it out after a minute with a sponge dipped in cold water, and had cold water applications made for ten hours. No inflammation resulted.

Four days later he varied the experiment by allowing the matter to remain two minutes and again no inflammation occurred. After another interval of four days the experiment was again repeated, the pus remaining in the eye for three minutes and the result was again the same. After another interval of five days pus was inserted and allowed to remain in the eye for five minutes; no cold applications were made; the result was a violent inflammation. This patient had pannus, which was cured by the treatment.

In order to try these experiments upon a perfectly normal conjunctiva he selected the eyes of an amaurotic beggar whom he paid for these privileges. In this case he found that no disease resulted if the blennorrhœic matter was washed out within three minutes after its entrance into the conjunctival sac and cold water applied. In three minutes any one who has accidentally infected his eyes can obtain fresh water with which to wash them!

In order to determine whether the washing out of the conjunctival sac would accomplish the same result without the use of ice applications, he infected the eye of a girl suffering with pannus with blennorrhœic matter and washed out the conjunctiva in three minutes. Ninety hours later a severe ophthalmia developed. And in a second case the experiment again resulted in the development of a purulent ophthalmia, but not until the fifth day, and in this case the ophthalmia was of a milder character. For these reasons he considers the cold water application as essential to the prevention of conjunctival blennorrhœa after infection has occurred. Many other questions are considered by Piringer, but this review embraces the essential points, and will, I trust, suffice to show its importance.

The care, the true scientific spirit, the accuracy of observation and experiment, the unbiased search for truth, form marked characteristics of Piringer's work. And yet he is so modest as not to claim that his results are "the absolute truth," though they are his own firm convictions; experiments and observations, he tells us, by other physicians at other times and places, made with care and without prejudice, are needed to confirm them as well as to clear away any errors. His experiments were arranged carefully and judiciously to determine the character and the attributes of the contagion, the time during which it acted, the gradual diminution of its powers to the point when they were entirely lost, the intensity of the contagion, and the degrees of dilution which could be borne without loss of all contagious properties. Many of these questions were given their final solution by Piringer. He separated the fluid portions of the pus which could be evaporated, from the more solid matter which contained the contagious quality. He proved that the unknown cause of contagion was a something which had to be transferred in substance from one mucous membrane to the other, and which never acted at a distance, thus disproving the old miasmatic principles which were still current in those days.

In what is our knowledge to-day greater than that of Piringer, excepting that the active agent, the living micro-organism, the gonococcus, has been discovered, a discovery only made in 1879? That it was a living organism even Piringer surmised, for, as we read above, he speaks of it as "growing older," and "dying," and "possessing organic life." Let us not forget when it was that Piringer worked. Though micro-organisms had been discovered toward the end of the seventeenth century, and micro-organisms were assigned as the causes of numerous diseases during the eighteenth century, it was not until 1840 that Henle first established the germ theory of disease upon the solid foundation of logic and fact.

One aspect of Piringer's experiments still deserves mention. Others had likewise made experiments with a view of transferring the disease which we have been considering; but most of these were unsystematic, few in number, and led only to confusion. Piringer's work was such as to give a definite solution to important questions, results which have stood the tests of time. His work was not in vain. His hopes were fulfilled that "the medical world would read not entirely without pleasure a number of results, whose collection in the field of practice had been made at the cost of much strain, great pains and many a sleepless night."

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of May 3, 1897.

Dr. Thayer in the Chair.

Hæmatomyelia from Gunshot Wound of the Cervical Spine.—Dr. Cushing.

This patient, a young woman of 27 years, was brought into Prof. Halsted's service, November 6th, 1896, with the history of having been shot twice in the neck a few hours before entrance. Our chief interest centres in the injury produced by the missile, whose wound of entrance is situated here on the right side of the neck at the level of the cricoid cartilage. These skiagraphs show the point of lodgment of the bullet in the centrum of the sixth cervical vertebra.

The case illustrates some unusual features of one type of the so-called Brown-Sequard paralysis; the value of the X-rays in locating the offending missile; a practical recovery without operative interference; a residuum of symptoms resembling those of syringomyelia.

At entrance she was suffering from agonizing "pains" of a "pins and needles" character, especially in the arms, so severe she would cry out when they were touched. No radiating pains, such as are described in the meningeal form of hemorrhage, were present. There had been no loss of consciousness. Motor paralysis was complete on the right side below the level of Thorburn's "5th root group." On the left there was a brachial monoplegia up to this same segmental level, namely that for the deltoid biceps and supinator longus muscles whose ventral horn ganglion cells lie in the 5th cervical segment, as you may see by comparison with this

familiar table of Starr's. Respiration was purely diaphragmatic.

On the left side, up to the second intercostal space and down the ulnar side of the arm over an area which corresponds, as these diagrams taken from Starr and Kocher demonstrate, to the cutaneous sensory fields of the eighth cervical and first dorsal segments, there existed anæsthesia to pain and thermic stimuli, and a slight dulling of tactile or pressure sensibility. A segmental zone of similar anæsthesia was present on the side of motor paralysis across the chest and including most of the right arm.

There was a marked elevation of surface temperature, considerable hyperalgesia, and also a diminution of reflex activity on the paralyzed side. Loss of sphincteric control over the contents of the bladder and rectum was also present.

Restitution from these paralytic symptoms has taken place up to the excellent condition in which you see the patient at present. The motor paralysis disappeared gradually. On the tenth day, motion, as is usual, was first observed in a slight flexion of the thigh. Turner in his experimental work called attention to this. At the present time there remains evidence of the degeneration of the right pyramidal tract in Wernicke's residuary paralysis of the dorsal flexors of the foot, giving the late hemiplegic character to the patient's gait. Mann has recently called attention to this residuum of motor paralysis and has shown that it selects a certain muscle unit (bewegung einheit), this unit being that which lifts and shortens the leg in the first stage of walking, as can be demonstrated in this patient. Paralysis remains alone complete in some of the small muscles of the right hand, representing destruction of ganglion cells at the site of the lesion. There is an exaggeration of all the deep reflexes of both extremities. Myotatic contractions, as you see, are elicited in the muscles of the right arm by gentle blows on the tendons. Resolution of the sensory disturbances has been less complete. Slight anæsthesia to painful and especially thermic stimuli persists on the left.

A month ago there was present a peculiar distribution of areas of hyperæsthesia, over which cold produced pain without thermic sense, and the threshold for pain was so low to touch or pressure stimuli that the latter could only be elicited with difficulty by v. Frey's æsthesiometer. This is illustrated by these diagrams.

The lesion was presumably due, as in Mann's case, to an intramedullary hemorrhage, the occurrence of which, especially in the cervical enlargement, as emphasized by Thorburn, is not uncommon. It seems that not only is traumatic hæmatomyelia much more common here than elsewhere in the cord, but that there is a certain level in this enlargement giving symptoms corresponding to the "typus inferior" of Krause, in which intramedullary hemorrhage is most likely to occur. This list of cases, collected from the literature, tends to confirm this view of a site of predilection in the lower cervical enlargement for hæmatomyelia, and illustrates the fact that not only in cases attributable to acute flexions of the neck does it occur, as was believed by Thorburn, but also in those due to a great variety of traumatic causes. The hemorrhage also is apt to occur most extensively on one side of the cord, thus often producing the symptom complex of a Brown-Sequard type of paralysis.

That the hemorrhage also in these cases selects by preference the gray matter of the cord, presumably from the greater vascularity and less support given to the vessels there, is well recognized. Frequent note has also been made of cavity formation at the original nidus of hemorrhage, which is interesting in consideration of the association of the syndrome of syringomyelia which Minor and others have pointed out to be a common sequence of traumatic hæmatomyelia and which persists in this patient.

The case which Mann has recently reported in full with post-mortem examination of the cord, in the Deut. Zeit. f. Nervenheil. for 1896, and which clinically bears such close similarity to this case, illustrates many of these points very completely.

Dr. Thomas.—This case seems to me to be one of particular interest, and the Society is to be congratulated on having it so admirably presented. Those of you who have had the opportunity of examining a similar case will recognize the difficulty of making such an exhaustive examination. I know of no case in the hospital records that has been worked up so carefully as this. Dr. Cushing was kind enough to bring the patient to me on several occasions for examination, and I confirmed the results which he had already obtained. The patient's condition, after she had been in the hospital for some time, was, as Dr. Cushing has described to you, briefly as follows: there was weakness of the right leg and right arm. The muscles of the right arm were atrophied, and there were sensory disturbances, as shown in the charts. The wound in the right side of the neck was in such a position that the bullet might have injured the brachial plexus before entering the spinal column, and thus have produced the condition found in the right arm. An electrical examination of the paralysed and atrophied muscles showed that they responded normally to the currents. This was believed to indicate that the brachial plexus was not injured, and also that the paralysis was not due to destruction of the anterior horns from which the nerves forming this plexus arise. I do not believe that there can be extensive destruction of the anterior horns without the occurrence of degenerative atrophy of those muscles which receive their nerves from that segment of the cord. In the case of Mann, to which Dr. Cushing has referred, there was paralysis and atrophy of the muscles of the left arm. This was completely recovered from, but, at the autopsy, a lesion in corresponding anterior horn was found. This case is, as far as I know, the only one bearing on this point, and it does not seem to me to be conclusive. The lesion was limited to the eighth cervical segment, as shown by the fact that the eighth root was degenerated, while the seventh was not, and the first thoracic root was only slightly so. We know that each muscle is represented in more than one spinal segment, and it can be understood how a limited lesion in one segment need not necessarily produce degenerative atrophy to such a degree that it could be discovered during life. The autopsy on Mann's case was incomplete, in that neither the muscles nor the peripheral nerves were examined.

Dr. Cushing's case is of interest from so many standpoints

that it is impossible to discuss it fully. Unilateral lesions of the cord are not very common. In the dispensary we have the records of only two typical cases. I have at present under observation a very beautiful example of this form of paralysis. The patient is a woman whose right leg is paralysed and who shows the disturbances of sensation in the left leg which Mann has pointed out as characteristic, *i. e.* the sensory conduction for touch is undisturbed, whereas pain, heat and cold stimuli do not produce their normal effect. The paths of sensory conduction within the cord have been and are the subject of much discussion. Of late the anatomists and physiologists have been inclined to the view that the paths do not cross, but remain on the same side of the cord until they reach the medulla. Clinicians, on the other hand, from the study of the cases of unilateral lesion of the spinal cord, have held to the belief that the sensory paths decussate soon after entering the spinal cord. That there must be an anatomical basis for the constant occurrence of the classical symptoms of Brown-Sequard's paralysis seems to me to be self-evident. The burden of proof must rest upon the anatomists and physiologists.

NOTES ON NEW BOOKS.

Diseases of the Rectum, Anus and Contiguous Textures. By S. G. Gant, M. D. (*Philadelphia: F. A. Davis*, 1896.)

With the exception of two chapters on Cancer of the Rectum and Colotomy by Allingham, a recognized authority on these subjects, the work of Dr. Gant is not to be commended. The book contains nothing new, and there are many superior works on this subject. The two chapters in which the author seems to take special pride, one on auto-infection, the other on effects of railroading on diseases of the rectum, are not remarkable, and the first is unsatisfactory. That employes of railroads suffer much from constipation and hemorrhoids as a result of their occupation may be true, but the figures he gives can be handled in many ways. If we eliminate from the author's statistics all cases suffering from these two very common conditions, we have less than 1 per cent. out of over 170,000 cases seen in various hospitals suffering from other diseases of the rectum and anus; and 5.7 per cent. in the same number of cases does not seem to us an excessive number to be suffering from the two conditions mentioned. We believe that among the poor laboring class constipation is the usual condition found, and that figures more striking than these could easily be collected to show that constipation was one of the commonest symptoms in all hospital cases. We question whether the jarring of a railroad train will continually rock a stomach from side to side, produce a "sea-sick stomach," or whether it is sufficient to bring about by itself dilatation of the veins about the anus and rectum by causing a venous stasis, and we know that swelling of the feet in railroad travelers is not an ordinary condition, to say the least. The chapter on sodomy might better have been omitted or much abbreviated; such a book does not call for a psychological explanation of this practice. In speaking of the relation of pulmonary tuberculosis to fistula, the author states: "So we meet with two kinds of tubercular fistula—one as a result of localized tubercular ulceration with or without any lung complication; the other a fistula in persons who have lung trouble, due to the absorption of fat about the ischia, general debility, and abscess. In the feces of the first variety can be found the tubercle bacilli of Koch, while in the second variety they cannot be found unless the sputum containing them has been swallowed, and gastric digestion has been impaired to such an extent as not to destroy them or their spores." In either form the fistula is tubercular and the bacilli can be found without these coming from the sputum; and gastric digestion, even when normal, does not ordinarily destroy them, as we know from the large number of cases of primary intestinal tuberculosis which occur. We do not think that the following statements as regards auto-infection are true. On p. 271 we read: "Our Creator, however, foresaw all dangers and provided us abundantly with safeguards with which we can destroy or neutralize the poisons on the one hand, or throw them off on the other, as soon as they are formed"; and on p. 272, "Just so long, however, as the emunctories are working in harmony and perform their individual functions, and there is no lesion of the intestinal mucosa, all is well, and all poisons, no matter whether they are the products of decomposition or of bacterial action, will do no harm, for the reason that they are thrown into a special reservoir (the liver) where they are destroyed or neutralized and afterward discharged from the body."

The colored illustrations in this work are hideous and unnatural, and the woodcuts are not models of artistic excellence. Would it not be well for authors to cease to reproduce cuts of the most common and ordinary instruments, and of well-known positions and procedures in operations, which are quite valueless (cf. cuts on pp. 20, 21, 22, 25, 218, 219, 220). We dislike extremely to see the author's autograph on the outside cover, and the long list of societies to which he belongs following his name on the title-page. If the book possesses merit of its own, this sort of cheap advertisement does it no good; and it does not help the work in any case.

BOOKS RECEIVED.

Second Catalogue of the Library of the Peabody Institute of the City of Baltimore. Including the additions made since 1882. Parts I–II. A—D. 1896-97. 4to. Baltimore.

The Semi-Centennial of Anæsthesia. October 16, 1846–October 16, 1896. 4to, 95 pages. 1897. Massachusetts General Hospital, Boston.

Saint Bartholomew's Hospital Reports. Edited by S. West, M. D., and W. J. Walsham, F. R. C. S. 1896. Vol. XXXII. 8vo, 548 + 197 pages. 1897. Smith, Elder & Co., London.

Transactions of the American Pediatric Society. Eighth session, held in Montreal, Canada, May 25, 26 and 27, 1896. Edited by Floyd M. Crandall, M. D. Vol. VIII. 1896. 8vo, 243 pages. Reprinted from the Archives of Pediatrics. New York.

Medical and Surgical Reports of the Boston City Hospital. Eighth Series. Edited by G. B. Shattuck, M. D, W. T. Councilman, M. D., and H. L. Burrell, M. D. 1897. 8vo, 391 pages. Published by the Trustees, Boston.

King's College Hospital Reports. Being the annual report of King's College Hospital and the medical department of King's College. Edited by N. Tirard, M. D., F. R. C. P., *et al.* Vol. III. (Oct. 1st, 1895–Sept. 30th, 1896.) 8vo. 1897. 332 pp. Printed by Adlard & Son, London.

Twentieth Century Practice. An international encyclopedia of modern medical science by leading authorities of Europe and America. Edited by T. L. Stedman, M. D. In twenty volumes. Vol. XI: Diseases of the Nervous System. 8vo. 1897. 962 pp. William Wood & Co., New York.

Burdett's Hospitals and Charities, 1897. Being the year-book of philanthropy. By Henry C. Burdett. 12mo. 1897. 1018 pages. The Scientific Press, London.

Archives of Skiagraphy. Edited by Sydney Rowland, B. A., Camb. Fol. Vol. I, No. 4. April, 1897. The Rebman Publishing Co., Limited, London.

A Pictorial Atlas of Skin Diseases and Syphilitic Affections in Photo-Lithochromes from Models in the Museum of the Saint Louis Hospital, Paris. With explanatory woodcuts and text by E. Besnier, A. Fournier *et al.* Edited and annotated by J. J. Pringle, M. B., F. R. C. P. Part X, 1897. W. B. Saunders, Philadelphia.

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Report in Pathology.

The Vessels and Walls of the Dog's Stomach; A Study of the Intestinal Contraction; Healing of Intestinal Sutures; Reversal of the Intestine; The Contraction of the Vena Portae and its Influence upon the Circulation. By F. P. MALL, M. D.

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Report in Dermatology.

Two Cases of Protozoan (Coccidioidal) Infection of the Skin and other Organs. By T. C. GILCHRIST, M. D., and EMMET RIXFORD, M. D.

A Case of Blastomycetic Dermatitis in Man; Comparisons of the Two Varieties of Protozoa, and the Blastomyces found in the preceding Cases, with the so-called Parasites found in Various Lesions of the Skin, etc.; Two Cases of Molluscum Fibrosum; The Pathology of a Case of Dermatitis Herpetiformis (Duhring). By T. C. GILCHRIST, M. D.

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An Experimental Study of the Thyroid Gland of Dogs, with especial consideration of Hypertrophy of this Gland. By W. S. HALSTED, M. D.

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CONTENTS.

A SECOND SERIES OF CATARACT OPERATIONS (ONE HUNDRED AND FIFTY-EIGHT).*

By Robert L. Randolph, M. D.

Five years ago I reported in the Bulletin of the Johns Hopkins Hospital a series of fifty consecutive cataract operations. Of these fifty operations six were performed in a hospital. With the exception of eighteen, the remaining twenty-six were among the poorer classes of a country population in Virginia and in a mining region in the western part of Maryland. This series then is chiefly interesting from the rather unusual conditions which surrounded most of the patients. For instance, the first case reported (Series I, Case 1) was operated on in a log cabin near Warrenton, Va., and the old man was nursed by his daughter, who saw him only at meal times and at night (she being in service), and as a consequence he was exposed not infrequently to risks during her absence. He went through the same experience a year later with his other eye and, as in the first instance, obtained excellent vision. Case 8 (in the same series) had been blind for three years and lived at a remote point on a plantation in Virginia, and he was nursed by his wife. His cabin was too dark for the operation and I put him on a cot and operated out in the yard. He was very timid and jumped when the iridectomy was performed, causing some loss of vitreous. He counted my fingers after the operation and I assisted him upstairs to a room next to the roof, as the only other room in the house opened out into the yard. He remained there for a week, and at the end of that time was allowed to come downstairs. He subsequently obtained perfect vision. Case 39 (Series I) was operated on in a cabin full of negro children, and he was looked after by his daughter. The result was most satisfactory. In this series of fifty, two failed to recover sight, and as the circumstances peculiar to these were rather unusual and as such might explain the failure, I shall relate the histories.

Case 49, woman 78 years old, had been troubled many years with dacryocystitis, more marked in the left eye than in the right. She had been blind from cataract for three years. Refused treatment for the lachrymal trouble, saying she was too weak and old to stand the pain incident upon the probing. She was made acquainted with the additional risk of a cataract operation performed on an eye where there was disease of the lachrymal sac. She was willing, however, to run the risk of infection from this source, so I operated on the least affected eye. The result was a perfect success. A year later she presented herself for operation upon the second eye. The operation was smooth and she counted fingers with ease immediately afterward. I left the city that evening, not expecting to see her again for two weeks. She was entrusted to the care of the physician who assisted me in the operation. It is well to state here that she belonged to a most ignorant class of white

* Read at the annual meeting of the American Ophthalmological Society, Washington, D. C., May, 1897.

people, and though nearly eighty years of age, was accustomed to going barefooted in warm weather. The first time I operated she had shown herself unmanageable and walked around the house three days after the operation. That was in the winter time. The second operation was in June last, and when I saw the patient two weeks after the operation her physician told me that she got up out of bed the next day, tore the plaster off her good eye and came downstairs and sat in the yard and smoked her pipe. The second day after the operation she walked nearly a mile barefooted to see her daughter. Whatever were the causes which produced it, when I saw her the second time the eye was lost. It is impossible, then, to say whether to attribute the loss of the eye to infection from the mucocele or to carelessness and exposure after the operation. Before each operation the contents of the lachrymal sac were pressed out, and, as far as possible, the conjunctival sac was rendered aseptic by irrigating it with a solution of corrosive sublimate $\frac{1}{4000}$.

The second case (Case No. 47) is that of a man sixty-one years old. He had been subject for many years to rheumatism, and had suffered also for a long time with varicose veins on both legs, and as a result of the latter condition his right leg was covered with an eczema. The blood-vessels at his wrists and temples were tortuous and hard. Left eye, total cataract and good field of vision for light. The operation was absolutely smooth, and after the delivery of the lens the patient could see my face and count fingers readily. I removed the speculum and closed the eye, putting on the usual bandage. Ten minutes later, and just before I was about to leave the house, he complained of violent pain in the eye. I suspected hemorrhage and immediately removed the bandage to investigate. I found the latter soaked with blood. The mass of blood and protruding vitreous were cleaned away and strong pressure applied. On returning six hours later it was found that the oozing had continued and he was still suffering pain. The lids were opened and a clot of vitreous was discovered between the edges of the wound. This was removed, and after first irrigating the conjunctival sac with a very weak sublimate solution, a pressure bandage was applied. At my visit the next day I found the bandage quite moist and there was every evidence that the oozing was persisting. I cleaned out the sac again and renewed the bandage. On the afternoon of the second day I saw him again and there were still signs of hemorrhage. The same course of treatment was pursued and on the third day I found the bandage clean. Of course he was told that vision was irrevocably gone from the onset of the hemorrhage. In nearly all cases of this class the cornea sloughs, but this termination I fortunately escaped. Hemorrhage after cataract extraction is rare. Dr. Knapp reports in a recent number of the Archives of Ophthalmology his only case. In my own case I can account for the hemorrhage only by the condition of the blood-vessels throughout his body. No doubt the vessels of the retina were tortuous and their walls atheromatous, and when the lens was removed and intraocular tension thereby lowered, the blood-vessel walls could not withstand the pressure from the increased volume of blood pouring into them; so they ruptured. The whole condition of the patient pointed to a diseased state of the circulatory apparatus. It is impossible to guard against such a termination, though I should regard it as a contra-indication for operation upon the other eye, for no matter how smooth the operation might be, the chances are that hemorrhage would follow the delivery of the lens.

Out of this series, then, all obtained useful vision but Cases 47 and 49.

Since the publication of this series I have operated upon 158* cases and the tabular statement is herewith appended. Two of the cases are especially interesting as being instances of maniacal excitement, possibly due to the use of atropine after the operation. The first case was a colored man, operated upon in the poorhouse of Mineral Co., W. Va. He was seventy-five years old and had been practically helpless from cataract for a year. Atropine was instilled immediately after the operation. The next morning the physician, Dr. C. S. Hoffman of Keyser, W. Va., was sent for and he wrote me that the patient had gotten up during the night, torn the bandage off, secured a razor from one of the inmates of the room and had gashed his throat in several places and was bleeding profusely when found. In the excitement which followed the eye was forgotten and it was some time before the bandage was replaced. He was quieted, and seven days later, that is, on the eighth day after the operation, he disappeared from the poorhouse and two months afterward was seen by Dr. Hoffman, in Piedmont, W. Va., 20 miles distant, where he was chopping wood and apparently getting along with absolute comfort. It might be added that he was entirely blind in the other eye.

The other case was also a very old colored man (88 years old). The operation was simple extraction, and atropine was instilled as usual at the operation. Before daybreak of the next day he was a raving maniac and had to be tied down to his bed. His bandage was torn off several times and he was incessantly tossing his head from side to side, until that too had to be secured so as to be as far as possible immovable. I did not dare look at the eye, as I supposed that it was lost. He did not recover his reason for a week, and all that was done was to apply hot moist compresses to the eye. When he became rational and I was enabled to get a satisfactory view of the eye I found a rather small pupil, a slight prolapse, but very little pericorneal congestion. On the tenth day he seemed to be completely himself again, and as the eye evidently needed a mydriatic, one drop of a solution of atropine (4 gr. —$\bar{3}$i) was instilled and the nurse was instructed to repeat the dose at bedtime. When I returned to the hospital the next day I found that during the night he had jumped out of the window—20 feet from the ground—scaled a high iron-spiked fence and was making off when overtaken by an orderly. Notwithstanding all this exposure he obtained $\frac{20}{70}$ vision. Nothing was done for the prolapse, which flattened out entirely.

Another interesting case was where the anterior chamber

*At the meeting of the Amer. Oph. Soc. only 147 cases were reported in my second series. Since the meeting I have operated upon eleven cases.

remained open for seventeen days. I have seen explanations for this phenomenon, but none seem adequate. The operation was the combined one, and the wound had united about half way up on one side and the rest of the incision remained open. More than once during these seventeen days a spatula was passed beneath the corneal flap, and it was easily seen that no union had taken place. The operation so far as could be seen appeared to have been normal, that is to say there was not the slightest hitch in any of the steps. Atropine and compress bandage were employed, and two weeks after he left the hospital his vision was $\frac{20}{200}$. Eight months later he returned to the hospital with serious iritis, and since then vision has been lost, though he still has light perception.

Iridectomy was performed in 102 cases and simple extraction in 42 cases. Soft cataract was operated upon by needling in three cases.

In thirty-one cases the vision was not tested. Three of these cases were in very young children and any subjective test would have been very unreliable. The remaining twenty-eight were ones which I had operated upon at a distance and most of whom I saw only once after the operation. A number of cataract glasses were sent to them from which to make a selection, and in this way I learned to what extent the operation had benefited the patient. It will be seen from the table that the operation and healing process were uncomplicated in all of these cases and all obtained useful vision.

The failures were as follows: *Case* 54. The operation was smooth, and when the bandage was removed she could see large objects in the room. This was on the seventh day. Two days later iritis of a very sluggish character developed, and in spite of all treatment ended in closed pupil and light perception. Dr. H. Harlan of this city operated on the other eye and obtained good vision, but he told me that the operation was also followed by iritis.

Case 72 had an exactly similar history.

Case 95 was one which I had treated for several months for dacryocystitis. Her left eye had been operated upon by a New York oculist two years previously, and the cause of the failure in the case of that eye was no doubt the same as in the case of the eye upon which I operated, for both eyes were affected with dacryocystitis. When first seen she had a fistulous opening which had been discharging for several months. Before operation she was under treatment for at least five months, during which time the fistula had closed and the epiphora had almost disappeared. She understood the danger, but being totally blind in the other eye, wanted the operation performed. The cornea sloughed within a week after the operation.

Case 137 was that of a man 81 years old. On opening the eye on the third day there was a very offensive discharge on the bandage and between the lids, and beginning clouding at the edge of the corneal wound. Vigorous local and constitutional treatment, however, prevented the corneal trouble from extending and he was left with a clear cornea and closed pupil. I think that I could have converted this failure into a success (as in Case 190) by iridotomy, but a few days before the proposed operation he was attacked with pneumonia and died on the eighth day.

The last case was that of an old colored man (Case 128) and the history here was similar to Cases 54 and 72.

In one case (male, both eyes, 67 and 68), the patient had good light perception, but after the extraction of the cataracts it was observed that while he could move about somewhat better, his sight continued very poor, and this was explained by the existence of optic nerve atrophy in both eyes.

In Cases 53 and 207 a cataractous lens (congenital) had undergone calcification and presented a bright white mass in the pupil. The operation was simply for cosmetic purposes.

As to prolapse of the iris. In the 42 cases of simple extraction there were five prolapses. In three of these cases nothing was done, though in Case 181 the prolapse looked as though it would extend through the entire wound. Under a compress bandage, however, and atropine the hernia smoothed over and she has now vision $\frac{20}{40}$. In Case 182 the prolapse got worse from day to day till it nearly filled the wound, and it continued bulging more and more. There was no hernia on the second day when the eye was inspected, but he had a little gush of tears that night followed by pain, and a small hernia was visible the next day. On the eighth day, fearing that the eyeball would be permanently disfigured (to say nothing of loss of sight), the protruding iris was cut off. There is now not the slightest ectasia of the cornea so far as can be seen, and the patient has $\frac{20}{30}$ vision.

In these last two cases lachrymation and photophobia were present to a marked extent and some little pain was felt at the time when the prolapse occurred, but after this pain was conspicuously absent. So far as could be seen there were no evidences of infection in any of the cases of prolapse. When I say evidences I mean cloudy media and exudates. I think that the absence of infection in these and similar cases is to be attributed to the fact that the wound is filled with the protruded iris and probably there is no way for the bacteria to make entrance into the anterior chamber. The profuse lachrymation which is usually present must be regarded as a more or less protection from a mechanical point of view, *i. e.* to some extent in washing away bacteria. And I think that an examination of the statistics of simple extraction will disclose the fact that the failures are as a rule not associated with prolapse.

In commenting upon the visual results it will probably strike many as singular that $\frac{20}{20}$ was obtained only four times, but this may be explained by the fact that discission was performed only ten times and that in quite a number of cases (31) I made no test of the vision.

In all of the operations the incision was made well within the limbus of the cornea and still a little further in at the top of the incision. The latter includes usually something less than half the circumference of the cornea.

The instruments with the exception of the knife are boiled. The knife is allowed to remain in Squibb's absolute alcohol for 20 minutes. The eyebrows and that side of the face are covered with a cloth saturated with a solution of sublimate 1:1000. Both the cocaine and atropine solutions are boiled in test tubes and only used once. Small pledgets of cotton secured by sponge holders and boiled are used for removing debris from the field of operation, such for instance

as strings of mucus and small clots of blood. The unoperated eye is closed till the second day and a small pad of sterilized absorbent cotton is placed over the operated eye and over this a four-tail bandage. The eye is inspected on the second day, and earlier if there be unusual pain. The room is darkened, but is not uncomfortably dark. The patient is allowed to get up on the second day, and the bandage is removed on the seventh day, though there was a time when I removed it earlier. The following is the arrangement of the visual results:

20/20	4
20/30	11
20/40	35
20/70	36
20/100	26
20/200	6
Vision not tested	31
Atrophy of the optic nerve	2
Cosmetic purposes	2
Failures	5
	158
Successes in the first series	48
Failures in the first series	2
Total number of cases operated upon	208

No.	Sex.	Age.	Health.	Cataract.	Operation.	Healing process.	Duration of treatment.	Primary Vision.
51	Male.	77.	Good.	Hard. R. E.	Iridectomy, smooth.	Uncomplicated.	2 weeks.	20/70
52	Male.	75.	Good.	" "	" "	Mild iritis.	2 "	20/100
53	Male.	36.	Good.	Calcareous. R. E.	" "	Uncomplicated.	2 "	Light perception.
54	Female.	50.	Good.	Hard. L. E.	" "	Iritis.	6 "	" "
55	Male.	71.	Good.	" "	" "	Uncomplicated.	2 "	20/30
56	Female.	68.	Bad.	" "	Escape vitreous.	Iritis.	5 "	20/70
57	Female.	66.	Good.	" "	Iridectomy, smooth.	Uncomplicated.	2 "	Not tested.
58	Female.	72.	Good.	" R. E.	" "	"	2 "	20/26
59	Female.	65.	Bad.	" L. E.	" "	Iritis.	4 "	20/100
60	Male.	70.	Good.	" R. E.	" "	Uncomplicated.	2 "	20/30
61	Male.	50.	Good.	" "	" "	"	2 "	20/40
62	Male.	50.	Good.	" L. E.	" "	"	2 "	20/40
63	Female.	55.	Good.	" R. E.	" "	"	2 "	20/100
64	Female.	60.	Bad.	" "	" "	"	2 "	24/40
65	Male.	55.	Good.	" L. E.	" "	Mild iritis.	5 "	20/70
66	Female.	62.	Good.	" "	" "	Uncomplicated.	2 "	Not tested.
67	Male.	75.	Bad.	" "	Simple Ext.	"	2 "	Atrophy.
68	Male.	75.	Bad.	" R. E.	Iridectomy.	"	2 "	O. Nerve.
69	Female.	60.	Good.	" "	"	"	2 "	20/40
70	Female.	60.	Good.	" L. E.	"	"	2 "	20/70
71	Female.	66.	Good.	" R. E.	"	Iritis.	3 "	20/100
72	Male.	80.	Good.	" L. E.	"	Irido-cyclitis.	8 "	Light perception.
73	Male.	63.	Good.	" "	"	Uncomplicated.	2 "	20/30
74	Male.	66.	Good.	" R. E.	"	"	2 "	20/20
75	Female.	71.	Good.	" L. E.	"	"	2 "	20/70
76	Female.	50.	Good.	" R. E.	"	"	2 "	Not tested.
77	Female.	61.	Good.	" L. E.	"	Mild iritis.	3 "	20/40
78	Female.	66.	Good.	" R. E.	"	Uncomplicated.	2 "	20/40
79	Female.	54.	Good.	" L. E.	"	"	2 "	20/40
80	Male.	75.	Good.	" R. E.	"	"	2 "	20/70
81	Male.	71.	Good.	" "	"	"	2 "	Not tested.
82	Female.	63.	Good.	" L. E.	"	Vitreous lost. Iritis.	4 "	20/100
83	Female.	50.	Good.	" "	"	Uncomplicated.	2 "	20/70
84	Female.	51.	Good.	" R. E.	"	"	2 "	20/40
85	Male.	80.	Bad.	" "	"	"	5 "	20/100
86	Male.	64.	Good.	" "	"	"	2 "	20/70
87	Male.	54.	Good.	" L. E.	"	"	2 "	20/40
88	Male.	66.	Good.	" R. E.	"	"	2 "	Not tested.
89	Male.	60.	Good.	" L. E.	"	"	2 "	" "
90	Male.	57.	Good.	" R. E.	"	"	2 "	20/40
91	Male.	51.	Good.	" L. E.	"	"	2 "	20/100
92	Female.	47.	Good.	" "	"	"	2 "	20/100
93	Male.	55.	Good.	" R. E.	"	"	2 "	20/70
94	Male.	71.	Good.	" "	"	"	2 "	20/70
95	Female.	65.	Bad.	" "	Escape vitreous.	Irido-cyclitis.	2 "	
96	Female.	52.	Good.	" L. E.	Iridectomy.	Uncomplicated.	3 "	20/200
97	Female.	53.	Good.	" R. E.	"	"	3 "	Not tested.
98	Female.	77.	Good.	" L. E.	"	Iritis.	4 "	20/100
99	Male.	56.	Bad.	" R. E.	"	Uncomplicated.	2 "	20/30
100	Male.	58.	Good.	" L. E.	"	"	2 "	Not tested.
101	Male.	54.	Good.	" R. E.	"	"	2 "	20/40
102	Male.	46.	Good.	" L. E.	"	"	2 "	20/70
103	Female.	76.	Bad.	" R. E.	"	"	2 "	Not tested.
104	Female.	64.	Good.	" "	"	"	3 "	20/40
105	Male.	50.	Good.	" "	"	"	2 "	20/70
106	Male.	65.	Bad.	" L. E.	"	"	2 "	20/70
107	Female.	60.	Good.	" "	"	"	2 "	20/40
108	Male.	72.	Good.	" R. E.	"	"	2 "	20/40

No.	Sex.	Age.	Health.	Cataract.	Operation.	Healing process.	Duration of treatment.	Primary Vision.
109	Female.	61.	Good.	Hard. L. E.	Iridectomy.	Uncomplicated.	3 weeks.	20/70
110	Male.	79.	Good.	" "	"	"	2 "	20/100
111	Male.	55.	Good.	" R. E.	"	"	2 "	20/40
112	Male.	80.	Good.	" L. E.	"	"	2 "	20/70
113	Female.	56.	Good.	" "	"	"	3 "	20/100
114	Female.	63.	Good.	" "	"	"	3 "	Not tested.
115	Male.	72.	Good.	" "	"	"	2 "	20/100
116	Male.	81.	Good.	" "	"	"	2 "	20/70
117	Female.	66.	Good.	" R. E.	"	"	2 "	20/70
118	Female.	50.	Good.	" "	"	"	2 "	20/40
119	Female.	49.	Good.	" L. E.	"	"	2 "	20/100
120	Female.	48.	Good.	" R. E.	"	"	3 "	20/70
121	Female.	53.	Good.	" "	"	"	2 "	20/30
122	Male.	68.	Good.	" L. E.	"	"	2 "	20/40
123	Male.	64.	Good.	" "	"	"	2 "	Not tested.
124	Female.	62.	Good.	" "	"	"	2 "	" "
125	Male.	7.	Bad.	Soft. R E.	Needling.	"	2 operations.	" "
126	Male.	7.	Bad.	" L. E.	"	"		" "
127	Male.	81.	Bad.	Hard. L. E.	Iridectomy.	"	3 weeks.	20/40
128	Male.	81.	Bad.	" R. E.	"	Irido-cyclitis.		Light perception.
129	Male.	22.	Good.	Soft. R. E.	Simple.	Uncomplicated.	2 weeks.	Not tested.
130	Male.	30.	Good.	" "	"	"	2 "	20/200
131	Male.	44.	Good.	Hard. L. E.	Iridectomy.	"	2 "	20/100
132	Male.	4.	Good.	Soft. L. E.	Needling.	"		Not tested.
133	Male.	77.	Good.	Hard. R. E.	Combined.	"	6 "	20/100
134	Male.	77.	Good.	" L. E.	"	"	2 "	Not tested.
135	Female.	52.	Good.	" R. E.	"	"	2 "	20/200
136	Male.	65.	Good.	" "	"	"	2 "	20/70
137	Female.	57.	Good.	" L. E.	"	"	2 "	20/40
138	Male.	69.	Good.	" "	"	"	2 "	20/40
139	Male.	82.	Bad.	" "	"	Escape vitreous.		No change but 3 weeks' vision. 20/70.
140	Male.	34.	Good.	Hard. R. E.	Simple Ext.	Uncomplicated.	2 weeks.	20/40
141	Female.	51.	Good.	" "	" "	"	2 "	20/70
142	Female.	51.	Good.	" L. E.	" "	"	2 "	20/40
143	Female.	45.	Good.	" R. E.	" "	"	2 "	20/200
144	Male.	58.	Good.	" "	" "	"	2 "	20/100
145	Male.	58.	Good.	" L. E.	" "	"	2 "	20/70
146	Male.	61.	Good.	" "	" "	Escape vitreous.	Iritis. 4 "	20/30
147	Female.	47.	Good.	" R. E.	" "	Uncomplicated.	2 "	20/40
148	Female.	60.	Good.	" "	" "	"	2 "	Not tested.
149	Female.	50.	Good.	" L. E.	" "	"	2 "	" "
150	Male.	60.	Good.	" "	" "	"	2 "	20/40
151	Male.	55.	Good.	" "	" "	"	2 "	20/70
152	Male.	44.	Good.	" "	" "	"	2 "	20/70
153	Male.	48.	Good.	" "	" "	"	2 "	20/40
154	Male.	51.	Good.	" R. E.	" "	"	2 "	20/70
155	Male.	62.	Good.	" "	" "	"	2 "	20/70
156	Female.	59.	Good.	" "	" "	"	2 "	20/100
157	Female.	71.	Good.	" L. E.	" "	"	2 "	20/70
158	Female.	73.	Good.	" R. E.	" "	"	2 "	20/40
159	Male.	47.	Good.	" "	" "	"	2 "	20/30
160	Female.	53.	Good.	" "	" "	"	2 "	Not tested.
161	Female.	62.	Good.	" "	" "	"	2 "	20/30
162	Female.	50.	Good.	" "	" "	Iritis.	4 "	20/100
163	Female.	58.	Good.	" "	" "	"	5 "	20/70
164	Female.	78.	Bad.	" L. E.	Iridectomy.	"	7 "	Closed pupil.
165	Female.	66.	Good.	" "	"	Uncomplicated.	2 "	20/70
166	Female.	66.	Good.	" R. E.	"	"	2 "	20/100
167	Male.	68.	Good.	" "	"	Ant. C., open	17 days.	20/200
168	Male.	28.	Good.	Soft. "	S. L. Extracture.	Uncomplicated.	10 "	Not tested.
169	Female.	47.	Good.	Hard. L. E.	Simple Ext.	"	2 weeks.	20/40
170	Female.	80.	Bad.	" R. E.	Iridectomy.	Iritis.	5 "	20/200
171	Female.	65.	Good.	" "	"	Uncomplicated.	2 "	20/70
172	Male.	88.	Good.	" L. E.	Simple Ext.	Prolapse iris.	3 "	20/100
173	Female.	70.	Bad.	" R. E.	" "	Iritis.	4 "	20/70
174	Female.	70.	Bad.	" L. E.	Iridectomy.	Uncomplicated.	2 "	20/70
175	Male.	44.	Good.	" R. E.	Simple Ext.	"	3 "	20/40
176	Male.	48.	Good.	" "	" "	Prolapse.	5 "	20/30
177	Male.	71.	Good.	" "	Iridectomy.	Uncomplicated.	2 "	Not tested.
178	Female.	70.	Good.	" "	"	"	2 "	20/100
179	Female.	61.	Good.	" L. E.	"	"	2 "	20/40
180	Female.	67.	Good.	" R. E.	"	Iritis.	4 "	20/40
181	Female.	66.	Good.	" L. E.	Simple Ext.	Big prolapse.	5 "	20/40
182	Male.	47.	Good.	" R. E.	"	"	4 "	20/30
183	Female.	58.	Good.	" "	Iridectomy.	Uncomplicated.	2 "	20/40
184	Female.	70.	Good.	" "	"	"	2 "	Not tested.
185	Female.	50.	Good.	" "	Simple Ext.	"	2 "	20/100
186	Male.	67.	Good.	" L. E.	Iridectomy.	"	2 "	20/20
187	Female.	77.	Bad.	" "	Simple Ext.	"	2 "	20/100
188	Female.	77.	Bad.	" R. E.	Iridectomy.	Iritis.	4 "	20/100

No.	Sex.	Age.	Health.	Cataract.	Operation.	Healing process.	Duration of treatment.	Primary Vision.
189	Male.	83.	Good	Hard. L. E.	Simple Ext.	Uncomplicated.	2 "	Not tested.
190	Female.	80.	Good.	" "	Iridectomy.	Closed pupil, but iridotomy gave.		20/200
191	Female.	70.	Good.	" R. E.	"	Uncomplicated.	2 weeks.	20/30
192	Female.	62.	Good.	" "	"	"	2 "	20/70
193	Male.	50.	Good.	" "	Simple Ext.	"	2 "	20/70
194	Male.	55.	Good.	" "	" "	"	2 "	Not tested.
195	Male.	60.	Good.	" "	" "	"	2 "	20/100
196	Male.	72.	Good.	" "	" "	"	2 "	20/70
197	Male.	72.	Good.	" L. E.	" "	"	2 "	20/70
198	Female.	70.	Good.	" "	Iridectomy.	"	2 "	20/20
199	Female.	70.	Good.	" R. E.	"	Slight iritis.	3 "	20/100
200	Female.	68.	Good.	" L. E.	Simple Ext.	Uncomplicated.	2 "	20/40
201	Female.	66.	Bad.	" R. E.	" "	Iritis.	4 "	Not tested.
202	Female.	68.	Delicate.	" "	Iridectomy.	Uncomplicated.	2 "	" "
203	Female.	65.	Good.	" "	"	"	2 "	20/40
204	Female.	65.	Good.	" L. E.	"	"	2 "	Not tested.
205	Female.	60.	Good.	" R. E.	"	"	2 "	" "
206	Male.	44.	Good.	" L. E.	"	"	2 "	" "
207	Male.	50.	Good.	" R. E.	"	"	2 "	Cosmetic.
208	Female.	55.	Good.	" "	"	"	2 "	Not tested.

PAROTITIS FOLLOWING VISCERAL INFLAMMATION.—A REPORT OF TWO CASES.

(Service of Dr. Osler.)

By A. Duval Atkinson, M. D.

It is well known that parotitis is a complication in pyæmia and many infectious diseases. There seems also to be a relation between the parotid gland and the generative organs, and an apparent sympathy (as pointed out by Stephen Paget in 1886) between the parotid gland and the abdominal viscera. Cases illustrating it are, however, of sufficient rarity to warrant the report of the following histories.

Case I. Parotitis following a supposed gastric ulcer.—A female, aged 34, single, by occupation housemaid, was admitted December 16th, 1895, complaining of general weakness and vertigo. Her family history was good; her mother died of "dropsy"; there was no history of tuberculosis. She had always enjoyed good health until one year ago. She had had none of the diseases of childhood. The catamenia began at fourteen and were always regular until a year ago. She had not menstruated for four months. She had been sick during the past year, but not confined to bed. At the beginning of the illness her chief complaint was of a continual dull pain in the epigastrium and "cramps" in the legs, a condition which lasted for about one month, when the pain left the abdomen, but not the extremities. In them it persisted with the utmost severity, being of a shooting, darting character, coming on often in paroxysms lasting several minutes. At the height of these pains a feeling of "pins and needles" would be felt in the hands and fingers. During the six months previous to her admission her arms and hands had been swollen to some extent, also her eyelids, the latter especially in the early morning; her eyesight had been failing.

She took to bed December 9th, 1895 (eight days before entrance. Late in the afternoon of that day she began to feel weak and nervous, and had a gnawing sensation in the epigastric region. Nausea immediately followed, and she vomited a considerable quantity of bloody-looking material. Four hours later she again vomited a considerable quantity of material which the patient thought was pure blood. She remained in bed on account of her extreme weakness until she came to the hospital.

Physical Examination. Patient's skin and mucous membranes were pale; sordes on lips; tongue pale, moist, and somewhat cracked. Distinct pulsation in external jugulars; pulse 25 to the quarter, regular in force and rhythm, tension distinctly raised; vessel wall a little thickened.

The thorax was long; costal angle narrow; expansion only fair, but apparently equal. Respiration over front of chest was negative; clear on percussion. Over the back the breath sounds were quite clear.

Heart. Point of maximum cardiac impulse diffuse over fifth and sixth spaces, in and a little outside the nipple line; relative dullness was at the upper border of the third rib, extending to the nipple line and a little beyond the left sternal margin. At the point of maximum cardiac impulse the first sound was loud and booming, accompanied by a blowing systolic murmur which was heard as far out as the anterior axillary line. The second sound was accentuated. A systolic murmur was also heard in the aortic region, where the second sound was sharp and loud. Over the sternum the murmur was increased and the second sound was more booming. At the costal angle the murmur was very distinct and the second sound was greatly increased in intensity.

Hepatic flatness began at the sixth intercostal space and extended to the costal margin in the mammillary line; the border was indistinctly felt. Spleen not palpable. No œdema. Reflexes normal. Blood count showed 2,214,000 red corpuscles to the cubic millimetre; white corpuscles, 8000; hæmoglobin 30 per cent. The urine was pale yellow in color; specific gravity varied from 1010 to 1006; there was a decided trace of albumen. Microscopically granular casts were seen. There were no rigors.

During the night of Dec. 16th, 1895, the patient began to complain of pain, and there was some swelling in the region

of the left parotid gland. The next morning (two days after entrance) the following condition was noted. The patient presents great swelling of the left parotid gland. The swelling extends up above the zygoma, and behind far over the mastoid. Below there is a marked amount of infiltration in side of neck, extending to the angle of the mouth. The swelling lifts the lobe of the ear. It is rounded, tense, hot, and very painful. The tongue is a little swollen. Nothing exudes from Steno's duct when external pressure is made over the gland. The abdomen is negative. There is no general enlargement of the superficial glands of the body.

At 12 noon, although no fluctuation was obtained, the gland was incised. Numerous small foci of inflammation were discovered, from which exuded a little creamy pus. Cover-slips from these areas showed streptococci and a large bacillus; the latter was supposed to have come from the mouth. Cultures showed a pure growth of streptococcus, the bacillus not growing.

The following day, December 20th, the pain in the region of the neck had in a measure subsided; the swelling, however, remained about the same; there was marked œdema of left eyelid.

The patient did fairly well until the 24th, the swelling and œdema of eyelids remaining about the same. On that day she was extremely pale, pulse 100, dropping a beat occasionally. The swelling of the cheek was perhaps a trifle less; she breathed noisily; no infiltration in the lower neck. The patient sank rapidly and died. Unfortunately no autopsy was allowed. The diagnosis of parotitis, gastric ulcer, and chronic interstitial nephritis was made.

Case II. Cholecystitis (post typhoidal) complicated by double parotitis.—J. L., single, age 34, German, butcher by occupation, was admitted to Ward F, November 25, 1895, complaining of continual headache, pains in his muscles and joints. His family history was good; there was no history of tuberculosis. His only disease during childhood was scarlet fever, from which he made a complete recovery, with no sequelæ, and excepting an attack of rheumatism, which confined him to bed nine months in 1893, had always been a strong, able-bodied man. He gave no history of syphilis or gonorrhœal infection. Had been a moderate drinker. The history of his present illness was that about one week before his admission he began to have headache, chills and nausea, accompanied by vomiting. The diagnosis of typhoid fever was made, and the patient had a typically mild course of fever, which was treated by means of the ice-baths. His temperature reached normal on December 5th, ten days after entrance. The urine showed a distinct diazo reaction, and there was a trace of albumen. The spleen was easily palpable, and there were a few typical rose spots. The liver was never palpable. Blood negative for malarial organisms. No leucocytosis. His convalescence was uninterrupted, and he was discharged well, January 1, 1896.

The patient was readmitted November 30, 1896, eleven months afterwards, complaining of headache and general weakness, stating that he had been feeling badly for ten days. The chief symptoms seemed to have been headache, muscular and slight abdominal pain. Two days before entrance he had had a slight chill followed by fever and sweating. On entrance his temperature registered 102.4°, pulse 27 to the quarter minute, full and strong. The physical examination was negative save for a slight enlargement of the spleen and some rigidity of the right rectus muscle. The liver was not palpable and the hepatic flatness was not increased. The blood was entirely negative for malarial organisms, and there was no leucocytosis. The conjunctivæ were injected, but there was no jaundice. No bile was found in the urine. His temperature, which reached 103° on the evening of his entrance, quickly dropped to normal, and the man was discharged December 15th, quite well, with no definite conclusions being reached concerning the nature of his trouble.

He again applied for admission March 5, 1897, stating that for three days he had had chills, accompanied, he thought, by fever, headache and pains in his back and limbs. His bowels had been very costive for some time.

The physical examination was as follows: Well nourished, strong-looking man; face flushed; eyes bloodshot; lips a trifle œdematous; tongue had a slight brown coat. Pulse, 32 to the quarter minute, dicrotic; capillary circulation rather sluggish. Thorax symmetrical, expansion equal; an occasional sonorous râle was to be heard over chest and axillæ. Heart sounds clear. Spleen just palpable on deep inspiration. Hepatic flatness began at the sixth rib, extending one finger's breadth below the costal margin. The muscular resistance of the abdominal wall was such that it was utterly impossible to palpate it. In the mammillary line there were 13 cm. of hepatic flatness. (Pain was complained of whenever deep palpation was attempted in the hypocondriac region.) On the following day, March 6th, there was no essential change in his condition. The morning temperature registered 104.2°, and that of evening 103°. There was well-marked tenderness on pressure in the hypocondriac region, and pressure between the crest of the ilium and ribs on the right side caused pain. The most tender part appeared to be just at the region of the gall-bladder. The conjunctivæ were a little muddy, but not distinctly jaundiced. There was a leucocytosis amounting to 11.200 to the cubic mm. The urine was negative, but no test for bile was made. On March 9th the conjunctivæ were slightly yellow, and the urine reacted for bile. There was still great tenderness in the region of the gall-bladder. His temperature, which had been gradually falling, reached normal at 2 a. m., where it remained until the 12th, when it was again elevated. On that day both parotid glands were swollen, the right more than the left. They were hot and very tender to pressure. No fluctuation was obtained. On the 15th both glands were greatly swollen, the tissue of the face and neck was infiltrated, and eyelids œdematous. The skin over the parotid glands was red, the gland itself imparting a hard infiltrated sensation to the examining hand. Both papillæ at orifice of duct were swollen, and pus could be forced out. Although the patient was in poor condition, his temperature registering 102.8°, he insisted upon leaving the hospital, and was therefore discharged.

Cultures from the blood on agar-agar and bouillon proved negative. Diagnosis: Cholecystitis (post-typhoidal), com-

plicated by double parotitis. Later both parotids were incised, the bacteriological examination showing a pure growth of staphylococcus aureus. The patient is now quite well.

The cases in many ways correspond to some of those referred to by Stephen Paget in the London Lancet for 1886, and spoken of in more detail in the British Medical Journal in 1887. In his series parotitis followed injury and diseases of the peritoneum, generative organs, and abdominal viscera. Two followed a supposed gastric ulcer. Of the 101 cases cited, 10 were due to injury of the urinary tract; 18 to diseases of the alimentary tract; 23 to injury or disease of the abdominal wall and peritoneum, or to the pelvic cellular tissues, and 50 to temporary derangement of the generative tract. He states that parotitis after abdominal or pelvic injury or disease is not as a rule accompanied by signs of septicæmia or pyæmia. Of his 101 cases mention is only made in 15 of septic symptoms. 37 died; of these 3 were over eighty years of age; 3 had internal cancer; 2 had perforation of the bowel; and 2 had strangulated hernia; 7 had undergone severe surgical operation involving abdominal section; 13 had septicæmia or pyæmia; 1 had infantile syphilis; 1 had marasmus; and 1 had heart trouble. He adds that death was not due to parotitis *per se*, but to a primary lesion, and he is unable to state to what extent parotitis is a dangerous complication. Its period of incubation is unknown, but in his opinion it is from one to thirteen days. There is as a rule no marked disturbance to general health, no rigors, and no high fever. On the other hand symptoms may be more severe from the onset, and great disturbance in general health may be noted. Rigors were noted in only 4 cases. In regard to the termination of the parotitis, whether by resolution or by suppuration, the figures show that out of 73 cases which give information on the point, 45 suppurated and 33 were resolved, and out of 45 that suppurated 24 died; but out of the 33 that resolved without suppuration only one died (in all probability from cancer). In other words, he thinks that they did not die because the parotids went on to suppuration, but that the parotids suppurated because they were going to die. In cases of undoubted septicæmia or pyæmia the parotids always went on to suppuration.

The only autopsy reported by Paget is that of a woman dying from the effects of the removal of a sarcomatous growth of the mesentery, having parotitis as a complication. On section the parotid was found to be evenly and in every part infiltrated, not with pus, but with a reddish, slightly turbid fluid, causing it to look like a section of the spleen. There were no abscesses anywhere. Just in the proximal end of the duct where it left the gland lay two or three drops of healthy pus and a tiny calculus. The acini were separated, compressed, and breaking up, and here and there were seen ducts filled with the same small round cells as were infiltrated among the acini. No bacteriological examination was made. Mr. Paget cites a case reported by Rosenbach of parotitis following operation for strangulated hernia, in which staphylococcus aureus was obtained. He further states that this form of parotitis is in many ways a peculiar lesion, so far as being due to septicæmia. It was in 93 cases an isolated lesion, unaccompanied by any other lesion like itself, having no fixed period of incubation, and running no common course. Its invasion is not as a rule marked by rigors or great rise of temperature. It may subside and swell up and subside again. These facts make it impossible to say that this form of parotitis is due to any ordinary form of septicæmia. It is not, he thinks, due to inflammation following a parched and sore mouth, as the mouths of pyæmic or septicæmic patients are not, as a rule, more parched than those of other patients. Also, he does not think that it is merely due to inflammation of the lymphatic tissue which is in the gland substance. "Admitting that the general condition of the patient, especially in cases of septicæmia and pyæmia, is considered in the production of this form of parotitis, must we not take into consideration the reflex action of the nervous system, as the influence, direct and reflex, of the nervous system upon the salivary glands is shown in countless ways; viz. gastritis may be followed by salivation or arrest of salivary secretion. Parotitis may follow gastric ulcer, gastrotomy, etc. Even operations on the rectum and again diseases of the thoracic viscera cause inequality of the pupils, differing not only in size, but in their susceptibility to light. Thus, with regard to pyæmia after abdominal or pelvic lesions, we may admit that the general condition of the patient may help to cause it, without denying the local influence of the nervous system."

A. J. Cribb (Lancet, 1886) reports two cases; in one parotitis followed irritation of the genito-urinary tract, and in the other ovaritis occurred in connection with parotitis. And again, Harkin (Lancet, 1886) reports parotitis in a woman aged 43 as one of the first symptoms of three successive pregnancies, no suppuration being present. These cases seem to point undoubtedly to some latent sympathy between the parotid glands and the organs either covered by or closely adjacent to the peritoneum. It is, however, difficult for us, with our present bacteriological knowledge, to conceive of inflammation being established in organs far remote from the seat of irritation by reflex causes alone, without the presence of micro-organisms. An interesting case, and one bearing a close resemblance in some respects to those cited, is one reported by W. Legg in the Pathological Society Reports for 1869, in which parotitis was a complication in contracted kidney and atheroma in a lad aged 16, who was admitted to the University College Hospital for albuminuria. Nine days after admission he complained of pain on right side of face. The day after well-marked right parotitis was noted. The swelling continued for eight days, when the patient died suddenly. There was found to be no obstruction to Steno's duct; the gland tissue was pale grey in color, not at all reddened, rather harder than natural, and on section there flowed from the cut surface a large quantity of pale greyish white fluid, somewhat thin, showing under the microscope a large number of rounded cells, larger on the average than pus corpuscles, having rather granular contents, and single small bright nuclei. The gland was the seat of small abscesses varying in size from a pin head to a barley corn. Microscopically was seen a great increase in epithelial elements, the acini being filled with them. The arteries were atheromatous

and the kidneys contracted. No mention is made of lesions in other organs.

W. B. Morrow, in the Montreal Medical Journal of March, '96, has related the histories of three cases of parotitis following pelvic disease. And Herbert and Hawkins, in the British Medical Journal of April 10, 1897, report two cases of operation for perforation of gastric ulcer, in one of which there was a double parotitis three days after operation, the patient eventually making a complete recovery, the glands subsiding without incision being necessary.

PALPATION OF THE FŒTAL HEART IMPULSE IN PREGNANCY.

By Douglas F. Duval, M. D., *Assistant Resident Gynecologist.*

It is not generally known that the impulse of the fœtal heart may under certain conditions be actually felt beating through the abdominal walls of the pregnant woman.

In this country but two cases have been observed, those of Dr. Kelly, which I now report. The first was in 1884 and the second in 1895. They represented the right bregmatic-iliac-anterior and left occipito-iliac-posterior presentations, the latter being observed in the eighth month of pregnancy, all previous cases having been during labor.

Of the other observers, Fischel, in 1881, was the first to publish a definite account describing accurately three cases in which this phenomenon occurred. These cases represented the left bregmatic-iliac-anterior, the right occipito-iliac-posterior and the left mento-iliac-anterior presentations. Valenta, however, in 1885, claimed priority of observation, stating that he had noted it in 1860 in a first face presentation, and had recorded it in his "Text-Book on Midwifery," and that since then he had repeatedly spoken of its importance as a diagnostic sign in anterior face presentations. Fleischman in 1885, stimulated by Fischel's communications, published an interesting case in which this phenomenon was observed in a right mento-iliac-anterior presentation.

The following is a brief account of the various cases:

Case I. Observed by Dr. Kelly, in Kensington, Philadelphia, in 1884. Multipara, of medium build, mother of four or five children, abdominal walls moderately thin. A right bregmatic-iliac-anterior presentation. Membranes ruptured, os half dilated, brow just engaging. The impulse of the fœtal heart was forcible and distinctly palpated over an area about 3 cm. in diameter; to the right and about half way between the umbilicus and Poupart's ligament, separate beats were easily counted, 130. The child was born living after a protracted labor and manual rectification of position.

Case II. Observed by Dr. Kelly. Patient short brunette, well nourished, abdominal walls not thin, eighth month of her first pregnancy. A left occipito-iliac-posterior presentation. Heart sounds heard loud over an area 10x10 cm., and easily counted 140. On moderate pressure a rapid fluttering sensation was clearly distinguished over an area about 2.5 cm. in diameter. The separate beats could not be distinguished; a few days later, on examination, the heart impulse could not be felt. The patient has since passed through a normal confinement.

Fischel's Cases.

Case I. Æt. 36, 1 para, well nourished, strong. Pains began on 30th at 9 p. m. Liquor amnii discharged on 31st at 12.15 a. m. At 7.45 a. m. os 6 cm. in diameter. Fœtus in left bregmatic-iliac-anterior presentation. Heart sounds to the left and below umbilicus. At 12.15 fœtal heart impulse palpated to left and beside umbilicus, synchronous with fœtal heart sounds, frequency 156–160. This phenomenon was observed for several hours. Change of presentation being impossible, craniotomy was performed.

Case II. Æt. 21. Well built, large, strong. Pains began at midnight. At 2 a. m. liquor amnii discharged. Entered hospital at 4 a. m. Cervix obliterated, back to the right, feet to the left above the umbilicus, chin 8 cm. above left os pubis, heart sounds above the symphysis. From this description very probably a right occipito-iliac-posterior presentation. The fœtal heart impulse was palpated just above the chin, easily demonstrable, frequency 156, maternal pulse 112. In the further course of labor, which was rapid and favorable, the impulse was palpated in the pauses between the pains, descending toward the symphysis and finally disappearing entirely, though the sounds continued to be heard. Examination of the child's heart after labor showed clearly that the sounds were of normal strength and clearness.

Case III. Æt. 30. 1 para, small, strongly built, moderately fat, abdominal walls thin. Pains began at 10 a. m. Entered hospital in the afternoon. External examination: Occiput above right os pubis, extremities to the left, heart sounds to the left of the umbilicus, loud and slow. The presentation in this case was *then* a left mento-iliac anterior. At 6.30 p. m. the heart impulse was clearly palpated 5 cm. to left of umbilicus. At 7.30 p. m. was 5 cm. to left of umbilicus, but lower. At 8 p. m. frequency ranged between 80 and 150; maternal pulse 66–72. At 11.30 p. m. heart impulse to left of umbilicus, but lower. Labor terminated at 12 m., fœtal heart sounds ceased two minutes before delivery, child stillborn.

Fleischman's Case.

Case I. Æt. 35. Abdominal walls thin and flabby. Entered hospital at 11 p. m., three hours after discharge of liquor amnii. Occiput over left os pubis, back to the left, heart sounds clearest four fingers' breadth to right of midline, chin to right and forward, forehead to left and backward. *Evidently* a right mento-iliac-anterior presentation. On the following morning the fœtal heart impulse was palpated in the right hypogastrium, at the junction of the middle and lower thirds of a line drawn between the umbilicus and middle of Poupart's ligament. In frequency doubled that of the maternal. The sounds were loud and clear.

Fleischman says: "The conditions in this case for the observation of the phenomenon were most favorable, the abdominal walls were thin and flabby and the liquor amnii had previously discharged, thus permitting the uterine walls to clasp firmly the fœtal thorax."

The following is a summary of *all* the cases:

Fischel, 1881, three cases: Left bregmatic-iliac-anterior, right occipito-iliac-posterior, left mento-iliac-anterior.

Valenta, 1885, one case: First face presentation (R. m. i. ant.)

Fleischman, 1885, one case: Right mento-iliac-anterior.

Kelly, two cases: First in 1884, a right bregmatic iliac-anterior presentation; second in 1895, left occipito-iliac-posterior presentation.

From the above it will be seen that the observation has been made in face, brow and occipito-posterior presentations—two of each. One may therefore infer that these are the most favorable presentations for the observation of this phenomenon; especially is this the case in face and brow presentations, the fœtal thorax being arched forward and therefore in closer proximity to the maternal abdominal walls. In occipito-posterior presentations the fœtal curve is directed backward and consequently less favorable.

The liquor amnii also plays an important part, as shown by the fact that in all cases, with the exception of the second case of Dr. Kelly, the observation was made during labor. In this case one must naturally suppose that a small amount of liquor amnii was present. As for the maternal abdominal walls, they should be thin and flabby in order that there may be little hindrance to the transmission of the impulse of the fœtal heart.

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SQUAMOUS EPITHELIOMA IN A DERMOID OF THE JAW.

By S. M. Cone, M. D., *Assistant in Surgical Pathology, The Johns Hopkins University.*

Few cases of epithelioma arising in dermoid cysts have been described. Tauffer, whose article on carcinoma arising in dermoids of the ovary is very complete, knows of none originating in dermoids elsewhere. In none of the dissertations on dermoids of the ovary with carcinoma in their walls do we find reference to like tumors in other regions of the body. I can find but three cases and they are not very fully described. That of Franke, on an epidermoid of the ball of the thumb with carcinoma originating in it, is most complete. Czerny in 1869 reported a case in the coccygeal region, the first to be noted anywhere, which is interesting moreover because of the expression of the opinion that the squamous epithelium developed from cylindrical epithelium such as is found in the intestinal tract, and the idea is expressed of the possibility of epithelium arising from connective tissue and lymph cells. Briddon reported a case before the New York Surgical Society and Dr. Thacher made the pathological report. This tumor was also from the coccygeal region. The sections which were kindly given me have some resemblance to the one I shall describe. The descriptions of those found in the ovaries are so much better described that it is best to reach our conclusions regarding origin and development through the gynecological literature.

Yamagiwa and Thumim have both reported cases this year. Thumim gives the literature on the subject up to date. Yamagiwa reports two cases, one of which he puts down as a glandular carcinoma developing from remains of a mammary gland in the dermoid. Thumim objects to including this among the dermoids with "carcinomatous degeneration" and rather thinks it to be part of a misplaced mammary gland forming a part of a teratoma of the ovary. If it is a true carcinoma it is the only one of its kind described; the remaining eight cases arising in the ovary and three elsewhere are all of the squamous cell variety.

All authors are careful to exclude the possibility of the growth of the epithelioma "per contiguitatem," both Tauffer and Thumim giving a list of doubtful cases. The analogous origin of carcinoma in atheromas and other cysts lined by epithelium is mentioned by Lubarsch in his review of the subject, and many others refer to the subject as something not long discovered. A very interesting point is alluded to by Yamagiwa when in writing of his first case he refers to its resemblance to alveolar sarcoma or endothelioma. Such cases have been reported, but are rare.

The case to be reported is that of Patrick D., age 42, blacksmith, who entered the surgical ward of the Johns Hopkins Hospital, June 20, 1894, with a tumor of the left lower jaw. Family history good; past history good.

Present Illness.—In September, 1893, the patient noticed a pea-sized growth under the horizontal ramus of his left lower jaw. It began to pain him in November and grew rapidly with incessant pain. He refers its quickened growth to a fall when he injured the jaw.

Physical Examination.—The tumor extends from 1 cm. in front of the angle to the junction of the middle and outer third of the horizontal ramus of the lower jaw. It extends to the hyoid bone and appears to be the size of a small orange. It is fixed firmly, is sharply circumscribed and has smooth, rounded borders. It is firm in consistency except at the most prominent portion, where slight fluctuation can be felt. The skin is œdematous and red. At one point there is a small opening from which serum exudes on pressure. Teeth are normal. Alveolar process is not involved.

On June 25th the patient was operated on by Dr. Halsted.

Tracheotomy was first performed, and the pharynx being tamponed the tumor and left lower jaw were excised. The patient's recovery from the operation was uninterruptedly good. He was discharged on July 13th. He returned September 6, 1894, and was treated for phthisis pulmonalis—tubercle bacilli being found in his sputum. He was discharged on September 14th unimproved and died at home of phthisis pulmonalis. No autopsy was performed.

Description of the tumor by Dr. Bloodgood.—The tumor is removed with an area of skin 8x6 cm. and a piece of the lower jaw 7 cm. long, including the angle of the jaw. This mass is surrounded by skin, periosteum and healthy muscle at every point except one, which is at the inner side of the jaw 3½ cm. from the angle where the tumor tissue is exposed. A second piece of the jaw including the two molar teeth and alveolar processes includes the remainder of the tumor, which is well circumscribed by muscle and mucous membrane; so that, putting the two pieces together, the entire mass is circumscribed. The point at which it is most superficial is beneath the myo-hyo-glossus muscle at its attachment to the alveolar process of bone which was removed.

The tumor has not invaded mucous membrane nor bone. On section from the skin to bone it consists of an encapsulated mass, the capsule being firmly adherent to periosteum on one hand and skin on the other. There are several points on the skin communicating with the cyst contents and through which the contents can be expressed. The capsule is 4–5 mm. in thickness. The inner surface is rough and granular. The fatty granular contents are easily removed; they resemble those of a dermoid cyst except at the outer third of the tumor near the symphysis of the jaw. Here the contents are firm in consistency, greyish in color, with pin-point dots of hemorrhage. In this tissue masses of the same consistency as that of the cyst can be found. The tumor presents the characteristics of a dermoid cyst.

On section of the mass within the jaw the submaxillary gland is found to be adherent to the capsule of the cyst. The contents of the cyst show fatty squamous epithelium and crystals of cholesterin.

Microscopical Examination.—Sections of the cyst wall with adjacent structures were made at many points. The cyst varies in thickness. The inner lining is of horny epithelium which is more or less loose and swollen and mixed with the cyst contents. The same cornified epithelium is found in whorls on the surface mixed with the cyst contents. These cells look like long flakes, some containing nuclei, others being free of them, which stain deeply with eosin and carbol fuchsin. Beneath this loosely arranged epithelium we see a denser layer and then the gradation of epithelium as in normal skin, only not so thick.

The stratum granulosum is much better marked in some places than in others. The stratum mucosum comprises the main mass of epidermis; the deeper cells of the malpighian layer are not pigmented. The cells appear swollen and œdematous. Some of the nuclei are vacuolated and irregular while others are fragmented. In the epidermis are a few irregular areas, about the size of the cells, which are granular and take the hæmatoxylon stain deeply—evidence of calcareous degeneration in the cyst wall. The cell borders are not nearly so well defined as in normal epidermis. The papillæ are fairly well marked, but there is an entire absence of sweat glands and hairs. A few sebaceous glands are to be seen in the corium, which is not well marked because of the invasion of its territory by profuse round cell infiltration about epithelial projections.

These epithelial downgrowths between the papillary stroma into the deepest parts of the cyst wall are made up of masses of cells such as are found in the stratum mucosum and enclose cells of the more superficial layers of epidermis. These cells of the outer epidermal layers are sometimes formed into whorls in the deepest ingrowths of the squamous epithelium, and form the "pearly bodies."

The epithelium of these downshoots has better staining nuclei than that on the surface. These inter-papillary growths seem to be kept in definite paths for the most part, but when the deepest portion of the cyst wall is reached one can see epithelial cells spread throughout the tissue, some being isolated without any demonstrable relation to the primary downgrowth. This sprouting of epithelium deeply and irregularly into the wall of the dermoid is seen throughout the entire tumor wall, but does not go any further, for it is always preceded by a zone of round cell infiltration made up of mononuclear cells. This zone is preceded by one of connective tissue of varying thickness which invariably intervenes between the epithelial cells and adjacent tissues and organs. There are papillary projections into the cyst of various lengths from 1 mm. to 2 cm. which all show a lining of epithelium already described, and have a supporting connective tissue basis. Between the stratum corneum and malpighian layer are to be seen hemorrhagic foci in some sections.

The round cell infiltration is intensely marked throughout the cyst wall. The papillary stroma and deep layers of the dermoid are full of mononuclear leucocytes which are aggregated in some places, resembling lymphoid nodules. These cells have also penetrated between the epithelial cells of the surface and ingrowths. The centres of the "pearly bodies" contain both mono- and polynuclear leucocytes and fragments of nuclei. There are typical tubercles in several sections which are most distinct in the sections containing muscle, including the sinuses alluded to above. No tubercle bacilli can be found in them, however.

The lining wall of the dermoid shows evidence of degeneration in areas; the epithelium is invaded by mono- and polymorpho-nuclear leucocytes. The nuclei stain poorly and are fragmented. The cells appear separated from one another and are swollen.

Sections including skin and dermoid wall made at different points have essentially the same appearance. The points in which the histology differs from the foregoing description are the giant cell formation between subcutaneous tissue and the fibrous limiting line of the dermoid and the openings in the skin alluded to in the macroscopic description. The giant cells are like the customary foreign body giant cells and are seen singly and in groups at the margin of the dermoid wall. They are especially numerous on the dermoid side of the dividing fibrous tissue. Where these are in

greatest number and collected in groups the fibrous separating line has been almost completely substituted by them and the accompanying mono- and polynuclear leucocytes. Here the definition between dermoid and skin is not so good as elsewhere.

The giant cells in the subcutaneous tissue are grouped about hair shafts; in the dermoid walls they enclose horny particles (stained deeply with carbol fuchsin), polynuclear leucocytes, fragmented nuclei and granules (stained deeply with hæmatoxylon and probably calcareous). Some have no contents and are vacuolated. Most of them contain large vesicular nuclei, grouped in the centre of the cell; in some the nuclei have a polar arrangement.

Beneath the epidermis of the skin there are masses of red blood corpuscles, polynuclear leucocytes and fragmented nuclei. Here no papillary arrangement of the skin exists and the epidermis is flattened and thinned. The epidermis, too, is infiltrated with leucocytes. Adjoining this area of hemorrhage and necrosis a discontinuity in the epithelial covering is detected. The edges of epidermis are turned in and are continuous with a sinus which can be traced deep into the subcutaneous tissue, but not so far as the fibrous demarcation between skin and dermoid. This sinus is lined by necrotic tissue containing blood and fragmented nuclei. In its depths the connective tissue of the part is denser, but there is no evidence of new formation of tissue. There is no epithelial lining. Vessels included between the dermoid walls and subcutaneous tissue are obliterated by endarteritis. Their walls are all thickened.

In one of the sections there is a variation from the usual structure of the dermoid wall. Instead of the interpapillary growths of epithelium dipping down at once into the depths of the wall, we see a network of epithelial rods one and two cells thick surrounded by small round cells. The epithelial lining is very thin at this point, being composed only of cornified epithelium. Beneath this interlacing network of cells we see the larger groups containing pearly bodies described in the other sections.

The submaxillary gland is included in several sections of the tumor and in none does the epithelioma invade the gland. The capsule of the submaxillary is greatly thickened and only at one point is there any suspicion of invasion. Here the round cell infiltration is most marked, the connective tissue formation not being evident. Into the round cells can be seen jutting epithelial sprouts, but they do not enter the interlobular connective tissue of the submaxillary. The changes in the submaxillary are due to pressure and infiltration of its connective tissue framework with small round cells. The connective tissue is thickened and some of the cells in the alveoli do not take the stain well. The cyst-wall next the submaxillary varies from 1 to 3 mm. in thickness and consists of epithelial masses and single cells included in the stroma, which is deeply infiltrated with small round cells. The epithelial cells are of the same kind as in the stratum mucosum, but better defined and with more regular nuclei.

The muscle next the tumor is densely infiltrated with small round cells and is atrophied. The nuclei of the muscle cells next to the dermoid wall are greatly increased in number and arranged in rows. The muscle substance stains but faintly and there is no striation in the first rows next to the fibrous line between tumor and muscle. It appears like a homogeneous mass containing rows and bunches of nuclei. There are no giant cells nor necrotic areas to be seen. A nerve is included in the section with muscle. It is surrounded by dense fibrous tissue. The epithelial cells crowd close up upon the epineurium, but do not penetrate it. The round cell infiltration and new formation of connective tissue are very prolific about the nerve.

The presence of tubercles in the cyst walls, the great and uniform round cell infiltration, the profusion of giant cells of both the foreign body and tuberculosis variety, and the uniform distribution of the epithelioma in the wall of the dermoid, are all striking points.

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THE INFECTIOUSNESS OF CHRONIC URETHRITIS.

By E. R. Owings, M. D., *Assistant in Genito-Urinary Surgery, The Johns Hopkins Hospital Dispensary.*

The possibility of infection from old cases of gonorrhœa is an important and by no means infrequent problem, presenting itself not only to the gynæcologist and genito-urinary specialist, but also to the general practitioner.

Many cases of gonorrhœa extend over months or even years, often in spite of persistent and systematic treatment, and in response to the inquiries, "Could I infect another?" or "Is my condition such that I may safely marry?" the physician must often give evasive or unsatisfactory replies.

There is no fact better established than that a gonorrhœal urethritis is due to the entrance and development within the urethra of a specific organism, the gonococcus Neisser,

which is constantly present in the discharge of an acute gonorrhœa.

The gonococcus, first described by Neisser[1] in 1879, has been isolated; a pure culture made first by Bumm,[2] since by Wertheim,[3] Steinschneider[4] and other observers; and a gonorrhœal urethritis produced by the introduction of pure culture within healthy urethra proving conclusively its etiological relation.

The infectiousness (*i. e.* power to produce gonorrhœa) therefore of an urethral inflammation depends upon the presence of the gonococcus; and upon the demonstration of the présence of this organism rests the determination of the infectiousness of an urethral inflammation.

The gonococcus is a diplococcus, ½ to 1 micromillimeter in diameter, not round, but of biscuit or coffee-bean shape, with flattened or concave surfaces contiguous, found within the leucocyte, around, never within the nuclei, and as determined by Roux,[5] if a preparation containing gonococci after being stained with aniline stain, be placed in Gram's solution, then decolorized by alcohol, the stain is not fixed by Gram's method, and the gonococci may be differentiated from other organisms found within the urethra, in that they are alone decolorized.

In 1887, Lustgarten and Mannaberg[6] in a series of investigations on the healthy urethra found among other organisms a coccus which they declare cannot be distinguished from the gonococcus Neisser by its morphology or staining reaction.

Petit and Wasserman,[7] on the contrary, in a large number of examinations (over 1000) of the normal urethra, have never found the organism described by Lustgarten, and in a number of cases of chronic urethritis were unable to demonstrate its presence.

Steinschneider[8] recognized beside the gonococcus four diplococci in the urethra, two of which were decolorized by Gram's method as follows:

	No.	Organ. decolor. Gram.	Gonococcus.
Urethra healthy, never infected by gonococcus,	13	1	0
Urethra healthy, no gonorrhœa for years,	3	0	0
Chronic gonorrhœa,	15	2	11
Acute " (untreated),	33	1	33
" " (under treatment),	22	0	22
	86	4	66

In 86 cases there was present in four a diplococcus decolorized by Gram's method, or about 4½ per cent., making Roux's test certain in about 95½ per cent. of all cases. He believes, however, that Roux's test, together with the characteristic grouping of the gonococcus within the pus cell around the nuclei, gives a definite result.

M. von Zeissl[18] has in the secretion of an urethritis due to chemical or medicinal irritants, found a diplococcus within the pus cell, which is decolorized by Gram's method; whether this is readily differentiated by grouping from the gonococcus he does not state.

Wendt[9] believes "Roux's color test never fails to gives correct interpretation."

Allen,[17] who worked conjointly with Wendt, believes "Roux's test final."

Carpenter[10] says: "Peculiar characteristics of the gonococcus almost positively diagnostic when confirmed by Roux's test practically leaves no room for doubt."

Heiman[20] says: "Diplococci found in normal urethra can be positively differentiated by Gram's stain."

Koplik[21] says: "In skilled and tutored hands a mistake of identity is not possible."

Finger[11] says: "There is no doubt that in addition to gonococci other organisms are present in blenorrhagic pus, but these never give rise to the slightest diagnostic doubt. The number of foreign organisms is so slight, and they are found to such a large extent outside the pus cells, their shape and grouping are so different, that the differences in staining are unnecessary to make a positive differential diagnosis."

Lustgarten[12], 1893, says: "If in a chronic torpid urethritis with a scanty whitish or greyish discharge, diplococci with all the characteristics of the gonococcus are found; it does not prove that the affection is contagious, especially if these diplococci are found in comparatively small number and are accompanied by a variety of organisms. As far as personal experience goes I believe that many of these cases are not contagious and that the wives of such men remain healthy and prolific."

In the absence of confirmatory proof by cultivation, which is not always practicable owing to the difficulty attending the growth of the gonococcus, ordinary media being unsuitable for its growth, and as in chronic urethritis where its demonstration is especially desirable the presence of other organisms by their rapid growth makes it impossible to secure discrete colonies of the organism, we are compelled in these cases to rely solely upon its morphology and Roux's test for identification. By these methods the gonococcus may be differentiated from micro-organisms found within the urethra, with the possible exception of the diplococcus described by Lustgarten, which at most is present in but a small per cent. of cases. The presence, in the secretion of an urethral inflammation, of a diplococcus with the characteristics and color reaction of the gonococcus is sufficient clinical though not medico-legal evidence of the infectiousness of same.

The examinations recorded in the paper were confined to chronic cases entirely. In many there was no discharge visible at the meatus, and in no case was there more than the "goutte militaire." Their duration varied from three months to four years. The majority were under active treatment at the Johns Hopkins Hospital Dispensary, and so far as was possible examinations were made on date of first visit and subsequently at short intervals. Unfortunately, as in all dispensaries, many failed to return after one or two visits, making it impossible in these instances to secure repeated examinations. The examinations recorded are of the tripperfäden, as in many of the cases this was the only material available.

The method pursued was as follows: The urine, and where possible the morning urine, was secured, one or two tripperfäden were drawn up with a pipette and after being gently teazed-out on a slide, were dried over a flame and then washed

carefully in warm water to dissolve out as far as possible salts of urine which were precipitated by evaporation. Specimens thus obtained were stained two minutes in aniline gentian violet solution, prepared by adding 1 cc. filtered concentrated solution to 15 cc. water.

In decolorizing the slides were placed in Gram's solution for 2 minutes, then in alcohol until no more blue color was extracted, generally from two to three minutes. A watery solution of Bismarck brown was used as counter stain.

In 15 instances no micro-organisms were found; in these cases the fäden consisted almost entirely of epithelial cells with here and there a few leucocytes.

In the 35 remaining micro-organisms were found; these were identical with varieties already described by Lustgarten and other observers, and consisted of 4 varieties of cocci and 2 bacilli, as follows:

I. Small coccus in zoogleæ.

II. Small coccus in chains.

III. Diplococcus about size of gonococcus.

IV. Large coccus, 1½ to 2 mm. in diameter, generally in pairs.

V. Long slender bacillus (smegma bacillus?).

VI. Short thick bacillus with rounded ends (suggestive of colon bacillus).

These were not all present in every specimen examined, nor did they occur in equal frequency. I, small coccus in zoogleæ, and IV, large coccus, 1½ to 2 mm. in diameter, were almost constantly present, while the smegma bacillus? was noted in comparatively few instances, and VI, bacillus, short, with rounded ends, in one case only.

In five specimens examined, in addition to one or more of the varieties already described, diplococci were seen lying within leucocyte, morphologically identical with the gonococcus and decolorized by Gram's method.

These were the only organisms seen within the leucocytes. Others were either free in the intercellular space, lying on epithelial cells or on, not within, leucocytes, as could be determined by careful focusing.

In 5 cases then we have an organism which could be positively identified as the gonococcus Neisser.

Three of these 5 cases were of from 4 to 6 months' duration, 1 was of 9 months' and 1 of 2 years' duration, or, tabulating cases as regards age of disease—

Number of cases.	Duration.	Gonococci.	Other micro-organisms.	Negative as to organisms.
12	Under 6 months.	3	8	4
8	6 to 9 "	1	5	3
7	1 year.	0	5	2
9	2 "	1	6	3
8	3 "	0	6	2
6	over 3 years	0	5	1
50		5	35	15

Out of 38 cases of more than 6 months' duration, in 2 instances only were gonococci demonstrated, and in 30 of more than a year's duration, in one case only could they be found.

Goll[13] in 1891 made repeated examinations of cases of chronic urethritis with the following results:

Duration.	No. of cases.	Gonococci.	No Gonococci.	Per cent.
6 months	55	8	47	14
1 year	83	12	71	14
2 "	135	7	128	5
3 "	80	2	78	25
Over 3 years	59	0	59	0
	412	29	383	

Petit and Wasserman[7] in their examination of chronic urethritis found various organisms, and believe them to be accidental or saprophytic, and that they vary with the individual.

Janet[72] has studied cases of chronic urethritis with respect to various organisms present, and divides them into three classes:

I. Gonococci present alone.

II. Gonococci and other micro-organisms.

III. No gonococci, but varied micro-organisms.

He believes that these organisms invade the urethra, probably in coitus, and the catarrhal mucous membrane presenting a favorable medium, they are able to keep up the inflammatory process after the disappearance of the gonococcus, producing an obstinate pseudo-gonorrhœa.

Hasse,[14] 1893, "in 625 cases of chronic urethritis found gonococci unattended by other organisms in 37 cases. In acute gonorrhœa he found gonococci alone and their presence constant; with their disappearance and an increase in the epithelial cells in the discharge, other bacteria, both bacilli and cocci, appeared in large numbers."

In the small percentage of cases where the gonococcus is definitely determined to be present, we can without hesitation declare their infectiousness. Unfortunately, however, in the large majority we are unable to say with certainty that we have to do with a non-infectious malady, that is, in those where the gonococci are uniformly absent or present in so few numbers as to elude detection. For while the detection of the gonococcus renders infectiousness certain, a failure to detect it does not guarantee its absence, as often after many negative examinations the gonococci may suddenly appear in considerable numbers.

In one of the above recorded cases, that of 2 years' duration, the examination of which extended over several months, after 3 or 4 negative examinations, following an injection of 3 to 5 per cent. of $AgNO_3$, with Tommasoli syringe, the gonococci could readily be detected.

In these cases then where there is still doubt, the test first proposed and still insisted upon by Neisser[19] is an invaluable adjunct, viz. the injection within the urethra of a solution of argent. nitrat. or hydrarg. chlor. corrosive, sufficiently strong to produce an inflammation with free purulent discharge, when, if the gonococci have been present but have escaped detection, they will be found in the discharge in sufficient number to make their identification positive, and at the same time with the desquamation of the epithelium the accidental micro-organisms are removed to a large extent.

Finger[11] "only permits marital intercourse after frequent examinations of the secretion or tripperfäden show an absence of pus cells; and the discharge following the application of Neisser's test contains no gonococci."

Morel Lavalleé[15] says:

I. "The gonococcus may rest latent for months or even years in the urethra.

II. It is impossible to permit marriage in a man that has the slightest discharge until by Neisser's test it has been proved free of organisms."

It is reasonably certain that the gonococci suffer enfeeblement during their stay in the urethra. This attenuation is due probably to alteration of medium, viz. the urethral mucous membrane, consequent upon growth of organism. In this way we can readily account for their presence without resultant inflammatory reaction. A localized chronic urethritis does not, however, confer any immunity from fresh infection. Finger[11] has produced in four instances an acute gonorrhœa on patients with chronic urethritis by inoculation with pure culture of gonococcus.

He believes that the gonococcus is attenuated by long residence in the urethra, and that women infected by their husbands who suffer from chronic gonorrhœa have a urethritis which runs a chronic course.

Jamain[16] believes "that the gonococcus becomes attenuated, but that in contact with a healthy mucous membrane in another individual it is rejuvenated and produces an acute gonorrhœa."

The secretion in cases of chronic urethritis being small as compared to an acute one, so small in many cases that it appears in the urine only as tripperfäden, it follows that after being washed off by the urine, it requires some time for regeneration. (Hence arises the importance of examining the first urine passed after an interval of several hours, preferably the morning urine, for if the patient has urinated within an hour or two the urine may be free from shreds.) So that a single act of coitus with an individual suffering from chronic urethritis and with a secretion bearing gonococci does not always produce infection.

Since we can only demonstrate the presence of the gonococcus in a small percentage of cases of chronic urethritis (in 37 of 625 reported by Hasse, or 6 per cent.; in 21 of 357 reported by Goll, of a duration of a year or more, or 6 per cent.; in 2 of 38, of same duration, reported in this paper, or 5½ per cent.), and since when present they are, as compared to an acute gonorrhœa, few in number, often only demonstrated after frequent, careful and repeated examination, and since they are from attenuation probably less virulent, we must conclude that:

I. In many cases of chronic urethritis we are unable to demonstrate the presence of the gonococcus; these cases are probably non-infectious.

II. In any case the possibility of infection as compared to an acute urethritis is small.

III. An urethritis due to an attenuated organism, and consequently modified in intensity, may be contracted from a chronic urethritis. Conversely:

IV. Several negative examinations of the secretion from a chronic urethritis do not prove its non-infectiousness.

V. The infectiousness or non-infectiousness of a chronic urethritis can only be determined by frequent and careful examinations of the secretion, and if these prove negative, by the non-appearance of the gonococcus after the application of Neisser's test.

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THE IMPORTANCE OF EMPLOYING PURE SALTS IN THE PREPARATION OF THE SCHOTT BATH.

EDITOR OF JOHNS HOPKINS HOSPITAL BULLETIN.

Dear Sir: I am lately in receipt of the following letter from a physician in the West. I submit to you the letter and my reply in full for publication, if you see fit, as I trust by so doing a similar mistake may be averted.

I am very truly,
C. N. B. CAMAC.

[COMMUNICATION.]

DR. C. N. B. CAMAC, Johns Hopkins Hospital, Baltimore, Md.

Dear Doctor:—The instructions contained in your article in the May issue of the Johns Hopkins Hospital BULLETIN on the Schott treatment of heart disease have recently been followed by me in a case of hypertrophy with organic lesions.

We nearly had a disastrous result owing to an evident error in those instructions.

Bath V calls for sodium bicarb. 1 lb., HCl 1 lb. Bath VI increases the HCl to 2 lbs., but leaves the sodium bicarb. still at 1 lb., thereby producing an excess of 1 lb. of HCl which is not provided for.

I gave the journal to the hospital druggist with instructions to prepare each bath in order in accordance with the directions, paying no thought to chemical results. When bath VI was given the patient was attended by only one nurse, while usually two or three had been present. She noticed the chlorine gas rising from the tub, but supposed it was all right and put the patient in. He had no sooner stepped in than he was nearly suffocated and was quickly assisted out without harm.

The nurse seemed seriously prostrated for a time with a very severe bronchitis and laryngitis and the hospital attendants had a lively time to relieve her.

I relate these circumstances in order to call your attention to a mistake that must have been made in the article in question.

The patient has been rather worse during the course of baths, but that may be due to the progress of the disease, which is serious. As it takes more than one swallow to make a summer, I cannot pass an opinion on the method of treatment. Very truly yours,

BALTIMORE, MD., *Sept.* 4, 1897.

Dear Doctor:—I am indebted to you for your communication in reference to the Schott treatment.

We have had no experience similar to yours in using bath No. VI, which I may say is seldom called for. Chemically, the results which you had seem an impossibility, no matter how excessive the amount of hydrochloric acid may be. Suppose, for example, we take a formula expressing an excess of hydrochloric acid as follows:

$$NaHCO_3 + 5HCl = NaCl + H_2O + CO_2 + 4HCl.$$

The other two salts, sodium-chloride and calcium-chloride, are already in solution, and being bases in combination with the acid hydrochloric, remain chemically unchanged.

The reason the carbonic acid is given off when bicarbonate of soda and hydrochloric acid are combined is because the hydrochloric acid has a greater affinity for the sodium than has the carbonic acid; the latter is, therefore, displaced, appearing as carbonic acid gas and the salt sodium chloride resulting.

The following would be the formula for this reaction:

$$NaHOCO_2 + HCl = NaCl + H_2O + CO_2.$$

I can only account for your unhappy accident by supposing that one of two mistakes was made:

1st. Your druggist may have given you sulphuric or nitric acid instead of hydrochloric, both of which acids have a greater affinity for the bases sodium and calcium than has hydrochloric acid, and which would have combined with these to form sulphates or nitrates, free HCl being formed. (Formula see below, Experiment No. 3.)

2d. The calcium chloride (which is the more likely to have occurred) may have been adulterated with chloride of lime, or indeed chloride of lime may have been given to you instead of calcium chloride. This hypochlorite of calcium being the ordinary bleaching powder and much cheaper than the pure salt calcium chloride, forms a ready salt for adulteration, which in the presence of only a small amount of hydrochloric acid yields chlorine gas and would be, I can readily understand, not only dangerous to a heart case but even seriously injurious to a healthy individual. (Formulæ see below, Experiments 4 and 5.)

Actuated by your letter I made the following experiments:

1st. Bath No. 6 with the amounts of constituents as directed in my pamphlet from which you quote. Result: Abundance of carbonic acid gas. No unpleasant effects.

2d. The same amount of constituents with excess of hydrochloric acid. Result: Same as experiment No. 1. (Nos. 1 and 2 performed in bath tub.)

3d. Small amount of sodium chloride, calcium chloride, and bicarbonate of soda and sulphuric acid (experiment performed in beaker glass). Result: Stifling odor; no fumes visible. This "stifling" odor was probably due to the HCl forming.

4th. Salts, sodium chloride, calcium hypochlorite (bleaching powder), bicarbonate of soda, *dilute* hydrochloric acid. Result: Chlorine given off; suffocating; beaker had to be placed under the hood.

5th. Sodium chloride, calcium hypochlorite bicarb. soda and sulphuric acid. Result: More pronounced than in experiment No. IV.

Allow me to thank you for your communication, which I consider of sufficient importance to publish in order that a like so serious mistake may not again be made.

Very truly yours,
C. N. B. CAMAC.

Formulæ:

Experiment No. 1. Same as formula given at beginning of letter.

Experiment No. 2. Same as formula given at beginning of letter.

Experiment No. 3. $2NaCl + CaCl_2 + 2NaHCO_3 + 3H_2SO_4 = 2Na_2SO_4 + CaSO_4 + 2H_2O + 2CO_2 + 4HCl$.

Experiment No. 4. $Ca(ClO)_2 + 4HCl = CaCl_2 + 2H_2O + 2Cl_2$.

Experiment No. 5. $Ca(ClO)_2 + CaCl_2 + 2H_2SO_4 = 2CaSO_4 + 2H_2O + 2Cl_2$.

Note.—I have not included in these last two formulæ—the NaCl, as it would have no effect upon the reaction—neither is the $NaHCO_3$ included, as CO_2 would be evolved as already noted.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of Monday, May 17, 1897.

Dr. Flexner in the Chair.

Demonstration of a Case. Probable Brain Tumor.—Dr. Thomas.

The patient whom I wish to present to the Society will be brought from the ward in a few moments. She is a young, unmarried woman of twenty-six, with a good family history, except that one brother is believed to have tuberculosis. She has been a fairly strong girl, and has had no serious illness of any kind. Her occupation is that of a sewing woman, and she has been learning stenography and type-writing.

About a year ago she had an attack of unconsciousness; this began with a painful contraction of the right hand, which lasted for a minute or two, and passed up the arm, when she became unconscious. She was found about half an hour afterwards by her brother, who shook her and brought her to herself. After this attack she was comparatively well, and went to her employment the next day as usual. In August of last year she was under a great deal of nervous strain on account of the death of a relative. About this time she had several nervous attacks, which she calls "nervous chills," and which seem to have been hysterical. On November 8, 1896, while sitting with her arm resting on the table, she became conscious of a sensation of numbness in the elbow of her right arm. This arm and the leg on the same side became suddenly powerless, and she has been told that her face was drawn to the left, but of this she was not conscious. With the onset of this paralysis she became absolutely unable to speak. She was put to bed, and showed so much nervousness that the attending physician, a very competent man, made the diagnosis of hysteria, and it was impressed upon her that she could, if she would, get up and walk and talk. The description which she gives of the loss of speech is remarkably distinct and clear. She says that she understood everything that was said to her, and remembers much of it. She knew every one who came into the room, but was absolutely unable to say a word. She thinks that she knew what she wanted to say, but had forgotten how to say it. She tried to write with the left hand, but could not form the letters and had forgotten how to spell the words. Upon making the attempt to read, after she had been sick about four days, she was unable to make anything of it, and three weeks afterwards she could not read the paper easily. After a week of complete speechlessness, during which every one around her had endeavored to make her talk, she was able to repeat the first four words of a text of scripture which had been said to her over and over again. By being taught day by day, her speech gradually improved; the first words that she said voluntarily were "go out." These she said to her sister, who had been sitting with her constantly for a good many days. She knew all the time just what she wanted to say, but it was only after a good deal of silent practice, and several attempts, that she was able to utter the two words. Her speech improved slowly, but steadily, until she regained the speech which she now has, which shows no defect.

The first of last December she had another attack, and another on the twelfth of February, and still another on the 26th of April. These attacks have all been of the same character, beginning with a painful contraction of the fingers of the right hand; this passes up the arm, and she describes an intense pain in her head. At this time she says that she loses all knowledge that the arm belongs to herself, although she still experiences pain in it. This is a remarkable statement. In these three attacks, consciousness seems not to have been lost.

As the patient enters the room, you will notice that she walks with a slight limp, and that the right hand is held in the manner so characteristic of hemiplegia. I have been unable to find the slightest disturbance of her speech. She now speaks voluntarily, without difficulty, writes long and short hand, understands everything that is said to her, and reads with ease. The ophthalmoscopic examination showed that the fundus was normal, although there is a slight degree of hyperæmia. She has a congenital squint and a slight nystagmus, but other than this, no abnormality of the cranial nerves. Her chief disability is in regard to her right arm, which, as you see, is very tremulous and nearly useless. She is unable to oppose the thumb to the little finger, and the movements of the finger are very weak. The movements at the wrist are better retained, and those at the elbow and shoulder better still. The movement of outward rotation of the arm is very weak indeed, whereas the inward rotation is comparatively strong. The deep reflexes are markedly exaggerated, percussion on any of the tendons causing active muscular contraction, and there is a well-marked wrist clonus. Objectively, there is not much muscular weakness of the right leg. Sensation is everywhere perfectly normal. I have tested particularly for any abnormality of the muscular sense of the right arm, and found that she appreciates even very slight movements of any of the joints. There is no muscular atrophy. The examination of the chest shows no abnormality, and we have been unable to discover anything that indicates a preceding specific infection (syphilitic).

I have been much interested in this patient, and it is surely an unusual case. That a young woman of her age should have been affected with a hemiplegia associated with a temporary loss of speech, and followed by recurring attacks simulating closely Jacksonian epilepsy, is very remarkable. The diagnosis of *hysteria* seems at first sight the most probable one. Organic vascular lesions are very rare at her age, except when they are associated with syphilis. In this case there is nothing in the previous history or in the present condition that suggests such a cause. The patient was at the onset undoubtedly very hysterical, and you will remember that she gave the history of preceding hysterical attacks, all of which speak for the diagnosis of hysteria; but the condition in which you have seen the patient suggests an organic paralysis more than an hysterical one. Mann and other observers have studied the distribution of the paralysis due to organic brain disease, and have determined that there are certain movements which are most apt to be paralysed. The movements which are most often paralysed are those of the thumb, and next in order of importance is the outward rotation of the arm. In the case before you, these are just the muscles which are paralysed. The excessive increase of the deep reflexes, which is present in this case, is also unusual in association with hysterical paralysis, so I think we are justified in stating that the character of the paralysis is that due to an organic brain lesion, rather than to hysteria. The character of the convulsive attacks also points to an organic lesion, as true Jacksonian attacks are, as far as my knowledge goes, extremely rare in hysteria. Although I am not very positive about it, still I believe that we have a definite disease of the brain in this case, and I am inclined to think that this disease is a slow-growing tumor. I have been led to this belief from an experience which we have lately had. Some of you will remember that I reported to this Society last fall the clinical history of a case upon which we had advised operation. The case was that of a man who, for six years, had had recurring attacks of Jacksonian epilepsy, beginning in his right foot, and which had later involved the right arm and face, and in whom there had developed paralysis of the leg, and of the arm. There were none of the general symptoms of brain tumor, and the operation revealed nothing abnormal; but the microscopical examination of the brain showed a most interesting new growth of the motor region, about which I hope Dr. Flexner will have something to say. The case which I have presented to you to-night, although not quite similar, will suggest this case strongly, and we fear is of a like nature.

Note.—While in the Hospital, in the early part of June, the patient had another attack. She was in the dining-room, talking with some friends, when the fingers of her right hand became stiff and painful. This extended up the arm, the hand and arm drew up, her head was drawn to the right side, and there was intense pain in her head. She then lost consciousness. Those who were about her say that her eyes were turned to the right and that her right leg was stiffened out, and that she fell to the floor. When she became conscious, in about five minutes, she could not talk for a few moments, and felt weak and badly, but was not hysterical.

Demonstration of Specimens.—By Dr. Cullen.

Several weeks ago at a meeting of this Society, Dr. Kelly spoke at length on the operative treatment of myomata and pointed out the ease with which these growths could be removed. Since that time I have operated upon two patients where the conditions present rendered the enucleation very difficult. Both of these cases present so many clinical points of interest that we may profitably discuss them for a few moments.

Case 1. *Umbilical hernia; multinodular myomatous uterus; large ovarian abscess communicating with the small intestine; hysterectomy.*

R. L., æt. 40. Admitted to Dr. Kelly's service March 23, 1897. Complaint, abdominal tumor, pains in the lower right abdomen and leg. She had been married 20 years, but gave no history of pregnancy. Menses began at 12 years, and were regular until August 15, 1896, when they ceased for 4 months, since which time they reappeared. Flow moderate, at times clotted; occasionally it is painful.

Family history negative.

Previous history unimportant.

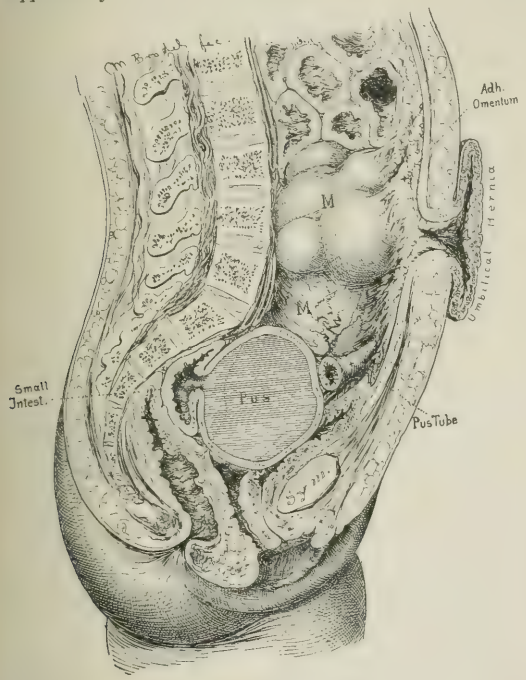
Present condition. Ten years ago she noticed a tumor about the size of an egg in the right side of the pelvis. This has steadily increased in size and has been almost constantly associated with a gnawing pain over its most prominent part. The pain has been so severe that she has at times been confined to bed, on one occasion for 3 months. The last attack was 3 months ago. Locomotion very difficult on account of pain in the legs. These are at times swollen and pit on pressure. No chills. No fever. The patient is well nourished, has a good appetite, bowels constipated. For the last two years she has had night sweats regularly.

The abdomen is much distended and presents an irregular lobulated appearance. At the umbilicus is a hernial sac fully 9 cm. in diameter. The skin over this can be drawn out for a distance of 6 cm., while the hernial ring whose margins are very sharply defined is 2 cm. in diameter. The following are the abdominal measurements: Distance from symphysis to umbilicus 14 cm.; from umbilicus to xyphoid 29 cm.; circumference at most prominent part of tumor 126 cm.; midway between umbilicus and xyphoid process 96 cm. Examination occasioned little pain.

Operation March 24, 1897. On account of the irregular hernial protrusion the abdominal incision was commenced at a point midway between the xyphoid cartilage and the umbilicus and continued downward to within a short distance of the pubes, the hernial sac being encircled and removed. At the umbilicus the omentum which was firmly adherent was ligated and then freed. Presenting at the incision were several subperitoneal myomata; to these the omentum was also firmly adherent. After loosening up these adhesions, the nodular myomatous uterus, 28x21 cm., was delivered. (See the accompanying figure.)

Occupying the posterior part of the pelvic cavity was an elastic tumor 17 cm. in diameter; this looked like an ovarian cyst and was intimately adherent to two loops of small intestine. On attempting to shell off the outer layers of the cyst

leaving them attached to the intestines, the cyst ruptured and was found to contain about 900 cc. of greyish fœtid pus. A glass trocar was introduced and the pus evacuated. The uterus was then removed in the usual way from left to right, but the left tube and ovary were left *in situ*. After bringing the cervical stump together the ovarian abscess was freed and the vessels at its pedicle controlled by silk ligatures. It was necessary, however, to leave a small part of the sac attached to the intestines, and on careful examination an opening 1 cm. in diameter was found between the intestine and the abscess sac. The margins of the intestinal opening were almost as dense as cartilage and at the same time very friable. After a good deal of dissection it was possible to turn the edges in and the opening was closed by fine silk sutures. This now was supported by a second and a third row.



A longitudinal section of the abdomen, showing from above downward the large multinodular myomatous uterus, to the upper and anterior surface of which the omentum is adherent, an umbilical hernia to whose ring the omentum has become adherent, a pus tube and an unusually large ovarian abscess which communicates with a loop of small intestine. The abscess was more on the right side of the body, but has been drawn on the same level to bring it out more clearly.

During the entire operation, which lasted 5 hours, the patient did not lose 3 oz. of blood. The abdomen was thoroughly cleansed with two litres of salt solution, the pelvic peritoneum drawn over the cervical stump and the abdomen closed without drainage.

On the eighth day the temperature rose to 100.8° and about the 20th day reached 101°. At that time there was considerable pain in the left iliac fossa and an indefinite thickening could be made out, but from this time on she rapidly recovered and was discharged May 4th feeling comparatively well.

From this case we may learn that where there is an umbilical hernia or adhesions are suspected it is well to begin the incision at a point above this; the finger can then be introduced into the abdomen to act as a guide. The presence of the ovarian abscess is very readily explained. There has evidently been an ovarian cyst. With the increase in size of the myoma the cyst has been firmly pressed against the intestines, adhesions have formed, and as continuous pressure promotes absorption, the walls have gradually atrophied until an opening has formed between the two. Attention may also be drawn to the fact that no drainage was employed.

Case 2. *Large myomatous uterus extending out laterally between folds of broad ligament; complete hysterectomy necessary as no cervix was left; danger of injuring the ureters.*

M. F., æt. 40, admitted to Dr. Kelly's service March 29, 1897. Complaint, an abdominal tumor. Menstrual history somewhat indefinite, but the periods were regular until two years ago, since which time the patient has had a continuous but not excessive bloody discharge.

Family History. Mother's family showed a decided tuberculous tendency.

Present Condition. She first noticed abdominal enlargement during the summer of 1896. It has steadily increased since then and showed more advancement on the left than right side. During the last four years she has had on an average one profuse uterine hemorrhage each year; the last was one week before admission and continued three days. For one year there has been marked but not constant pain in the lower abdomen. Micturition frequent. No history of chills or fever.

Abdominal Examination. The abdomen is the size of a full term pregnancy, the greatest prominence is to the left of the umbilicus. Just below the umbilicus in the mid-line is a hard flattened area 8 cm. broad, to the right of which is a second nodule. From the character and consistence of the nodules one instantly suspects myomata.

Measurements. Distance from symphysis pubes to umbilicus 24 cm.; from umbilicus to xyphoid process 20 cm.; from right ant. sup. spine to umbilicus 25 cm.; from left ant. sup. spine to umbilicus 24.5 cm., girth at umbilicus 88 cm., greatest girth which is 8 cm. below the umbilicus is 91 cm.

On vaginal examination the cervix was felt as a half-moon-shaped slit directly behind the pubes, while the whole upper part of the pelvis was filled with a hard globular mass, forming a part of that occupying the abdomen.

Operation March 31, 1897. Hysteromyomectomy. The abdominal incision extended from a point 4 cm. above the umbilicus almost to the pubes. The myoma was delivered without difficulty, but found firmly fixed in the pelvis. Upward it reached a point midway between the umbilicus and xyphoid cartilage, was lobulated and laterally stretched out under the broad ligaments. The right round ligament was tied and cut, the vessels of the right tube and ovary were controlled and the appendages on this side were left *in situ*. On the left side the

tube and ovary were found lying on the upper surface of the tumor and could not be saved. After ligating and cutting the left round ligament the folds of the broad ligament were separated, exposing an artery 2 mm. in diameter lying on the surface of the tumor—this was probably the ovarian artery; it was tied off and the bladder peritoneum freed from the tumor. The myoma was then rolled upward and to the right, but on the left side the uterine vessels as such could not be isolated; they were, however, controlled by passing stout sutures at their usual site.

It was now my intention to amputate at the cervix, but as this was entirely involved by the tumor the vault of the vagina was opened into, its upper portion being removed. The right uterine vessels were caught by the forceps and the tumor was freed. In both broad ligaments were many dilated lymph spaces. After controlling the large vessels with silk and checking all oozing along the vaginal cut surface with catgut the vaginal mucosa was turned down into the vagina and the raw surfaces were brought together, thus shutting off the pelvic cavity. The bladder peritoneum was then drawn backward over the stump and united with that of Douglas' sac. Considerable anxiety was felt as to the safety of the ureters, as it was necessary on account of the vaginal vault being so widely opened to control the uterine vessels further out than usual. On the left side a rounded cord was seen included in the ligature, but on unraveling this it was found to be a fold of peritoneum. After washing out the pelvis with two litres of salt solution the abdominal cavity was closed. The patient made a perfect recovery and was discharged May 3, 1897.

In this case the chief anxiety was centred around the ureters. We were loath to close the abdomen without further examination as to their safety, but the patient's condition did not warrant any delay. Strict orders were given to have all the urine measured to determine if sufficient were secreted. The amount obtained satisfied us that both kidneys were doing their normal amount of work. Had a ureter been tied the abdomen would have been again opened and the ureter anastomosed into the bladder.

NOTES ON NEW BOOKS.

Archives of Clinical Skiagraphy. Sydney Rowland, B. A. Camb., Editor. Volume I, Parts I–IV. 1896–7. (*The Rebman Publishing Company, Limited, London.*)

A publication whose object is "to put on record in permanent form some of the most striking applications of the 'New Photography to the Needs of Medicine and Surgery,' is being edited by Mr. Sydney Rowland, the special commissioner appointed by the British Medical Journal to make inquiry into the above-mentioned applications. The Archives of Clinical Skiagraphy published its first number in May, 1886. Since then three more numbers have appeared at irregular intervals. Each of them contains a series of six collotype plates, taken from some excellent X-ray negatives, to which a brief clinical and explanatory note is appended. Most of the plates are of simple skeletal lesions of the extremities, illustrative of fractures, malformations and neoplasms.

There are few reproductions of the more difficult exposures through the pelvis or chest, and but cursory mention of attempts to recognize lesions other than osseous ones, such as intra-thoracic aneurism, changes in the cardiac area, pulmonary affections, renal calculi and the like. There is an excellent skiagraph of tubercular arthritis of the hip in No. 3 and of congenital dislocation of the hip in No. 4, evidently in children.

In the last number (April, 1897) the scope of the publication has been enlarged somewhat, and reproductions of subjects other than purely clinical ones are presented, such as of zoological specimens, and reference is made to the possibility of taking moving shadow pictures for cinematographic purposes.

The life of such a publication, if devoted purely to clinical subjects, seems to come to a natural termination when its mission of calling attention to the great usefulness of the X-rays for the diagnosis of many pathological conditions has been fulfilled.

To-day an X-ray apparatus has become an almost necessary adjunct to the hospital or private armamentarium, and skiagraphs are as much to be expected in a clinical report as ordinary photographs, and will occupy an equally important place in the forthcoming text-books on fractures, orthopædics, etc.

It seems, therefore, that the value of such a periodical would be enhanced if it aimed, as do some of the better photographic journals, towards the perfection of the ways and means of bettering the art of skiagraphy rather than towards the mere reproduction of its quite familiar results.

The Archives are very handsomely published by the Rebman Publishing Company. The reproductions are good. Such type, paper and broad margins would be welcomed in many better known and more generally useful medical magazines. H. W. C.

Injuries and Diseases of the Ear, being Reprints of Papers on Otology. By Macleod Yearsley, F. R C. S., Fellow of the British Laryngological, Rhinological and Otological Association, etc. (1897, *London: The Rebman Publishing Co., Limited*, 11 *Adams St., Strand.*)

This little book is an interesting collection of monographs, and is not a systematic treatise on diseases of the ear. All of the articles are interesting and suggestive. We would especially commend "Foreign bodies in the ear and their treatment," "What not to do in diseases of the ear," and "On the care of the ear in children." The chapter on "Aural Reflexes" is too brief to be satisfactory. It is to be hoped that the author will at some future time expand it into a book.

Inebriety. Its Source, Prevention and Cure. By C. F. Palmer. (*New York: F. H. Revell Co.*, 1897.)

This short tract or sermon is not in any way a scientific discussion of this subject, and so lacks all special value for a physician. It is only suitable for that body of the laity who have a small amount of scientific knowledge. The point on which the author lays most stress is that inebriety is due to a neuro-psychopathic constitution, and that consequently it is a result of mental deformity rather than a moral infraction, and he believes that almost all inebriety may be traced back to a mentally or physically diseased ancestry. But his remarks might be applied with almost as much fitness to any other form of mental deformity as inebriety.

Medical and Surgical Report of the Presbyterian Hospital in the City of New York. Vol. II, January, 1897.

This report compares very favorably with Volume I, and with more supervision in the editing would be still better. Many of the papers published in this volume have appeared before in the New York medical journals, which detracts from their vivid interest. For those who have not read the journals there are good papers on typhoid fever, tuberculosis, and a variety of other topics both surgical and medical, reported at greater or lesser length. The description of the operating pavilion as an aid in construction for other hospitals is most valuable.

Hysteria and Certain Allied Conditions. Their Nature and Treatment with Special Reference to the Application of the Rest Cure, Massage, Electro-therapy, Hypnotism, etc. By George J. Preston, M. D., Professor of the Diseases of the Nervous System, College of Physicians and Surgeons, Baltimore, etc. 8vo, pp. 298. (*P. Blackiston, Son & Co., Philadelphia*, 1897.)

Dr. Preston modestly prefaces his book with an explanatory apology. Two reasons, he says, may perhaps be deemed of sufficient weight to warrant its appearance; first the great importance of hysteria, and secondly the lack of a recent book in English on the subject. The book is intended for the American general practitioner. Its "object is to present the symptomatology and differential diagnosis of hysteria in as concise a manner as possible, and to indicate the various therapeutic measures that have been found useful in the treatment of the disorder."

The author first gives a short sketch of the history of hysteria, in which special attention is given to the epidemics of hysteria so common in the Middle Ages and occasionally seen since then. An interesting account is given of the hysterical "orgies" enacted at the religious revivals of Kentucky and Tennessee in the early part of this century, and of the camp-meeting "trances" of the Southern negro.

The historical account is followed by a chapter on the "Nature of Hysteria." The etiology is considered in some detail. Sex, age, race, climate, heredity, diathesis, education and environment, and "reflex irritation" are discussed. In regard to "race," the author, who has had considerable experience with hysteria in the negro, thinks that the disorder is more frequent in that race to-day than it was during the slavery period. Indeed, it is at present by no means uncommon. Special stress is put upon the part that environment plays in the etiology of hysteria. The part played by "reflex irritation" is considered undetermined. It is rare that an abnormal condition of the organs of generation gives rise to the disease, though a morbid train of associated ideas often makes the hysterical woman refer her troubles to these parts.

The consideration of the etiology of the disease is followed by a brief review of the many theories that have been held as to its nature. The author concludes that hysteria is an affection of the higher brain centres, perhaps an actual though temporary loss of protoplasm. In bringing together his reason for this conclusion Dr. Preston shows an acquaintance with the more recent work on the fine anatomy of the cerebral cortex and an admirable hesitancy in making deductions from the suggestive results of the histologists.

There follows a chapter on "Symptomatology." Hysteria is considered as a single disease, though most protean in nature. The symptoms of the disease are divided into the following categories: 1. Disturbances of sensation: anaesthesia, paraesthesia, hyperaesthesia, affecting both the general sensibility and also the special senses. 2. Disturbances of motion: paralysis, contracture, tremor, convulsive seizures. 3. Vaso-motor, visceral, and nutritive disturbances. 4. Mental symptoms. 5. Miscellaneous symptoms.

The disturbances of sensation are treated with the fulness of detail which the subject warrants. Special attention is given to "hysterogenesis." The author feels convinced from cases of his own that the hysterogenic zones, first described by Charcot, have a real existence and are not the result of suggestion.

A good description is given of the various disturbances of the motor-system. The author draws an interesting comparison between the manifestations of hysteria in this country and those in France. "I have often been struck," he says, "with the similarity between the cases of hysteria in negroes, who, of course, have never been in any possible manner under the influence of suggestion, and the so-called 'show cases' at the Salpétrière."

Under "mental symptoms" are considered the general mental state of the hysterical patient,* hysterical insanity, lethargy, narcolepsy, catalepsy, ecstasy, somnambulism, and vigil ambulism. Somnambulism, while not necessarily hysterical in nature, is considered to be very closely allied to hysteria on the one hand and to hypnotism on the other.

The visceral disturbances include contracture of the œsophagus, vomiting, hematemesis, hysterical anorexia, intestinal disturbances; affections of the genito-urinary apparatus; disturbances of the respiration and of the voice. Under cardiac and vaso-motor symptoms are considered tachycardia, flushing of the face and upper part of the body, autographism and cutaneous affections. Nutritional disturbances include muscular atrophy and hysterical fever. The latter, the author concludes, is a real though rare condition.

A third of the book is given up to a detailed consideration of the diagnosis and treatment of hysteria. There has been an evident and successful effort to make this clear, practical and helpful. Under differential diagnosis emphasis is put upon the fact that though hysteria is manifold in nature it is almost always characterized by certain stigmata, as for instance anaesthesia, which as a rule may be clearly distinguished from similar disturbances due to organic disease. "The central idea in the treatment of hysteria may be expressed in the word 'suggestion.'" The physician must have the confidence of his patient. In the general treatment of the disease the main reliance is to be placed upon a careful regulation of the diet, the meals, rest, exercise, occupation, and habits. Drugs are useful mainly because the patient is apt to have faith in medicine. The treatment of special symptoms likewise depends chiefly on suggestion. In case of severe attacks pressure on the hysterogenic zones, ice suppositories, apomorphia, chloroform, at times hypnotism, may help to terminate the attack.

Electricity, which has proved so valuable in the treatment of hysteria, owes its main effects to the power of suggestion. On the other hand, water as a therapeutic agent has a direct marked beneficial physiological effect in addition to its suggestive use. For the routine treatment of hysteria the alternate warm and cold douche is warmly recommended. Massage is chiefly applicable to those cases of hysteria, often complicated with neurasthenia, in which the patient cannot or will not take out-door exercise. The Weir Mitchell Rest Cure is considered in some detail. Hypnotism, of which the author gives a very interesting account, is considered very valuable in some cases, though on the whole it has proved disappointing as a therapeutic agent. Its great value is "that it has taught us how to make our treatment of the hysterical subject suggestive." Surgical interference is rarely necessary or of value. The author deplores the frequency with which ovariotomy has been done in this country merely for the relief of hysteria.

The book as a whole is admirably fitted for the purpose for which it was designed. The author makes no attempt at an original treatment of hysteria. He has drawn extensively from the literature on the subject, giving references to the more important articles. Yet he is far from being a mere compiler. He views the subject throughout from a modest yet independent standpoint, based on an experience with hysterical patients rendered the more valuable by an evident deep personal interest in the subject. The style is direct, clear, and interesting, though at times rough. The book is illustrated by diagrams taken from Charcot and Gilles de la Tourette, and by pictures from the drawings of Richer. It is well printed and well bound. It should prove not only most valuable to the general practitioner, but also of interest to the specialist in nervous diseases.

C. R. B.

* "As has been aptly put, the hysterical patient says 'I cannot,' it looks like 'I will not,' but it really is 'I cannot will.'"

THE JOHNS HOPKINS MEDICAL SCHOOL. SESSION 1897-1898.

FACULTY.

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IRA REMSEN, M. D., Ph. D., LL. D., Professor of Chemistry.
WILLIAM OSLER, M. D., LL. D., F. R. C. P., Professor of the Principles and Practice of Medicine.
HENRY M. HURD, M. D., LL. D., Professor of Psychiatry.
WILLIAM S. HALSTED, M. D., Professor of Surgery.
HOWARD A. KELLY, M. D., Professor of Gynecology and Obstetrics.
FRANKLIN P. MALL, M. D., Professor of Anatomy.
JOHN J. ABEL, M. D., Professor of Pharmacology.
WILLIAM H. HOWELL, Ph. D., M. D., Professor of Physiology.
WILLIAM K. BROOKS, Ph. D., LL. D., Professor of Comparative Anatomy and Zoölogy.
JOHN S. BILLINGS, M. D., LL. D., Lecturer on the History and Literature of Medicine.
CHARLES WARDELL STILES, Ph. D., M. S., Lecturer on Medical Zoology.
WILLIAM D. BOOKER, M. D., Clinical Professor of Diseases of Children.
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SAMUEL THEOBALD, M. D., Clinical Professor of Ophthalmology and Otology.
HENRY M. THOMAS, M. D., Clinical Professor of Diseases of the Nervous System.
SIMON FLEXNER, M. D., Associate Professor of Pathology.
J. WHITRIDGE WILLIAMS, M. D., Associate Professor of Obstetrics.
LEWELLYS F. BARKER, M. B., Associate Professor of Anatomy.
WILLIAM S. THAYER, M. D., Associate Professor of Medicine.
JOHN M. T. FINNEY, M. D., Associate Professor of Surgery.
GEORGE P. DREVER, Ph. D., Associate in Physiology.
WILLIAM W. RUSSELL, M. D., Associate in Gynecology.
HENRY J. BERKLEY, M. D., Associate in Neuro-Pathology.
J. WILLIAMS LORD, M. D., Associate in Dermatology and Instructor in Anatomy.
T. CASPAR GILCHRIST, M. R. C. S., Associate in Dermatology.
ROBERT L. RANDOLPH, M. D., Associate in Ophthalmology and Otology.
THOMAS B. ALDRICH, Ph. D., Associate in Physiological Chemistry.
THOMAS B. FUTCHER, M. B., Associate in Medicine.
JOSEPH C. BLOODGOOD, M. D., Instructor in Surgery.
THOMAS S. CULLEN, M. B., Instructor in Gynecology.
FRANK R. SMITH, M. D., Instructor in Medicine.
GEORGE W. DORRIS, M. D., Assistant in Obstetrics.
WALTER JONES, Ph. D., Assistant in Physiological Chemistry.
ADOLPH G. HOEN, M. D., Instructor in Photo-Micrography.
SYDNEY M. CONE, M. D., Assistant in Surgical Pathology.
LOUIS E. LIVINGOOD, M. D., Assistant in Pathology.
ROSS G. HARRISON, Ph. D., Instructor in Anatomy.
HENRY BARTON JACOBS, M. D., Instructor in Medicine.
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GENERAL STATEMENT.

The Medical Department of the Johns Hopkins University was opened for the instruction of students October, 1893. This School of Medicine is an integral and coördinate part of the Johns Hopkins University, and it also derives great advantages from its close affiliation with the Johns Hopkins Hospital.

The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter.

The course of instruction is planned for the professional education of those who have received a liberal education, as indicated by a collegiate degree in arts or science, including a reading knowledge of French and German and adequate training in those branches of science, such as physics, chemistry and biology, which underlie the medical sciences. Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have acquaintance with Latin and a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry, and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one.

The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology.

These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, beside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital.

These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the

REGISTRAR OF THE JOHNS HOPKINS MEDICAL SCHOOL, BALTIMORE.

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BULLETIN

OF

THE JOHNS HOPKINS HOSPITAL.

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CONTENTS.

A RARE CASE OF LITHOPEDION.

By J. G. Clark, M. D.

During the month of August, 1896, a patient suffering with an abdominal tumor, dyspnœa and pain in the lower abdomen, was admitted to the gynecological wards of the Johns Hopkins Hospital for treatment, and, through the kindness of Dr. Kelly, I was given charge of the case.

The patient's history was strongly suggestive of the rupture, four years previous to her admission, of an extra-uterine pregnancy sac, with the extrusion of the fœtus into the abdominal cavity, and the physical examination revealed a stony-like mass, resembling a fœtus in form, which proved at operation to be a lithopedion.

As the formation of a true lithopedion is of rare occurrence, and as this was a typical case, I have thought it worthy of publication.

History of Case.

B. H., colored, married, age 45 years. Admitted August 8, 1896.

Chief Complaints. Pains in the lower abdomen, enlargement of the abdomen, and dyspnœa.

Marital History. Married 14 years, three children, oldest 12, youngest 7 years old.

First labor difficult, attended by a midwife, who had to call in a physician to remove an adherent placenta. Last two labors easy, slight chills and fever after birth of last child.

Menstrual History. Flow appeared first in her thirteenth year, always regular, but accompanied by much pain in the left side. For the last three years the flow has been regular, lasting 4 to 5 days.

Family History. Mother is insane, otherwise no history of hereditary disease.

Present Illness. Four years ago the menstrual flow ceased and the patient had all the symptoms of early pregnancy.

Towards the end of term her lower extremities swelled very much, and she felt so weak and miserable that she was compelled to go to bed, where she remained until long after the regular term. During the latter months of pregnancy fœtal movements were distinctly felt. About the time for her confinement she had an attack of severe pain in the left side and felt something break. Much watery fluid was passed by the vagina.

At the end of a week her physician was called, who told her that she had an extra-uterine pregnancy and advised an operation, which she declined. During the time while her legs were œdematous she became almost blind. The size of the abdomen has decreased slightly, but the pains in the left side still persist, and of late have grown more severe.

General Condition. Tall, emaciated woman, tongue slightly coated, lips and mucous membranes pale, patient seems moody and of a despondent disposition.

Bowels constipated, at times she goes a week or ten days without a movement.

Micturition painless. Appetite poor.

Examination.

Abdomen irregularly distended by a tumor which presents most prominently on the left side. It is quite hard,

only slightly movable, and is apparently connected by adhesions with the anterior and lateral abdominal walls.

The tumor lies in an oblique position within the abdomen, the upper extremity is felt beneath the left lower rib, the lower extremity being crowded down into the right inguinal region.

The general surface of the tumor is smooth, but numerous hard projections are felt over it, which are denser than the main body of the tumor.

Abdomen tympanitic over right half. Immediately below and one inch to the left of the umbilicus, where the most resistant part of the mass is felt, the percussion note is flat.

No percussion wave.

Examination under anæsthesia. Outlet relaxed, cervix in axis of vagina. Uterus normal in size, in anteposition, pushed forward against pubes by a mass posterior and above uterus.

The left tube and ovary are enlarged; nothing detected on right side except general, ill-defined bogginess.

The main body of the tumor may be pushed away from the uterus, but seems to have a slender pedicle.

The ill-defined mass in the right side, by rectal examination, feels very boggy and is in close relationship with the hard tumor.

Urinary Examination. Color clear amber, slight cloudy sediment, sp. gr. 1025, acid reaction, no sugar or albumen. A few pus cells.

Operation.

Operation by Dr. Clark, August 14, 1896.

Abdominal section for the removal of a lithopedion, double salpingo-oophorectomy for hydrosalpinx and cystic ovary on left side, and for the removal of the right tube and ovary, which were converted into an ectopic gestation sac.

Complications. Adhesions between the anterior abdominal wall and back of fœtus. Dense adhesions binding the gestation sac to the intestines. Placenta necrotic.

Incision 10 cm. in length, revealing a mottled yellow tumor closely adherent to the abdominal wall.

On releasing these adhesions and passing the hand up beneath the left lower rib, the fœtal head was felt lying in close contact with the spleen. The left arm and shoulder were closely adherent to the anterior abdominal wall near the umbilicus.

In order to facilitate the delivery of the fœtus the abdominal incision was enlarged to a point midway between the ensiform cartilage and umbilicus.

Numerous bleeding tags of adhesions were ligated.

The fœtus occupied an oblique position in the abdomen, its chest lying in close contact with the aorta, from which it derived a distinct pulsation impulse.

The fœtal head was grasped and gently delivered from the abdominal incision, after which the umbilical cord was cut close to its placental attachment in the pelvis. On inspecting the pelvic structures the fimbriated end of the tube was found adherent to the ectopic sac, having been apparently torn from the body of the Fallopian tube at the time of the primary rupture.

The secondary or adventitious sac was situated between the folds of the broad ligament. On the floor of the pelvis a large placenta was attached. The larger portion of the sac projected up into the abdominal cavity, and was densely adherent to the vermiform appendix, cæcum and intestine. Secondary rupture had occurred in the superior wall of the sac, the umbilical cord projecting through it into the abdominal cavity.

The placenta was very friable, and on attempting to detach it, broke up into small bits, requiring its removal piecemeal. The ectopic sac was dissected free from the intestine and its attachments in the pelvis, and enucleated with the right tube. The ovary could not be distinguished in the necrotic mass.

A large cystic ovary and hydrosalpinx were removed from the left side.

Abdominal cavity irrigated with 5 litres of salt solution. Abdomen closed with buried silver and subcutaneous cat-gut sutures.

Pulse at beginning of operation 120, at completion 90 beats a minute.

Patient made an uncomplicated recovery, temperature at no time after operation rising above 100° F.

Discharged 28 days after operation, well.

Dr. Barnum's History of the Case.

In a private letter, Dr. Barnum, of Lancaster, Va., has given the following account of the case:

I remember the case of Mrs. Harris very well, owing to the fact that it is the only one of the kind ever seen by me. I was called to see the case in October, 1892. I found the patient weak, nervous, despondent, and at times with a mind decidedly unbalanced. From her and her husband, who is a colored man of intelligence and good standing, I learned that she became pregnant the previous November. There was the usual suppression of the menses, morning sickness, quickening, filling out of the breasts, and all of the signs which she, as the mother of several children, recognized as indications of the pregnant condition.

In August she was taken with perfectly normal labor pains and the colored midwife was sent for. Neither the patient nor her colored attendant suspected that anything was wrong until forced to believe it by the delay in the delivery.

At my first visit to the patient, two months later, an external examination showed her pregnant condition.

Digital examination, however, revealed the uterus of a non-pregnant woman.

At a still later visit I was able to grasp a knee of the fœtus through the abdominal walls of the mother.

A rigid questioning of both husband and wife failed to elicit any history of previous abnormal pregnancy or miscarriage.

As this pregnancy had not been interrupted by any unusual sickness, I gave it as my opinion that this was a case of abdominal pregnancy; or if it at any time had been one of tubal pregnancy, the tube must have ruptured early in the pregnancy.

At my first and at all of my subsequent visits I urged the patient to go to the hospital for treatment. As she was not willing to do this, I gave her tonics and remedies to improve her mental condition. She gradually improved, and has employed no physician, I think, during the past year. Allow me to thank you for your letter announcing the operation which confirmed my diagnosis.

Pathological Report.

Extra-uterine fœtus removed from the abdominal cavity four years after the rupture of the gestation sac.

Fœtal measurements:

Occipito-mental diameter,	12.2 cm.
" frontal "	9.2 "
Sub-occipito bregmatic diameter,	9.2 "
Bitemporal diameter,	7.9 "
Biparietal "	7.9 "
Circumference of head,	30. "
" " shoulders,	32. "
Length of fœtus,	42. "
Weight of fœtus,	4¾ lbs.

The fœtus is entirely covered with a thin translucent membrane which is easily peeled off.

Only the general outlines of the face can be distinguished, the eyes, nose, mouth and ears being entirely covered in with the membranous covering, through which the hair of the fœtus can be seen as a black mat.

Scattered throughout the fœtal envelope are numerous yellowish white spots composed of a fatty, saponaceous material.

The cheeks are quite prominent, the left being much more so than the right.

The skin covering the face and forehead is of a brownish red color resembling burnt leather, slightly mottled, and is firm and resistant, having lost all of its pliability.

On cutting into the skin at this point the knife encounters numerous gritty particles, but the general body of the skin is composed of adipocere.

The occiput and a part of the parietal bones may be seen projecting immediately beneath the membranous covering.

The parietal bones overlap the occipital, and the jagged sutures feel like saw-teeth.

The skin covering the left side of the head is of a white, bleached appearance, similar to the washerwoman's skin.

The membranous envelope, which is probably the remains of the amnion, is closely attached to the fœtus, but can be peeled off. It is ten millimetres in thickness and has no visible blood-vessels when held up to the light.

The arm on the right side is closely glued to the body, and the space between the axilla and elbow is entirely obliterated.

The right forearm is flexed on the arm, and the fingers on the hand.

The dorsal tendons of the hand are seen as glistening cords beneath the mummified fœtal skin.

The left forearm is half-way flexed upon the arm and presents the same general appearance as the right side

The feet are flexed upon the legs, the legs upon the thighs, and the thighs partially upon the abdomen.

There is a considerable accumulation of adipocere and calcareous matter in slightly raised plaques over the lower extremities.

The genital organs are entirely hidden by the enveloping membrane, so that it is impossible to differentiate the sex of the fœtus without further dissection. The entire posterior aspect of the fœtus is covered with glistening white organized tags of adhesions which have connected the fœtus with the maternal tissues. On floating these adhesions out in water they are seen to form a thick wavy veil.

On dissecting this layer of adhesions, loose numerous fatty plaques are seen in the skin.

The dorsal vertebræ form a prominent ridge, and at points where the spinous processes shimmer through the translucent skin are seen to be in a cartilaginous state.

The skin of the buttocks and the underlying fat and gluteal muscles have undergone saponaceous change, with here and there patches of calcareous matter sparingly interspersed through the external portions of the tissues

The umbilical cord is shrunken to about half its usual size and contains many calcareous nodules.

Median incision from the neck down to and through the symphysis pubis reveals the following condition: Superficially the body is covered with a membranous layer which can be peeled off easily, next comes the thick brawny bacon-like

skin, and beneath it the brownish red muscle which contains multiple fatty areas about the size of millet seeds.

The peritoneum is of a dull slate color, like that seen in an old post-mortem subject.

The intestines are collapsed, soft, pliable, and, except for the shrinking of the tissues from absorption of the watery elements, appear to have undergone little or no change.

The liver is of a light brownish red tint interspersed with slate colored patches.

On section the liver is found to be much denser than normal, the stroma is of a greenish brown color, with many minute yellowish spots.

The lungs are atelectatic and have a dense fleshy feeling. The color is brownish red, resembling the color of the liver.

On section, gritty particles are encountered with the knife.

The heart is collapsed, wrinkled, and of a dark brown color.

The spleen is small and dense.

On freeing the genital organs of the enveloping membrane the fœtus is found to be of the male sex.

Microscopical Examination. Lungs: the air spaces are small and the epithelial lining is not visible, but appears to be changed into fatty detritus and star-shaped crystals.

The connective tissue between the air spaces is pale, opaque and of a uniform homogeneous appearance, the separate connective tissue fibres not being distinguishable.

Interspersed throughout the connective tissue septa are many star-shaped crystals.

The muscular tissue of the heart still maintains its characteristic form, although undergoing marked fatty degeneration. No calcareous changes visible.

The general histological structure of the liver is unchanged, although the liver cells are undergoing fatty degeneration.

Diagnosis. Extra-uterine fœtus undergoing saponaceous mummification and calcareous changes. (Lithopedion.) The calcareous change is limited to the enveloping membrane, skin and lungs, the remainder of the internal organs showing only those changes due to fatty degeneration and absorption of their watery constituents.

Kuchenmeister makes the following classification of the calcareous changes which may occur in an extra-uterine embryo after its death:

Lithokelyphos, a condition in which the fœtal envelopes alone undergo calcareous changes, the fœtus shrinking to a mummified mass after the absorption of the amniotic fluid.

Lithokelyphopedion, a condition in which the fœtal envelopes and those parts of the fœtus which come in contact with the membranes undergo calcareous changes.

Lithopedion, a condition in which the fœtus after its expulsion into the abdominal cavity undergoes calcareous change, beginning externally in the vernix caseosa.

In ectopic pregnancy cases which survive the primary or secondary rupture of the gestation sac and are not subjected to operation, the embryo may be disposed of in various ways, depending upon its age and the maternal conditions surrounding it.

Complete absorption only occurs when the embryonic tissues are largely composed of watery elements and the bones are yet in a cartilaginous state; it is therefore highly improbable that an embryo more than three months old ever completely disappears in this way.

In order to arrive at an approximate idea concerning the ability of the human peritoneum to dispose of a young extra-uterine embryo when expelled into the abdominal cavity, Leopold* made an extremely interesting experimental study upon rabbits.

For this purpose he selected four series of pregnant animals at different stages of pregnancy, from which he removed the embryos by abdominal section and implanted them in the peritoneal cavity of other rabbits.

The embryos were of the following sizes: 2.5 cm. long, 5 to 6 cm. long, 8 cm. long, and the fully matured fœtus with intact membranes.

Some of the animals became infected and died from purulent peritonitis.

In these cases the rate of absorption was much more rapid than in those where the peritoneum remained normal.

Although the many experimental studies upon the function of the peritoneum have demonstrated its phenomenal absorptive ability, we are hardly prepared for Leopold's statement that when there was an accompanying peritonitis an embryo 2.5 cm. long was so completely absorbed by the end of the second day that no further trace of it could be found; that a 5-cm. long fœtus at the end of 24 hours showed only a small mass of bones, the epidermis and all of the internal organs having been absorbed; that of an 8-cm. long fœtus there remained only a small mass of tissue consisting of the skin, paws and nails and the shrunken internal organs and skeleton; and finally that the fully matured fœtus with its enveloping membranes was little less rapidly absorbed.

As the rupture of an ectopic pregnancy sac is in the majority of cases a sterile process, the results obtained in those experiments of Leopold in which there was no accompanying peritonitis probably more nearly indicate the approximate rate of absorption in the human being.

In those animals the absorption was quite as effective, although much slower.

After a few days embryos 2.5 cm. long were very much softened; in two instances, at the end of fourteen days they were only the size of a lentil, after thirty-four days they were still smaller, and at the end of fifty-two days were either completely absorbed or only a small trace of them could be found.

From these experiments Leopold concludes that a small embryo may be absorbed completely.

The accumulated observations upon the clinical course of extra-uterine pregnancy tend to prove that the great majority of cases will rupture within the first two months of pregnancy, and also that probably many accidents of this kind occur without the patient dying from their effects or being subjected to operation.

The natural course, therefore, in these cases will be for the embryo to be absorbed completely. It is only when the primary rupture is delayed beyond the third month, or when the embryo survives the rupture and continues to develop in an

*Archiv f. Gyn., vol. XVIII, p. 53.

adventitious sac until a secondary rupture occurs, that a lithopedion is likely to be formed.

In these cases the extruded embryo may lie free in the abdominal cavity as a non-irritant foreign body, or as is more likely, a wall of adhesions will form about it and thus shut it off from the peritoneal cavity. The close proximity of these encapsulated masses to the intestines and rectum renders them liable to infection at any time.

In the event of this complication extensive suppuration will occur and the fœtus quickly becomes skeletonized, and its bones may be discharged through a fistulous track into the rectum, vagina, bladder, or through the abdominal wall. It is only in the non-infected cases that mummification, saponaceous and calcareous changes take place.

The first cases of lithopedion recorded excited the liveliest curiosity and speculation among physicians as to their origin, and usually the conclusion was reached that no law governed their formation and that their origin was due to some mysterious or occult influence.

As an evidence of the views held by these earlier physicians, we find the case referred to by Spachius prefaced by the following lines: "Deucalion cast stones behind him and thus fashioned the human race, hence comes it that nowadays the tender flesh of babes is formed of stone."

In 1881 Kuchenmeister* reported a case in which a lithopedion had lain in the abdominal cavity of a woman 57 years. He carefully reviewed the literature bearing upon the subject of lithopedion, covering the period between the report of Albosius's case in 1582 and the time of the publication of his article in 1880.

From the fact that a lithopedion has always been considered such a unique production it is safe to assume that more of these cases in proportion to the number which have actually occurred, have been reported than of almost any other pathological anomaly, and yet from 1582 until 1880 Kuchenmeister was able to collect only 47 cases of mummified, skeletonized and calcified fœtuses, and of this number only a few can be accepted as true lithopedions.

Many of the earlier cases were dignified by special titles, such as the Lithopædion Senoense, Das Heidelberger Lithopädion von Nebel (1767), Das Berliner Lithopädion von Walter (1775), Das Dresdener Lithopädion von Seiler, Sen. (1819), etc.

Notwithstanding the great activity in the field of abdominal surgery since 1880, the year of Kuchenmeister's publication, comparatively few additional cases have been reported, a fact which still further proves that they are of very rare occurrence. If we select those cases from Kuchenmeister's review which represent a definite epoch or interesting fact in the history of this subject, we find that Albosius's case (1582) was the first reported. Varnier and Mangin's case (1785) was the first of double ectopic fœtation with the formation of a skeletonized fœtus and a lithokelyphos. Von Weinhardt's case (1802) was the first successfully operated upon by abdominal section, Bonisch's case (1821) the first successfully removed through the vagina, Lee Heiskell's case (1828) the first reported in the United States, and Kuchenmeister's case (1880) the one of longest standing. The case which I now report is the largest lithopedion yet removed by abdominal operation followed by recovery of the patient.

The cases just referred to are of sufficient interest to merit a short resumé of their histories.

In Varnier and Mangin's case (1785) there were two extra-uterine fœtuses of different ages found at autopsy.

A woman who had borne twelve children again became pregnant and went on to an apparently normal labor, March, 1752. The labor pains continued many days; water and considerable blood were expelled from the uterus, causing her to become weak and faint. After this false labor the patient gradually recovered, the abdomen, however, remaining enlarged. Eighteen months later she again had bleeding, from which she recovered, and continued well until the time of her death, 1785, in her 75th year.

At autopsy a white, moderately hard tumor of 5½ pounds weight was found adherent to the abdominal wall, intestines and mesentery. The outer surface was partly calcified, and within the tumor a male fœtus with its placenta and umbilical cord was found. The joints were flexible, not friable; the extremities were hard, but still fleshy and not calcified. The muscles were hard and brown; the skin dense and yellow.

Ovaries and tubes normal. Close to the left uterine wall and between it and the rectum, a hard, chalky tumor the size of a hen's egg was found, which contained a thick reddish slime and the bones of a two or three months fœtus.

This sac communicated through perforations in the uterine wall with the uterine cavity.

Von Weinhardt's case, 1802, should occupy a prominent place in the history of abdominal surgery on account of the courage exhibited by this barber-surgeon in attempting such a hazardous operation.

In this case the patient gave a history so characteristic of the rupture of an extra-uterine pregnancy sac that V. Weinhardt, after making an examination, not only diagnosed her true condition, but advised an operation, which he performed Sept. 25, 1801.

After exposing through an abdominal incision the tumor mass, the surface of which was covered with veins, he delivered it with a "flesh hook." Within the mass the fœtal bones could be felt distinctly. The foetus was removed, but no attempt was made to enucleate the placenta. The umbilical cord was brought out through the abdominal incision. The abdominal wound was dressed with cotton and a solution of balsam Peru and adhesive plaster. The patient recovered.

In this case the fœtal envelope alone had undergone calcareous changes, the fœtus having become skeletonized. Kuchenmeister therefore classified it as a lithokelyphos.

In the case of Bonisch (1815) the fœtus had lain in the abdomen for seven years before the operation.

The patient first noticed a large lump in her left side, accompanied by pain which she referred to the region of the umbilicus. This was her eighth pregnancy. The fœtal movements had been quite vigorous, and at full term all of the usual symptoms of labor came on and continued for three days, after which they ceased and her breasts decreased in

*Archiv f. Gyn., vol. XVII, p. 153.

size. For five weeks she had a bloody vaginal discharge. At the end of nine months the menses returned. The patient did not wholly recover, but suffered from dysuria, constipation, occasional abdominal pains, and emaciation. In 1817 and in 1819 she again bore children, but the pain and emaciation which had previously existed continued, and in addition she had a foul-smelling vaginal discharge.

At the time of the operation a sharp bone (frontal bone) projected into the vagina; this was first removed, accompanied by the escape of pus, after which the cranium was crushed with bone forceps and removed piecemeal. The left arm was then torn off with a hook, but remained attached by adhesions to the abdominal wall.

The bone was removed, leaving the soft parts behind. The hook was then fastened to the right arm, and all of the parts removed except the right thigh. This bone with the adherent parts was removed later.

The patient recovered, but had an occasional discharge of calcareous and cheesy masses, and the soft parts which were left behind formed a hard swelling over the pubes. Involuntary urination still continued.

Lee Heiskell's case is of interest merely because it was the first reported in the United States. The lithopedion was removed at autopsy and weighed four pounds and six ounces.

The clinical history of Kuchenmeister's case was reported by Hirt, an accoucheur in Zittau, in V. Siebold's Journal für Geburtshülfe in 1834.

The patient gave birth to a dead fœtus in 1819, after which she again menstruated regularly until the end of the year 1823, when symptoms of another pregnancy appeared.

During the second half of her pregnancy she began to have much pain, which increased as the fœtal movements grew stronger, until she did not have an hour free from suffering. At the time of her expected confinement she experienced labor-like pains for a few days.

On Oct. 25th, after eating a light midday meal, she suddenly had a feeling of heart anguish, cramp and lancinating pain in the abdomen accompanied by vomiting.

After this time she became very sick and no longer felt the fœtal movements or labor pains. Three days later Hirt was called and found the woman in an unconscious condition, with all the signs of a septic fever associated with an inflammatory attack in the abdomen. On account of the tympanitic condition of the abdomen Hirt was only able to make out rather indefinitely the transverse position of the fœtus above the umbilicus.

After an examination of the uterus, which he found empty, he felt convinced that this was a case of "abdominal pregnancy." On account of the serious condition of the patient and the death of the fœtus he did not consider the recovery of the patient possible without an operation, but under the administration of medicines "nature asserted herself," and Hirt says, "Truly I had the pleasure of seeing a slow recovery set in." After this time the patient had an ill-smelling diarrhœa which gradually disappeared. Milk appeared in the breasts on the 21st day and was present for 14 days. Nine weeks after the first day of her illness she had a bright red flow of blood mixed with pieces of skin and fibres.

From this time on the patient made a good recovery, and with the exception of pain which she noticed in certain movements of the body as in bending far forwards, and an occasional sharp, sticking pain in the right side, she suffered no inconvenience. Ten years after the attack Hirt examined the patient and found the fœtus still in a transverse position, the head towards the right side of the mother. Through the posterior wall of the vagina a part of the fœtus which he took for one of the upper extremities could be felt.

In 1846, 13 years after Hirt's last note, Kuchenmeister first saw the case and found a tumor one and a half times as large as a head adherent to the abdominal wall in a transverse direction, making a prominent conical tumor near the umbilicus. The tumor was closely adherent to the abdominal wall and was only movable in so far as the abdominal wall was movable. The fœtal parts could not be recognized. The uterus was normal in size and form and at most slightly anteverted. By the vagina the tumor could not be felt.

The patient continued in good health until 1880, when she died in her 88th year. The autopsy was performed by Kuchenmeister, June 3d, 1880. The body was greatly emaciated, and the abdomen presented a prominent conical appearance, most marked near the umbilicus. The tumor was intimately adherent to the mesentery and anterior abdominal wall, requiring the knife to separate the adhesions. The tumor was in part directly adherent beneath and at the sides to the adjacent intestine, and in part connected by band-like adhesions with the more distant intestines and especially with the uterine appendages. The broadest adhesions resembled the bursted tubal sac. From one part of the tumor a fœtal foot projected, the skin over which was dry and the tendons stood out prominently like those seen in dried anatomical preparations. The tumor was hard, inflexible and calcified. The placenta was soft and easily differentiated from the ectopic sac.

On opening the sac a full-term mummified fœtus was found. It was very much shrunken, the face was distorted but not calcified and was covered by the right arm. The umbilical cord was wound around the thorax of the fœtus and easily visible. All of the inner organs could be recognized without difficulty. The general appearance of the scalp, cranium, brain, lungs, heart, pericardial sac, diaphragm, spleen and liver was preserved, but the intestines had shrunk into an unrecognizable mass.

A microscopical examination of this and another specimen was made by T. Wyder, who found only calcareous deposits in the skin and amniotic sac and not in the internal organs. The various tissues were mostly easily recognized and in part were wholly preserved. In the denser tissues the cell elements were most resistant and retained their normal appearance and arrangement. In all localities where fat had previously existed margarine and cholesterine crystals were found.

As Kuchenmeister's table possesses considerable historical interest I have rearranged it according to the chronological report of the cases and append it to this paper.

Since the publication of Kuchenmeister's paper cases have been reported by the following writers, but none of them

possess any special points of interest over the cases found in his report:

Dahlmann, Archiv f. Gyn., 1879, Vol. XV, p. 128.

Oettinger, Progrès Med., 1884, Vol. XII, p. 196.

Sarrante, Archiv de Tocol., 1885, Vol. XII, p. 237.

Oppel, A., Münch. med. Wochen., 1888, Vol. XIII, p. 151.

Stonham, Tr. Path. Soc. London, 1886–7, Vol. XXXVIII, p. 445.

Hammer, Prag. med. Wochen., 1888, Vol. XIII, p. 151.

Fales, W. H., Boston M. and S. J., 1887, Vol. CXVII, p. 131.

Tarnier, Bull. Acad. de Méd., 1889, Vol. XXII, p. 57.

Schotte, G., Münch. med. Woch., 1890, Vol. XXXVII, pp. 471, 489, 503.

Wilson, E. H., Brooklyn M. J., 1891, p. 515.

Elbing, R., St. Petersb. med. Woch., 1890, Vol. VII, p. 299.

Lusk, Med. Rec., N. Y., 1892, Vol. XLII, p. 405.

Hofmeier, Sitzungs. d. phys.-med. Gesellsch., Würzburg, 1892, p. 134.

Gottschalk, Canad. Pract., 1893.

Patellani, Ann. di Obstet., Milano, 1893, Vol. XV, p. 817.

Dean and Marnoch, J. Anat. and Physiol., London, 1893–94, p. 77.

Fabbrovich, Gazz. d. Osp. Milano, 1894, Vol. XV, p. 890.

Djemil-Bey, Ann. de Gynéc. et d'Obstet., Paris, 1894, Vol. XLII, p. 333.

KUCHENMEISTER'S TABLE OF CASES REPORTED BETWEEN THE YEARS 1582 AND 1880.

Case No.	Year of observation.	Name of observer.	Number of births before the ectopic pregnancy.	Time when labor pains or symptoms of rupture occurred.	Length of time fœtus was retained.	Lithokelyphos.	Lithokelyphopedion.	Lithopedion.	Skeletonization.	Saponification.	Primary site.	Age of the woman at death.	Escape of water from uterus.	Escape of decidua from uterus.	Return of menses.	Other births after the ectopic pregnancy.	Remarks.
1	1582	Albosius.	None.	...	28 yrs.	..	1	..	..	..	Normal uterus.	66 years.	Yes.	Yes.	....	....	
2	1659	Densius, Pont à Mousson.	"	6th month.	?	..	1	..	..	..	....	....	....	....	....	....	
3	1661	Schnorffs in Dole.	....	9th month.	....	..	..	1	..	..	....	53 years.	....	..	Yes.	....	
4	1675	de Blegny (Toulouse).	10	Full term.	28 yrs.	..	..	1	..	..	Tube.	25 years.	....	Prolonged purulent discharge	....	....	Pregnancy in the uterine end of the Fallopian tube. Fœtal head in fundus uteri.
5	1719	Bompard.	....	7th month. 2 days in labor.	15 yrs.	..	..	..	1	..	Uterus?	....	....	....	....	....	Skeletonization and softening of the fœtus with partial spontaneous extrusion.
6	1720	Orth, Steinkind, Von Leinzell.	....	Full term. Labor pains 3 to 4 weeks.	51 yrs.	..	1	..	..	..	Probably in one horn of uterus.	91 years.	....	....	....	2	
7	1728	Bianchi.	2	In the 9th month.	15 yrs.	1	..	..	..	..	Ovary.	....	...	...	....	....	
8	1741	Bromfield.	....	Full term.	9 yrs.	1	..	..	..	..	Uterus, perforation of the cervix uteri.	....	....	.	....	...	
9	1747	Middleton.	....	Full term.	16 yrs.	..	..	1	..	..	Fimbriated extremity of tube.	....	Yes.	.. .	....	4	
10	1748	Bourdon and Chamerau in Troyes.	1 miscarriage.	Full term. Labor pains 2 days.	30 yrs.	1	..	..	..	..	Right tube.	61 years.	....	....	...	....	Two incisor teeth in jaw.
11	1767	Heidelberg case of Nebel.	2	Full term.	54 yrs.	..	..	1	..	..	...	91 years.	Yes.	...	Yes.	2 abortions.	Patient recovered after many weeks.
12	1775	Walter, of Berlin.	1	9th month.	22 yrs.	..	..	1	..	..	Right ovary.	....	...	....	....	....	
13	1784	.....	2	Full term. Labor pains for 3 days.	8 yrs.	1	..	..	..	..	Left tube.	45 years.	....	Yes.	Two years later.	....	
14	1785	Varnier and Mangin.	12	Full term. Labor pains for many days.	33 yrs.	1	..	..	1	..	One fœtus in abdom. cavity, the other in saccommunicating with uterus.	75 years.	Escape of water with blood.	Probably decidua.	18 months later.	....	One fœtus fully developed (9th month), the other 3 months old.
15	1786	Mühlbeck.	1	11th month.	14½ yrs.	..	..	1	..	..	Uterus.	....	Yes.	....	...	....	Fœtus died in the 7th month.
16	1798	Cheston (case 1).	3	Full term. Labor pains 3 weeks.	50 yrs.	1	..	..	..	..	Uterus unicornis unicollis (mit Nebenhorn).	80 years.	....	...	....	....	
17	1798	Cheston (case 2).	....	Full term.	4 yrs.	..	.	..	1	..	Normal uterus.	Operated upon in 29th year.	Flow of fetid water for 15 months	...	4 years after operation.	. ..	
18	1800	Denmann.	1 full term. Many miscarriages.	9th month.	32 yrs.	..	..	..	.	..	...	....	....	...	...	....	History of case very imperfect.
19	1802	Von Weinhardt.	...	Near the 7th month.	7 yrs. to the time of operation.	1	..	..	..	..	Probably extra-uterine.	....	Yes, one week.	Blood and fleshy matter.	...	....	Recovery.
20	1805	Cadwell.	No.	Full term. Labor pains one day.	26 yrs.	..	..	1	..	..	Retained in uterus.	....	....	Yes.	....	. ..	Died from operation performed through the cervix.
21	1806	Grivel.	....	....	....	..	..	..	.	..	Abdomen.	83 years.	....	. ..	. ..	....	

KUCHENMEISTER'S TABLE OF CASES REPORTED BETWEEN THE YEARS 1582 AND 1880.—*Continued.*

Case No.	Year of observation.	Name of observer.	Number of births before the ectopic pregnancy.	Time when labor pains or symptoms of rupture occurred.	Length of time fœtus was retained.	Lithokelyphos.	Lithokelyphodion	Lithopedion.	Skeletonization.	Saponification.	Primary site.	Age of the woman at death.	Escape of water from uterus.	Escape of decidua from uterus.	Return of menses.	Other births after the ectopic pregnancy.	Remarks.
22	1810	Mascagni.	9	At the end of the 9th month.	14 yrs.	1	..	..	..	..	Right tube.	53 years.	....	Blood.	Yes.	....	
23	1819	Seiler.	No.	...	46 yrs.	..	..	1	..	..	Abdomen.	80 years.	....	....	....	. ..	Spontaneous delivery through vagina and rectum.
24	1819	Praël.	1	No symptoms of labor.	28 yrs.	..	.	.	1	..	Uterus.	68 years.	...	....	....	....	
25	1820	Bruns.	....	....	50 yrs.	..	..	..	..	..	....	....	....	..	....	....	History of case imperfect.
26	1821	Bönisch.	7	Full term, 3 days long.	7 yrs. up to time of operation.	..	..	1	..	..	....	....	....	....	....	.. .	Recovery. Fœtus removed through the vagina.
27	1825	Cruveilhier.	3	7th month.	47 yrs.	1	..	..	..	..	R. tube and ovary	82 years.	....	....	Yes.	2	
28	1828	Lee Heiskell.	....	....	40 yrs.	1	..	..	..	..	Abdominal cavity	....	....	..	....	....	
29	1832	Stoltz.	1	End of the 9th month.	2 yrs.	.	..	..	..	..	Posterior wall of uterus and its adductor. Possibly in one corner of uterus.	. .	Slight.	Small amount of blood.	.. ....	....	
30	1836	Case reported from the city of Danzig, author not cited.	....	Labor pains at full term.	40 yrs.	1	..	..	..	..	Abdominal cavity.	....	....	....	....	....	
31	1839	Bondet.	1	Labor pains at full term.	29 yrs.	1	..	.	..	..	Abdominal cavity.	....	...	....	....	...	
32	1841	Löscher.	2	Full term. Labor pains continued 2 days.	11 yrs.	..	.	1	..	..	R. ovary.	..	Yes.	....	Yes.	...	
33	1849	Virchow.	....	...	26 yrs.	1	..	..	..	..	L. ovary.	?	....	....	...	....	
34	1854	Will.	1	Full term.	10 yrs.	1	..	..	..	..	L. ovary?	39 years.	....	Bloody discharge.	..	2	
35	1855	Stein in Steinau	1, 10 years before.	Full term. Labor pains 14 days.	½ yr.	..	..	1	..	..	Regio. mesar.	....	....	....	..	....	
36	1859	Von Genns and Schrant.	7 full terms, 3 abortions.	..	12 yrs.	1	..	..	..	..	R. ovar. and parov.	44 years.	....	...	....	....	
37	1864	Playfair.	2	Full term.	2 yrs.	..	..	..	1	1	Tube and ovary.	....	....	....	Yes.	...	Vienna paste applied to the sac per vag. Before it was eroded the patient died.
38	1866	Platzer.	....	7th month	½ yr.	1	..	..	..	..	Fimbriated end of left tube and l. ovary	....	....	4 months after the death of the fœtus.	....	....	
39	1866	Turner.	....	....	⅛ yr.	1	..	..	..	..	In one cornu uteri.	....	....	....	....	....	The fœtus was more than a half year over term before it was delivered.
40	1872	Wurm in Teinach.	1 full term, 2 abort.	7th month.	2 yrs.	1	..	..	..	..	Tube and ovary.	....	....	Nine days after the death of fœtus.	....	...	
41	1872	Bossi.	....	....	6 yrs.	1	..	..	..	1	L. ovary.	....	....	....	....	4 times delivered artificially.	
42	1876	Chiari.	7	8th month.	49 yrs.	1	..	.	..	..	L. ovary absent.	82 years.	....	....	....	..	
43	1876	Galli.	2	7½ months.	37 yrs.	1	..	..	..	..	...	....	....	...	....	1	
44	1877	Deschamps.	1	Full term. Labor pains for 3 days.	7 yrs.	..	..	..	..	..	Uterus.	....	....	....	....	1	
45	1878	Chiari.	...	....	5 yrs.	1	.	..	..	..	Canalis inter-canaliculi.	....	....	....	...	....	The fœtus was undergoing suppuration.
46	1878	McCollom.	Many.	Full term. Labor pains 36 hours.	11 yrs.	..	..	..	1	..	....	....	....	....	After 3 months.	....	
47	1880	Kuchenmeister.	1	Full term. Few days.	57 yrs.	1	..	..	..	..	Left tube.	88 years.	....	Nine days after the death of fœtus.	Yes.	...	

ON TUBERCULOSIS OF THE ŒSOPHAGUS, WITH THE REPORT OF A CASE OF UNUSUAL INFECTION.

By Claribel Cone, M. D., *Professor of Pathology, Woman's Medical College, Baltimore.*

[*From the Pathological Laboratory of the Johns Hopkins University and Hospital.*]

Renewed attention to the subject of tuberculosis of the œsophagus has shown that this organ is not so often spared in tuberculous affections as was at one time believed. Thus, in a critical review of the subject published in 1893, Dr. Flexner,* who reported a new case, was able to collect from the literature up to that date only eighteen undoubted cases. Since his publication there have appeared, so far as has come to the writer's notice, twenty-eight additional cases. Of these twenty-eight cases it is worthy of remark that nine were described by one observer, Mazzotti.†

Another case from this pathological laboratory is to be added to the list, and now that the affection is no longer recognized as of great rarity, its report is suggested as much by the peculiar distribution of the tubercles as by the pathological condition itself. It seems worth while at the same time to re-collect all the cases and to consider the classification with reference to their ætiology.

The classification suggested by Flexner is as follows:

I. Instances in which the tuberculous process arises through continuity or contiguity of structure.

(*a*) Where a caseous bronchial gland or group of glands becomes adherent to the œsophagus and ulcerates into the latter.

(*b*) In consequence of perforation of abscesses associated with caries of the vertebræ.

(*c*) Where tuberculous ulcers of the pharynx pass down and invade the œsophagus.

II. Cases in which there exists in the œsophageal mucous membrane a previous lesion to be regarded as predisposing to the tuberculous infection.

III. Instances in which (*a*) the œsophagus is affected in the course of a general disseminated miliary tuberculosis, and (*b*) in which there is infection of the mucous membrane from tuberculous sputum where no previous lesion existed.

Of the nineteen cases collected by Flexner,‡ eleven belong to the first class, two to the second, and six to the third. In the first group are included the cases of Weichselbaum (1), Beck (2), Penzoldt (3), Orth (2), Pitt (1), and Zenker (2); in the second group those of Eppinger (1) and Breus (1); while the third class includes the cases of Mazzotti (3), Spillman (1), Frerichs (1), and Flexner (1).

Of the six cases comprising the last group, one only occurred in the course of a disseminated miliary tuberculosis giving rise to an eruption of miliary tubercles in the œsophagus. This case, which was reported by Mazzotti,§ is the only published account of miliary tuberculosis affecting the œsophagus.

The additional twenty-eight cases which have been reported since 1893, including cases omitted from Flexner's original publication, can be divided so that thirteen fall in the first, three in the second, and twelve in the third class.

A.—Infection by Continuity or Contiguity of Structure.

1. Selenkow* reported a case of partial destruction of the œsophagus by tuberculosis. Gastrostomy was followed by impaired nutrition and death. In the lungs were found old tuberculous lesions, which, approaching the root on the right side, invaded the lymph glands. The latter became adherent to one another, forming a diffuse caseous mass both anterior and posterior to the œsophagus, and finally ulcerated into the anterior wall of the tube below the bifurcation of the trachea. A cavity about the size of a hen's egg was produced in the enlarged and caseous lymph glands, which was filled with detritus and into which the lumen of the œsophagus opened freely. Two distinct perforations occupying an area 5 cm. long and separated by a narrow strip of tissue existed. The lumen of the œsophagus was constricted in the lower segment and was only about half the size of the upper part. Although no bacteriological or histological examination was made in this case, the tuberculous nature of the lesions can scarcely be doubted.

2. Voelcker† reports the case of a boy, aged 9 years, in whom the post-mortem examination showed a mass of cretaceous glands at the hilum of the right lung. On opening the œsophagus a perforation was found on the anterior wall, a little to the right of the middle line and a little below the level of the bifurcation of the trachea. The opening was about 5 mm. in diameter; the edges were puckered and led into a cavity in which caseous material could be seen.

Voelcker has also collected from 2504 autopsies in the post-mortem records of the Hospital for Sick Children, four other cases of tuberculosis of the œsophagus associated with general tuberculosis, to which he briefly refers.

3–4–5. In three of these cases caseous glands ruptured into the œsophagus.‡

Letulle§ reports three cases, one of Londe and two of his own.

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* Flexner: Tuberculosis of the Œsophagus. Johns Hopkins Hospital Bulletin, IV, 1893–4.

† Mazzotti: Nuove osservazioni intorno alla tuberculosi dell' esofago. Dal Bulletino d. Scienze Mediche di Bologna, VII, ser. VII, 1896, 553–579.

‡ Flexner: Op. cit.

§ Mazzotti: Revista Clinica, Januar, 1885.

* Selenkow: Kasuistische Mittheilungen a. d. ausser-städtischen Hospital. St. Petersburger med. Wochenschr., IX, 1884, 491.

† Voelcker, A. F. Caseous Gland opening into the Œsophagus. Tr. Path. Soc., Lond., XLII, 1890–91, 87.

‡ The additional case was one in which an oval ulcer, three-quarters of an inch long, existed at the level of the bifurcation of the trachea; but in this case the note says: "The muscular coat remains, the floor is smooth as if healed up, although in the neighborhood of a caseating gland. The ulceration, as far as could be seen, had not started from or been in any way caused by the gland." The ætiology in this case must certainly be regarded as doubtful.

§ Letulle: Lesions tuberculeuses de l'œsophage. Bull. Soc. Anat. de Paris, LXVIII, 1893, 246.

6. Londe's case was that of a man 50 years old, who died suddenly of hæmatemesis. The autopsy revealed a fistula in the anterior surface of the œsophagus immediately below the bifurcation of the trachea, still filled with blood and leading into a small tuberculous cavity which had developed in a caseous bronchial lymph gland. The starting point of the tuberculous lesions was found in a miliary tuberculosis of the pleura which, invading the thoracic glands, produced caseation and calcification, and later adhesion between the affected bronchial glands and the œsophagus, with ultimate perforation of the latter.

7. Letulle states that his first case was very similar to that of Londe and omits in his publication all details.

8. His second case occurred in a young man, the subject of a tuberculous empyema which had ruptured into the œsophagus. On microscopic examination the œsophagus showed infiltration of the muscular and submucous coats with embryonic cells, little caseation and no giant cells. Tubercle bacilli were not found.*

K. Zenker† adds four cases, of which two belong to the present class.

9. In the first case the tuberculous lesion of the œsophagus occurring in a young consumptive was accidentally discovered at autopsy. The tuberculosis originated in the lungs, spread to the bronchial lymph glands, the peri-glandular tissue, and the œsophagus, infiltrating the walls of the latter from without inward until ulceration and perforation were produced. The microscopic examination showed tubercles in the muscular and submucous coats chiefly, and numerous tubercle bacilli.

10. Zenker's second case was a man 46 years old who had tuberculosis of the serous membranes. The bronchial glands were considerably enlarged and caseous, and had ulcerated into the œsophagus at its mid-portion in three places. The histological examination of the œsophagus showed tuberculous infiltration of the muscularis and submucosa, while the epithelium was scarcely affected. In the neighborhood of the ulcers, tubercles were found in the submucosa. These contained tubercle bacilli.

11. A case reported by Danel‡ also belongs to this group. There were tubercle nodules in both lungs, general glandular enlargement, and tubercles, some of which had ulcerated in the mucosa of the pharynx. The œsophagus in its posterior portion showed an extensive ulceration of the mucosa. The ulcer was about 10 cm. long and extended longitudinally. Its edges were eroded and it contained granules resembling tubercles. Other nodules taken to be tubercles were found on the anterior surface. The cause of the infection of the œsophagus was a softened bronchial lymphatic gland situated at about the bifurcation of the trachea, which, having become adherent to the œsophagus, perforated into this organ. The opening between the gland and the œsophagus measured about 1 cm. Although no histological or bacteriological examination was made, there can be no doubt of the specific nature of this case.

Of the nine cases added by Mazzotti to the three previously reported by him only one belongs to the present group. He confirmed his diagnosis of tuberculosis in each case by the demonstration of tubercle bacilli. His experience is remarkable, not only because of the large collection of cases of a pathological condition, the rarity of which is generally acknowledged, but also because of the predominance among them of that form of lesion which is admitted to be most infrequent. In eight of his cases the process began within the œsophagus, while, as stated, in one only there was an extension inward from caseous bronchial glands.

12. This case was that of a man aged 21 years, who died of pulmonary and intestinal tuberculosis. The œsophagus at the union of the upper with the middle third showed two ulcers, one near the other, somewhat elongated and of the size of a *centesimo*. The edges of the ulcers were smooth and of a greenish color; the irregular bases were also green. The ulcers perforated all the coats of the œsophagus, and their bases were formed by a collection of detritus situated under the œsophagus itself, and found to proceed from softened caseous bronchial glands. Two similar ulcers, also close together, communicating with each other beneath the mucosa, were seen at the junction of the middle and lower thirds of the œsophagus; while yet below, were small superficial elliptical ulcers in the longitudinal direction of the canal. The lymph glands had also ulcerated into the left bronchus just at its origin from the trachea.

13. A case arising through continuity of structure is reported briefly by Birch-Hirschfeld.* At the autopsy (sex and age not given) there were found tuberculosis of the lungs and numerous tuberculous ulcers in the larynx, pharynx and upper third of the œsophagus. Tubercle bacilli were demonstrated.

B.—Predisposition to Infection due to a Previous Lesion.

1. K. Zenker's third case was an example of coincident carcinoma and tuberculosis of the œsophagus. A stricture of the tube, produced by a girdle ulcer of rodent character, existed, which on microscopic examination showed the typical appearance of squamous epithelioma. This growth invaded the deeper strata of the mucosa and at times penetrated the muscularis. In the border of the cancerous portion, toward the normal tissue, typical tubercles existed, some of which were caseous. The neighboring lymph glands also were involved in the cancerous and tuberculous conditions. Tubercle bacilli were found in small number in the tubercles. Zenker does not commit himself as to whether the carcino-

*The validity of this case may well be questioned. Mixed infections in empyema are by no means unknown, so that the possibility of the invasion of the œsophagus by other micro-organisms (pyogenic cocci?) is well worth considering.

†K. Zenker: Carcinom und Tuberkel in selben Organe. Deut. Arch. f. klin. Med., XLVII, 1891, 191; Beitrag zur Aetiologie und Casuistik der Tuberculose der Speiseröhre. Deut. Arch. f. klin. Med., LV, 1895, 405.

‡Danel: Œsophagite tuberculeuse consécutive à une ancienne tuberculose peri-bronchique généralisation ganglionnaire. J. d. Sc. méd. de Lille, XIX, 1896, 1, 520.

*Birch-Hirschfeld: Lehrbuch der path. Anat., II, 1894, 620.

matous or tuberculous lesion was primary, but favors the former view because of the admitted resistance offered by the intact epithelium to tuberculous infection.

2. In this group of cases the one reported by Cordua* is to be placed.

A man 60 years of age came to autopsy, the clinical diagnosis of carcinoma of the œsophagus, incipient pulmonary tuberculosis, and adhesive pleuritis having been made. In the œsophagus, at about the bifurcation of the trachea, was found an ulcer 10 to 15 cm. long, which affected this structure in its entire circumference. The edges of the ulcer were somewhat elevated and firm; the base was very soft and pulpy. A sound could be passed from the middle of the ulcer far into the periœsophageal tissues, but not into the air passages. Upon sectioning the ulcer, the entire wall of the œsophagus was found to be almost destroyed, forming a small tumor mass. The microscopic examination showed, in addition to the carcinomatous, a tuberculous infection. Tubercles in process of caseation were found in the middle of the cancerous ulcer and about its periphery. Careful search failed to reveal tubercle bacilli.

Cordua favors the view that the tuberculous invasion of the cancerous ulcer took place through the lymphatics leading from tuberculous areas in the lungs; and he assigns as reasons for his belief in this mode of infection, the absence of cancerous metastases and the presence of coal pigment in the lymph glands, the deep location of the older tubercles in the cancerous ulcer, and the more superficial situation of the younger ones. It would seem, however, more probable that the secondary tuberculous infection was due to sputum deglutition.

3. Pepper and Edsall† report the case of a man, 42 years of age, who had tuberculosis of the lungs, larynx, cervical glands and œsophagus. The œsophagus was patulous and normal as high up as the level of the arch of the aorta. Above this point and to the junction with the pharynx, the lumen had entirely disappeared. The œsophageal walls and surrounding tissues had formed a band of dense fibrous tissue, about 1.25 cm. thick and 3.75 cm. broad, which was firmly bound to the vertebræ. Sections of the growth examined microscopically showed cancerous tissue in a dense fibrous tissue basis, tubercle-like masses undergoing fibroid change, an occasional giant cell, and tubercle bacilli.

The central and deeper portions of the tumor were composed mainly of fibrous tissue, and this appearance led the authors to conclude that tuberculosis was evidently the original cause of the disease, while cancer subsequently infiltrated the occlusion. (?) That the cancer was primary they consider improbable, both from the microscopic appearance of "infiltration of a previously existing mass, and from the history of cancer being here as elsewhere one of inexorable growth and onward progress, ulceration, and sloughing."

*Cordua: Ein Fall von krebsig-tuberculosem Geschwür des Oesophagus. Arbeiten a. d. pathologischen Institut in Göttingen, 1893, 147.

†Pepper and Edsall: Tuberculous occlusion of the œsophagus with partial cancerous infiltration. Amer. Jour. of the Med. Sci., CXIV, 1897, 44.

C.—Infection of the Intact Membrane directly (by Sputa) or from the Circulating Blood.

This class embraces those lesions which heretofore were regarded as most unusual, but which from Mazzotti's experience must rank in frequency with those described in class I. The eight cases of Mazzotti belonging to this group would seem for the most part to have been caused by the deglutition of tuberculous sputum, though the coexistence of ulcers and nodules makes it difficult in some instances to differentiate certainly the inoculation of tuberculous sputum from infection through the blood.

1. The first case reported by Mazzotti was a woman, aged 33 years, who died of pulmonary and œsophageal tuberculosis. At autopsy the mucosa of the œsophagus, normal in its upper part, was found reddened below. The redness increased in intensity from above downward, becoming scarlet near the cardiac orifice of the stomach. On this red base were scattered numerous tuberculous ulcers. These were small and superficial in the upper segment, measuring several millimetres in diameter, becoming larger lower down, until near the cardiac orifice of the stomach several of them coalesced, forming an extensive loss of substance. The large ulcer thus produced was more irregular and deeper than the others, extending indeed to the muscular tunic.

2. The second occurred in a man, aged 40 years, who died of pulmonary phthisis. The œsophagus presented above, and in the anterior wall at its junction with the larynx, several white, rounded prominences, slightly larger than the head of a pin, with ulcerated centres. A little lower down there was an elliptical longitudinal ulcer with smooth base and slightly elevated edge, 5 cm. in circumference. Lower still, and rather near the end of the œsophagus, a yellowish nodule projected from the mucosa. This had ulcerated, and in all respects resembled the elliptical ulcer described. The mucous membrane in general was pale, but near the stomach there was some injection without ulceration.

3. The third case was a woman, aged 35 years, who had died of pulmonary tuberculosis. The œsophagus was normal in its upper part. At about the middle third the mucosa was of a greyish black color and contained several superficial ulcers with smooth margins and regular white bases. They were elliptical in the longitudinal direction. In the lower third the mucosa was pale, but here, too, were elliptical ulcers, smaller than the former, which they resembled in every other particular. The deepest of these ulcers scarcely reached the muscular coat.

4. The fourth was a man, aged 60 years, who succumbed to pulmonary and intestinal tuberculosis. The mucosa of the œsophagus in its lower half contained about 30 elliptical ulcers with smooth, regular margins and bases. They were smaller and more superficial above, but on descending the canal approached each other more closely, became larger and deeper, extending finally to the submucosa.

5. The fifth example was furnished by a male, aged 18 years, who died of pulmonary phthisis. Throughout the œsophagus were scattered numerous ulcers. They were elliptical in form, the larger ones being relatively longer than the smaller. In

some places several ulcers were united in such a way as to present an irregular shape. In other places the ulcers were separated by little tracts of healthy mucosa, giving the appearance of a network. They were not very deep, touching at most the submucous tissue, and had greyish bases and smooth, regular, slightly elevated edges.

6. The sixth was a man, aged 67 years, in whom pulmonary and intestinal tuberculosis were also found. In the œsophagus, three inches from its origin, was an ulcer of the mucosa 5 cm. in length. Near this were two small ulcers, while a little below was one of intermediate size. The remainder of the mucosa contained only smooth white elevations about the size of a pin-head. At the junction of the middle and lower third of the œsophagus, was a diverticulum as large as the end of the little finger.

7. The seventh was a woman, aged 48 years, who presented the lesions of pulmonary and intestinal tuberculosis. In the lower two-thirds of the œsophagus the mucosa attracted attention by an intense redness which extended over a wide area. In the midst of this were twelve or fifteen ulcers of various sizes. The smaller ones were round, measuring 0.5 cm. in diameter; the larger were elongated, the diameter of the largest reaching more than 3 cm. The rest were all regular, with smooth superficial margins, except a single deeper one situated at the union of the middle and lower thirds.

8. Mazzotti's final case was a man, aged 61 years, who succumbed to pulmonary phthisis. The œsophagus in its upper part presented four or five scars several millimetres in length, with ulcerated centres, in the vicinity of which the mucosa was pale, but otherwise of normal appearance.

9. Zenker's fourth case belongs to this class. It occurred in a man 38 years old, who suffered from tuberculosis of the lungs, nose and throat, enlarged lymphatic glands, and stenosis of the œsophagus. At the autopsy, the œsophagus in its uppermost part presented a large superficial scar-like ulcer which included almost the entire circumference of the canal, and formed a marked constriction. At about its middle portion the œsophagus showed an elevated nodule the size of a bean, from which thin pus escaped. The bronchial and peri-œsophageal lymph glands were enlarged and caseous. The microscopic examination of the lesions in the œsophagus exhibited the histological characters of tuberculosis, which was limited to the mucosa and submucosa. Numerous tubercle bacilli were demonstrated in the tubercles and pus.

Zenker* believes that the infection in this case was due to sputum deglutition, and brings forward the fact of the superficial character of the ulcers in support of this view.

10. Hasselmann† describes the case of a boy six months old, in whom, in addition to tuberculosis of the œsophagus, there existed tuberculosis of the lungs and lymph glands. In the lower part of the œsophagus three crater-like ulcers were found which had no connection with either the trachea or the caseous lymph glands. The microscopic examination proved them to be tuberculous in nature. The infection is believed to have taken place from the swallowed sputum.

11. The case reported by E. Fränkel* occurred in a man 33 years of age, who died of pulmonary and intestinal tuberculosis. The œsophagus contained a large number of yellowish spherical nodules about the size of a hemp seed, some with superficial loss of substance, others still covered with the intact mucosa. Adjacent to these were found small masses with irregular edges and uneven bases, and several small round ulcers with abrupt edges and perfectly smooth bases, averaging 3 mm. in diameter. The larynx, trachea and peritracheal lymph glands were quite intact. The microscopic examination of the lesions showed besides epithelioid and giant cells, tubercle bacilli.

Regarding the mode of infection in this case, Fränkel does not consider it possible to conclude certainly between a hæmatogenous origin and the inoculation of tuberculous sputum, but he inclines to the latter view.

12. Glockner† describes a case which he regards as of hæmatogenous origin, and which is peculiar in the limitation of the tubercles to the muscular coat of the œsophagus.

It occurred in a man, 48 years of age, in whom the autopsy showed old tuberculous areas in the apices of both lungs, tuberculosis of the pleura, peribronchial and mesenteric lymph glands, œsophagus and viscera generally. The œsophagus at its mid-portion contained an irregular thickened zone, encircling the wall of the tube, 5 cm. in width, and from 5 to 7 mm. in thickness. On section of this thickened area it was found to consist of numerous caseous tubercles, varying in size from a pin-head to a hemp seed, irregularly infiltrating the muscular coat, to which they were strictly limited. The mucosa and submucosa were perfectly intact and freely movable over the deeper lying structures. The peri-œsophageal tissue was likewise free from diffuse infiltration, but contained several small strands with interrupted nodular swellings the size of a millet seed. These strands were interpreted by Glockner as tubercle-infiltrated afferent vessels of lymph glands. The lymph glands in the neighborhood of the thickening, as well as those about 3 cm. above, were somewhat enlarged and caseous, but not abnormally adherent to the peri-œsophageal tissue. Microscopic examination showed the typical structure of caseous tubercles, and tubercle bacilli in great numbers were found.

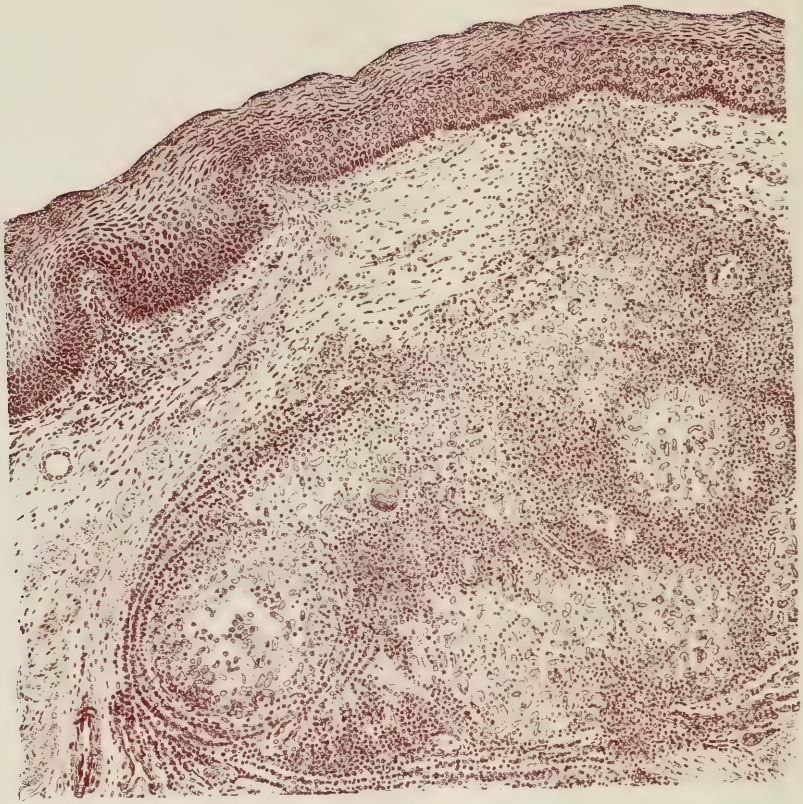
Glockner regards this case as certainly of hæmatogenous origin and believes that he excludes all other modes of infection. Infection through continuity he eliminates by the absence of lesions in the continuous structures; direct inoculation of the inner surface of the mucous membrane is rendered improbable by the intact condition of both mucosa and submucosa; invasion from the peribronchial lymphatic glands, through lymph transport of tubercle bacilli, he excludes by the freedom from tuberculous infiltration of the peri-œsophageal tissue. In favor of hæmatogenous infection

* Zenker: Op. cit.

† Hasselmann: Ueber Tuberculose des Oesophagus. Inaug.-Dissertation, München, 1895.

* E. Fränkel: Ueber seltene Localisation der Tuberculose. Munch. med. Wochenschr., XLIII, 1896, 27.

† Glockner: Ueber eine neue Form von Oesophagus-Tuberculose. Prag. med. Woch XXI, 1896, 114, 127, 138.



Section of the œsophagus showing discrete tubercles composed of epithelioid and giant cells in a lymph-node extending into the mucosa. Hæmatoxylin staining. Zeiss objective DD, eye-piece No. 1.

is adduced not only the peculiar localization of tubercles in the muscular coat of the œsophagus, but also the dissemination of miliary tubercles in the viscera generally.

To this last series of cases may be added the one from this laboratory. It occurred in a colored man, aged 33 years, admitted to the surgical wards of the Johns Hopkins Hospital, service of Dr. Halsted, to whom we are indebted for the clinical notes. The history, however, has but little bearing upon the lesions in the œsophagus, and may therefore be briefly stated.

Clinical History. The first admission to the hospital was on September 16th, 1895, for an enlarged right testicle. There was a tuberculous family history. The patient had previously suffered from typhoid fever, gonorrhœa and syphilis, and for the past four years had been short of breath. His general health, however, had been good until a few months before admission. The examination showed, besides tuberculosis of the right testicle, a slight involvement of the right lung at the apex, and a dark and mottled condition of the mucous membrane of the mouth. The right testicle was removed, the wound healed promptly, and the patient was discharged from the hospital, October 22nd, 1895.

On February 7th, 1897, he returned to the hospital suffering with tuberculosis of the left testicle and cough. He failed rapidly and died March 1st, 1897.

The autopsy was performed by Dr. Flexner four hours after death. I shall abstract the protocol and give only the anatomical diagnosis and such notes as bear upon the lesions in the œsophagus.

Anatomical Diagnosis. Removal of testicle (for tuberculosis) eighteen months previously; tuberculosis of epididymis and remaining testicle, seminal vesicles and prostate gland; generalized tuberculosis; chronic tuberculosis of lungs; peculiar nodular form of tuberculosis of spleen and kidneys; tuberculosis of adrenal glands; Addison's disease; pigmentation of mucous membrane of mouth.

The œsophagus shows in its lower two-thirds elevated dots and larger nodules in great numbers. None of these are caseous, but the smaller points resemble the individual tubercles found in the spleen, liver and other glands.

The tubercles in these organs are minute granulomata, submiliary in size, of pale grayish-white color, opaque and non-caseating.

Histological Examination. The elevated dots and nodules found in the lower two-thirds of the œsophagus are seen to be enlarged lymphoid follicles, invaded by miliary tubercles which at times become conglomerated. A section of one of the larger oval nodules, measuring 1.25x1.50 mm., contains nine small, pale, irregularly circular areas of different sizes, with more or less definite contours, arranged in horse-shoe fashion around the periphery of the nodule. These pale areas contrast sharply with the more deeply-stained normal lymphoid structure.

Under somewhat greater magnification the pale areas are seen to consist of epithelioid cells, at times distinctly separated one from the other by irregular spaces in which are found sparsely scattered lymphoid cells. A scant reticulum holds these elements loosely together. The epithelioid cells are round or oval, with abundant protoplasm and vesicular nuclei. The nuclei are round, oval, elongated or kidney-shaped. Some of these cells contain two or more nuclei, and occasionally is seen a well-defined giant cell with a mural arrangement of its nuclei. The epithelioid clumps are surrounded by lymphoid cells, but these cannot be differentiated from the normal structure of the lymphoid nodule. At other levels the nodule shows partial coalescence of the discrete tubercles, thus giving an appearance of more diffuse infiltration.

Other nodules examined show an appearance similar to that just described; while the smaller dots, at times of microscopic size, often contain a single cellular tubercle.

Tubercle bacilli are present in small number.

Nowhere are the tubercles found outside the lymphoid nodules, and in no instance do they extend beneath the mucosa. The œsophagus is otherwise normal.

The mode of infection in this case offers no difficulties; it is clearly of hæmatogenous origin, the original focus being the diseased testicle. The case forms, together with the one instance of miliary tuberculosis of Mazzotti, excluding for the time the less certain cases of E. Fränkel and Glockner, the instances of undoubted blood infection of the œsophagus.

No other instance of the localization of the tuberculous lesions in the lymphoid structures of the œsophagus has thus far been published. According to Dürck* the relative insusceptibility of the œsophagus to tuberculosis depends in part upon the slight development of its lymphatic apparatus. There is, however, no great dearth of small nodular accumulations of lymphoid cells in the submucosa and mucous membrane of this organ, which may after all be oftener the seat of tubercles than is generally considered. The insignificance of these structures, even when, as in this case, they are involved in a general tuberculosis, may easily lead to their being overlooked. Without the microscopical examination of many different segments in a given case, the disease could readily escape observation.

The relative immunity of the œsophagus from other forms of tuberculosis, especially from those varieties included under classes II and III, may be explained in part upon purely mechanical grounds; namely, the rapid passage of infectious material over the mucous membrane of the œsophagus, and the resistance to such infection offered by the stratified pavement epithelium.

A review of the entire subject tends, however, to modify considerably the opinion once held that tuberculosis of the œsophagus arises in a large majority of cases through continuity or contiguity of structure. Thus, of the total forty-eight cases collected, only twenty-four took origin in this way, five arose through the addition of the tuberculous process to a previous predisposing lesion, four by blood infection, while the remaining fifteen arose through the inoculation of the mucous membrane by tuberculous sputum, without the existence of a previous demonstrable lesion.

The study of this subject was undertaken at the suggestion of Dr. Flexner, to whom the writer is indebted for kind assistance in the preparation of these notes.

* Dürck: Ueber Tuberculose des Oesophagus. Ergebnisse der Pathologie, I, 1897.

A RARE ANOMALY OF THE ARCH OF THE AORTA, WITH AN ADDITIONAL MUSCLE IN THE NECK.

By A. B. Herrick.

The variation herewith reported is from the cadaver of a negro dissected in the Anatomical Laboratory of the Johns Hopkins University. With the exception of the supernumerary muscle, the variation can easily be explained by an arrest of the development of the aortic arches, showing also that in these cases the inferior laryngeal nerve is no longer held down by the fifth aortic arch and drawn into the chest.

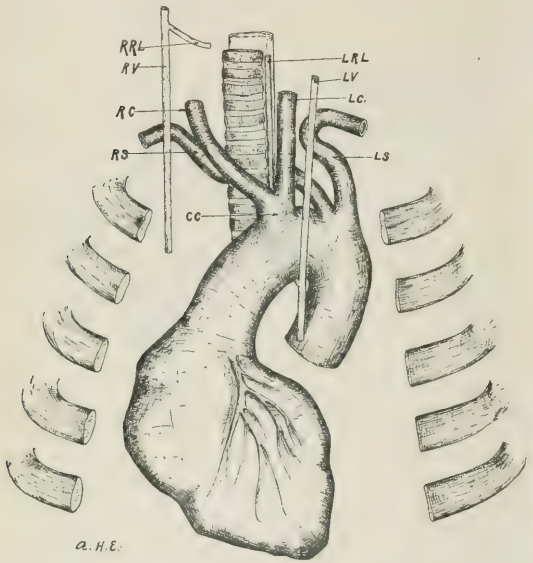


Fig. 1. The aortic arch and its branches, showing their relations to the trachea and œsophagus, and the position of the recurrent laryngeal nerves.

CC, common trunk of the two carotids; *RS*, right subclavian; *LS*, left subclavian; *RC*, right carotid; *LC*, left carotid; *RV*, right vagus; *LV*, left vagus; *RRL*, right recurrent laryngeal; *LRL*, left recurrent laryngeal.

The number of arteries arising from the arch was normal, but their arrangement was unusual; the two carotids arising nearest the heart by a common trunk, then the left subclavian, and lastly the right subclavian passing behind the trachea and œsophagus. The common trunk of the two carotids is about 10 mm. in length and arises from the beginning of the transverse arch. The left carotid passes vertically upward, while the right passes transversely in front of the trachea, and at its right border turns upward to take its usual position. The left subclavian takes its origin from the highest part of the arch and follows the usual course. The right subclavian, however, arises just behind and to the right of the left, and almost immediately passes transversely behind the œsophagus to the right side of the body. It extends beyond the œsophagus for about 8 mm., then turns upward 25 mm., and passes outward behind the scalenus anticus, reaching a point a little higher than normal, after which it continues downward in its usual course. The accompanying figure gives the origin and relation of the blood-vessels to one another. The vertebral arteries arise as usual.

The inferior laryngeal nerve on the left side arises from the vagus in the usual way, while on the right side it is not hooked around the subclavian, but passes directly from the vagus to the larynx in the neighborhood of the lower border of the cricoid cartilage.

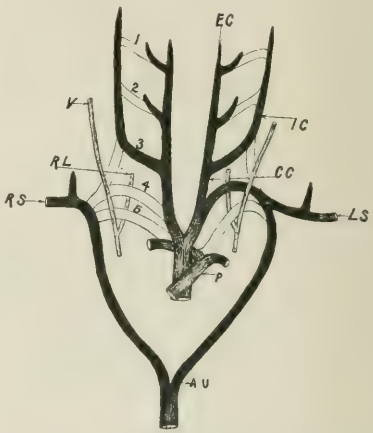


Fig. 2. Diagram showing the mode of development of the great arteries in this anomaly. (Modified from Quain's Anatomy.)

AU, union of aortæ; *RS*, right subclavian; *LS*, left subclavian; *CC*, common carotid; *IC*, internal carotid; *EC*, external carotid; *P*, pulmonary trunk; *V*, vagus; *RL*, recurrent laryngeal; 1, 2, 3, 4, 5, aortic arches.

The origin of this anomaly is easily understood when the development of the aortic arches is taken into consideration. The scheme of the development of the aortic arches is shown in Fig. 2. As the successive bronchial arches are developed they receive within them, passing from their ventral to their dorsal side, the aortic arches. These encircle the pharynx and are collected into two descending aortæ, which later on unite. The point of union is represented in the figure at *AU*. Hand in hand with the development of the aortic arches, the ganglia of the nerves arise from the neural crest and at first lie lateral to the arteries. A twig from the vagus passes over to the pharynx behind the fourth branchial arch, and crosses the fifth aortic arch at right angles. The descent of the vessels into the chest throws the vagus on the ventral side of the aortic arches, and the twig to the pharynx being caught by

the arch, becomes elongated to form the inferior laryngeal nerve.

In the diagram that portion of the arches which is to remain to form an anomaly such as this is printed black, while the vessels which are to disappear are only outlined. Through some mishap the fourth arch on the right side degenerated, thus liberating the inferior laryngeal nerve, while the circulation with the right arm was continued through the descending aorta of that side. By the later enlargement of these vessels the origin of the right subclavian was next shifted over to the left side of the body, thus making it arise immediately below the left subclavian from the arch of the aorta.

This variation has already been described by a number of authors,* but in this specimen the presence of an additional muscle within the neck adds interest to it and may possibly be the cause of this rare anomaly.

The anomalous muscle.—This muscle was present on the right side of the neck, as a thin, narrow, ribbon-like body, five centimetres in length, and in appearance resembled the anterior belly of the omohyoid muscle, as Fig. 3 shows. It arises from the anterior tubercle of the transverse process of the fifth cervical vertebra, and is inserted by an expanded aponeurosis into the posterior border of the clavicle. This expansion greatly resembles a fibrous arch, being easily detached from the bone at its center, but is firmly adherent at each lateral margin, which corresponds with the junction of the middle with the outer and the inner thirds of the clavicle.

Henle† considers this muscle as a variation of the omohyoid, regarding those specimens where either the anterior or posterior belly of the muscle is inserted into the clavicle as a transition stage between the normal, and this rarer anomaly. This muscle may take its origin from any or from all of the middle cervical vertebræ.

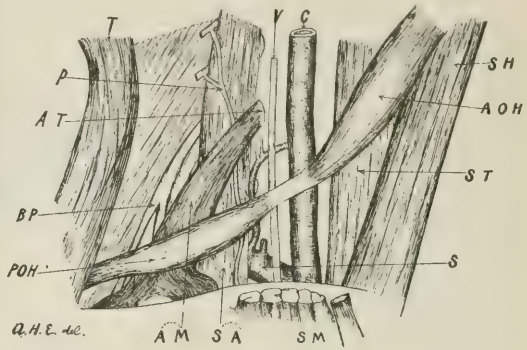


Fig. 3. The position and relations of the supernumerary muscle in the neck.

AM, additional muscle; *SA*, scalenus anticus; *SM*, sterno-mastoid; *ST*, sterno-thyroid; *SH*, sterno-hyoid; *AOH*, anterior belly of the omohyoid; *POH*, posterior belly of the omohyoid; *T*, trapezius; *V*, vagus; *P*, phrenic; *BP*, brachial plexus; *S*, subclavian; *C*, carotid; *AT*, anterior tubercle of the fifth cervical vertebra.

If it is true that the muscles in their development shift their position so that their attachment in the adult is only secondary, then we can see in this muscle a summation of the additional attachments of the two ends of the omohyoid. In one instance the posterior belly arises altogether or by an additional slip from the clavicle; in the other instance the anterior belly is inserted, by an additional slip, to the transverse process of a cervical vertebra. In the specimen reported these two variations are blended into a new muscle, and the omohyoid remains normal.

* Meckel, Pathologische Anatomie; Henle, Handbuch der Anatomie; and Quain, Commentaries on the Arteries.

† Henle, Anatomie, III, S. 121.

ON THE HÆMATOZOAN INFECTIONS OF BIRDS.

By W. G. MacCallum, M. D. (Johns Hopkins), *Johns Hopkins Hospital, Baltimore.*

In the adult examples of the Halteridium of Labbé, which occurs abundantly in crows in Ontario, Opie in 1896–7 pointed out a distinction between two forms—a hyaline, non-staining form, and a form which is granular and takes on a comparatively dark stain with methylene blue—and suggested that the hyaline form alone might become flagellated. This distinction is readily confirmed, and it is a fact that only the hyaline forms become flagellated, the granular forms being extruded, and lying quiet as spheres beside the free nuclei of the red corpuscles which lately contained them.

Motile fusiform bodies, identical with the "Vermiculus" described by Danilewsky in his "Parasitologie comparée du Sang," in 1889, are seen after fifteen or twenty-five minutes to develop from these quiet spheres and wander away. By careful watching of the two adult forms on extrusion from the corpuscle, it is seen that the flagella from the flagellated forms, tearing themselves free, constitute themselves fertilizing agents or spermatozoa, and proceeding directly to the granular sphere, wriggle about it. One only of these gains admission, and plunges itself into the sphere, which after some agitation of the pigment becomes quiet for a period of fifteen or twenty-five minutes, after which it puts out a conical process, which grows and draws the protoplasm into itself, until we finally have the fusiform body with a small pigmented appendage and refractive, nucleus-like body such as was described by Danilewsky as a "Vermiculus." The origin of the vermiculus is in every case exactly the same.

In other words, we have a sexual process with a resulting motile form, occurring under unfavorable circumstances, and comparable with analogous processes observed in the lower plants and animals.

It is thought that a similar process may be expected in the case of the human malaria.

The vermiculus moves actively and has great powers of penetration by means of its pointed anterior end, with which it breaks up the red corpuscles in its path, and it is thought that possibly it may penetrate the intestinal wall and escape as the resistant form which gains the external world. This idea is supported by the finding of free organisms in the mucous contents of the intestine.

In the organs, the connective tissue skeleton is one great storehouse of pigment, the branching cells being often loaded with foreign material. The endothelial cells are also very generally pigmented, and there occur in some of the organs, as well as in their blood-vessels, large makrophages loaded with pigment and other debris. Many large phagocytic cells occur in various organs which engulf whole corpuscles with their contained organisms.

The organs found pigmented are, in the order of intensity of pigmentation, the spleen, liver, bone-marrow, intestine, kidney, adrenals and thyroid. The leucocytes take but little part in phagocytosis in the organs, although phagocytosis goes on actively in a slide of blood.

During the last week I have examined the blood of a woman suffering from an infection with the æstivo-autumnal type of organism, in which a great number of crescents were to be seen. These in a freshly made slide of blood, with very few exceptions, retained their crescentic shape for only a few minutes. They soon drew themselves up, thus straightening out the curve of the crescent while shortening themselves into the well-known ovoid form. After the lapse of 10 to 12 minutes most of them were quite round and extra-corpuscular, the "bib" lying beside them as a delicate circle or "shadow" of the red corpuscle.

After 20 to 25 minutes certain ones of these spherical forms became flagellated; others, and especially those in which the pigment formed a definite ring and was not diffused throughout the organism, remained quiet and did not become flagellated. In a field where an example of each form could be watched, the flagella broke from the flagellated form and struggled about among the corpuscles, finally approaching the quiet spherical form; one of them entered, agitating the pigment greatly, sometimes spinning the ring about. The rest were refused admission, but swarmed about, beating their heads against the wall of the organism. This occurred after 35 to 45 minutes.

After the entrance of the flagellum the organism again became quiet and rather swollen, but although in the two instances in which this process was traced the fertilized form was watched for a long time, no form analogous to the "vermiculus" was seen.

This is evidently for the human being what was foreshadowed by the organisms of the bird.

(In part an abstract of a paper read before the British Association for the Advancement of Science, August 24, 1897, and shortly to appear, *in extenso*, in the Journal of Experimental Medicine.)

A CASE OF CAVERNOUS ANGIOMA (VASCULAR NÆVUS) OF THE TUNICA CONJUNCTIVA.

By Dr. H. O. Reik.

James Minor, colored, aged 16 years, came to the Baltimore Eye, Ear and Throat Hospital, March 1st, 1897, for treatment of a growth on his left eye. His mother states that very shortly after birth a small, red, raised spot, probably twice as large as a pin-head, was noticed on his left eye. This statement is confirmed by the midwife; there was no physician in attendance. For some time no change was noticed in the eye, but by the end of his first year the spot had increased some in size, and for the next five years continued to grow steadily, though not rapidly. It never seemed to give any pain nor did the tissue immediately surrounding it become inflamed at any time, so it was not considered necessary to consult a physician. The growth assumed its present size by the time he was six years old, and since then, his mother thinks, it has undergone little or no change. He consulted me simply because he desired, if possible, to have his appearance improved.

The tumor was quite noticeable even at some distance, but on close inspection, with the eye turned outward so that the cornea almost reached the outer canthus, an appearance like that seen in the accompanying reproduction was obtained. (Fig. 1.) To the nasal side and about 3 millimetres removed from cornea was a dark purplish-red tumor about 15 mm. long, 3 to 5 mm. wide and 5 mm. in thickness, narrowed somewhat toward its upper extremity, which was rounded, and extending below under the lid into the *conjunctiva fornicis inferioris*. Its anterior surface was convex, smooth and shiny, covered by conjunctiva, and two narrow, light bands of connective tissue appear to pass almost horizontally across the tumor, thus producing a slightly lobulated appearance. Its posterior surface was slightly concave and rested in its entire length upon the *bulbus oculi*. The tumor was situated entirely in the *tunica conjunctivæ bulbi*, and one or two good-sized vessels passed from it below into the *conjunctiva fornicis* after pursuing a somewhat tortuous course. By pressure the tumor could be moved very slightly from side to side, but sufficiently to indicate that it was not adherent to the sclera. The *plica semilunaris conjunctivæ* was hypertrophied, slightly congested, and, when the eye was rotated inward, presented several delicate folds.

An incision was made in the conjunctiva near the outer edge of the growth, blunt-pointed scissors were then passed beneath the tumor and it was easily lifted off its bed. No hemorrhage was encountered until the base was cut well down in the *conjunctiva fornicis*, and even then the bleeding was slight.

I saw the patient last on March 28th. The wound was perfectly healed and the eye looked normal, save that the vessels mentioned before as connected with the tumor were still present, though greatly reduced in size.

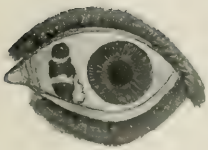


Fig. 1.

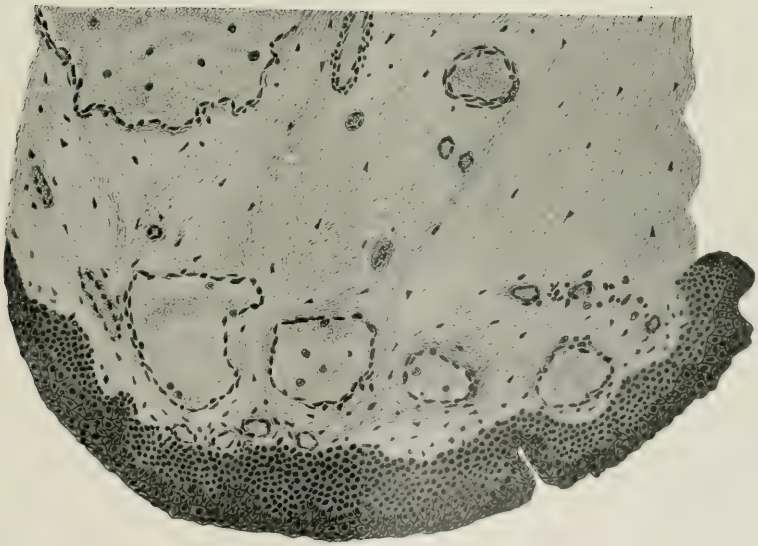


Fig. 2.

Anterior portion of Cross-Section.

The specimen was hardened in formalin and embedded in celloiden. Sections were cut in different directions through the growth and stained in hæmatoxylin and eosin, picro-carmine, methylene-blue and lithium-carmine.

Under the low power the tissue seemed to be composed of a loose connective tissue with many small areolar spaces and to contain very numerous blood-vessels. These vessels run in every direction, and within a small radius one sees various sections of them, taken in their long axis, obliquely or crosswise. In addition, in the most vascular parts of the tumor, large blood spaces are to be made out with tolerably thin walls of connective tissue, walls which in places appear to be lined by endothelium, though this is not easily made out everywhere. These cavernous spaces show thin connective tissue bands running across them, lined by endothelium, and one can think of there being partial or complete partitions separating adjacent thin-walled sinuses.

By the higher power the connective tissue is seen to consist mainly of the white fibrous variety, loosely constructed and not very rich in connective tissue corpuscles. The anterior surface of the periphery of the growth is covered by conjunctival epithelium, below which is a narrow band-like area of round cell infiltration. The endothelial cells lining the numerous small vessels are easily distinguished and the lumina of the vessels are filled with blood. The relative proportions of the different varieties of leucocytes, so far as could be judged, were not abnormal. (Fig. 2.) The tumor is then, histologically, a cavernous angioma, or it may be called if preferred, a vascular nævus.

A careful search of literature for any similar cases which might have been reported has served to show us how very rare they are. As the distinction between angioma and vascular nævus is not a very clear one, depending apparently upon the question as to whether the tumor is actively growing or is remaining stationary, it occurred to me that various writers might have made different classification, so I looked not only for reports of angioma, but of vascular nævi and telangiectasia as well. I could not believe that these growths were so extremely rare as this search would make it appear. So far as I am aware only one case has heretofore been reported in this country, that of Lippincott, and I have been able to find only two others in the English language, both by Dr. Simeon Snell, of London. One of Snell's reports is accompanied by a colored plate, and the shape, size and position of the tumor give it a strong resemblance to my own. No microscopical examination of either of his cases is mentioned. Lippincott's* specimen was examined by Prof. Whitney, of Harvard, and is described as a cavernous angioma. Rampoldi and Stefanini,† Armaignac,‡ Dubois,§ Talko,‖ Van Ammon and Blessig¶ have each described or mentioned one or two cases. Bossalino and Hallaner,* Reich† and Kroschinski‡ have each reported a single case accompanied by histological reports, and their findings are essentially similar to those described in the present case.

Fuchs in his treatise on diseases of the eye says "Angiomata of the conjunctiva are of rare occurrence. They are as a rule congenital and increase in size after birth."

Noyes says that "Angioma of the conjunctiva sometimes occurs. Its most frequent seat is the caruncle." Neither of these authors mentions nævi of the *tunica conjunctivæ bulbi*.

"Angioma of the conjunctiva," says Saemisch, "either spread there from a palpebral tumor or develop primarily in that membrane. They are mostly congenital and occur as a rule in the neighborhood of the inner commissure, or, exactly, on the *plica semi-lunaris conjunctivæ*." He advises their removal, "because after remaining unchanged for some years, they gradually increase in circumference, and through narrowing of the conjunctival sac, and later by projection from the palpebral fissure, become quite troublesome."

These tumors developing primarily in the conjunctiva, according to Virchow, "are very rare and seldom progress beyond the nævus stage, although an occasional observation of more extensive growth is known."

* Trs. Am. Oph. Soc., vol. 7, p. 372.
† Ann. di Ottal., Pavia, 1884, vol. XIII, p. 75.
‡ Rev. Clin. d'Ocul., Paris, 1886, vol. VI, p. 73.
§ Anal. d'Ocul., Brux., 1855, vol. XXXIV, p. 267.
‖ Klin. Monats. f. Augenh., Erlangen, 1873, vol. XI, p. 335.
¶ Græfe und Sæmisch Handbuch, vol. IV.

* Archiv f. Ophthalmologie, Leipz., 1895, vol. XLI, p. 186.
† Centralbl. f. prakt. Augenheilk , Leipz., 1877, vol. I, p. 176.
‡ Beiträge zur Augenheilkunde, June, 1894.

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The Medical Department of the Johns Hopkins University was opened for the instruction of students October, 1893. This School of Medicine is an integral and coördinate part of the Johns Hopkins University, and it also derives great advantages from its close affiliation with the Johns Hopkins Hospital.

The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter.

Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have acquaintance with Latin and a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry, and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

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Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, beside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the

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BULLETIN

OF

THE JOHNS HOPKINS HOSPITAL.

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CONTENTS.

KING ARTHUR'S MEDICINE.*

By George M. Gould, M. D., and Walter L. Pyle, M. D., *Philadelphia.*

"The Kynge Arthur toke the Kynge Ban, and the Kynge Bohors, and Merlin, and saide, 'Lete us go se oure felowes that be seke.'"

We English folk are most fortunate in that we have a literature of our racial adolescence which, certainly not excepting that of the Greeks, is infinitely richer and truer than any other, and pictures a people of far greater purity and power, beauty and bravery, loyalty and love. Although not "meek" we are still fated to "inherit the earth," and that inheritance has been gained because the man had a youth such as the Arthurian legends picture. The child is proverbially the father to the man, and peace and justice are to-day the enjoyment of the Indian, of the Egyptian, and of the commoners of England themselves, because Arthur's knights and ladies were what they were. To these legends we must progressively direct our attention as the purest materials of our future poetry and inspiration. As nowhere else, we here find a sincerity, an honor, an unbiased and uncolored revelation of the noble human heart not as yet spoiled by sin or self-consciousness. And now—as Glennie has pointed out—that science has come to us with its all-absorbing, all-transforming interest, revolutionizing most all methods and data of thought, these primitive records of our English and Cymric Paradise must become still more priceless and precious; for science has not explained, and never can explain, life and character, and back to the time when life and character was (or was recorded to be) the sweetest and noblest ever conceived by the fancy of man we must ever go to find the comfort and inspiriting we so sadly need in ages of meanness, doubt, and selfishness.

Of this early age and of its records Tennyson says that they are—

> "Touched by the adulterous finger of a time
> That hovered between war and wantonness,
> And crownings and dethronings."

To which our answer must be—Contemptible cant! With all our "progress" and self-conceit we cannot claim that we have lessened the adultery and the wantonness. War and crownings and dethronings have not been unlearned, but where are the courage, the banter, irony and humor, the give-all-to-love, the loyalty, the inerrant sense of and obedience to right, that made these men and women greater than all their joys and sorrows? Had we but also inherited the "honor rooted in dishonor"! With relief we turn from the emasculate "Idylls" to the innocent sins, the personal warmth, the splendid vices, the thrilling pathos of these our ancestors for better poetry and more untarnished ideals than the effeminate and self-conscious echoes of later-day rhymesters. Better adultery with bravery and honor unto death, than adultery without these things!

* Read by Dr. Gould before the Historical Club, Nov. 8, 1897.

Study of these legends must therefore remain the pleasure and duty of those who love our race-spirit, and any new aspect of truth that may be gleaned from them must be rated as not without value even if it help but a little toward a final true comprehension. It is indeed difficult to keep the mind down to its task in attempting a distinctly medical gleaning. So many alluring glimpses, such paramount witchery, such dominant healthfulness is everywhere so manifest, the soul is so present and lordly, the body so forgotten, or so gloriously proud to serve in silence, that morbidity and therapeusis are kept from emerging out of the subliminal "Unbewusst." And our difficulty is doubled by the fact that it was so with them, and consequently they chronicled but a few hints, hid only a stray pebble or two which the medical mind may pick out beneath the gorgeous heap of flashing precious stones showered in our lap.

Although the specifically medical and physiologic findings are thus comparatively few and unimportant, their gathering and lessons are not unimportant; even for the corroborative testimony they bear to general mental and emotional characteristics, they would be worth the collecting and systematization. These beings really had bodies as well as loves, consciences, desires, and wills, and they are brought closer to us, our vision of them made all the clearer, and our love the warmer, by a recognition of their corporeal wants, woes, and wounds. But in the comparison of their medical science, or unscience, with that of later days, the physician finds at least historic lessons of professional interest well worth his labor, if indeed he were not more than compensated in other ways.

We must add another prefatory word, because it is, it seems to us, too little considered by our critics. We allude to the great difficulty—in the present state of criticism and research doubtless an impossibility—of distinguishing between the true records of premedieval life and the later additions. Malory, we know, made free use, but also free additions and changes as regards his texts. He was not the best editor in the world. But how much those who compiled the records he used changed and colored the earlier story, how far they truly represent to us the original documents—these things of course must at present make our deductions matters of some doubt. Perhaps it was five hundred years after Round-Table times that those wrote who served Malory with documents, and Malory himself was a thousand years removed. Where are the records of "Blayse the Mayster of Merlin that he did do wryte"? But where are the snows of yester-year? Internal evidence, however, tells us much, and, in reading, the alert sympathy is constantly aroused by the feeling that this or that is surely not the voice of frank Cymric childhood, but is the sorry tarnishings of the Latin-French media, the corruption of a self-conscious "civilization," or of a mind far removed from pristine juvenility and resilient buoyancy. Some time we shall perhaps know just how much each later age has added to and changed the primitive revelation—every such a debasing, certainly—and then we shall have a body of pure and luminous texts for our infinite reheartening and delight.

Despite Tennyson, neither war nor wantonness was the essential spirit, the inner *Trieb* of this age. Its dominant characteristic, the source of both the war and the wantonness (the latter a belieing and a belittling word), was the abounding sense of exuberant life, the fulness and immediacy of health that filled the actors and made of the women eternal models of *das ewig weibliche*, and so spurred the men that they were forced to find outlets for their inexhaustible physical energy in jousting, adventures, and feats of strength and endurance beyond our knowledge and belief. We are not mindless of the exaggeration of the hero-singer and the mythology-maker, but after all allowances have been made that a sceptical science may demand, the central fact remains that, physiologically speaking, these men were marvels of energy and endurance. Every page of *Merlin* and of *Le Morte darthur* bears witness of the fact. What modern athlete could don the helmet and coat of mail these men wore, much less carry them, nay, fight with them on and wield the huge *glayves* they used so effectually? The weight of the helmets is attested by the blows they resisted; the strength of the arms that handled the swords is proved by the fact that the blows frequently clave through helmet and skull to the teeth. When one thinks of men in hot August days covered with these ponderous steel casings, head and face solidly bound with iron, and fighting all day long with the fiercest activity, one can only stand aghast at such wonders of bodily organization. It is perhaps useless to ask if the human arms are capable of certain feats that are frequently reported, as the cleaving at one stroke of a body through, or to the navel, the cutting off at one blow of a head and with such force that it rolls into the field.

Skill and strength for their own sake, the aim of modern "athletics," seem unknown. There are no evidences of useless games and braggart power, leading to nothing. Muscle *per se* is not the *summum bonum*. The everlasting jousting appears the only game, but this was almost too serious to satisfy any purely "sporting" instinct, and it was of course in every case the actual and necessary exercise preparatory to dealing in life and death in the great business of the morrow. And even in this business of death one sees that simple physical power is, however necessary, only a secondary thing. It is the courtesy and honor, the moral energy and power of will and emotion behind the man's muscles that give the victory and that make him the beloved and revered.

Giants there are (some ridiculously large, by the help of Continental imaginations we suspect), but they are as hideous and detestable as the modern children's books could suggest. Giants and those only physically strong are cowards and are always defeated by those whose strength is pre-eminently of the soul.

In this connection it might be noted that drunkenness and gluttony are not even suspected. There is here no all-day or all-night sitting at meat or drinking out of skulls till intoxication stops further drinking. There is "feasting," but with ladies always present, always in moderation, always with witty or serious converse, always as a preparation for something better. Moreover, the manner of its doing is always in view rather than the matter—after bathing, *e. g.*, and the putting on of clean clothes.

It was a superstition that a man's physical strength some

times varied according to the time of day or the intensity of the sun's rays. It is said that "Syr Gauwayn had suche a grace and gyfte that an holy man had gyuen to him, that euery day in the yere from underne tyl hyhe none hys myght encreaced tho thre houres as moche as thryse hys strengthe, and that caused Syr Gauwayn to wynne grete honour."* Another reference to this curious belief is in that narrative of Sir Beaumayn, who is warned not to challenge the Knyght of the reed laund until afternoon, as all the forenoon his strength increased and at high noon he had the strength of seven men.

The surgical interest in the results of encounters is that most frequently excited. In the competitive jousts the object was to overcome by superior strength, skill and horsemanship. In them the mortality did not probably exceed that of a modern game of football or cross-country riding. To intentionally maim or kill was the greatest shame of which a knight could be guilty. Sir Launcelot is said to have unhorsed five hundred knights, winning the victory over them all, and yet none is killed.

Even though severely wounded the spirit is not conquered; with a spear-head in his side Sir Launcelot fights all day, overcoming more than thirty knights. And he recovers in a few days. In the conflict between Balan and Balin they "hadde eyther symtem other seuen grete woundes so that the lest of them myght have ben the dethe of the myghtyest gyaunt in the world." Sir Percyval and a knight inflict upon each other fifteen wounds, and they "bledde soo moche that it was merueyl that they stoode on their feet." Alysander "had no foote ne myght to stande upon the erthe, for he had syxtene grete wounds and in especyl one of them was lyke to be his dethe." Exhaustion from profuse hemorrhage with the signs of extreme collapse is a frequent ending of a genuine combat. In such accounts the romancer's imagination is doubtless frequently evident, but in all the stories are descriptions too peculiar and detailed not to be the result of direct observation.

We find that it was quite possible to kill a man with a single blow. It is related that Marhaus kills a knight "stark dede" at a single encounter. The most common injuries were about the chest or side, as these were the points at which the spears were most directed. After an opponent is unhorsed a hand-to-hand combat on foot usually ensued, in which the principals hacked and struck at one another with swords; and it is in these latter battles that the most serious wounds were inflicted.

Cerebral concussion is, of course, frequent. The modern lay description of "seeing stars" has its analogue in several passages. It is even said that a maiden gives Alysander such a buffet "that he thought the fyre flewe oute of his eyen." In one of his combats Sir Launcelot is struck on the helm so hard that "fyre sprange out of his eyen." Cerebral concussion followed by death, possibly by *contre-coup*, is evident in the account that Sir Gawayne smote his (helmeted) opponent so hard that "it went to the braynes and the Knyght felle downe dede."

The common sign of basal fracture—hemorrhage from the nose, mouth and ears—occurs several times. How graphic is the account of Sir Launcelot's smiting of Sir Galahantyne on the helmet so "that his nose braste oute on blood and eeyrs and mouthe bothe, and ther with his hede hange lowe." He strikes another opponent so hard that the stroke "troubled his braynes, the blood brastynge oute of his mouthe, the nose, and the eres," and the knight falling to the earth as if dead. Syr Gareth and Sir Gaherys are also smitten "upon the brayne pannes" and killed. Arthur gives Sir Accolon such a buffet that "blood came oute at his eres, his nose and his mouthe." We read later that Accolon lived four days, and his ultimate death is attributed to the loss of blood, in ignorance of the fatal fracture. These symptoms, however, are not always precursors of fatality, for Sir Blamore has such a fall "that the blood braste oute at nose, mouth and his eres, but at the laste he recouerd well by good surgyens."

A noteworthy case of foreign body in the brain is that of Sir Marhaus, who was struck such a "myghty stroke" by Sir Trystram "that hit went thorou his helme and thorou the cayse of stele and thorou the brayn pan, and the swerd stak soo fast in the helme and in his brayn pan that Sir Trystram pulled thryes at his swerd or ever he myght pulle it out from his hede." "The edge" of the sword was left in "the brayne pan," and Marhaus ran groaning away. The foreign body could not be extracted by the surgeons, and at last caused the death of Marhaus. His sister, la beale Isoud, got the bit of sword, and by it her lover Tristram was identified as the one who had killed her brother—a great story well known and sung by later poets.

So mighty were the blows delivered on the head that we read of King Pellenore giving his opponent such a stroke on the helm "that he clafe the hede doune to the chynne that he fylle to the earthe dede"; and once more this mighty swordsman "clafe another hede unto the pappys" (breasts). A similar blow is delivered by Sir Launcelot, who "clafe his opponent's hede and neck unto the throte." Again it is said that Pellenore strikes King Lot "thorow the helme and hede unto the browes."

An occasional result of combat was a broken neck. Sir Florence rode against Sir Feraunt of Spain and "smote hym in the forhede and brake his necke bone." Syr Gryffet ran unto a king, the fourth of his opponents, "and gaf hym suche a fall that his neck brake." Launcelot smites a porter under the ear with his gauntlet and breaks his neck. A mighty blow was that of Marhaus who smote his opponent so hard that "he brake his neck and the hors back."

An example of an injury to the neck, and a splendid sample of English irony is, "And Segramor lete renne to a Knight that com shovinge after hym, and he smote hym thourgh the throte that he fill deed up-right; and thein he seide, 'Sir Knyght, with soche morsels I can yow fede and myn other enymes. Now be stille ther and a-bide hem that come after, and telle hem that this way gon the messagiers of the Kynge Arthur, that is theire rightfull lorde.'"

*To save space we omit the references. They are from Sommer's edition of Malory, the Merlin of the Early English Text Society, and the various French works obtainable, from which Malory drew his stories.

Protected by the visor the face is rarely injured. We note once that the teeth were "stryken in tweyne."

For a similar reason thoracic wounds are usually non-penetrating. However, Sir Kehydius is wounded "on hyghe above the pappys" [breasts], and Gawayn gives an opponent such a blow that one "myghte see bothe lyver and long," and again he smote a Saracen and "slitte hym down right so that men myght se his longes." Syr Tor smites his opponent through the "coost [rib or side] but the stroke slew hym not." The ribs of Arthur and of others are broken by the crushing embrace of another's arms. The single reference to cardiac injury we have noted is that whereby King Mark strikes his brother to the heart with a dagger. The wound was immediately fatal.

A remarkable abdominal and pelvic injury from a single blow is that whereby Arthur in a duel with a giant "hytte hym ageyn that he carf his bely and cutte of his genytours [genitals] that his guttes and his entraylles fylle doune to the ground." Sir Launcelot smites another giant "on the shoulder, and clafe hym to the navel."

Examples of transfixion from a single blow are found. Arthur smites Gryflet and "brake the spere that the troncheon stack in his body." A knight is "smote thorou shelde and thurgh the body." Launcelot smites a knight "thorugh the brest and thorou oute the back more than an ell." Probably the most interesting of this class of injuries is recorded in the description of the last combat in which Arthur smites Mordred "under the shelde wyth a foyne of his spere thoroughoute the body more than a fadom." And yet thus transfixed, and with this wound, Mordred is able to push himself onward up to the hand-guard of the spear so as to reach his father, and before dying deals him his death-blow, his sword cutting through the helmet to the brain—a ghastly and powerful deed!

It was a common belief that if a weapon entered the trunk, either very deeply or in a vital part, it should not be immediately withdrawn for fear of instant death. Bors pulls out a spear from his opponent's side and the man swoons. As Gawayne draws out a truncheon from Vwayne's side his soul departed from the body. Lauayne says to a wounded knight, "and I pulle oute the truncheon ye shall be in perylle of dethe." Later, Lauayne pulls the truncheon from the wounded man's side and the resultant symptoms are thus graphically described: "He gaf a grete shryche and a merueillous grysely grone, and the blood braste oute nyghe a pint at ones that at the last he sanke doun upon his buttoks an so swouned pale and dedely." That this was not the invariable result is shown by the fact that Sir Melyas drew out of his own body a truncheon, and swooned, but recovered in seven weeks by the aid of the ancient monk who had previously been a knight.

Vertebral fractures are occasionally mentioned and invariably spoken of as broken back. Sir Tristram smites an opponent's "back in sonder." Sir Launcelot breaks his opponent's back, and in another combat he broke the backs of four knights.

A curious wound of the buttocks is reported as happening to Launcelot, who by misfortune was shot accidentally by a lady "in the thyck of the buttok over the barbys." It is further related that "thenne with grete payne the heremyte got ovte the arowes hede oute of Syr launcelots buttok, and moche of his blood he shedde," "and the wound was passynge sore, and unhappyly smyten, for it was in suche a place that he myght not sytte in noo sadyl."

Of the injuries to the thigh we read that on one occasion Sir Tristram showed an arrow-wound of the thigh six inches deep. Launcelot is wounded by a boar that "rafe hym on the brawne of the thygh up to the houghbone" [hip-bone]. Sir Vwayne smites Edward so hard that "his swerd kerved [cut, carved] unto his canel-bone" [tibia]. In remorse, Sir Percyual "rofe hym self thurgh the thygh." Another reference to possible self-mutilation is found in the passage which says that Alysander, when told of the amorous intentions of Morgan le Fay towards him, replies that "I had leuer cutte away my hangers [testicles] than I wold do her suche pleasyr." Happily he was spared the necessity.

Amputations at a single stroke are frequently reported. A knight has an arm stricken away in combat; Galahad smites off the left arm of an opponent; Marhaus smote off a giant's "ryght arme above the elbowe"; Arthur peremptorily disposes of another giant named Galapas, "he shorted hym and smote of both his legges by the knees"; making the combat more equal as regards discrepancy in size of the participants.

Dislocations are spoken of in the following passages: King Pellenore's lady's horse stumbles and her arm is put "oute of lythe" [out of joint], and she almost swoons from pain; Launcelot bears down an opponent "soo that his shoulder wente out of lyth."

Fractures were not uncommon results of combats. Syr Dynas smites an opponent "that with the fall he brake his legge and his arm"; Sir Launcelot smites downe the Kynge of Northgalys who "brake his thye in the falle"; another time Launcelot turns on a reviling mob "and of some he brake the legges and the armes."

It is plain that the frequency of wounds and accidents made necessary those who should play the part of surgeons. It is, we think, almost equally sure that there was no official and separate profession. There is no record in the characteristic texts of any who made exclusive practice of surgery or medicine. In the *Mabinogion*, a book of Unarthurian and apochryphal character, it is recorded that Arthur "caused Morgan Tut to be called to him. He was the chief physician." It is supposed that this person was probably the same as that Morgan the Wise who prepared the ointment which restored Owain (Gawayne) to a state of health and sanity, in the romance of Ywaine and Gawin.*

In *La Mort au Roi Artus*, the "maistre chirurgian" is several times spoken of who attends Launcelot, but later it is said that Boors sends *the knight* who healed Launcelot to the king, etc. Allusion to "the barbours of Bretayne" is, of

* His reputation appears to have extended to Brittany, where the inhabitants still call by the name of *Morgan Tut* an herb to which they ascribe the most universal healing properties. The name Morgan has been given to the *Anthemis cotula*, Linn. (camomile) and *Maruta cotula* (dog-fennel).

course, not Arthurian. There is no mention of a court physician in *Le Morte darthur*, or *Merlin*. It is quite likely that had there been one, some mention of the fact would have been made, and the people would have deserted the hermits for this official physician, as it is said in *Le Mort darthur*, in speaking of the speedy popularity of Modred, "the people were soo newe fangle."

We have much evidence as to the disposition of the wounded. The sick and wounded were frequently sent to the monasteries and nunneries. Malory says that the hermits of those days were not like those of his time, but "held grete householde, and refresshyed people that were in distresse." It is a hermit who heals Sir Launcelot after one of his many accidents. After combat with Pellinore, Arthur "departed and wente untyl an ermyte that was a good man and grete leche"; Sir Palamydes goes to a nunnery to be cured. At the "lytel pryory" of Marhaus "laydes and damosels looked to their hurtes." In fact, not only the female inmates of religious asylums were skilled in dressing wounds, but many of the noble-women were experts in this art. Mayden Lynet comes to Sir Beaumayns and "serched his wounds, and stynted his blood." This damoiselle also stanches Sir Gareth's and Sir Gawayn's wounds. Tristram's wounds are "serched" by la beale Isoud, who was a "noble surgeon." She found in the bottom of this wound "poyson and heled him." It is said that after his fight with Marhaus, Tristram is searched by "alle manere of leches and surgeons both unto men and wymmen." Here there may possibly be indicated some distinction between a leche and a surgeon, such as arose later. The knights themselves were often skilled in surgery. Sir Baudewyn of Bretayn is called a "ful noble surgeon and a good leche." King Arthur attends on Syr Gawayn and "dyd so ransake his woundes and comforted hym." "Sir Mador was had to leche craft, and Sir Launcelot was helyd of his wound."

It is related of Sir Percyual that he "stopped his bledyng wounde with a pyce of sherte"—an excellent bit of emergency-surgery.

Of the limitations of the power of the leeches we have ample proof. "Sir Gawayn laye seek thre wekes in his tentes with al maner of leche crafte that myght be had." Even malpractice was recognized, for, according to Tristram, Sir Marhaus "dyed through fals leches."

From these quotations it is made certain that what represented the practice of medicine was carried on by women and men without any official status or special training other than that picked up by aptitude, circumstances, and experience. The application of the terms *surgeon* and *leche* to women is indicative of the same fact and of the primitive simplicity of all the arrangements. There is little record of much more extended or varied treatment of the wounded than that of *ransaking* and *serching* the wounds, stopping the flow of blood, applying salves, etc. The broken, dislocated, or amputated limbs and the thousand surgical diseases we know were left to the care of the *vis medicatrix naturæ*. The business of life was to give the enemy the wounds. *Vae Victis!* These heroic children of our race stood before disease much as does a child of to-day, without discrimination, diagnosis, or suggestion of treatment. All diseases to them were alike mysterious. Where our nosologies register thousands, theirs saw but one—"sekenesse."

The pulse was a factor in diagnosis. Launcelot was found lying by a chamber door, and "they looked upon hym and felte his pouse to wyte whether there were any lyf in hym." Malory shows knowledge of the blood-vessels in narrating that Gawayn received a blow that caused a "grete wound and kytte a vayne, and he bledde sore." Sir Gareth is given a wound "a shaftmon brode, and had cutte atwo many vaynes and senewes." Recent wounds were called "grene wounds." Trystram was so stirred by his desire for his fair bedfellow that "in his ragyne he took no kepe of his grene wound" and breaks it open. Disastrous results are attributed to the breaking open of wounds. Launcelot suffers this accident by getting on a horse too soon after convalescence. Gauwayn is stricken by Launcelot, and an old wound is broken open by the blow, which ultimately causes his death.

Just as infection of wounds is called by the laity of to-day "taking cold," so we read that Arthur tells Syr Bedwere he has taken cold and will soon die. After being sore wounded by Marhaus, Tristram "ful sore bled that he myght not within a lytel while when he had take cold unnethe stere hym of his lymmes"—a fact that may refer to inability to walk due to rheumatism contracted from exposure.

All wounds are treated by salves and ointments. Gawayn is healed of a wound by salve, and after the battle between Launcelot and Arthur, "to the wounded men they leid softe salues." Sir Gauwayn was borne "in to Kyng Arthur's pauyllon, and leches were brought to him and serched and salued with softe oynementes." After a battle "they putte salf unto the wounded men." It is evident when infection was expected, as after animal bites, which of course were supposed to be venomous, the wounds were carefully cleansed. After killing the great cat Arthur was led to his tent and unarmed, "and loked on the cracchinge and the bitinge of the catte; and the leches waisshed softly his wounds, and laide thereto salue and onyementes to cleanse the venym." There is a belief in the almost magical effects of some of the salves. Lynet undertakes to heal Gareth in fifteen days, "and thenne she leid an oynement and a salue to him." After his battle with Pellinore, a "hermyte serched all his woundys and gaf hym good salues," healing him in three days. Sir Pryamus heals his own and Gawayne's wounds by "a vyolle ful of the four waters that came oute of paradys, and with certain baume," in an hour they were "as hole as euer they were." This is plainly an oriental echo. Some of the styptic ointments were very severe, as Morgan le Fay searched Alexander's wounds and "gaf suche an oynement unto hym that he shold have dyed, and on the morne whanne she came to hym he complayned hym sore, and thenne she put other oynements upon hym and thenne he was out of his payne."

But there is occasionally slow convalescence from wounds. Trystram lies at a nunnery a half year to recover from a wound. Sir Vwayn stops with a layde a half year that "he myghte be hole of his grete hurtes"!

Potions and alcoholics are frequently administered. Gareth is given a "drynke that relieved him wonderly wel." Besides

being attended to surgically by his magnanimous opponent "Sir la Cote male tayle is given wyn," and a hermit stanches Sir Launcelot's blood and gives him wine to strengthen him.

Healing by enchantment, miracle, and divine influence is a natural belief of the time, and there is a curious faith in virtue, moral qualities, virginity, etc., to heal wounds. This is doubtless due either to the desire of vengeance, or to that secret conscience of sin and lapse from virtue which brought about the injury or illness. The murderer of Syr Gylbert can never be "hole" until some knight goes to the "chappel peryllous" and finds a sword and a bloody cloth that the knight is wrapped in and "serches" the wounds with them. Launcelot achieves this and heals the sick knight with Sir Gylbert's sword and by wiping his wound with the bloody cloth. Balyn's host tells of his son's wounds "that can not be hole tyll I haue of that knighte's blood." Balyn procures the blood by killing this knight, obeying the old injunction of an eye for an eye, a tooth for a tooth. Sir Vrre has seven great wounds, three on the head and four on the body, which at one time festered, at another bled, and which could only be healed by being searched by the best knight in the world. At the command of Arthur, Vrre is searched by one hundred and ten knights, but Launcelot being the best knight, alone is able to heal the wounds. The Sangrail is of course effective in curing and healing. The damsel from the castle comes out with a dish "assés grant par raison," and tells Balaain's companion (another lady) that the lady of the castle has been long suffering from a terrible disease "comme est de liepre." All remedies hitherto have been proved useless, but "un seul homme viel et anchiien" had told her she could get well again through the blood of "une pucielle vierge en volonté et en oevre, fille de roi et de roine." The lady is bled at both arms. "This custom," says the pseudo Robert de Boron, "will be continued unto the day when the lady of the castle is healed by the blood of la serour de Percheval le Galois." By a logical reversal is it not possible that later the belief gave rise to the custom of bleeding? If good blood could cure, bleeding the patient would appear to lessen the quantity, so to speak, of disease contained in him. The damosel with Balyn is voluntarily bled to help the victim, but to no avail. The blood of Sir Percyval's sister finally cures the lady, but the benefactress loses her own life. It is an old superstition, perpetuated in remote parts of Ireland to this day, that venereal disease can only be cured by coitus or genital contact with a virgin. Modern instances of infection have been traced to this superstition.

There is, of course, doubt as to the correct interpretation of the term *mesel*. It may have been used to designate leprosy, as the learned think (somewhat doubtfully), but it may also have been applied to another disease. Our indecision becomes clearer by what is the most interesting quotation as to disease we have met in the stories. In *Merlin* (p. 527, Early English Text Society) we find that King Looth, after censuring his son Agravain for his disrespectful treatment of women, says: "Yef ye yow thus demene as ye say, wite ye well ye shull myscheve, and that shull ye well se." The paragraph ends by saying, "and euen as the kynge seide so hym be-fill, after that he langwissid longe a-boue the erthe for the vilonye that he dide to a mayden, that rode with her frende with whom he faught till that he hadde dicounfitted and maymed of oon of his armes, and after wolde haue leyen by his love and fonde hir roynouse of oon of hir thighes, and seid her soche vilonye that she after hurte his oo thigh and his arme, so that it sholde neuer be made hooll; but yef it were be tweyne of the beste knyghtes of the worlde to whom she sette terme of garison, as the booke shall yow devyse here-after, how that it was warrisshed by Gawein his brother and by launcelot de lak that was so noble a knyght." However we may doubt of the cure, it appears from all the evidence that we have here proof of the existence of syphilis at this time. *Roynouse* means itchy, scaly, etc., and the French *rogne* to-day means the itch. But for patent reasons such a meaning cannot be applied in this case, and the context makes more clear the virulent nature of the disease. The location of the lesion, the duration of the disease, and the girl's plain knowledge of its infectious nature are evident. In the Quest of the Holy Grail Launcelot laments that through his sinful life he has lost his eyesight and his strength—an addition to the original record, doubtless, by a later hand.

There are allusions to violent epistaxis. It is said that the venerable Joseph "bled sore at nose, so that he myght not by no meane be staunched"; and of Garynsch we read that on beholding his faithless lady sleeping with her paramour, "for pure sorou his mouth and nose braste oute on bledynge." In *Le Conte de la Charrette* Keux is declared not guilty by the queen, because "her nose bled during the night, as it often does."

Swooning is most commonly due to physical exhaustion and extreme hemorrhage, but we read of instances due to fright and violent emotion. When told Tristram was near, "for very pure Joye la beale Isoud swooned." Quite natural is the act of Bois, who "dawes" (sprinkles the face) of the swooning Queen Gueneuer. It is said that the hermit knight, seeing Sir Launcelot helpless and bleeding, "put a thynge in his nose and a lytel dele of water in his mouthe, and thenne Sir Launcelot waked of his swoune." The "thynge" was probably some pungent substance, not unlike the custom of to-day.

The obstetrician finds an occasional line of interest. The babe Arthur was placed in charge of Sir Ector, whose "wyf nourysshed hym with her owne pappe." The significance of the last words arises from the belief that the child's characteristics are derived from the mother or the one who nurses him, through the milk. In this way is explained the baddish character of Arthur's foster-brother Sir Kay, who, as a babe, was given to another woman to nurse. Explaining the bad character of Keux "et se il est fel es faus et vilains, vous le devés bien sousfrir," says Auctor to Artus, "que toutes les mauvaises choses qu'il a n'a il prises se par le norriche non qui l'alaita, et pour vous norrir est il si desnaturés." An instance of premature labor is recorded in the case of Elisabeth, the wife of King Melyodas, who ran into a forest to seek her spouse and by reason of her violent exercise "began to travaille fast of her child and had many grymly throwes" and was delivered "with grete paynes" by a gentlewoman. A distressing case of rape is that of the Duchess of Bretayne,

who was murderously assaulted by a giant who "in forcyne her slytte her unto the nauyl." The body of the babe Merlin is covered with hair, a fact that frightens the mother and women. In the *Suite de Merlin* an interesting medico-legal question is solved by Arthur and Merlin as to the illegitimacy of Tor, begotten as a result of rape by Pellinor upon "une pastorelle," who kept the fact a secret and was married to a "vakier" the same week. The conte is finely told, with true English humor. To the fact that Tor is a king's son is ascribed his longing to be a knight, all his other numerous brothers, according to the then conception of the laws of heredity, being content with their plebeian lot, because they were the legitimate sons of the cowherd.

The neurologist and alienist will note what may be called a case of aphasia, that of King Uther, the father of Arthur, who "fyll passynge sore seke, so that thre dayes and thre nights he was specheles." Frequent references to insanity are couched in the terms "madde man," "out of wytte," "wood man," etc. Loss of mind through unrequited or unsatisfied love is quite common. Launcelot becomes insane through his love for Queen Gueneviere, runs about almost nude, and is compared to a "wood man in his sherte." He "empayred and waxed feble bothe of his body and of his wit for defaute of sustenaunce" and became "more wooder." Tristram is another victim of love, and his paramour, Queen Isoud, "maade suche sorowe, that she was nyghe oute of her mynde." Merlin makes a bed that "never a man lye therein but he wente oute of his wytte." Sir Kehydius died for love of this same fair Queen. Sir Matto le breune "felle oute of his wytte by cause he lost his lady." That Launcelot was, in modern lingo, of a neurotic temperament appears from a number of hints; *e. g.*, "he woulde clater in his sleep," and a peculiar effect of his great attack of sleeplessness was anorexia and adipsia; "he drys and dwindles away until he was a kybbet (cubit) shorter." On another occasion he lay unconscious for twenty-four days and nights.

The criminal use of narcotics and poisonous potions is noticed. Queen Morgan le fay gives "Alysander such a drynke that in three dayes and three nyghtes he waken neuer but slepte." King Mark gives Trystram a drink causing him to fall asleep. There is mention of a "remedy that is the grettest poyson that euer ye herd speke of," to poison Arthur while he is at Camelot. Pyonel poisons the apple at the Queen's feast, hoping to make way with Gawayn, who was particularly fond of apples, but happily the victim escapes, the unfortunate Sir Patryse eating the fatal fruit, which causes him to swell and burst and fall dead. We cannot imagine what was the nature of such a poison. Unless mistaken for the fatal infection from an ordinary wound, we must believe poisoned weapons were used. Tristram is shot through the shoulder with a poisoned arrow. In medieval times it was commonly believed that certain persons possessed poisons, the antidote of which they alone knew. Tristram is struck in the side by Marhaus with an "enueymed" spear, and had to go to Ireland, the source of the poison, in order to be relieved. Wounded in the arm by a *saiete envenimee* by an archer, Gavain is weakened by the shot, and the next morning he finds that his arm is swollen, and "*estoit assés plus gras que la cuisse d'un homme*," and believes without help he must die. Merlin later prophesies Gavain will soon recover, which comes to pass.

Reference is made to the use of what our balneologists would call a medicated bath. Sir Launcelot "made fayre Elayne to gadre herbes for hym to make hym a bayne." There is one reference to gout. Uterpendragon "fell into a grete sekeness of the gowte in the handes and feet." (This is hardly sixth century wisdom.) Besides the one quoted there is a possible allusion to leprosy in the passages relating to la beale Isoud's confinement in a "lazar cote," and to the lady who "felle unto a mesel." Lamorek desires a remedy to make him whole of the disease which he had "taken in the see," which may have been one of the numerous complications resulting from exposure in cold water.

The use of horse-litters to convey the wounded was well known.

The embalming of sixty fallen Roman Senators, etc., is surely not of Cymric or English origin.

Is it possible that Gueneviere had some chronic bronchial or pulmonary disease? It is recorded that she "coughed soo loude that Syre Launcelot awaked and he knewe her hemynge." Of course a beautiful woman never snores! In one text also she seeks to avert suspicion as regards the blood on the bed-clothing by saying that her nose bled in the night "as it often does."

We thus learn that in the heroic youth-time of our race the indications gleaned from these early records of the practice and condition of medicine were singularly in harmony with the character of the people. We are well aware that in such matters omission of descriptions and details does not imply their non-existence, and yet in general the picture is fairly and essentially accurate and complete. The thousand unconscious hints and touches conveyed in other matters as to things just beyond the definite and intended purpose would have been also given in regard to matters medical if they had been actualities. Had there been more competent physicians than la belle Isoud, she would not have been called "the noble surgeon," and the lives of the heroes would not have been entrusted to her cure. Professional practice did not exist, except as by-play, in the hands of the more intelligent and expert of those a little less busy than the heroes. It engrossed no one's sole attention.

It is also to be noted, as we have seen, that the method of treatment was extremely simple and unlearned except as a result of common sense and self-gained experience. It consisted almost entirely of the highly sound practice of removing foreign bodies from wounds and cleansing them, then in applying some simple herbal ointment with a bandage. The rest was left to God and a little quiet. As to the treatment of diseases other than surgical, it consisted in perhaps the exhibition of some simple herbal decoction, and a little wine and food. So far the patient was only cursed with the disease, and not, as later, with both disease and physician. Through all was the belief in the identity of disease and virtue, and when possible of the substitution or imputation of the moral health of another for the physical disease. This latter belief was, we must confess, a truthful error, the

adumbration of a profound verity which our materialistic age in ignoring falls into an opposite and equally grave blunder. Almost all disease, if we but knew it, has a moral or metaphysical cause and result. For the rest, most remarkable is the entire absence of medical superstition of the distinctively primitive or medieval type. Where else do we find in the adolescence or childhood of a race such an utter absence of medical barbarism and savagery? There is not here any faintest glimpse of delight in the nasty, the obscene, the ugly and the outrageous. There is no pouring into the sufferer recipes outdoing in hideousness the mess of the witches' cauldron.

Now all this, and especially the last-mentioned fact, has most emphatic, exceptional and manifold significance:—

1. It is an added proof of the remarkable psychologic sanity and natural elevation of character, of splendid nobility of soul, on the part of our young racial ancestors. It may not show any medical "science" (that began gestation only a thousand or more years later), but it shows freedom from pseudo-science, medical filth, and egregious superstition. Great must be the purity of a people in mind and body that needs no medicine-man caste, that makes the most beautiful and revered women its best surgeons, and that keeps the disgusting out of its materia medica.

2. It throws a strong side-light for the benefit of literary and historic criticism on the genuineness of documents by which we have come into possession of the pricelessly precious Arthurian legends. So little has this aid and value been recognized that Sommer has failed to include in the Glossary of his superb edition of Malory all medical and anatomic terms. We have little doubt that it will be found that future critical exegetists will learn that all the allusions, *e. g.* to embalming, to what pertains to the medically nasty and superstitious, the recondite, civilized, scientific, or miraculous, are interpolations, ill weeds, mostly of Continental and Oriental sowing, and may serve as clues to be dropped in our voyage of discovery backward to the originally pure, natural and healthy fountain of eternal youth.

3. As a profession the fact may teach us to hark back to the Cymric springs of our English tributary stream and properly to reverence and value its earlier purity. A further study of medieval medicine will yield us little to honor more, and much to be heartily ashamed of. Slowly we shall see flowing into the limpid English mountain brook the polluting streams of therapeutic filth and nonsense that have rendered the river so nauseous, and that still prevent a newly-arisen and genuine science from ridding ourselves of the loathsome quackeries and sectarianisms that infect its waters and prevent the "healing of the nations."

THE PRESENCE IN THE BLOOD OF FREE GRANULES DERIVED FROM LEUCOCYTES, AND THEIR POSSIBLE RELATIONS TO IMMUNITY.*

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I.—Free Granular Bodies in the Blood.

H. F. Müller,[1] an assistant in Nothnagel's clinic in Vienna, has recently described certain "small, generally round, colorless granules," which he finds constantly present in the freshly-drawn blood from healthy and diseased persons. These granules are readily distinguishable from blood plates.

We have been able to confirm Müller's observation by the examination of numerous specimens of blood taken from human beings and certain of the lower animals. Since some of our conclusions are different from those drawn by Müller, we shall first present an abstract of his work and then the results of our own experiments.

Müller always found the above-mentioned granules in fresh human blood, and by means of their small size he was able to differentiate them from red blood corpuscles, leucocytes and blood plates. He describes them as small, round, colorless bodies, about the size of the finest fat particles, and is quite sure that they are normal constituents of the blood and not foreign matter introduced through accident. His attention was first called to these granules by observing many small bodies resembling micrococci free in the plasma of a case of Addison's disease. Upon examining healthy blood as a control, the presence of similar granules was demonstrated, and, as mentioned above, after many observations upon the blood of healthy and diseased individuals, Müller came to the conclusion that these refractive bodies are regularly present in the blood. Their diameter is 1 μ or under, their size being somewhat variable. They are further described as highly refractive, round or dumb-bell shaped bodies, which show a dancing, molecular movement, but no independent motion. When the fresh blood is prevented from drying by surrounding the cover-slip with oil, these granules can still be seen after 24 hours, and the same may be said when the blood is mounted in 1 per cent. osmic acid. The reaction for fat does not occur with this acid, nor can they be dissolved by acetic acid or ether. They are not concerned in the formation of fibrin, since they remain outside of the fibrinous network or are only accidentally attached to it.

From these observations the author concludes that these granules are a normal constituent of the blood. His technique guarded against the introduction of foreign particles from the skin, etc. He does not consider them as Ehrlich's neutrophilic granules escaped from leucocytes. He states that the neutrophilic granules are dissolved by dilute acetic acid, while the bodies which he has studied are not dissolved by this acid.

*Read before the Johns Hopkins Hospital Medical Society, October 18th, 1897.

He does not believe that they are true particles of fat, since they do not give a reaction with osmic acid, but advances the opinion that they may be bodies resembling fat, but which fail to show the osmic acid stain. He leaves the question open as to their fatty or albuminous nature, and ends by calling them "Haemokonien," or "Blutstäubchen" (blood dust). No mention is made of any attempts at staining.

Briefly stated, therefore, Müller has observed a varying number of small refractive, spherical bodies, of undetermined origin and composition, in all of the specimens of human blood which he examined.

Other authors have also observed bodies resembling fat granules in the blood of normal human beings, Kölliker,[2] Ranvier,[3] Bizzozero,[4] and von Limbeck[5] all mention such bodies in the blood. Müller was unable to reconcile their description by these authors with the bodies which he observed, but he thinks that certain fat drops or granules described by Schiefferdecker and Kossel[6] are probably identical with his bodies. Hayem[7] also speaks of spherical granulations resembling fatty particles, which Müller considers as identical with the granules described by himself.

The bodies which we have observed correspond in their general appearance to those described by Müller. We especially wish to emphasize the fact already mentioned that the granules vary in size. Occasionally one meets with the larger round body about 1 μ in diameter, but by far the more frequent variety are the fine granules, almost dust-like in appearance. They exhibit molecular movement, but no independent motility.

We first began the study of the bodies by ordinary daylight, but we soon found that they can be brought out much more clearly by means of the artificial light of the Welsbach gas-burner. We have been able to demonstrate the presence of these granules in the fresh specimens of blood taken from the lobes of the ears of about 500 persons. Most of the specimens were from dispensary patients, but about 100 were taken from normal individuals. Care was always taken to thoroughly cleanse the ear, and the first drop of blood was always wiped away with a clean towel. In perfectly fresh specimens the granules were not numerous, but they seemed somewhat increased in patients who had been taking tonics or the various alcoholic drinks. No attempt was made to determine their relative frequency in different diseases.

After having observed these granules in all of the specimens of human blood which we had examined, the question naturally arose as to their origin. It was first noted that these granules, when examined by artificial light, resembled those of the eosinophilic and neutrophilic leucocyte. These leucocytes, when observed at once in a perfectly fresh drop of blood, kept at the room temperature, are usually motionless, and the granulations show no activity. When the blood specimen is surrounded by vaseline and is then exposed to a temperature of 35° C. for an hour or more, the picture becomes somewhat different. At times the granular leucocytes become actively amœboid, and the granules within the neutrophile exhibit a characteristic activity, which might be compared to the swarming of bees around a hive. The number of fine granules free in the plasma is perceptibly increased. The eosinophilic granulations also show a less vigorous tremulous motion, and both varieties follow the changes in the direction of the pseudopodia, the protoplasm being thrown out first, and the granules slowly following. The characteristic dancing motion of the granules in the neutrophilic leucocyte can be brought out very plainly by simply mixing the drop of blood with an equal amount of distilled water containing 1 per cent. of alcohol. The granules soon become very active and present a characteristic picture.

And now a difficult question presents itself. Can these granules be actually seen to leave the leucocyte? It is certainly not easy to be sure, even after continuous observation for an hour or more, that one has actually seen one of these granules leave an amœboid leucocyte. We think, however, that we have observed this phenomenon upon several occasions, both in fresh specimens of blood exposed to 35° C. and in blood to which 1 per cent. of alcohol had been added.

As already mentioned, Müller does not think that his granular bodies can be derived from the neutrophilic leucocytes, since Ehrlich's granules are dissolved by dilute acetic acid, while the bodies which he describes are not dissolved by this fluid. According to our observation, dilute solutions of glacial acetic acid (c. p. 99.5 per cent.) cause a great increase in the number of granules free in the plasma when added in equal parts to fresh blood. Many granules can still be seen in the protoplasm of both varieties of granular leucocytes, however, and we cannot convince ourselves that any destruction of the granules has taken place. If a 0.5 per cent. solution of this acid be added to a drop of blood, the eosinophilic and neutrophilic leucocytes often become amœboid, and the granules of the eosinophile often show a slight tremulous motion. The neutrophilic granules exhibit a most characteristic movement, and soon flow into and fill the clear spaces present in the fresh pseudopodia of amœboid leucocytes. Many fine granules can be seen in the clear plasma and around the neutrophile, and it would seem that occasionally a granule leaves the active leucocyte and becomes free in the surrounding fluid. When 1 per cent. glacial acetic acid is employed the leucocytes are no longer amœboid, nor the intracellular granules active. Many granules can still be made out, however, within the protoplasm of the leucocyte, and there are more granules present in the plasma than in the fluid portion of untreated blood. When 5 per cent., 10 per cent., and even stronger solutions are used, the protoplasm of the leucocyte becomes clear and practically free from granules.

Similar free granules can also be made out in the clear blood serum, and they are fairly numerous if the separation has taken place at 35° C. In specimens of blood heated in the usual way for microscopical study, extracellular granules can be stained by a deep red solution of aqueous eosin. This stains the eosinophilic and neutrophilic granulations, and at times a granule of both kinds can be seen immediately adjacent to the leucocyte. Of course such pictures may be due to the manipulation of spreading, and the most convincing phenomena are certainly to be obtained by studying specimens of fresh blood.

Our next series of investigations consisted in the observation of the blood of various animals. In the blood of the

horse the eosinophile presents a remarkable appearance, the individual granules being often from five to ten times the size of the human variety. Even in perfectly fresh horse's blood a few large, round, refractive bodies can be seen free in the plasma, which entirely resemble the intracellular bodies in size and appearance. Another variety of leucocyte containing granules about the size of the human eosinophilic granules is also present, and a few granules of the same size can be made out in the surrounding fluid. When the specimens of horse's blood are exposed to 35° C. for an hour or more, both varieties become amœboid, and the intracellular granules show a slow flowing motion. The number of the granules free in the plasma, resembling both varieties, is also perceptibly increased, and the conclusion seems almost irresistible that they have been extruded from the leucocytes. The serum which has separated from the clot also contains many granules resembling those described above, especially if the separation has taken place at 35° C.

The eosinophile is the only granular leucocyte present in rabbit's blood, and the granules are about the size of those of the human eosinophile. When the blood has been exposed to a temperature of 35° for an hour, a few round bodies can be seen free in the plasma which resemble the granules of the eosinophile in size and appearance. No smaller dust-like particles can be seen, and this can probably be explained by the fact that the rabbit possesses no finely granular leucocytes. In hardened specimens stained by aqueous eosin the intracellular granules can be easily seen, and at times similar bodies can be observed outside of the leucocyte.

The cat's blood contains about an equal number of eosinophiles and finely granular leucocytes, and the granules are about the size of those present in these respective leucocytes of the human being. Even in perfectly fresh specimens a few granules can be found corresponding exactly to both varieties mentioned above, and when the blood is exposed in the thermostat for an hour there is a great increase in the number of granules of both kinds.

In the guinea-pig the blood contains a few eosinophiles, and many more finely granular polymorphonuclear cells, and the granules of both varieties can be plainly made out in the leucocyte; while if the blood is placed at an artificial temperature, similar granules can be seen dancing round the leucocytes, or free in the plasma. When stained by aqueous eosin the smaller granules are slightly smaller than the human neutrophile, while the larger granules about equal the human variety in size.

In the blood of the rat both eosinophilic and finely granular leucoytes are present. Many large and small granules, entirely resembling those inclosed in the protoplasm of both varieties, can be made out free in the plasma, especially after an hour at 35° C. In stained specimens the fine granules are as small as the human variety, and the rarer eosinophilic leucocytes contain perceptibly larger granules.

After exposure to a temperature of 35° C. for an hour there are more free granules present in the blood of the cat and white rat than in the blood of the other animals which we have studied. There are also granules present in the blood of such animals as mice, frogs, fishes, land-terrapins, tadpoles, and even oysters and clams. They are also present in hydrocele fluid, and the serum of such animals as the horse, hog, steer, rabbit, and dog. They present a striking appearance in the usual varieties of pus, and the intracellular granules are often active.

These observations simply strengthen the conclusion that the granules of the eosinophile and the neutrophile are present as free bodies in the plasma and serum.

II.—Bearing of the Foregoing Observations upon Immunity and Natural Resistance.

Our observations indicate that granules derived from leucocytes appear free in the blood. It occurred to us that these granules may be concerned in the protective properties of the blood in immunity. A brief review of the two principal theories in regard to immunity, and the later work concerning this matter, will here be in place.

Metchnikoff, as is well known, believes that bacteria are destroyed in the body chiefly by means of the leucocytes. These amœboid cells or phagocytes engulf the invading organisms and gradually destroy them, being attracted to certain bacteria by means of positive chemotaxis. If this attraction exists between the phagocytes and the bacteria, and the former are able to include and destroy the latter, the animal is saved. If, on the other hand, the bacteria repel the phagocytes by means of negative chemotaxis, or the phagocytes are incapable of completely destroying or preventing the development of the infectious organisms, the bacteria gain the upper hand and the animal suffers a fatal infection. This well known theory of phagocytosis is summarized by Metchnikoff as follows:

"We have the right to maintain that in the property of its amœboid cells to include and to destroy micro-organisms the animal body possesses a formidable means of resistance and defense against infectious agents."

The work of Buchner has certainly imposed some restrictions upon the unqualified acceptance of this theory, although his later investigations point towards the leucocyte as the origin of the germicidal material. Buchner demonstrated that the bactericidal property of blood is not dependent upon the presence of leucocytes, inasmuch as the serum of the dog and rabbit, which had been freed from cellular elements by separation and centrifugalization, is still capable of destroying such bacteria as the typhoid and anthrax bacilli, and the spirillum of Asiatic cholera.

After freezing and thawing the blood serum he found that it still remained bactericidal while this treatment destroyed the leucocytes, and he excluded the action of these cells by filtration of the serum through double filter paper. From these results he concluded that the actual presence of the leucocyte is not necessary for the bactericidal power of the serum. He later modified his earlier views by admitting that the leucocytes probably furnish a bactericidal substance, although he does not believe that they actually as a rule consume and destroy the agents of infection.

He demonstrated this property of the leucocytes to furnish a germicidal substance in the following manner. He first injected a sterilized emulsion of wheat-flour paste into the

pleural cavity of dogs and rabbits, thereby obtaining an exudate which had much more germicidal strength than the blood or serum of the injected animals. Although this was referred to the greatly increased number of leucocytes present, he argued that it was not due to their phagocytic action, since by freezing the exudate the leucocytes were destroyed, and yet upon thawing out this material the bactericidal properties of this fluid were even slightly increased.

Other observers have also recently pointed out that the leucocytes seem to contain germicidal substances in a concentrated form. Hahn[8] has confirmed the work of Buchner in regard to the heightened bactericidal effect of pleural exudates containing a large number of leucocytes, and he has also succeeded in partially extracting this material and imparting the power of destroying bacteria to other fluids than serum. He first introduced wads moistened with sterile chemotactic substances into the peritoneal cavity of rabbits. After 24 hours these wads were removed and were found to contain countless leucocytes. The fluid from the sponges was then frozen and the leucocytes thereby destroyed. After thawing, this fluid was found to possess decided bactericidal effects. From his experiments he concludes that the germicidal material is not a product of the destruction of the leucocyte by the system, but that it is a secretion formed during the active existence of this cell.

Bordet[9] has also made a number of important communications bearing upon this subject. This investigator produced an œdematous fluid free from leucotypes in guinea-pigs immune from the cholera spirillum, by means of compression exerted by rubber bands around the extremities. He then compared the bactericidal power of this cell-free fluid to that of the animal's serum containing leucocytes, by introducing into each equal numbers of cholera spirilla. He found that cultures made from the serum were always sterile in from one to one and a half hours, while similar cultures taken from the œdematous fluid showed a perceptible increase in the number of bacteria. Later cultures from the œdematous fluid showed even greater increase. He also produced a hypoleucocytosis by means of carmine injections, and found that the power of such blood to destroy bacteria was greatly decreased when compared with its bactericidal properties before the artificial diminution of the leucocytes. Bordet concludes that the leucocyte is the seat of the bactericidal material, which under abnormal circumstances it gives up to the surrounding fluid.

Schattenfroh[10] has made some exceedingly interesting observations in regard to the bactericidal properties of the leucocyte. He has found that the diluted inflammatory exudates from rabbits were much more bactericidal when he added many leucocytes than when the fluid was free from cellular elements. He also secured leucocytes by centrifugalizing these fluids, and by adding the sediment to salt solution he found that this fluid became capable of destroying bacteria. By drying this sediment of leucocytes in a vacuum over phosphorus pentoxide he secured a fine powder which rendered salt solution very destructive to bacteria. He thinks that the leucocytes furnish the bactericidal substance by a process of destruction. His promised detailed account should be a communication of great interest.

Bail[17] has made some tests which in his opinion prove that the leucocytes contain a bactericidal material. After injecting virulent staphylococci into the pleural cavity of rabbits he found that the leucocytes underwent a characteristic change. They formed round, empty bodies, containing several vacuoles in the nucleus. The granules generally disappeared. Upon destroying the staphylococci by adding ether, and diluting the centrifugalized sediment, the granules showed a dancing motion, and were seen to leave the periphery of the cell and enter the surrounding medium.

He also secured leucocytes by Buchner's method, added sterile salt solution, and obtained a sediment of leucocytes by centrifugalization. By adding a diluted product of the staphylococcus pyogenes aureus called leukocidin to this sediment, he found that the leucocytes were destroyed, and that they then gave up their bactericidal material to the surrounding fluid. If the leukocidin was heated to 60° C. it lost its property of destroying leucocytes. He found that nutrient fluids to which untreated leukocidin and leucocytes were added, became very destructive to bacteria. This he explained by the fact that the leukocidin destroyed the leucocytes, thus freeing the alexin. When the leukocidin was heated to 60° C. its destructive powers were destroyed, and when this altered material was added to the fluid containing the sediment of leucocytes the fluid was not destructive to bacteria. This was because the inactive leukocidin could not free the bactericidal substance from the leucocytes. Such bacteria as the typhoid and colon bacillus, the spirillum of Asiatic cholera, and the staphylococcus pyogenes aureus were practically destroyed in 6 hours.

Bail concluded from these and other experiments that the white blood corpuscles of the rabbit contain a bactericidal material, which at times becomes free and appears in the surrounding medium.

We have also performed a series of experiments which seem to show that the leucocytes are directly concerned in furnishing a definite amount of bactericidal material, but the methods need a preliminary explanation.

Certain investigations were made for the purpose of determining whether there existed any difference in the bactericidal power of fresh blood serum before and after it had been filtered through new sterile Müncke filter-cylinders.

Dziergowski[11] has shown that such fluids as abrin solution, diphtheria toxin and tetanus toxin suffer a slight diminution in their toxic properties when filtered through porcelain cylinders, and Martini[12] has shown that the antitoxin of diphtheria is also weakened by this process.

Denys and Havet[15] consider that the leucocytes of the dog play the principal part in the destruction of bacteria, and they base their conclusions upon the results obtained from the following experiments.

They first proved that the blood of the dog was capable of destroying many more colon bacilli than the serum of this animal in a given space of time. Thinking that this increase in the bactericidal power of the blood, as compared to that of the serum, might be due to the greater number of leucocytes present in the former fluid, they next compared the relative destructive powers of filtered and unfiltered blood. The fluid

was filtered through double filter paper, as this method was found to deprive the blood of its white blood corpuscles. They found an enormous difference between the bactericidal power of the blood possessing its leucocytes, and that which had been deprived of the same by filtration.

These observers were also able to greatly increase the bactericidal power of the serum by the addition of the sediment of leucocytes obtained from a sero-purulent exudate in the pleural cavity of a dog. This was produced by the injection of dead fluid cultures of the staphylococcus pyogenes aureus. By the addition to filtered blood of the leucocytes obtained from the pleural fluid of a dog injected with dead spirilla of Asiatic cholera they were able to restore the lost bactericidal properties of the blood.

They conclude from the observations above mentioned that the blood of the dog when filtered loses its bactericidal power, but that this property can be restored by the addition of living leucocytes.

The blood from which we obtained our serum was secured from rabbits and dogs by means of a sterile cannula introduced into the carotid artery under aseptic precautions. The first few drops were allowed to escape and the rest of the blood was caught in sterile jars. These were stoppered with cotton and allowed to stand at 22° C. for from 12 to 24 hours, when one-half of the serum was filtered through porcelain, while the other half was siphoned off into sterile flasks, care being taken to prevent any admixture of red blood corpuscles. We never worked with serum over 48 hours old.

Our first series of experiments demonstrated a decided difference between the undiluted serum of dogs and rabbits before and after filtration through the unglazed porcelain filter.

When such motile bacteria as the spirillum of Asiatic cholera, the Finkler-Prior spirillum, and the typhoid bacillus were introduced into unfiltered dog serum, complete agglutination took place in from 15 to 20 minutes, together with cessation of motility; but when filtered serum was used no cessation of motility or agglutination took place, even after 3 hours. The rabbit's unfiltered serum caused agglutination and cessation of motility of the typhoid and cholera organism in 15 minutes, and affected the Finkler-Prior spirillum and bacillus pyocyaneus similarly in about 30 minutes. This condition did not change during 24 hours. The specimens in filtered serum remained active and showed no signs of agglutination, even after 24 hours.

The specimens were all examined in hanging drop-slides, and allowed to remain at the room temperature. From the foregoing experiments we concluded that filtration of the undiluted serum of rabbits and dogs removes their normal property of causing the agglutination and cessation of motility of the organisms above mentioned.

Our next endeavor was to ascertain whether we could demonstrate any difference in the capacity of the filtered and unfiltered serum actually to destroy these bacteria, and for this purpose we adopted the following method:

Twenty-four hour cultures on slanted glycerine-agar of the various organisms to be mentioned below were prepared, and one loopful of the surface growth was transferred into 2 cubic centimeters of sterile salt solution. Two loopfuls of this fluid were then introduced into 1 cubic centimeter of the unfiltered serum of the rabbit, and a similar amount was used in 1 cubic centimeter of the filtered serum. The same loop was always used, and an agar plate culture was made from the filtered and unfiltered serum at once, in order to compare the number of germs originally introduced with those present in the serum at varying intervals of time. In all our experiments control plates made from the serum before using remained sterile.

Five loopfuls were planted at the end of 2 hours from both varieties of serum, and at the end of 17 hours 1 loop was planted from the different filtered serums, and 5 loops were planted from the unfiltered serums. With anthrax 1 loopful of the culture was directly introduced into the serums. All of the specimens were kept at a temperature of 35° C. during the experiments.

TABLE I.—RESULTS WITH RABBIT'S SERUM.*

	At once.	2 hrs.	17 hrs.
Bacillus typhosus. Colonies.			
Filtered serum.	1960	720	Great increase.
Unfiltered serun.	926	Sterile.	Sterile.
Spirillum of Finkler-Prior.			
Filtered serum.	1230	1010	Great increase.
Unfiltered serum.	959	Sterile.	Sterile.
Cholera spirillum.			
Filtered serum.	201	960	Great increase.
Unfiltered serum.	...	3	Sterile.
Proteus mirabilis.			
Filtered serum.	1740	1650	Great increase.
Unfiltered serum.	1934	1806	" "
Anthrax bacillus.			
Filtered serum.	804	1530	Great increase.
Unfiltered serum.	643	162	" "
Staph. pyog. aur.			
Filtered serum.	743	283	Great increase.
Unfiltered serum.	1050	348	" "

The foregoing table shows that while unfiltered serum will completely destroy such organisms as the typhoid bacillus and the spirilla of cholera and Finkler-Prior, these same bacteria will increase enormously in filtered serum. The growth of the anthrax bacillus was only temporarily restrained, while the remaining bacteria were not affected.

A similar series of experiments was carried on with the serum of a dog.

* All serums from the same species of animal are not equally bactericidal, and the results are affected by the amount of serum used and the number of bacteria introduced. Buchner says 1 cubic centimeter of serum will destroy 1000 typhoid bacilli. With a certain rabbit's unfiltered serum we obtained the following results: One cc. of serum. Typhoid bacillus; at once, 734; 2 hrs., 4 colonies; 5 hrs., sterile; 20 hrs., great increase.—Anthrax; at once, 9144; 2 hrs., 2394; 5 hrs., 354; 20 hrs., 28,800.

Table II.—Results with Dog Serum.

	At once.	2 hrs.	20 hrs.
Spirillum of cholera.			
Filtered serum.	941	1224	Great increase.
Unfiltered serum.	876	Sterile.	Sterile.
Bacillus typhosus.			
Filtered serum.	525	455	Great increase.
Unfiltered serum.	638	28	Sterile.
Spirillum of Finkler-Prior.			
Filtered serum.	1208	1494	Great increase.
Unfiltered serum.	...	Sterile.	Sterile.
Bacillus pyocyaneus.			
Filtered serum.	1800	1140	Great increase.
Unfiltered serum.	...	240	" "

These tables show that the filtered serum cannot destroy the typhoid bacillus or the spirilla of cholera and of Finkler-Prior, while the unfiltered serum can practically bring about this result in about two hours.

Having demonstrated that the filtered serum had lost its bactericidal property, our next endeavor was to ascertain whether we could restore this lost property by adding the leucocytes to the filtered serum. We found that the centrifugalization of clear serum will cause the precipitation of many leucocytes and red blood corpuscles. Many granules similar to those described before were also present in the sediment.

Our method of restoring the leucocytes to the serum was as follows:

Ten cubic centimeters of clear unfiltered dog serum were thoroughly centrifugalized in sterile tubes, and the supernatant fluid was then poured off, care being taken not to contaminate the sediment. The few remaining drops were removed from the sediment by means of sterilized swabs of absorbent paper, and a semi-fluid deposit was allowed to remain in the bottom of the tube. Under the microscope this consisted of leucocytes, free granules and red blood corpuscles. This we designated as the small sediment. In another instance 10 more cubic centimeters of serum were added to a tube already containing a sediment, and a second deposit was obtained from this fluid by means of centrifugalization, making the accumulated deposit from 20 cubic centimeters of unfiltered serum. This we called the large sediment.

Two cubic centimeters of filtered (non-bactericidal) serum were then added to tubes containing the large and small sediment, and as a control, filtered and unfiltered serum was used. All of the serum tubes were then inoculated by means of the following method.

One loop of a 24-hour culture of the typhoid bacillus was added to 3 cubic centimeters of sterile bouillon, and 1 loop of this fluid was then added to the filtered serum, the filtered serums plus the sediments, and the unfiltered serum. Three loops from the inoculated serums were always used for the plates made for numerical comparison, and the serum was kept at 35° C. during the experiments. The plates were allowed to remain in the thermostat for 48 hours before counting. The typhoid bacillus was used for the experiments.

Table III.—Results with Bacillus Typhosus.

Colonies present.	At once.	3 hrs.	5 hrs.	20 hrs.
Filtered serum plus Small sediment.	382	367	690	Great increase.
Filtered serum plus Large sediment.	462	318	596	" "
Filtered serum.	324	900	29445	" "
Unfiltered serum.	246	Sterile.	Sterile.	Sterile.

These figures show conclusively that the presence of the sediment consisting of granules, leucocytes and red blood corpuscles in the filtered serum rendered this fluid capable of inhibiting the growth of large numbers of bacteria, although it was incapable of preventing the subsequent development of bacteria in this fluid. This later development was probably due to the presence of the nutritive material in the red blood corpuscle, which property gradually neutralized the germicidal qualities of the serum. The abstraction of the red blood corpuscles by water robbed the sediment of its bactericidal qualities, so that so far we have been unable to eliminate its nutritive effect. This has been accomplished by the work of Schattenfroh and others, and the results, therefore, accord with our experiments. We have not been able to render the bactericidal power of filtered serum equal to that of the unfiltered fluid, but we mention our method at this time in order to propose a simple method of obtaining large quantities of fluid for further experimentation, and as a slight addition to the mass of evidence in favor of considering the leucocyte as the dispenser of the bactericidal material.

Conclusions.

In the blood plasma and serum of man and many of the lower animals there are present varying numbers of granules, which resemble the granules of the eosinophilic and neutrophilic leucocytes in size and appearance.

After addition of dilute acids, dilute alcohol, etc., and subjection to body temperature, the granules of the leucocyte assume marked activity, and such treatment increases the number of granules present in these fluids. These free granules are almost certainly derived from the granular leucocytes.

The filtration of the serum of the dog and rabbit through new Müncke porcelain cylinders removes its normal property of causing the agglutination and cessation of motility of many motile pathogenic bacteria, and of destroying large numbers of these organisms. This property can be partially restored by adding a sediment consisting of leucocytes, free granules and red blood corpuscles. Since the red blood corpuscles are not germicidal (Buchner), it follows that the restoration of the bactericidal property is due to the addition of the leucocytes and free granules, and that these cells can furnish a germicidal material.

The larger extracellular granules of man, and of the frog, horse and rabbit can be stained by eosin, or by means of Ehrlich's triple blood stain.

Theory of Immunity based upon these Observations.

And now it being demonstrated that the leucocytes not only contain a bactericidal substance, but also under certain conditions can give up a portion of their protoplasm to the sur-

rounding medium, one naturally looks for some experimental proof showing that the germicidal substance and the material that leaves the leucocyte are identical. This proof, however, is extremely difficult to furnish, since filtration of a sediment even through double filter paper will allow leucocytes as well as granules to pass.

We have added the typhoid bacillus to various normal bloods and serums, but without demonstrating any distinct attraction of the bacilli for the free granules. We have succeeded in immunizing a guinea-pig from the typhoid bacillus by means of Pfeiffer's method, and upon adding 24-hour motile bacilli to the fresh blood of such an animal the results are slightly more suggestive.

The bacilli become immediately motionless and clumped, and after 15 minutes at 35° C. fine granules can be seen around the periphery of the clumps, or even dancing about in the meshes of the massed organisms. This condition can be noticed even after several hours, but the granules are never very numerous. Often several can be seen about a single typhoid bacillus.

Novy and Vaughn[13] have extracted a germicidal nuclein from blood serum, and they think that it is derived from the leucocyte. Hankin[14] believes that the granules of the eosinophile gradually dissolve in the serum, thereby furnishing the alexin.

The suggestive work of Kanthack and Hardy[16] should also be mentioned in this connection. These investigators made a number of painstaking observations concerning the effect of the introduction of a few anthrax bacilli into the lymph of the frog. They either injected the bacilli into the various lymph sacs and then withdrew the mixture of lymph and bacilli at varying intervals of time, or they mixed the lymph and bacteria, and then observed the specimen in the hanging drop for several hours.

They found that the destruction of the bacteria could be divided into two distinct stages. The first stage consisted in the approach of the oxyphilic or eosinophilic leucocyte to the chains of anthrax bacilli. These leucocytes were said to apply themselves to the surfaces of the chains of bacilli, and then discharge their granules by a quick streaming motion, when the bacilli would begin to show signs of degeneration.

The next stage in the phenomenon of destruction was the approach of a cell described by the writers as the hyaline cell, which was said to contain a round or kidney-shaped nucleus, but no granules. These cells were seen to approach the masses of eosinophiles and bacilli and gradually replace the eosinophiles.

The hyaline cells would then include the bacteria within their protoplasm, and many cells could be found possessing vacuoles containing fragmented bacilli. The eosinophiles were thought to prepare the bacteria for ingestion by the hyaline cells, but they never were seen to include the bacteria themselves.

Although in a more limited series of observations on five frogs we have failed to observe any distinct clinging of the eosinophile to the chains of anthrax bacilli, we have noticed the fact that after an hour or more the eosinophile will frequently only contain a few granules. Many large eosinophilic granules can be made out free in the plasma, but these are accompanied by smaller dust-like granules. We believe that these smaller granules are derived from the leucocyte of the frog possessing fine granules and a nucleus of the polymorphous variety. These fine granules are at times active within the protoplasm of the cell, and upon one occasion we observed such a leucocyte with active granules which contained an anthrax bacillus in its protoplasm. When specimens taken from the subcutaneous sacs of the frog into which a few anthrax bacilli had been introduced, were stained with methylene blue, typical phagocytosis could be observed in cover-slips prepared half an hour after the injection of the bacilli. Often from one to three bacilli could be made out within the protoplasm of a cell containing a typical polymorphous nucleus, and resembling the ordinary pus cell.

In hardened specimens stained by Ehrlich's triple blood stain, or simple eosin and methylene blue, many large granules exactly resembling the large intracellular granules of the eosinophilic leucocyte could be made out as extracellular bodies, but bacilli were never found within the protoplasm of the eosinophile. The eosinophile seems to form the majority of the white blood corpuscles of the frog, the finely granular cell being more rarely seen.

It would seem, therefore, that the free granules, both from the eosinophilic and finely granular leucocyte, may weaken and destroy the anthrax bacilli by their presence in the plasma, and that then the finely granular leucocyte with the nucleus of the polymorphous variety, together with the hyaline cell of Kanthack and Hardy, complete the process of destruction by including the bacteria within their protoplasm.

The many suggestive facts which we have just mentioned have induced us to advance the following theory:

The bactericidal power of the leucocyte of the blood, and of the serum of man and many animals, is due to the presence of specific granules, especially the eosinophilic and neutrophilic.

When called upon to resist the action of invading bacteria, the granular leucocytes can give up their granules to the surrounding fluids or tissues.

Not only does this enable us to understand how apparently cell-free fluids can destroy bacteria, but the production of the alexin by the leucocytes also affords a better explanation of the hyperleucocytosis of infection so strongly urged by Metchnikoff, and by no means disproves the supposition that the leucocytes can take up bacteria either while alive or after being destroyed by means of the germicidal granules.

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ON THE ANATOMICAL RELATIONS OF THE NUCLEI OF RECEPTION OF THE COCHLEAR AND VESTIBULAR NERVES.

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Since the investigations of Babinski,[1] v. Bechterew,[2] Bumm,[3] Cramer,[5] Flechsig,[6] Forel,[7] Kirilzew,[9] v. Monakow,[12] Onufrowicz,[13] and Roller,[14] much light has been thrown on the central connections of the cochlear and vestibular nerves by Ramón y Cajal,[4] Held,[8] v. Kölliker,[10] Martin[11] and Sala.[16] The exact topographical relations of these nuclei have, however, so far been only imperfectly described.

The material used in the present study was human tissue and consisted of two superb sets of serial sections, transverse and horizontal, through the medulla of the new-born babe, prepared by Dr. John Hewetson at the Anatomical Laboratory of the University of Leipzig. Through the courtesy of Dr. Hewetson these preparations have been made accessible for study to research-workers in the Anatomical Laboratory of the Johns Hopkins University.

A flat reconstruction on millimetre paper has been made from the right-hand side of the sections of the transverse series which show the nuclei in question. Reference to the diagram (Fig. 1) will show the following points: At the lower end of the diagram the zero point on the scale represents the superior (anterior) limit of the decussation of the pyramids, and at the upper end the diagram extends nearly to the lower border of the inferior colliculus of the corpora quadrigemina. The lines drawn across the diagram represent approximately the planes of the sections having the corresponding numbers.* The areas occupied by the nuclei of the nervus hypoglossus and nervus abducens are given to help in orientation. The lines *a–a* represent the lateral boundary of the fourth ventricle, which has been traced from the point at which the canalis centralis opens out into the floor of the ventricle, through the area of the recessus lateralis and forwards to the aqueductus cerebri. The line *b–b* represents the lateral boundary of the corpus restiforme. The entrance of the corpus restiforme into the cerebellum is not shown, but the line runs to its upper limit. The motor and sensory nuclei of the nervus trigeminus are shown with the exception of the nuclei minores (radicis descendentis). The tractus spinalis nervi trigemini, together with the adjacent substantia gelatinosa, is represented in outline from its beginning, at the entry zone of the nerve, downward as far as the decussation of the pyramids. Its course further spinalwards is not given. The entering root bundle of the nervus trigeminus is also not illustrated, but the lowest section which shows it corresponds to number 45 on the scale, and as the nuclei of the nerve are inferior to the point where it enters, the fibres can be traced farther upwards than the diagram goes. The lines d_3 and d_4 represent the surface markings on the floor of the fourth ventricle corresponding to the ala cinerea. The complete length of the nucleus alæ cinereæ is not shown, but it can be traced from the inferior end of the nucleus nervi hypoglossi to the point marked d_1 on the diagram. The line d_1–d_2, in which the two sulci meet, corresponds to the portion of the ala cinerea which has been pushed into the depth by the spreading of the nucleus nervi vestibularis medialis dorsal to it over the floor of the ventricle.

The line *e* represents the continuation of the lateral sulcus over the area occupied by the nucleus nervi abducentis. The sulcus is here further lateral, corresponding to the position of the nucleus nervi abducentis, which is further from the median line than the nucleus nervi hypoglossi.

Nervus vestibuli. The area of entrance of the root bundle of the vestibular nerve is shown in the diagram. The well known fact that the vestibular root bundle is farther forwards (cerebralwards) than the cochlear root bundle is well illustrated. The reconstruction shows clearly the generally recognized fact that the four principal vestibular nuclei are continuous with one another. (See *M.*, *L.*, *S.*, and *R. d. n. ve.* in the diagram.) These nuclei can be distinguished in part by position and in part by the character of the cells within them. The relation of the nucleus nervi vestibularis medialis to the nucleus of the descending tract of the vestibular nerve is very striking. Ramón y Cajal has already pointed out their close connection. The lowest sections in which descending vestibular fibres can be distinctly made out show cells between the fibres (sections between 15 and 17 on the scale). These cells higher up make an oval mass which lies

*The planes of the sections are in reality slightly different from those represented by the lines on the diagram, which are drawn at right angles to the median line. The sections have been cut slightly obliquely, the right side being struck at a higher plane than the left. The slight discrepancies between the drawings of the sections and the diagrams are thus explained.

lateral to the ala cinerea and extends dorsal and medial to the descending vestibular fibres. As the ala cinerea recedes into the depth, and the nucleus nervi hypoglossi disappears, these cells spread to very near the middle line. The large area *M*, together with the dark area *Y*, represents the nucleus nervi vestibularis medialis; it can easily be seen that any division between this nucleus and the nucleus of the descending vestibular tract, throughout their whole extent, must be merely an arbitrary one. It is extremely difficult, too, to determine exactly the medial border of the nucleus nervi vestibuli medialis; it goes over insensibly into the central gray matter surrounding the ventricle. In general the nucleus nervi vestibularis medialis begins from 2½ to 3 mm. below the superior end of the nucleus nervi hypoglossi and extends in the floor of the fourth ventricle as far forward as the nucleus nervi abducentis. Its anterior extremity (*Y* in the diagram) passes forward some distance further lateral to the nucleus of the sixth nerve. The descending tract of the nervus vestibuli begins at the entry zone of the vestibular root fibres in the region of the nucleus nervi vestibularis superior (Bechterew), and of the nucleus nervi vestibularis lateralis (Deiters). It is made up of the descending branches of the root fibres and lies dorsal to the tractus spinalis nervi trigemini, at first at a distance of 1.3 mm. from the floor of the ventricle (Fig. 3). Farther posterior it approaches the floor, and the isolated bundles of fibres of which it is made up occupy a very characteristic oval area, the long diameter of which lies in the dorso-ventral direction (Fig. 2). A reference to the diagram will show that it extends downward from its origin in a straight line as far as the level of the superior (anterior) end of the nucleus nervi hypoglossi. From this point it curves medialwards, giving place to the nucleus funiculi cuneati. It can be traced downwards to a plane a little superior to the middle of the nucleus nervi hypoglossi. The ascending branches of the vestibular fibres are not represented in the diagram, but they are shown in figs. 3 and 4.*

At the extreme superior and lateral angle of the nucleus nervi vestibularis medialis is situated a large group of cells, in part capping the descending tract of the vestibular nerve (Fig. 3, *Nu. y*). It is oval in shape and is distinctly visible in section just below the floor of the fourth ventricle. As will be seen in the diagram (Fig. 1, *Y*), it lies adjacent to the nucleus nervi vestibularis lateralis, to the nucleus nervi vestibularis medialis, and to the nucleus nervi vestibularis spinalis (Radix descendens). This nucleus, however, is worthy of a special description in that it is peculiar: (1) in the size of the cells, they being much larger than those of that part of the nucleus nervi vestibularis medialis marked *M* in the diagram, but smaller than those of the nucleus nervi vestibularis lateralis; (2) by the staining capacity of the mass, which on the whole stains in Weigert-Pal preparations of the new-born babe much darker than Deiters' nucleus of the same section; (3) by the fact that the cells are closely packed together, which brings it into marked contrast with the more scattered cells of the nucleus nervi vestibularis lateralis; (4) by its distinct outline in *well stained* preparations, which makes this group of cells easier to differentiate than any of the other vestibular nuclei. A reference to Figs. 3 and 4, and to the diagram, Fig. 1, will show the position of the nucleus. This nucleus evidently corresponds to a part of the *ganglion dorsale acustici* of v. Kölliker (*Hauptkern* of Schwalbe.) It is continuous posteriorly with the nucleus of the descending root, and laterally (in its posterior part) with the rest of the nucleus nervi vestibuli medialis. It is not so easy to locate it definitely in series in which the gray masses are not particularly well differentiated, but even in such a series, after having defined it easily in Dr. Hewetson's sections, its limits have been recognized without much difficulty. Until attention can be paid to the course of the axones of these cells and a comparison can be instituted between its constituent neurones and those of the other vestibular nuclei, I prefer to give the group a distinct place in the diagram and to refer to it as nucleus *y*.

It may further be seen in the diagram that the nucleus nervi vestibularis lateralis and the nucleus nervi vestibularis superior are in the region of the entry zone of the vestibular nerve. The lateral nucleus appears to be separated into two portions by the root fibres of the nerve. One part (L_1 in Fig. 1, and *Nu. n. v. l*, in Fig. 3) is further inferior (posterior) and lateral, and it lies also further ventral than the other part (*L* in Fig. 1, and *Nu. n. v. l* in Fig. 4). L_1 lies between the entry zone of the vestibular root fibres and the corpus restiforme. Its cells are rather smaller than those of *L*. The part of Deiters' nucleus marked *L* lies in its upper part almost in the floor of the fourth ventricle and is continuous laterally with Bechterew's nucleus, from which it can be easily distinguished, however, by the size of the cells. In the longitudinal series these two parts of Deiters' nuclei *L* and L_1 are seen to be in reality continuous; a few scattered cells joining them can be seen between the fibres of the nerve. They are seen with the high power not to be such separate entities as the diagram would make them appear. In his articles on the medulla oblongata Ramón y Cajal describes the nucleus nervi vestibularis lateralis in the white mouse as a crescent-shaped mass, convex on its dorsal border, and showing two sorts of cells, the larger being further ventral, the smaller more dorsal and lateral. In human tissue I find that the nucleus is convex on the ventral border, and to be so inclined that on the whole the smaller cells are further ventral as well as lateral. Fig. 3 shows the lateral portion (L_1) of the nucleus nervi vestibularis lateralis, while Fig. 4, which represents a section .6 mm. further forward, shows the medial portion (*L*).

The nucleus nervi vestibularis superior (Bechterew) lies in the floor and lateral wall of the fourth ventricle, occupying its lateral angle. In the diagram, Fig. 1, it is marked *S* and is given a heavy outline. It lies in a plane dorsal to that of the nucleus nervi vestibularis medialis, and its inferior (posterior) extremity corresponds about to the inferior (posterior) end of Deiters' nucleus. As seen in the diagram

* The so-called cerebellar acoustic nucleus of Ramón y Cajal, the cells of which accompany these fibres, is not represented. No attempt was made to locate in the diagram the gray masses in the roof of the cerebellum, with which the ascending branches of the vestibular nerve undoubtedly come into relation.

it extends even further laterally than does the nucleus nervi vestibularis lateralis of Deiters. A reference to Figs. 3 and 4 will show that it is bounded laterally in a part of its course by the corpus restiforme. As the nucleus extends upwards (cerebralwards) it lies more and more dorsally, so that it comes to lie between the lateral wall of the ventricle and the brachium conjunctivum. It is interesting to note how far it can be traced at its cephalic extremity into the region of the nuclei of the nervus trigeminus. It is traversed by the ascending branches of the root fibres of the vestibular nerve.

There seems to be a general agreement that the root fibres of the vestibular nerve bifurcate. The descending limbs pass into the descending root, many of the ascending go up into the cerebellum. Recent investigations make it probable that axones also run in the opposite direction from the cerebellum to the nucleus nervi vestibularis lateralis. Fig. 4 shows two distinct sets of fibres extending between the cerebellum and Deiters' nucleus; one running between the brachium conjunctivum and the corpus restiforme and lying in the plane of the transverse section for a considerable distance, the other being more medial and going actually through the nucleus nervi vestibularis superior and the brachium conjunctivum. The latter fibres are so inclined that they do not run far in the plane of any one section, but by following the series downward (caudalwards) from the region of Deiters' nucleus, scattered fibres show in the brachium conjunctivum, lying in a plane perpendicular to the fibres of the latter, and so contrasting strongly with them. These fibres are farther dorsal in each succeeding section downward as far as the nucleus fastigii, dorsal to which a well marked decussation is visible (Figs. 3 and 2).

Fig. 5 represents a longitudinal section taken through the area of the vestibular nuclei. The lines 66 on the transverse sections represent approximately the plane of this section. All of the vestibular nuclei, the nucleus nervi vestibularis medialis (with the part of it which I have designated nucleus *Y*), the nucleus of the descending vestibular root, the nucleus nervi vestibularis lateralis and nucleus nervi vestibularis superior, are shown.

Very little of the nucleus nervi vestibularis superior shows, however, inasmuch as this nucleus lies for the most part dorsal to the plane of this section. It will be seen that there is a well marked group of fibres β running obliquely forwards from the region of the nucleus nervi vestibularis superior. These fibres have been traced on both series, and the area they occupy is represented in the general diagram (Fig. 1, *z*). They extend between the nuclei of the nervus trigeminus and the raphe. Toward the floor of the ventricle they pass through the nucleus nervi vestibularis superior, as is shown in the diagram. They decussate in the raphe dorsal to the fasciculus longitudinalis medialis. As to their further course it is impossible to say from these sections.

Nervus Cochleæ. The areas corresponding to the nuclei of the nervus cochleæ are illustrated in Fig. 1. It is interesting to note that the nucleus nervi cochlearis dorsalis is continuous with the nucleus nervi cochlearis ventralis and that the transition from the one to the other is very rapid. Figure 6 represents a reconstruction to show the relations of the cochlear nuclei to the corpus trapezoideum and the complex of the nucleus olivaris superior. The nucleus nervi cochlearis dorsalis begins just above (anterior to) the nucleus nervi hypoglossi. It is in the dorso-ventral direction a long, narrow nucleus, the apparent breadth of the area representing it in the diagram being due to the fact that it curves somewhat around the corpus restiforme. Its size and general character are illustrated in Fig. 2. Both the section and the diagram show how far lateral it lies, though it by no means extends so far lateral as the nucleus nervi cochlearis ventralis, a point which is in disagreement with many of the figures in the text-books. It has comparatively few medullated axones in it, and these run parallel to the long axis of the nucleus as seen in transverse section. The division into three zones, a mesial, middle and lateral, is clearly shown in Fig. 2. This division has already been described by von Kölliker and by Sala. The mesial and lateral zones are rich in medullated fibres.*

In Fig. 6 is represented a flat reconstruction of the mesial and lateral bundles of medullated fibres of the nucleus nervi cochlearis dorsalis. The mesial bundle is marked *m*, and the lateral *l*. It may be seen that the areas corresponding to both bundles run toward the middle line.

The fact that the root bundle of the cochlear nerve enters the nucleus nervi cochlearis ventralis has been observed by Held and Sala. It is interesting to note in Fig. 6 that the area of the entering root bundle of the nervus cochleæ is considerably superior (anterior) to that of the nucleus nervi cochleæ dorsalis. Both Held and von Kölliker have described the bifurcation of the cochlear root fibres. Ramón y Cajal has observed the bifurcation both in the new-born mouse and in the rabbit and says that it takes place in the nucleus nervi cochlearis ventralis.

The two branches are, he states, usually equal in calibre, but the ascending branches are short and end in the nucleus nervi cochlearis ventralis. On the other hand the descending branches are longer and can be traced in a definite bundle to the inferior part of the nucleus nervi cochlearis ventralis and the nucleus nervi cochlearis dorsalis. He says that in the mouse these fibres, at first scattered, soon form a definite bundle, which can be traced to the inferior part of the nucleus nervi cochlearis dorsalis. A bundle of medullated fibres, apparently corresponding to the bundle of axones described by Ramón y Cajal, has been easily traced in the sections I have studied, and is shown in the figure (Fig. 6, *h*). Near the entry zone of the cochlear nerve it consists of scattered fibres, but it soon forms a compact bundle on the mesial border of the ventral nucleus. The bundle runs spinalwards and at the same time so rapidly dorsalwards that in cross section its fibres are cut almost longitudinally. The reconstruction brings out the fact that it is connected with the mesial zone of the nucleus nervi cochlearis dorsalis corresponding to the area of medullated fibres *m* (Fig. 6).

The arrangement of the fibres of the nucleus nervi cochlearis dorsalis in parallel lines has already been mentioned (Fig. 2). In strong contrast to this is the appearance of the nucleus

*According to Sala the cells of the mesial layer and the middle zone give rise to the striæ acusticæ.

nervi cochlearis ventralis (Fig. 3). The arrangement of the cells and fibres of the ventral nucleus in the form of a basket-work has already been described by Held, von Kölliker and Ramón y Cajal. The latter divides the nucleus nervi cochlearis ventralis into two regions, an inferior (tail) and a superior (head). In the human tissue which I have studied it is the inferior part that is characterized by the basketwork. In the superior portion the cells are fewer and more scattered. Indeed, the cells are so scattered and there are so many fibres running to the corpus trapezoideum in this region that it is very difficult to determine exactly in Weigert-Pal preparations the superior limit of the nucleus. The area *C. t.* (Fig. 6) represents the corpus trapezoideum. It may be noticed that the lateral boundary of the corpus trapezoideum is continuous with that of the lemniscus lateralis. In both series of sections a continuous line of cells can be traced from the nucleus olivaris superior to the nucleus of the lemniscus lateralis, so that it is impossible to say where the nucleus of the lemniscus lateralis begins. A description of the auditory neurones of the second order cannot be entered into at this time. The diagram shows very clearly, however, the intimate connection of the nucleus nervi cochlearis ventralis with the corpus trapezoideum and superior olivary complex. An examination of Fig. 2 shows how few fibres are medullated at this period in the nucleus nervi cochlearis dorsalis. They are so scattered after leaving the nucleus that it is very difficult to follow them far. The long distance between the nucleus olivaris superior and the anterior extremity of the dorsal cochlear nucleus is another striking feature of the diagram.

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Legends for Figures.

Fig. 1. Diagram representing flat reconstruction of the nuclei of reception of the cochlear and vestibular nerves. The line *a*, *a* represents the lateral wall of the ventricle; the line *b* corresponds to the lateral outline of the corpus restiforme; the line d_1 to d_4, d_1 to d_2, and the line *e*, *e*, *e* correspond to sulci in the floor of the fourth ventricle; *C. d.*, nucleus nervi cochlearis dorsalis; *C. v.*, nucleus nervi cochlearis ventralis; the graduated line corresponds to the middle line of the floor of the ventricle. *Floc.*, flocculus; *K. VII*, knee of nervus facialis; *L.*, medial portion of nucleus nervi vestibuli lateralis (Deiters); L_1, lateral portion of nucleus nervi vestibuli lateralis (Deiters); *M* together with *y*, nucleus nervi vestibuli medialis (Schwalbe); *Nuc. XII*, nucleus nervi hypoglossi; *Nuc. VI*, nucleus nervi abducentis; *P. f.*, pedunculus flocculi; *N. m. p. V.*, nucleus motorius princeps nervi trigemini; *N. o. s.*, nucleus olivaris superior; *N. s. V.*, nucleus nervi trigemini (sensory); *N. c.*, root bundle of nervus cochleæ; *N. vest.*, root bundle of nervus vestibuli; *R. d. n. ve.*, radix descendens nervi

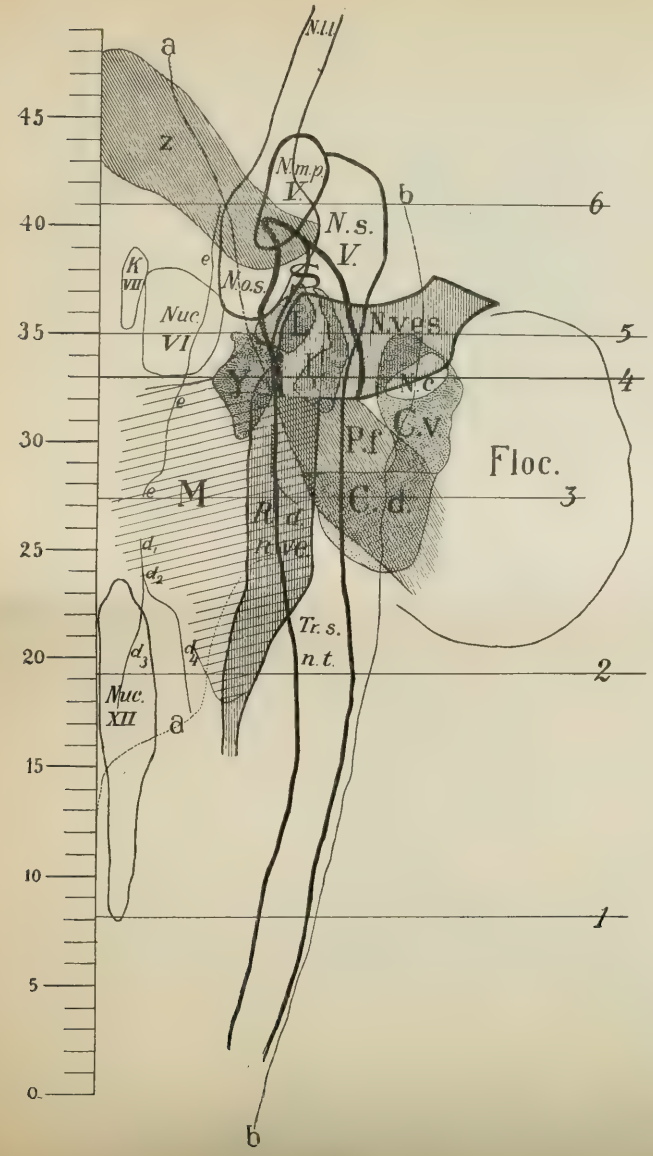

Fig. 1.

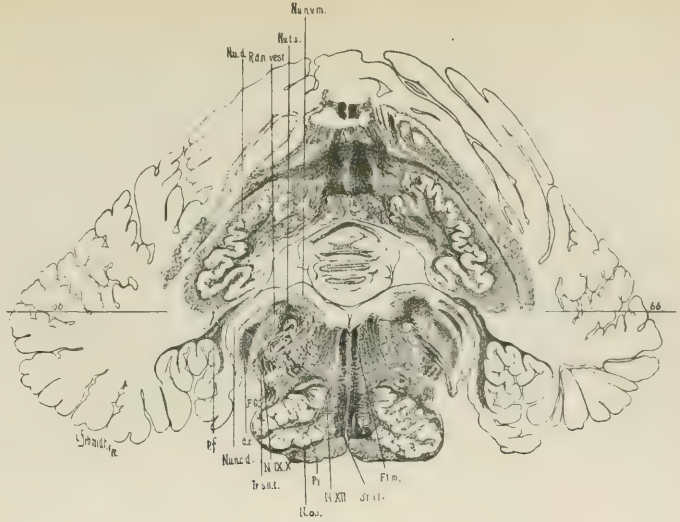

Fig. 2.

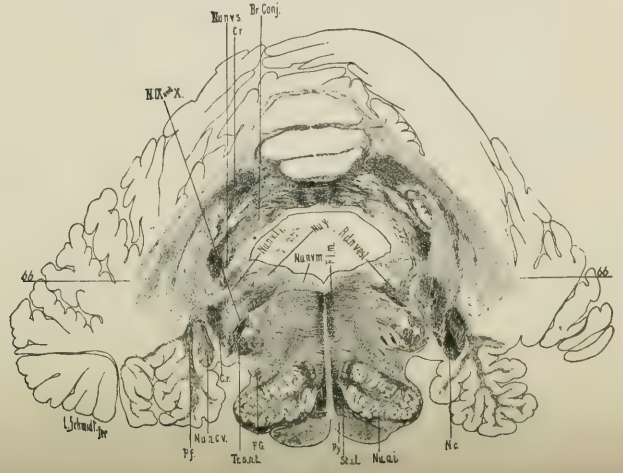

Fig. 3.

vestibuli; *S.*, nucleus nervi vestibuli superior (Bechterew) (area enclosed in the broad black line); *Tr. s. n. t.*, tractus spinalis nervi trigemini; *Y*, nucleus *y*, antero-lateral portion of nucleus nervi vestibuli medialis; *z*, decussatio nervi trigemini.

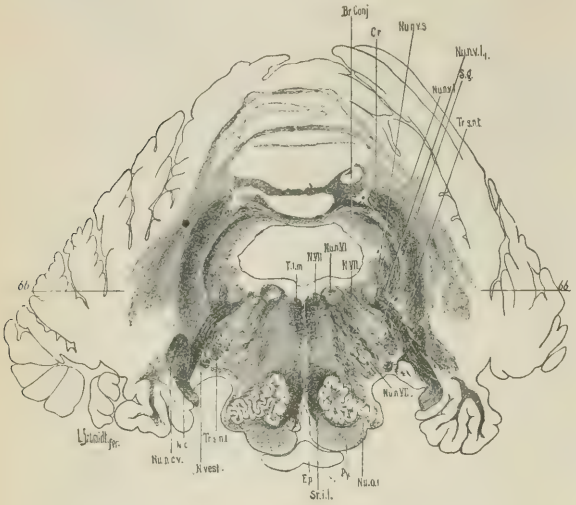

FIG. 1.

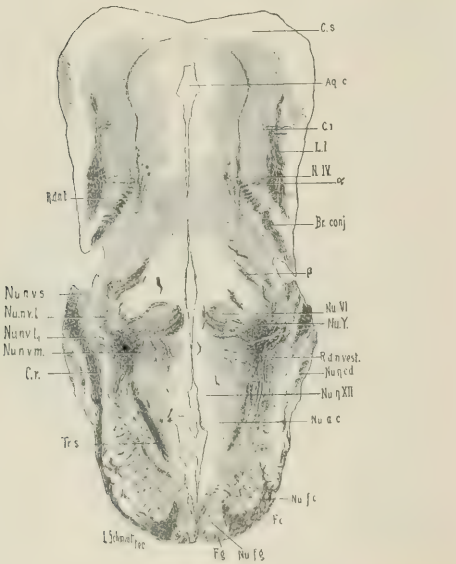

FIG. 5.

Fig. 2 (corresponds approximately to line 3 on the diagram, Fig. 1). *C. r.*, corpus restiforme; *F. G.*, fasciculus ventro-lateralis (Gowersi); *F. l. m.*, fasciculus longitudinalis medialis; *N. XII*, root bundles of the nervus hypoglossus; *Nu. d.*, nucleus dentatus cerebelli; *Nu. n. c. d.*, nucleus nervi cochlearis dorsalis; *N. o. i.*, nucleus olivaris inferior; *Nu. n. v. m.*, nucleus nervi vestibularis medialis; *Nu. t. s.*, nucleus tractus solitarius; *Py.*, pyramis; *R. d. n. vest.*, radix descendens nervi vestibuli.

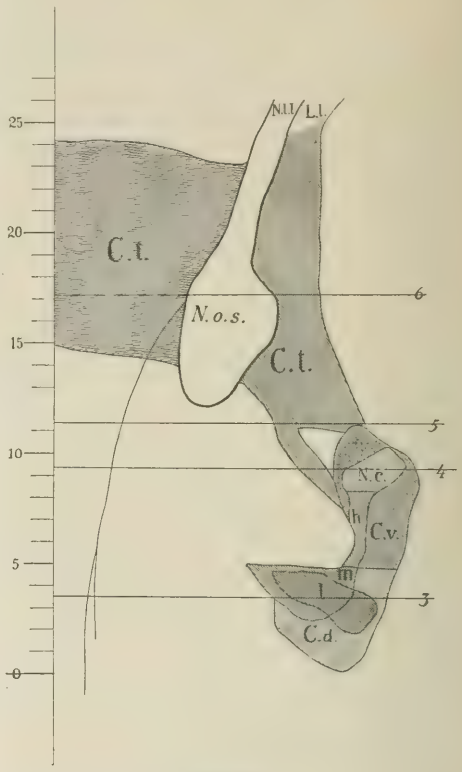

FIG. 6.

Fig. 3 (corresponds approximately to line 4 on the diag. Fig. 1). *Br. Conj.*, brachium conjunctivum; *C. r.*, corpus restiforme; *F. G.*, fasciculus ventro-lateralis (Gowersi); *F. l. m.*, fasciculus longitudinalis medialis; *N. c.*, nervus cochleæ; *N. IX and X*, nervus glossopharyngeus et vagus; *Nu. n. c. v.*, nucleus nervi cochlearis ventralis; *Nu. n. v. l.*, nucleus nervi vestibularis lateralis (Deiters); *Nu. n. v. m.*, nucleus nervi vestibularis medialis (Schwalbe); *Nu. n. v. s.*, nucleus nervi vestibularis superior (Bechterew); *Nu. o. i.*, nucleus olivaris inferior; *Nu. y.*, nucleus *y* (anterior-lateral portion of nucleus nervi vestibularis medialis); *P. f.*, pedunculus flocculi; *Py.*, pyramis; *R. d. n. vest.*, radix descendens nervi vestibuli; *St. i. l.*, stratum interolivare lemnisci.

Fig. 4 (corresponds approximately to line 5 on the diagram, Fig. 1). *Br. Conj.*, brachium conjunctivum; *C. r.*, corpus restiforme; *F. l. m.*, fasciculus longitudinalis medialis; *F. p.*, fibræ pontis; *N. c.*, nervus cochleæ; *N. VII*, nervus facialis;

N. vest., nervus vestibuli; *Nu. n. VI*, nucleus nervi abducentis; *Nu. n. VII*, nucleus nervi facialis; *Nu. n. c. v.*, nucleus nervi cochlearis ventralis; *Nu. o. i.*, nucleus olivaris inferior; *Py.*, pyramis; *S. g.*, substantia gelatinosa; *St. i. l.*, stratum interolivare lemnisci; *Tr. s. n. t.*, tractus spinalis nervi trigemini.

Fig. 5 (section 66, horizontal series). *a*, fibres extending between lateral lemniscus and brachium conjunctivum; *Aq. c.*, aqueductus cerebri; *β*, decussating fibres of nervus trigeminus; *C. i.*, colliculus inferior; *C. r.*, corpus restiforme; *C. s.*, colliculus superior; *F. c.*, fasciculus cuneatus; *F. g.*, fasciculus gracilis; *L. l.*, lemniscus lateralis; *N. IV*, root fibres of nervus trochlearis; *Nu. a. c.*, nucleus alæ cinereæ; *Nu. n. c. d.*, nucleus nervi cochlearis dorsalis; *Nu. f. c.*, nucleus funiculi cuneati; *Nu. f. g.*, nucleus funiculi gracilis; *Nu. n. v. l.*, nucleus nervi vestibularis lateralis (pars medialis); *Nu. n. v. l*, nucleus nervi vestibularis lateralis (pars lateralis); *Nu. n. v. m.*, nucleus nervi vestibularis medialis; *Nu. n. v. s.*, nucleus nervi vestibularis superior (Bechterew); *Nu. n. XII*, nucleus nervi hypoglossi; *Nu. VI*, nucleus nervi abducentis; *Nu. Y*, nucleus *y* (antero-lateral portion of nucleus nervi vestibularis medialis); *R. d. n. t.*, radix descendens nervi trigemini; *R. d. n. vest.*, radix descendens nervi vestibuli; *Tr. s.*, tractus solitarius.

Fig. 6. Diagram representing flat reconstruction of nuclei nervi cochlearis and corpus trapezoideum. *C. d*, nucleus nervi cochlearis dorsalis; *C. t.*, corpus trapezoideum; *C. v.*, nucleus nervi cochlearis ventralis; *h.*, portion of root bundle of cochlear nerve running past the ventral cochlear nucleus to the region of the dorsal cochlear nucleus; *l.*, area occupied by medullated fibres of lateral portion of dorsal cochlear nucleus; *m.*, area occupied by medullated fibres in the medial portion of the dorsal cochlear nucleus; *L. l.*, region of lemniscus lateralis; *N. c.*, nervus cochleæ; *N. o. s.*, complex of nucleus olivaris superior.

TYPHOID INFECTION WITHOUT INTESTINAL LESIONS.*

BY SIMON FLEXNER, M. D., AND NORMAN MCL. HARRIS, M. B.

[*From the Pathological Laboratory of the Johns Hopkins University and Hospital.*]

The observation that the clinical symptoms of typhoid fever may co-exist with relatively very slight intestinal lesions indicative of the disease is not a new one, but it was not possible before the present era in bacteriological study, and especially before the isolation of the bacillus typhosus by Gaffky, to bring forward conclusive evidence of the occurrence of typhoid fever without any demonstrable intestinal lesions whatever. The studies of the last few years have shown the typhoid bacillus to be much more widely disseminated than would have been predicted, and to be associated with a considerable number of different pathological conditions. But thus far the number of instances in which the typhoid bacillus has been found in human cases which presented during life the symptoms of typhoid fever and in which there was an entire absence of intestinal lesions at autopsy, is limited to a very few authentic reports. Accepting the cases reported by Banti,† Karlinski,‡ and Guarnieri,‖ which date from a period in which the difficulty in separating the bacillus typhosus from the colon group of organisms was less appreciated than now, there exist, in addition, in the literature available to us, the cases of Du Cazal,§ Kühnau,¶ Guinon and Meunier,** Pick,†† and especially those of Chiari and Kraus.‡‡

Guarnieri as early as 1892 described a case of primary typhoid infection of the bile passages (angio-cholitis). Lesions of the intestine were absent; but cultures from the liver and spleen, as well as a culture made from the blood 12 days before death, gave growths of bacilli having the character of the bacillus typhosus. In the case reported by Du Cazal the symptoms during life were those of typhoid fever, but at the autopsy there could not be discovered, even upon the closest inspection, any lesion of the intestinal mucosa. However, the mesenteric glands, spleen and kidneys were in a swollen and congested condition, and cultures from the much enlarged spleen yielded a growth of bacilli morphologically and culturally agreeing with the bacillus typhosus.

The very recent case of Kühnau occurred in a puerperal woman 32 years of age, who died in the eighth week of the disease. There was an absence of intestinal lesions at the autopsy. The mesenteric glands were swollen and showed areas of necroses or abscesses, the kidneys also contained abscesses, and the left internal spermatic vein contained a partially softened thrombus. Typhoid bacilli were isolated from the abscesses and from the spleen. The case of Guinon and Meunier is of much interest, as it indicates an unusual portal of entry of the typhoid bacillus. The patient, a boy 8 years of age, presented the symptoms of recent lung tuberculosis. Some days after his entrance to the hospital rose spots appeared and the temperature curve became typhoidal. The Widal reaction was positive. At the autopsy the lesions appeared to be those of acute miliary tuberculosis, small ulcers in the intestine being typically tubercular in character. Typhoid bacilli, however, were cultivated from the spleen, pleural fluid and lungs. The peculiar lesions of typhoid fever were not present. Pick's case gave a marked positive serum reaction, but at autopsy no typhoid intestinal lesions and no swelling of the spleen were found; the bacteri-

*A more complete report on this subject is reserved for the Report on Typhoid Fever, No. 3, to be issued in the Johns Hopkins Hospital Reports, Vol. VII.

†Riforma medica, Ottobre 1887; Ref. Baumgarten's Jahresbericht, 1888, p. 148.

‡Wiener med. Wochenschrift, 1891, No. 11 u. 12.

‖Riv. gen. ital. di clin. med. 1892; Ref. Baumgarten's Jahresbericht, 1892, p. 234.

§Bull. et mém. Soc. med. d. hôp. de Paris, 1893, p. 243.

¶Berliner klin. Wochenschrift, 1896, No. 30.

**Le Bull. méd., 1897, p. 313.

††Wiener klin. Wochenschrift, 1897, No. 4.

‡‡Zeitschrift f. Heilkunde, 1897, Heft. V u. VI, p. 471.

ological examination gave typhoid bacilli, not, however, in the spleen.

The most important contribution to this subject has just been made by Chiari and Kraus. They had the remarkable experience of finding in 19 cases (autopsies from January to May, 1897) of typhoid fever, 7 in which the anatomical lesions of the disease were wanting. The negative cases from the *post mortem* point of view had, however, given positive serum reactions. Chiari and Kraus divide the cases of typhoid fever into four anatomical groups. The first is the group of anatomically typhoid cases; the second, anatomically atypical cases in which, however, at the autopsy a diagnosis can still be made; the third comprises cases in which an anatomical diagnosis of typhoid fever is not possible, but in which the bacteriological examination discloses infection with typhoid bacilli. Among these cases examples of typhoid septicæmia are met with. His fourth group contains instances in which no anatomical typhoid lesions exist, the serum test during life being positive, but in which at autopsy the bacteriological examination is negative while the serum test may still be positive.

Of interest to us, in this connection, are groups II and III, especially the latter. In the three cases reported by Chiari and Kraus belonging to the second group the intestinal lesions consisted of slight swelling of follicles in the ileum or large intestine; no necrosis. Mesenteric glands and spleen usually enlarged. The cultures from the mesenteric glands, spleen and bile were positive in one case only, so that the diagnosis of typhoid fever rests largely upon the serum reaction.

Chiari and Kraus describe in their third group five cases. These are regarded as anatomically non-diagnoscible. They represent, in their opinion, examples of typhoid septicæmia. We purposely refrain from discussing their views at this time, but will call attention only to the fact that in three of the cases only were bacilli demonstrated in cultures. In their Case XIII, from the gall-bladder and mesenteric glands; spleen negative; Case XIV, bile immediately at autopsy negative, but from the bile after several days in the thermostat pure culture of bacillus typhosus; mesenteric glands and spleen negative; Case XVII, gall-bladder, b. coli com.; spleen, staphylococcus aureus; urine, staphylococcus aureus and b. typhi; abscesses kidney, s. aureus; pneumonic lung, micrococcus lanceolatus. The remaining two cases (XV and XVI) showed upon histological examination clumps of bacilli in mesenteric glands, and in Case XV in the spleen as well; cultures negative.

The case which we have encountered will be found to belong to the third group of the above classification. It, however, fulfills the conditions there laid down much more perfectly than any of the cases given. We are indebted to Dr. Osler for the privilege of abstracting the clinical notes.

Clinical Summary. W. G., male, aged 68, native of U. S., admitted to hospital, October 28th. On entrance complains of shortness of breath. Past history unimportant. Present illness dates back two months, since which time he has been losing weight and strength. Appetite poor. No chills or fever; no night sweats. Two weeks ago suffered from severe pain in the back; shortness of breath began at this time, as well as painful sensations in the abdomen. October 26th, while undressing, fell to the floor; very quiet next day, not having moved from the position in which he had been placed on the bed.

On admission (Oct. 28th) very dull and listless; seems in much pain; groaning with each expiration. Respirations 44 to minute. Thorax: somewhat barrel-shaped; right side more prominent than left; percussion note in front hyper-resonant; in back more resonant than normal. Respiration harsh; expiration prolonged; loud friction rub in axilla. Heart: relative dullness at sternal margin 3d rib; absolute dullness at 4th rib. Point of maximum impulse visible and palpable in 5th space 10 cm. from median line. Spleen: not palpable. Examination of blood negative for malarial organisms; leucocytosis of 18,000. Patient gradually sank and died at 10 o'clock, October 30th.

Abstract of Protocol.—*Anatomical Diagnosis.* Typhoid fever without intestinal lesions; typhoid septicæmia. Thrombosis of main branch of pulmonary artery supplying lower lobe of right lung; gangrene of lung; perforation of pleura; pyo-pneumo-thorax. Acute splenic tumor. Parenchymatous degeneration of liver and kidneys; obliteration of lumen of appendix vermiformis.

Autopsy, one hour *post mortem.* Body of a large, strongly-built and moderately well-nourished man. Surface of the body presents a sallow hue. Patchy livor mortis over posterior aspects of the trunk.

The right half of the thorax is more prominent than the left; on percussion hyper-resonant. Diaphragm at right side 7th rib; left side 6th space. On puncturing the right pleural cavity under water free escape of gas.

The right lung is compressed, the upper and middle lobes are quite airless; the lower lobe more voluminous; this lobe is bound to the diaphragm by old adhesions. The parietal pleura is generally thickened and covered by a layer of shaggy fibrin. The fibrinous membrane is thickest over the visceral pleural membrane. The lower lobe is not only voluminous, but of very dark color and quite solid consistence. The pseudo-membrane covering this portion of the lung is also dark in color. On the removal of this membrane several defects in the pleura become evident; but the whole pleural membrane is so friable that it easily breaks on handling the specimen. The main branch of the pulmonary artery supplying this lobe is occluded by a moderately firm, partially decolorized thrombus, from which more recent, usually red, thrombi extend into the communicating branches in several directions. The section of this lobe of the lung presents a dark greyish appearance. The odor is moderately offensive.

Spleen weighs 160 grams; consistence diminished; cut surface dark in color.

The gall-bladder moderately distended with thick, dark-colored bile. Contains a large number of small concretions (gall-stones).

The œsophagus, stomach and intestines, except the appendix vermiformis, which is converted into a fibrous cord, show nothing abnormal.

The mesenteric glands are not swollen.

Bacteriological examination. Plate cultures upon agar-agar were made from the heart's blood, right lung (gangrenous portion), left lung, liver, kidneys and spleen, and a blood serum tube was inoculated from the cerebro-spinal fluid. After 48 hours in the thermostat at 37° C. the plate from the heart and the serum tube only remained sterile.

The results of the plate method were as follows: Plate from the consolidated right lung crowded with colonies, necessitating replating; plate from left lung about 65 separate colonies; from the spleen eleven colonies; liver 80 to 90 colonies; kidney a single colony only. With the exception of the single colony in the kidney, which proved to be a diplococcus forming at times short chains, a single bacillary form only was found in all the plates.

In morphology the organism isolated from the plates agreed with the bacillus typhosus. The tests employed to distinguish the colonies from each plate consisted of growths on agar-agar, potato, litmus-milk and 1 per cent. glucose-agar; the absence of indol in Dunham's solution,* the demonstration of flagella with the arrangement seen in typhoid bacilli (peri-tricha), and finally the reaction with blood serum from a case of undoubted typhoid fever.

The bacilli isolated from the various sources were actively motile, grew characteristically upon agar-agar, slightly reddened but did not coagulate the litmus-milk, failed to ferment glucose-agar, but upon the potatoes gave rise to a slightly visible growth. Parallel cultures upon potato made with typhoid bacilli of known origin showed a similar growth in each. The agglutinating reaction was obtained in 20 minutes with a serum dilution of 1 to 25, and in one hour with a dilution of 1 to 50.

The cover-slip preparations from the gangrenous lung and pleural exudate showed bacillary forms of several kinds, including large, coarse individuals not unlike certain putrefactive bacteria. It is interesting to note that upon the aerobic plates only the bacillus typhosus developed.

Histological examination. Study of sections of the liver, spleen and kidneys from the case stained by the ordinary histological methods, and especially for bacteria (carbol-thionin, polychrome methylene-blue, alkaline methylene-blue), failed to develop anything which especially supports the diagnosis of typhoid infection. The "lymphomata" so often found in the liver of ordinary cases of typhoid fever were absent, a single area of necrotic liver cells the size of a miliary tubercle alone being found in many sections; and the typical appearance of clumping of the bacilli in the spleen and liver was wanting, while, however, single bacilli were discovered in several sections. The spleen showed a moderate hyperplasia of lymph cells and considerable congestion; the liver cells were swollen and granular.

The tests employed for the identification of the organisms isolated from the several viscera leave no doubt as to their nature, and the case therefore is properly to be regarded as one of typhoid infection without intestinal lesions or glandular enlargement. Indeed it would have been impossible to diagnose the case as typhoid fever in the absence of the bacteriological examination.

APPARATUS FOR STERILIZING INSTRUMENTS WITH FORMALDEHYDE; EXPERIMENTAL TESTS.

BY H. O. REIK, M. D., AND W. T. WATSON, M. D.

At the recent meeting of the American Medical Association in Philadelphia, Dr. E. A. de Schweinitz, bacteriologist to the Bureau of Animal Industry, United States Department of Agriculture, presented to the Ophthalmological Section a paper treating of the sterilization of instruments by formaldehyde, both in solution and in the gaseous form.

Knives which had been used in dissecting were washed in water and placed in a 1 to 2000 formaldehyde solution. It was found that in thirty-five minutes they were completely sterilized.

In testing the effect of the gas, a small copper drying oven was used, and 25 cc. of 40 per cent. formaldehyde solution (the preparation known as formalin) was placed in a small dish in the bottom of the oven. The instruments used were proven sterile, then infected with staphylococcus pyogenes aureus, wiped with dry cotton, placed in the oven, and when tested after ten minutes showed growth on culture media. If knives infected in a similar manner were rinsed in hot water, wiped dry and placed in the oven, no growth was noted after a ten minutes' exposure. Forceps treated in the same way required from fifteen to twenty minutes. The gas used was obtained by spontaneous evaporation of formalin, but it is important to note that "the solution of the gas was placed in the oven some hours before the instruments which were to be disinfected, in order that a sufficient volume of the gas might be present to act immediately upon the organisms adhering to the knives."

The length of time required to disinfect the knives by the formalin solution and the length of time required to generate the gas in the chamber previous to disinfection would materially interfere with the practicability of these methods, for if so much time is necessary to put them into operation they offer but little advantage over other methods.

Again, we would respectfully suggest that the tests were scarcely conclusive as to the value of the gas, for, may not some portion, at least, of the disinfection have been produced by the rinsing of the infected instruments in hot water and their subsequent wiping with dry cotton?

We have seen no other report of work in the direction of disinfecting instruments with formaldehyde, although Dr. Valude, in the Revue Generale d'Ophthalmologie for July, 1893, recommended that, "as formalin does not attack metals,

*Planted in Peckham's alkali-peptone-bouillon and incubated for 3 days, a faint but unmistakable indol reaction could be obtained. See Journal Experimental Medicine, No. 5, 1897.

it is well adapted for antiseptic solutions in which to keep instruments before and during operations."

The report by Dr. de Schweinitz, however, in connection with the experiments of others to disinfect various objects and large areas, led us to expect that instruments could be more quickly sterilized by the gas if it could be conveniently and rapidly prepared in a small apparatus. We used in our experiments the box exhibited here, simply an air-tight tin oven with a capacity of 1½ cubic feet. By the introduction of wooden blocks the capacity was reduced to 1 cubic foot. Two racks or trays for holding instruments are suspended in the upper half of the box and the gas is manufactured below. We first attempted to secure the gas by spontaneous evaporation. One hundred cc. of the 40 per cent. solution, formalin, was placed in an evaporating dish in the bottom of the box and presented a surface of about 16 sq. inches. The knives and probes here presented, and which were used in all our tests, were infected with a fresh culture of staphylococcus pyogenes aureus and placed on the racks over the formalin dish. The cover was then removed from this dish, the door of the apparatus quickly closed and evaporation allowed to proceed. At the end of 1 minute the door was opened, the knife removed, and the formalin dish re-covered. A culture was made from this knife upon agar and placed in the thermostat. Control cultures were also made from the aureus used, in order to be sure of its vitality.

This experiment was repeated with the exception that the time of exposure was lengthened to 2, 3, 4, 5, 10 and 15 minutes. Then a jump of large intervals was made, the tests being at half-hour intervals up to four hours. In every interval between the tests the door of the box was left open to permit escape of the gas, so that there might be no accumulation of it and we might thus be able to determine just how long an exposure to the spontaneous evaporation of the gas would be necessary. The time proved much longer than we had expected, and it was only after a 2½ hour exposure that we could feel sure of sterilization. This would evidently not do for practical work and we were compelled to look for some more rapid means.

We did not use formalin for the generation of the formaldehyde gas by heat, for two reasons: 1st, we feared that the heat which would drive off the gas would at the same time vaporize the water which contained it and thus possibly cause a rusting of the instruments; 2nd, we found in paraform a much more convenient substance for the purpose.

Paraform is polymerized formaldehyde and occurs as a light white powder, which can by means of heat be entirely converted into formaldehyde. Commercially it can be obtained in the form of pastilles weighing 1 gram each.

The next problem was how to get the gas in the chamber. Should it be generated outside and then introduced, or could we generate it inside the apparatus? To generate it outside has many objections. Our next experiments were made to discover if it were possible to vaporize the tablets by means of a lamp inside the closed chamber. We feared that the oxygen contained in the chamber would not support combustion long enough to develop sufficient heat to generate the amount of formaldehyde needed. Our fears in this regard proved to be quite unfounded, but we found that the kind of alcohol lamp used was a very important factor. After using two ordinary alcohol lamps in our possession we abandoned them for the Schering formalin lamp, which we found more efficacious, generating far more gas with the amount of oxygen at our disposal and being much more economical in the use of alcohol.

This lamp we find will burn in a closed chamber containing 1 cubic foot of air for about 14 minutes. In that time it will vaporize 35 grains of paraform. The temperature of the apparatus will be raised in this time to less than 30 degrees Centigrade, so that the element of heat does not affect our results.

This amount (35 grains) of paraform was found to be far in excess of the quantity necessary to disinfect this chamber. We then proceeded to find the minimum amount of paraform required to disinfect the chamber in a reasonable length of time. We vaporized quantities ranging from 2 grains up to 10 grains for different intervals of time. Even 2 grains will sterilize the chamber if given sufficient time. Three grains will do it in 15 minutes, 5 grains in 10 minutes, and 10 grains in 7 minutes. We could not proceed in this way indefinitely to use larger quantities and diminish the time because 10 grains in 7 minutes is the full vaporizing capacity of the lamp. Nor is it desirable to increase the amount of paraform, for when the chamber is opened there is an escape of gas into the room which, while not injurious or particularly objectionable, yet is not to be desired. For practical purposes 10 or 15 minutes is a short enough time for the sterilization of instruments, and this can be done with 5 or 3 grains of paraform.

The micro-organisms used in these experiments were the staphylococcus pyogenes aureus and the anthrax bacillus. The knives were sterilized by boiling and then infected from slant agar cultures. The germs could in every instance be seen *en masse* upon the instruments when put into the chamber. After exposure to the gas, cultures were made upon slant agar.

One feature of this disinfection by evaporation of the paraform needs a little further investigation. After performing numerous experiments during which large quantities of paraform were vaporized, there appeared upon the sides of the chamber a thin greasy deposit which afterwards became converted into a dry white powder. This, we are informed from the literature on the subject, is paraform which has become deposited again from the gaseous state. We did not in any instance find this deposit visible upon our instruments, still the possibility of its adhering we have in mind, and later will experiment to determine whether or not it is present, and if so, whether or not it would have a deleterious influence upon wounds. From the literature at our command we believe that there is but little danger from this source.

Another important matter to be considered is whether or not the cutting edge of the instruments is dulled by this method of disinfection. Upon this point we have the opinions of Drs. E. A. de Schweinitz and Swan M. Burnett of Washington, who state that from the use both of the gas and of the liquid formalin there has been no influence whatever upon the sharpness of the instruments.

From these experiments we conclude that:

1st. A lamp will burn in any absolutely closed chamber long enough to generate more than sufficient formaldehyde for its disinfection.

2nd. In a chamber of 1 cubic foot space 3 grains of paraform in 15 minutes, or 5 grains in 10 minutes, will accomplish disinfection.

3rd. The expense of such disinfection, including the cost of paraform and alcohol, will not exceed 1 cent, and the labor involved is almost nil.

4th. For the disinfection of small instruments, such as those used by ophthalmologists, otologists, laryngologists and dentists, it is by far the most convenient and speedy method.

5th. This method, probably better than any other, for the work designed, carries out the principles of disinfection laid down by Koch, viz. "the absolutely certain destruction of all pathogenic organisms, in the shortest possible time, at the least expense and with a minimum of injury to the object of disinfection."

E. B. Meyrowitz, of New York, has in preparation an apparatus specially designed by us for the use of this method, and Schering and Glatz will manufacture pastilles of 5 grains each for use in the apparatus.

In concluding we wish to thank Dr. McShane for permission to conduct these experiments in the City's Bacteriological Laboratory, and Dr. Stokes for advice and guidance in our work.

Discussion.

Dr. Cullen.—Dr. Hurdon is, at the suggestion of Dr. Kelly, now carrying on experiments in this line. The apparatus used contains about 6 cubic feet, and particular attention has been paid to the sterilization of dressings. Using four pastilles of paraform it was possible to render a piece of gauze that had been dipped in a pure culture of anthrax, sterile in ten minutes, but if the piece of gauze was wrapped in seven or eight layers of gauze and this bundle enveloped in three thicknesses of foolscap paper, twenty minutes were required for sterilization. The only disadvantage noted was that on opening the box the escaping gas caused considerable irritation of the eyes of those in the room. With regard to the effect on instruments I was glad to hear what Dr. Reik said, because the ophthalmologist's instruments are so delicate, and, as Dr. Kinyoun, in a recent report on experiments with formaldehyde, states that gold and silver are not affected, but that the effect on the iron is to cause oxidation.

Dr. Theobald.—I was very much interested in the report by Dr. Reik, and I think it would be a distinct advantage if we could have such a sure and easy method of disinfection of our instruments. It is very difficult to submit our instruments to boiling or even to dry heat without dulling the knives, and they also become tarnished when immersed only for a few moments. To sterilize them by this method would certainly seem to be a distinct gain.

Dr. Watson.—I would like to ask Dr. Cullen whether Dr. Hurdon found much deposit on the bandages. I read in a circular issued by the manufacturers of the pastilles that after vaporizing the paraform it was readily deposited upon woolen goods. We did not find it on the knives at all, and thought possibly this might be due to their smooth surfaces or to the nature of the metal.

Dr. Cullen.—The box used was six cubic feet, very large, and Dr. Hurdon has not noticed any deposit.

Dr. Stokes.—These experiments are of value when viewed from several different standpoints. It is a good thing to have proved that the spontaneous evaporation of the gas is not a very practical method for the sterilization of instruments, and again it is of value to have shown that the evaporation of such small quantities of the gas from the solid pastilles will cause the thorough surface disinfection of such a chamber.

This work seems to show that it is possible to render not only the instruments of the ophthalmologists sterile, but to destroy bacteria on the surfaces of even larger instruments, and so this method may be applied in general surgery.

I am also glad to learn from Dr. Cullen that several layers of gauze can be disinfected even when wrapped in paper, for that seems to show that the ordinary dressings used by the ophthalmologists, for instance, may be rendered sterile. I think the general experience with formaldehyde has shown that with finely woven textures, like cotton, penetration is a difficult thing to attain.

In regard to Kinyoun's experiments, they were performed in a large room and the gas was allowed to remain in contact with the iron for some time. I hardly think that any harm could be done the instruments in just the few minutes they are exposed in this chamber, but this can be determined by further experimentation.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of October 4, 1897.

Dr. Barker in the Chair.

Exhibition of Specimens.—Fibroid Lung-Bronchiectasis—Brain Abscess.—Dr. Livingood.

The first is a section of lung showing fibroid induration. The upper lobe is uniformly solid, grey and very firm. The middle lobe is not so firm. The lower lobe is congested and shows an area of fibrous induration in the lower part. Extending through these solidified portions are tubular bronchiectatic cavities with blood-stained walls.

The other specimen is a section through the right hemisphere of the brain about the paracentral convolution, in the upper part of which is an abscess cavity the walls of which are irregular.

Both these specimens came from the same case and demonstrate an interesting association. Their color is partially preserved by the Kaiserling method, but is no longer as intense as at the time of autopsy.

The case was that of a young colored man (F. C.), 21 years old, who was brought here by strangers in a half-conscious condition, so that at the time of admission no history at all could be obtained, except that he had been working but half a day at North Point, when he was "taken with a fit," his condition later being the same as at the time of admission. It was learned later that he had been living a rough life, wandering about the country in search of work; that he had had a cough for two years and was said by his friends to have had "consumption."

On admission he did not present the appearance of one who was suffering from chronic disease; his frame was well formed and there was no evidence of emaciation. He died four days after admission. During this time his condition remained about the same, except that he became progressively weaker, and during the last two days had an apparent right-sided hemiplegia and athetoid movements of left arm. His greatest distress seemed to be a violent pain in the head. He was in profound stupor during this whole time; was seized with paroxysms of coughing of a sharp, moist character, accompanied by very little expectoration owing to his weakness and stupor. The sputum which was obtained was of a dark reddish-brown color, containing necrotic material and of extremely fœtid odor. Examination showed it to contain pus and epithelial cells and a great number of organisms, both cocci and bacilli, none of which showed the typical staining reaction of tubercle bacilli. He was extremely restless at times, and in the last two days showed athetoid movements of the left side. I will have to omit the other interesting nervous phenomena which were noted by Dr. Camac and Dr. Bardeen at different times. His temperature curve was very irregular, running up each evening; once to 104.5° F.

Physical examination of his chest indicated complete consolidation of the upper lobe of the right lung, which was noted to be very intense; signs of partial consolidation in the lower lobe. Associated with these signs were coarse, moist râles. The left lung was apparently normal during the first three days, on the fourth day there developed signs of broncho-pneumonia.

At autopsy the right pleural cavity was found obliterated in the upper part. The middle lobe of the lung was slightly adherent. The lower lobe was very firmly attached to the diaphragm about the middle of its posterior margin. The fibrous adhesions about the upper lobe were very dense, and at two points the sub-pleural tissue seemed to be involved, so that on freeing the lung some of its substance remained adherent to the ribs at these points. In this way two cavities were exposed extending into the lung tissue.

The pleura covering the upper lobe was œdematous. The lobe was strikingly firm, voluminous, with little puckering and of grey color. The middle lobe was more resistant than normal, likewise grey, but more translucent than the upper lobe. The lower lobe was for the most part congested, but through its substance ran an area of fibrous consolidation, broadest in the lower part where the lung was adherent to the diaphragm.

On section through the lung, the upper lobe had a firm, glistening, almost cartilaginous appearance, with broad strands of fibrous tissue radiating out from the thickened bronchi. Scattered over the surface were small translucent and opaque yellow points resembling miliary tubercles. The middle lobe was not so completely solidified, it appeared more translucent and elastic. The lower lobe had a salmon pink color; its density was generally increased, and through its centre extended downwards an area presenting the same condition as upper lobe.

Through the upper, middle and dense portion of lower lobe ran tubular cavities, the lumen about a centimeter in diameter. The walls were much thickened and the inner surface hæmorrhagic. These cavities communicated freely with the bronchi, and sections showed that they were directly continuous with them. They contained a fœtid, blood-stained muco-pus. The peribronchial glands were enlarged, but showed no tubercles. The left lung was congested and in the lower lobe showed patches of broncho-pneumonia.

Examination of the brain showed that the dura was adherent and thickened, especially on the right side. There was slight œdema of the pia at a point where the brain surface was discolored and depressed. This corresponded to a point at the upper end of the fissure of Rolando in the right hemisphere. On lifting up the pia an underlying cavity discharged a small amount of a greenish fœtid pus. This cavity, measuring about 3 cm. in all diameters, was seen to occupy the paracentral convolution and to cause a bulging of this area into the longitudinal fissure. The ascending frontal convolution showed no involvement, but the area of softening extended down the ascending parietal convolution for a distance of 5 cm.

Microscopically the induration of the lung is seen to consist of broad strands of fibrous tissue which represent thickened inter- and intra-lobular connective tissue. These main strands have the appearance of old fibrous tissue, poor in cells. Encroaching still more upon the bronchioles and individual alveoli is a younger, much more cellular, fibrous tissue, which surrounds them and which has compressed the alveoli into the form of small racemose gland acini, the epithelium having reverted to its embryonic cubical form. Often the alveoli are filled with fatty epithelial cells which, in the gross specimen, gave the appearance of caseous tubercles. The walls of the bronchi are very thick and are surrounded by cellular fibrous tissue, and are infiltrated with polymorpho-nuclear leucocytes. The bronchi are filled with pus cells and desquamated epithelial cells. The induration in the middle lobe is of the same character but is not so complete. There is a slight deposit of coal pigment in the peribronchial tissue.

The type of fibroid lung here seen is not that which has been described by Ziegler, Von Kahlden and others, in which there is an organization of an alveolar exudate by an outgrowth from the connective tissue of the alveoli, nor of the type secondary to atelectasis described by Orth. It is rather a more common form due to a thickening of the interlobular connective tissue, but is of interest in its extensiveness and in the distribution which seems to indicate its etiology. Structurally it has the appearance, described by Charcot, which follows subacute broncho-pneumonia.

By far the commonest cause of fibroid lung is tuberculosis,

but I think that we have grounds to exclude this in the present case. There is no evidence of tuberculosis elsewhere, no appearance of tubercle or of tuberculous tissue in the lung itself, no areas of caseation, sections stained for tubercle bacilli after careful search failed to reveal the organism. There are a few giant cells, but they have the character found about foreign bodies, with centrally located nuclei and distinct, rounded peripheries.

Inhalation of dust and of irritating vapors is a frequent cause of induration. As in this case there is a distribution along the bronchi, but our specimen shows but little foreign substance, coal pigment,—not enough to give rise to the marked changes.

Syphilis, which has its distribution along the bronchi, is difficult to exclude, although its involvement is usually at the root of the lung and is sometimes associated with gummata. The distribution and histological picture in this case seem to indicate that it is one of those cases of induration subsequent to the absorption of toxic substances, bacterial in origin, by way of the bronchi : a subacute bronchitis and peri-bronchitis. The irritation is not intense enough at any time to produce an acute reaction throughout the lung, but sets up a slow formation of connective tissue. Subsequently, as frequently happens, there is the formation of bronchiectatic cavities at the points where the bronchial walls are weakened by the more intense effects of the toxic substances, and these cavities in turn offer opportunity for lodgment and activity of various kinds of bacteria. In this way a fresh inflammatory process is lit up and a vicious circle is established which in time causes complete induration of the lung tissue.

The association of brain abscess with bronchiectatic cavities has frequently been noted. Williamson has recently reported that out of 39 cases of brain abscess, 17 were associated with putrid bronchiectasis.

On cover-slips from the cavities there appeared a great variety of organisms, from which I succeeded in isolating but one, the pyogenic streptococcus. Cover-slips from the brain abscess showed likewise a great number of organisms, some of which I had recognized on cover-slips from the lung. None, however, grew out on my culture plates. If the streptococcus pyogenes was present, it failed to grow.

NOTES ON NEW BOOKS.

Burdett's Hospital and Charities, 1897, being the Year-Book of Philanthropy, containing a Review of the Position and Requirements, and Chapters on the Management, Revenue and Cost of the Charities, etc. By HENRY C. BURDETT, Editor of "The Hospital." (*London: The Scientific Press, Limited*, 1897.)

We have had occasion in previous years to speak in the highest terms of this Year-Book which is now in the eighth year of publication. It presents a volume of statistics of the greatest utility to all who are engaged in any form of philanthropic work. It would be fortunate for all charitable boards, not only of hospitals, but of missionary societies, orphanages, nursing and convalescent homes, if copies could be placed in the hands of each member.

As might be anticipated in view of the fact that the Queen of England and the Prince of Wales have shown great interest in hospitals and nurses' training schools, two chapters of the present volume are given up to the Queen's commemoration and the Prince of Wales' fund for the relief of distressed London hospitals.

The chapter on "Hospital Construction during 1896" is a new feature and one which is destined to become increasingly valuable. It gives sensible and brief criticisms on the plans of infirmaries, general hospitals, nurses' homes, cottage hospitals and convalescent homes which have been erected in Great Britain during the year. If a similar chapter can become an annual affair it is altogether probable that many mistakes in future hospitals will be corrected. The editor in a previous volume recommended that all hospital plans be revised by competent experts prior to letting any contracts or commencing any building. It is to be hoped that the present attempt to criticise hospital plans may eventually lead to this.

We are much gratified to know that the editor still insists upon his former dictum in hospital expenditures, viz. that lavish expenditures do not necessarily imply efficient administration. The list of institutions for the insane in the United States is far from complete and should be revised before another edition of the book.

Lectures on the Malarial Fevers. By WM. SYDNEY THAYER, Associate Professor of Medicine in the Johns Hopkins University. pp. 1–326, with 19 illustrative charts and 3 lithographic plates. (*New York: D. Appleton & Co.*, 1897.)

The publication of this book has occurred opportunely. The exhaustive studies which have been made during the past seventeen years have led to marked changes in the ideas of the medical profession concerning the nature of the malarial diseases. These researches, especially those dealing with the parasitology, have now attained to a degree of completeness which permits of a satisfactory collective treatment of the subject.

When Laveran in 1880, while studying the blood of fever patients in Algiers, discovered the malarial parasite, he could have had but little idea of the richness of the mine in which he was doing such successful prospecting. He knew he had made a valuable finding, for within a month after his first positive observation a preliminary paper concerning it was presented to the Academy of Paris. This was soon followed by other communications from the same investigator, who appeared to be well aware that where so valuable a nugget had been easily extracted, richer treasures might reasonably be supposed to exist.

Laveran was at once convinced, on seeing the organism, that he was dealing with a living parasite. He studied the various forms which it assumed, and the descriptions which he has given us of his early observations are interesting and accurate. His contributions, however, remained for some time without marked influence, a fact attributable largely to the wide acceptance met with by the ideas concerning the ætiology of malaria which had been advanced by Klebs and Tomassi Crudelli in 1879. The doctrine of the bacillary origin of malaria, fathered by these investigators, was advanced in the blooming period of the science of bacteriology at a time when protozoan diseases had scarcely been heard of. Notwithstanding its falsity it is perhaps but little wonder that it attained to such sudden general credence.

Although Richard, as a result of his own research, confirmed Laveran's statements, and the latter made personal demonstrations of the parasite to others, it was not until some five years later that general interest became aroused in the subject and investigators in different countries recognized the truth and significance of his reports. About this time a number of clinicians began investigating for themselves, and since 1885 a host of men have been at work at the subject in the most different parts of the world, perhaps most actively in Italy and America.

Three distinct varieties of the malarial parasite have been identified: (1) that of quartan fever; (2) that of tertian fever; (3) that of the æstivo-autumnal fevers. Each of these varieties of the parasite undergoes a peculiar and characteristic developmental

cycle, culminating in its multiplication by the process of segmentation. Coincident with the segmentation simultaneously of a large group of parasites a malarial paroxysm occurs.

The cycle of development of the parasite in quartan and tertian infections was first made out by Golgi; that of the æstivo-autumnal fevers was independently established by Marchiafava and Celli and Canalis.

The clinician has now at his disposal a mass of diagnostic and prognostic data with reference to the malarial diseases. Not only have the various stages in the developmental cycle of each variety of the parasite been accurately studied and described, but the time relations in the different cycles have been ascertained with astonishing exactness. The skilled hæmatologist can now decide, from his study of the blood alone, not only that he is dealing with a case of malaria, but also as to the particular nature of the attack. He can tell the patient the periods of past paroxysms, and if the case be left untreated, can prophesy within tolerably narrow limits the time of occurrence of those to come. He is afforded many clues as to the gravity or benignancy of a given infection, and is able to draw valuable conclusions concerning the probable efficacy of quinine in a given case. He is further able to pass judgment as to whether urgency in the treatment is essential, and thus is ready to suggest the method of administration of the specific drug most suitable to the case.

The bibliography of the malarial fevers has by now assumed enormous proportions, for although many important veins remain to be followed up, the malarial mine has already been very thoroughly worked. In the process much pure metal has been extracted. A great deal of valuable material is still mixed, however, with baser mineral, and unfortunately the literature also is encumbered with quantities of spurious ore, consequent mainly upon investigation guided by the "divining rod" of preconceived idea.

To write a comprehensive and discriminative book on the malarial fevers correspondent to the needs of students and practitioners at the present time, one not only must be widely read in the bibliography of his subject, but he must also have had an extensive practical acquaintance with the microscopic characters of the blood of a large number of patients at various seasons of the year. To read and assimilate all the articles—and there are now many hundreds of them—dealing with malaria since 1880 is of itself no small task. To painstakingly analyze more than 1600 cases of malarial infection in which the type-diagnosis has been established by actually demonstrating the variety or varieties of the parasite present in the blood or in the juice removed from the spleen is a laborious undertaking. "It's dogged as does it," but it is thus that the author of the lectures before us has qualified himself for his work.

Dr. Thayer's book, which, very appropriately we think, he has dedicated to Dr. Osler, contains nine lectures. In these the essential facts concerning the parasitology of the disease, the clinical phenomena, the morbid anatomy, the pathogenesis, diagnosis, prognosis, treatment and prophylaxis are dealt with.

In the first lecture a brief history of the development of knowledge concerning the pathogenic agent of the malarial fevers is given. Copious references in the form of footnotes make it possible for the reader to consult the original articles in all languages. The different views which have been advanced concerning the classification of the parasites, their finer structure and manner of reproduction, are here briefly but clearly discussed. The author believes in the specificity of the three main types of malarial parasites —tertian, quartan, and æstivo-autumnal, and combats the idea still held by some that the organisms are all varieties of one parasite, and that the morphology varies simply according to the season of the year and the conditions to which it is subjected. To the view formerly expressed in his monograph (in conjunction with Hewetson) entitled "The Malarial Fevers of Baltimore," concerning the parasites of the æstivo-autumnal fevers, namely, that they all represent varieties of one specific type, and are not divisible into a quotidian and tertian variety as Marchiafava and Bignami assert, in the absence of inoculation experiments bearing on the question, the author still adheres.

The methods of examination of the blood and the appearances of the different varieties of the parasite in all stages of development in fresh blood and in dried and stained specimens, are described at length in the second and third lectures. We are glad to see italicized as the opening paragraph of this section of the book the following statement:—"*It is impossible to make reliable examinations of the blood for malarial parasites without first being familiar with the ordinary appearances of normal blood and the more common pathological changes.*" How many unfortunate mistakes and lamentable exhibitions of ignorance would have been avoided had the appreciation of this fact been more general! Non-acquaintance with the vacuole-like appearances so often met with in the red corpuscles, certain puzzling forms encountered in poikilocytic conditions, the blood platelets, the various kinds of white blood corpuscles which exist, or the artefacts which can arise from faulty preparation of the specimen and the like, has led many an observer into error, and has been responsible for more than one publication which should have, if it has not, made its author long for an obscurity in which, as Johnson put it, he could be "glad to be hid, and proud to be forgot." However excusable some of those may have been who have fallen into such traps in the past, there is no longer any justification for the repetition of these foolish and unnecessary errors, and it is a pity that articles containing them still occasionally creep into respectable medical journals.

All who have had practical experience will agree with the statement on page 35 that "the best method of studying the malarial parasite is in the fresh untreated blood at the bedside or in the consulting room." Dried and stained specimens are at best an unsatisfactory substitute for the fresh blood-slide. The directions given in this section are detailed and might at first thought seem unnecessarily minute, but any one who has observed students fail over and over again simply from the non-observance of some trifling technical point will approve of the explicit directions. It would seem scarcely possible, with the clean-cut morphological description of tertian, quartan and æstivo-autumnal parasites given in these pages, that the careful student should fail to identify them, especially as the descriptions are accompanied by three admirable lithographic plates reproducing Max Broedel's drawings made directly from the parasites in the fresh blood. These plates include some 35 illustrations of the parasite of tertian fever, 17 of those of quartan, and 49 of those of æstivo-autumnal fever. In fact, all the forms likely to be met with in ordinary clinical examinations are faithfully delineated.

The various views which have been advanced concerning the nature of the flagellate bodies are outlined on page 78 and the following three pages. Since the writing of Dr. Thayer's book, much new light has been thrown upon these curious structures by the researches of Dr. W. G. MacCallum. When another edition of the book is called for, it will be the author's pleasant task to supplement the unsatisfactory hypotheses concerning the flagella referred to in the present volume with a description of the process of fertilization in the malarial parasite, as observed by the investigator referred to.

The general conditions under which the malarial fevers prevail are dealt with on pages 82 to 96. The geographical distribution; the effect of climate, seasons, time of day; the influence of moisture, soil, altitude, and winds; the effects of cultivation and drainage of malarious districts; the relation of malaria to the drinking water, are among the topics which here receive attention. There are short paragraphs also on the significance of race, sex, age and occupation in connection with malaria. The various modes of infection which have been suggested are discussed; it is to be regretted that the author, concluding this section, is compelled to make the statement, "We are absolutely ignorant of the form in

which the malarial parasite exists outside of the human body, and equally ignorant of the manner in which it enters."

The clinical description of the malarial fevers is given in Lectures IV and V. Each type of the fever is analyzed, and the various modifications met with fully illustrated. This portion of the book is liberally interleaved with charts showing the temperature-range in typical cases personally observed by the author. The description given of the pernicious fevers is worthy of especial mention, as are the paragraphs dealing with masked malarial infections, and the cases in which combined infections with different varieties of the malarial parasite have been encountered.

The sequelæ and complications of the malarial fevers are next taken up. The cases in which simple insolation has been confused with pernicious malaria are among those referred to under this heading.

In his lectures on the morbid anatomy of the malarial diseases, Dr. Thayer follows closely the accurate descriptions of Bignami, the investigator who certainly has made more important contributions in this field than any other single individual. The anatomical changes in both acute and chronic infections are clearly set forth, though not at greater length than is consonant with the nature of a clinical manual.

The only part of the book in which the writer has indulged in speculation is in Lecture VIII, the section on General Pathology. The hypotheses brought forward are, however, unmistakably designated as such, and nowhere are they confused with a statement of facts. Considering the extended first-hand knowledge which the author possesses, there will be scarcely any one, we believe, deeply interested in the problems discussed, who will not seek his opinion respectfully regarding disputed points, or who will not weigh carefully the conclusions to which he has arrived. Dr. Thayer thinks it highly probable that the febrile manifestations in malaria are excited by the presence of circulating toxic substances, and proceeds to enquire as to the nature and origin of the toxines. Considering the data at hand he says (p. 254): "Despite the lack of absolute proof, we are inevitably led to the conclusion that the most important exciting cause of the malarial paroxysm is the liberation of some toxic substance by the specific parasites at the time of their sporulation. While, very possibly, toxic substances may arise as a result of the disintegration and destruction of red blood corpuscles which occur at this period, it is improbable that these play the primary part in exciting the paroxysm."

After brief paragraphs upon the pathogeny of the anæmia, the pain in the bones, the jaundice, the cerebral symptoms, and the phenomena referable to disturbance of the alimentary tract, two important topics are considered: (1) The Origin of Infections with Multiple Groups of Parasites, and (2) The Mechanisms of Defence in Malarial Infections. With regard to the former subject, the author thinks that the main difficulty lies in the explanation, not of the multiple æstivo-autumnal, but rather of the double tertian, and of the double and triple quartan infections. The occurrence of the paroxysms so nearly at intervals of 24 hours, and the tendency to segmentation in the morning hours, are especially difficult things to explain, and it is admitted that the whole question still remains unsolved. The author believes that a number of the cases represent instances of multiple infection from the beginning, but thinks that there are examples in which a second group may be derived from one original generation, through anticipation or retardation of the ripening of certain of the parasites. Some ingenious suggestions are offered to explain this process, and especially to account for the fact that the anticipation or retardation usually amounts to almost exactly twenty-four hours.

As regards the mechanisms of defence involved in malarial infections, the author is of the opinion that too much stress has been laid by many upon the rôle played by phagocytes. He would rather assume that the more important factor in spontaneous cure is some parasiticidal substance or substances circulating in the blood serum, admitting, however, that the latter may be of cellular origin. The dispute is an old one, and is not limited to malaria alone, but pertains to the whole group of infectious diseases, and is, moreover, one not likely to be settled to the entire satisfaction of all, at least in the very near future.

The last chapter of the book deals with diagnosis, prognosis, treatment, and prophylaxis. This chapter is eminently satisfactory. The disease is sharply differentiated from conditions likely to be confounded with it, and the diagnosis is helped out to a certain extent by the introduction of comparative tables in the text. Concerning the treatment, the writer seems to have rejoiced at the opportunity of dealing with a disease in which there can be no talk of therapeutic nihilism. The modes of administration of the specific drug best suited to the different kinds of malarial infection are treated of at some length. Sensible advice is also given as to the application of general measures, such as rest in bed, change of surroundings and diet.

The work of the publishers is, on the whole, excellent; the type and paper are agreeable, and the binding neat. One finds rather more imperfect letters, however, than should appear in a first edition. We prefer the spelling *defence* rather than *defense* as employed throughout the book. The index is full, and as far as we have tested it, accurate. The introduction of an index of authors' names is a pleasing feature. The book will not only be valuable to clinicians in the districts in which malaria prevails, but doubtless will, from the especial interest which the subject has excited, also appeal to many who practice in regions in which the disease is but rarely met with. L. F. B.

A Manual of the Practice of Medicine. By GEORGE ROE LOCKWOOD, M. D., Professor of Practice in the Woman's College of the New York Infirmary, etc. With 75 illustrations in the text and 22 full-page colored plates. (*Philadelphia: W. B. Saunders*, 1896.)

This admirable little book is a useful manual for students and medical men who desire to get terse and clear accounts of diseases and their treatment. Some of the sections are models of concise, orderly and systematic statements. Take for example the opening section on typhoid fever, the sections on nervous diseases and the section on malarial fever. Some of the remarks on treatment are less satisfactory, as for example, in the treatment of cholera infantum no mention is made of the desirability of withdrawing milk, which in the majority of cases is the essential thing to do. In delirium also bleeding and purging are recommended. The letterpress and illustrations are good, and the book is almost wholly free from annoying typographical errors. We notice, however, that cholera nostras appears as cholera *nostra*.

BOOKS RECEIVED.

A Pictorial Atlas of Skin Diseases and Syphilitic Affections, in Photolithochromes from Models in the Museum of the Saint Louis Hospital, Paris. By E. Besnier, A. Fournier *et al.* Edited and annotated by J. J. Pringle, M. B., F. R. C. P. Fol. 1897. Part XII. W. B. Saunders, Phila., Pa.

Constipation in Adults and Children. With especial reference to habitual constipation and its most successful treatment by the mechanical methods. By H. Illoway, M. D. 8vo. 1897. 495 pages. The Macmillan Co., New York.

Twenty-eighth Annual Report of the State Board of Health of Massachusetts, 1896. 8vo. 920 pages. 1897. Wright & Potter Printing Co., Boston.

Fiftieth Anniversary of the Hartford Medical Society. Founded September 15, 1846. Proceedings at the Celebration, October 26, 1896. 4to. 124 pages. Hartford, Connecticut.

Essentials of Bacteriology: being a Concise and Systematic Introduction to the Study of Micro-organisms. M. N. Ball, M. D. Third edition. 1897. 12mo. 218 pages. W. B. Saunders, Phila.

Archives of the Roentgen Ray. (*Formerly* Archives of Skiagraphy. Edited by W. S. Hedley, M. D., and S. Rowland, M. A. Fol. Vol. II, No. 1. July, 1897. The Rebman Publishing Co., Limited, London. W. B. Saunders, Philadelphia.

Pathological Technique. A Practical Manual for the Pathological Laboratory. By Frank Burr Mallory, A. M., M. D., and James Homer Wright, A. M., M. D. 1897. 8vo. 397 pages. W. B. Saunders, Phila.

Transactions of the Chicago Pathological Society from December, 1895, *to April*, 1897. Vol. II. 1897. 12mo. 328 pages. American Medical Association Press, Chicago.

Report of the Sewerage Commission of the City of Baltimore; consisting of Mendes Cohen, F. H. Hambleton and E. L. Bartlett, appointed by joint resolution of the City Council, approved May 25th, 1893. 8vo. 1897. 231 pages. (Plates.) Baltimore, 1897.

An Epitome of the History of Medicine. By Roswell Park, A. M., M. D. Based upon a Course of Lectures delivered in the University of Buffalo. 1897. 8vo. 348 pages. The F. A. Davis Co., Phila.

A Text-Book of the Practice of Medicine. By James M. Anders, M. D., Ph. D., LL. D. 1898. 8vo. 1287 pages. W. B. Saunders, Phila.

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A Contribution to the Pathology of the Gelatinous Type of Cerebellar Sclerosis (Atrophy). By HENRY J. BERKLEY, M. D.

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A Case of Blastomycetic Dermatitis in Man; Comparisons of the Two Varieties of Protozoa, and the Blastomyces found in the preceding Cases, with the so-called Parasites found in Various Lesions of the Skin, etc.; Two Cases of Molluscum Fibrosum; The Pathology of a Case of Dermatitis Herpetiformis (Duhring). By T. C. GILCHRIST, M. D.

Report in Pathology.

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ON CERTAIN ACTIVITIES OF THE EPITHELIAL TISSUE OF THE SKIN OF THE GUINEA-PIG, AND SIMILAR OCCURRENCES IN TUMORS.*

By Leo Loeb, M. D., *Baltimore.*

In order to cause migration of the epithelial tissue in the guinea-pig the most certain method is to make a wound in the epithelium, thus, to use Weigert's expression, removing the tension on one side. Under these circumstances the whole epithelial mass in the immediate neighborhood of the injury begins to move. The boundaries between the cells become invisible, and we have one large protoplasmatic mass with nuclei. The size of this tissue increases very much, and the nuclei also become enlarged. The latter often turn to that side towards which the whole mass is migrating. This can sometimes be seen very distinctly in pigmented epithelium, where the pigment caps turn with the nuclei. The shape of the nuclei and the surrounding protoplasm becomes elongated in the direction of the wandering tissue, the granular and keratine layers disappear, and instead we see a homogeneous mass, which may be called the upper protoplasmatic layer, which contains nuclei that have taken the form of rods.

These changes are seen not only at the edge of the wound, but also somewhat removed from it, throughout that extent to which the epithelium is moving. Now there soon begins an increase in the number of dividing nuclei, but this does not occur before the migration has begun. The migration is certainly not the result of the increase in the nuclear divisions. In the lower layers of the epithelium the form of division is mitotic; the form of division which occurs in the upper layers of the epithelium is amitotic. This migration may be directed sidewards in the wound or downwards, in which case a certain kind of atypical epithelial growth is thus produced. The shape of the protoplasm and of the nuclei, as described above, indicates very often the direction of the migrating tissue. We have a control for this in the wandering of epithelial tissue in blood-clots, where we are enabled to see that the epithelial tissue migrates in that direction which is indicated by the structure of the whole epithelial mass. This appearance is still more marked, in that the fibrillar structure of the epithelial tissue becomes very clear under these conditions, so much so indeed that it can easily be seen without staining. These fibres connect all nuclei, no interruption being discernible between them that could correspond to cell boundaries. It may be added that under certain conditions* it is possible to show very distinctly the connection of the epithelial protoplasm with the fibrillar network below the epithelium. Some-

*This is to a great extent a preliminary account of a part of my investigations on the regeneration of the epithelium, the more detailed description of which will appear in the Archiv für Entwickelungsmechanik, Bd. VI, 3.

*Arch. f. Entwickelungsmechanik, loc. cit.

times the sub-epithelial fibres appear to be the direct continuation of the epithelial fibres, the epithelial cell seems to ramify, and it is in fact impossible to determine which part of this sub-epithelial fibrillar network is of epithelial origin and which part of it originates from the connective tissue below the epithelium. According to the direction in which the tissue is wandering, which direction is indicated by the position of the foremost nuclei together with their surrounding protoplasm, traction comes to be exercised on the tissue behind by the advancing line of epithelium, and these circumstances determine the different types of structures of the epithelium. (See Figs. 1 and 2.) In structures as indicated by Fig. 2, one can see that the protoplasm gives way between the nuclei under the influence of the traction.

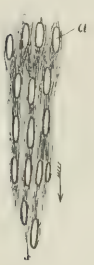

Fig. 1.

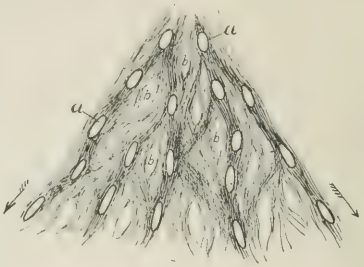

Fig. 2.

a, epithelial nuclei.
b, holes in protoplasm produced by the traction.

We have seen that all layers of the epithelium participate in the migration, the shape of the different layers becoming very similar to each other, with exception of the upper protoplasmatic layer. But there is one marked difference, namely, the velocity with which the different layers are moving, in so far as the upper protoplasmatic layer moves fastest, the velocity gradually decreasing towards the deeper layers, the basal layer being usually the slowest. Indeed the upper protoplasmatic layer, which corresponds to those structures that seem to have lost the greatest part of their vitality, is migrating so fast that after 36 hours a part of the wound is covered by it, and the remains of this layer form a considerable part of the scab together with the rod-like nuclei found in the middle of the scab, where they seem to undergo disintegration.

The activity of the epithelial tissue goes further than merely to migrate. It can and in most cases does actually penetrate into the blood-clot, occasionally into the connective tissue; and it was even possible to get microscopical specimens in which all stages of the epithelial tissue breaking through the cartilage of the ear and dissolving it could be seen. But it must be stated that in these cases it is not to be excluded that the cartilage and connective tissue may have been lessened in their vitality, although microscopically the cartilage appeared quite normal. At some places one sees this process nearly finished; the plate of ear cartilage being divided in two parts by the epithelial tissue. There are in the nearly re-established epithelial layer still some round hyaline or granular bodies visible as the remainder of the cartilage at the very place where it was to be expected. In other places one sees how the epithelial protoplasm with nuclei begins forcibly to break through the still nearly intact cartilage, especially in this case protoplasm and nuclei having a very elongated shape. Between these two extreme cases different phases in which the epithelial protoplasmatic masses have broken through and are flowing around those round bodies just mentioned—which are nothing else than the cartilage cells in a swollen state—may be made out. This swollen condition of the disintegrated cartilage seems to be preparatory to its perfect dissolution. In the same way the migrating epithelial cells have the power to break through connective tissue. Not quite so rarely one can see how the protoplasmatic masses move sidewards and downwards in the infiltrated connective tissue, the different arms of the divided epithelial masses separating it in islands and at last dissolving it wholly. This process is very similar to an amoeba-like multinuclear mass flowing around a foreign body and digesting it. This process is also similar to the action of the egg-cells of Polyclades, which form later on the intestinal epithelium and which break in the same way through the yolk and dissolve it. In an apparently equal way the syncytium seems to act in what is usually called deciduoma malignum, a malignant growth which is, according to Marchand, brought about by the activity of the syncytium. Here also protoplasmatic masses break through the tissue, the different arms of the divided masses separating it in islands; and there is no reason to doubt that they act on the tissue in the same way as the epithelial masses do, namely, to dissolve it, the microscopical appearances and the results being in both cases very similar. In connection with this it may be mentioned that the growth of the epithelium in carcinomata of the skin shows some resemblances to the migrating epithelium produced by injuring the normal skin. The formation of keratine seems to bear often more resemblance to the upper protoplasmatic layer than to the keratine layer of the normal skin. Pianese shows, in his work on carcinoma, pictures of the same kind of arrangement of the epithelial tissue, especially of the arrangement of the epithelial fibres, and in carcinomata one sees not rarely columns of epithelial masses that have an elongated shape moving towards the connective tissue, at the apex of which connective tissue cells are sometimes included between the epithelial cells. At other places one sees more isolated cells advancing.

As stated above, the epithelial masses that penetrate in the scab or through the cartilage have as a rule an elongated shape. In this connection it may be mentioned that H. Driech made the interesting observation that the mesenchym cells of echinus microtuberculatus also assume an elongated shape if they begin to migrate. So we may assume that the epithelial cells of carcinomata have the same activity as the regenerating epithelium and migrate through the tissues, and that especially the elongated shape of the cells indicates active migration, especially through tissues which offer a certain amount of resistance. Similar pictures, so far as the structure of the whole epithelium, and especially the fibrillar structure, is concerned, are met with in different skin diseases, among which may be mentioned psoriasis. In these pathological conditions such pictures have been differently explained.

The significance of those pictures observed in experimental healing of wounds is open to little doubt; and it may be suggested that also the other changes in the arrangement of the epithelial masses which are met in carcinoma and in skin diseases, and which have been referred to above, are brought about by migration or the tendency to migration and the traction caused by this activity on the part of the epithelial elements.

The best proof that the epithelial tissue really breaks through the connective tissue is found in those cases where one can see the epithelial masses migrating beneath a hair follicle that is lying in connective tissue, this gland being so entirely separated from its surroundings.

A phenomenon more frequently observed than the foregoing is the penetration of the epithelial masses into the scab, which consists, as is well known, partly of coagulated blood. Here under one form or another one sees the epithelial masses breaking in all directions through the clot, extending in the form of arms, and dissolving fibrin and blood corpuscles. I will mention a few of the ways in which this takes place. Of all the layers, the upper ones of epithelium, which are the quickest ones to migrate, are also most active in breaking through the tissue and scab. At places where more resistance is offered to the advancing epithelium, the protoplasmatic masses of the epithelial tissue flow around these obstacles in circles that continually become closer, and if possible dissolve them. From this there result not unusually cyst-like formations that lie, in the case that the upper protoplasmatic layer has formed them, above the newly formed epithelium. These upper protoplasmatic cysts are only of short duration. The nature of the action by which the epithelial protoplasm is able to dissolve the tissue is unknown. It is certain that phagocytosis plays no part in it, the epithelial protoplasm does not engulf the foreign body, but the close contact with it seems to be sufficient to cause the secretion of the substance which, be it of the character of a proteolytic ferment or some other chemical agent, has this dissolving effect. The circumstance that it seems easier for this solving effect to be exerted upon injured rather than healthy tissue would favor the assumption that the hypothetical body is a ferment, for this is a well-known condition of action of trypsin. Further investigations which have already been started may possibly yield more certain knowledge of this question; but in any case contact with the foreign body seems to be the stimulus that brings about the secretion of this substance, in the same way as the glands of the alimentary canal secrete their digestive substances when in contact with food. Leucocytes not improbably have the same faculty.

It is a well-known fact that the cells of malignant tumors, especially of carcinomata, break through all kinds of tissue; but the precise manner of this action has been conceived by different observers in different ways. If we study experimentally the regeneration of epithelium, we see, in the course of a few days, all the changes described above. Indeed, we not only appreciate that cartilage is destroyed, but we may even follow all stages of the process, and thus really obtain a picture not only of the results, which could be explained in different ways, but also of the kind of activity of the tissue by which this result is achieved. And if there can be no doubt that in regeneration the epithelium has the above described power, we may conclude that the carcinomatous cells which can penetrate through all tissues do so in very much the same way, that is, by actually dissolving the tissues by chemical means. This is the more probable inasmuch as the histological pictures in spreading malignant epithelial tumors often show places strongly resembling the penetration of regenerating epithelium. The principal reason that this kind of activity of the carcinomatous tissue has so far not been more generally recognized, may probably be found in the circumstance that such a power would have been to be regarded as a new quality of the epithelial cells for which no analogy had existed. But seeing now that the regenerating epithelial tissue possesses this faculty, this objection no longer holds good. That malignant tumors act also by other means, as *e. g.* by pressure on the surrounding tissue, is, however, not excluded. It has long been known that endothelial and connective tissue cells have the power to penetrate into blood-clots as into thrombi, and also in foreign bodies, and to replace these by connective tissue. We have seen that the epithelial tissue replaces blood-clots quite in the same way, and the result of this replacement is, in many cases, the production of an epithelial tissue which occupies the position formerly held by the blood-clot, or even the cartilage and connective tissue. We may therefore speak of this process as *epithelial organization*, in contradistinction to the well-known connective tissue organization. The similarity between the behavior of the epithelial tissue towards a blood-clot with the action of the endothelial and connective tissue or vessels in the organization of thrombi, would probably still be more apparent if it were possible to replace the cutis by blood in such a manner that the deeper epithelial layers come to lie in close contact with the blood-clot.

Although so far only those changes of regenerating tissue have been described that occur in the skin of the guinea-pig, there seems to be little doubt that also other epithelial tissue has the same kind of activity. The account which Peipers gives of the regeneration of the kidney makes it very probable that also the kidney cells have the faculty of penetrating into the blood-clot and dissolving it. The same holds probably good of the liver and salivary glands. I have already begun experiments in order to ascertain how far there is an analogy in the activity of these cells and of the epithelial cells of the skin.

When we see the epithelial tissue thus in motion we may ask, are there any limitations as to the directions in which it may move, or is it possible to detect any kind of influence of the surroundings that determines the direction of the migration? As to the first point, there is no limitation in the directions of migration. One might suppose that the epithelial masses are able only to move in the wound because only this movement would be of value in the healing of the injury. But this is not the case; the epithelial masses have the faculty even to go in the directly opposite way, and indeed a part of the protoplasmatic masses may go in one direction while another part branches through another side. The whole process reminds one of an amoeba that creeps and sends protoplasmatic arms to different sides. But there is one circumstance that invariably

determines the direction of the flowing epithelial mass, that is, the contact with a solid body. If it once touches a foreign body it never leaves it again, but flows all around it. One can see how it flows around the balls formed by the hair-glands, similar to what is observed in Dewitz's experiments, in which spermatozoa are seen to wander around glass balls, never ceasing to touch them. The epithelial masses follow every furrow on the upper side of the scab, and especially of the upper side of the wounded connective tissue; and the contact with the latter especially is the cause that in wound-healing the epithelial masses are brought usually to cover the connective tissue, in this way restoring the normal epithelial layer. There is no difference in the different layers of the epithelium in regard to this irritability, and one can sometimes observe how the upper protoplasmatic layer with its characteristic nuclei migrates in contact with the edge of the deeper layer. Fig. 3 shows such an occurrence. The above-described rod-like nuclei seem to continue the basal layers. Hence we see a factor that comes into play to determine the structure of the epithelial tissue of a mammalian is the same that is active in the life of plants and of the simplest forms of invertebrate animals and of spermatozoa.*

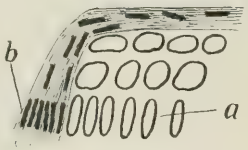

Fig 3.

a, basal layer.
b, rod-like nuclei of the upper protoplasmic layer.

The possibility of a chemotropic irritability of the epithelial cells in addition to the stereotropism described, is not to be wholly excluded, especially as the epithelial masses tend to penetrate in the blood-clot. But thus far it has not been possible to prove the presence of this form of irritability.

† We have now spoken of several different activities of the epithelial masses, but there is still another and very curious kind which can be called epithelial infiltration, by which is meant the penetration and replacement of an epithelial tissue by a neighboring one. This process of epithelial infiltration can be produced by transplanting the pigmented skin of a guinea-pig to a place where the original skin is unpigmented, or conversely by transplanting unpigmented skin to a pigmented area. Without discussing how far these experiments on transplantation answer questions relating to the problems of transplantation in general, it may be mentioned that after the transplantation the black skin not only keeps its own pigment, but one can see, after a variable period in different cases, even with the naked eye, that the boundaries of the transplanted skin which before were very distinct become indistinct, a darker line appearing at the margins, and gradually the pigmented area spreads in the white skin. The same happens under certain conditions when white skin is transplanted to dark, the black pigment spreading in the white skin. This behavior was also observed by Carnot and Mlle. Deflandre, who gave an account of it in the Comptes rendus (see also Carnot's report in the Bulletin scientifique). But the fact alone could be explained in different ways. It is in the first place possible that the transplantation causes an augmentation in the production of pigment by the pigmented epithelium. The surplus of pigment would be carried away either by leucocytes or by some other means, and brought into the neighboring white epithelium, gradually causing it to become pigmented. After some time the effect of the transplantation ceases, and therefore the surplus production of the pigment, and there would be no further progress in the pigmentation of the white skin. That this explanation is not correct is shown by the following experiment. The transplanted black skin is made to regenerate, from which one observes that the transplanted black skin regenerates wholly, like the original black skin, going through four distinct stages which need not be mentioned here. Next one makes that part of the skin regenerate which has originally been white but had afterwards become black through the influence of the neighboring transplanted black skin. Fig. 4 gives a sketch of both cases. In the latter case one sees that this secondarily black skin regenerates in precisely the same manner as the originally black skin did, namely in four stages. Now if the pigment had only been passively transferred to the white skin, this characteristic kind of regeneration could not have taken place. The white skin would have regenerated as white skin does.

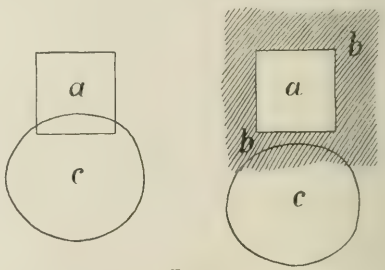

Fig. 4.

a, transplanted black skin.
b, area where transplanted skin has grown.
c, skin that was afterwards removed.

This experiment proves that the white skin in the neighborhood of transplanted black skin becomes true pigmented skin.

*The endothelial cells of a vessel which organize a thrombus seem to have the same kind of irritability. In the drawings that Cornil gives *e. g.* (Journal de l'anatomie, 1897) one sees how the endothelial cells migrate around the thrombus, applying themselves to every furrow and penetrating later on its substance. Ranvier (C. r. vol. 112) describes, in inflammation of the peritoneum that leads to adhesions, the endothelial cells, which are to become connective tissue cells, as creeping along in contact with the fibrin films. That seems to be another instance of stereotropism.

† For a fuller account of the following part it may be referred to Arch. f. Entwickelungsmechanik, Bd. VI, 1.: Ueber Transplantation von weisser Haut etc. am Ohr des Meerschweinchens. These experiments on transplantation have been carried out at the suggestion of Prof. Ribbert in the Pathol. Institut in Zürich.

This can take place only by the emigration of the black epithelial tissue into the white. Any influence of the underlying connective tissue could with certainty be excluded. Microscopically we see in this intermediate zone, where the white epithelium becomes black, chromatophores in the deepest layer of the epithelium. Soon afterwards the cap pigment around the nuclei appears, until at last the whole epithelium has the character of the typical pigmented epithelium. One might be tempted from the microscopical appearance to take it for granted that the pigmentation of the originally white epithelium is caused by the emigration of chromatophores which act as a kind of unicellular glands, gradually supplying the pigment to the whole epithelial tissue. But this explanation is not applicable, for there are facts that show that the chromatophores do not act as glands. There remain two other possibilities. Either the chromatophores are able in the same way as the basal cells of the epithelium to give rise by cell division to the upper layer of the epithelium and the basal cells as well, or not only are the chromatophores migrating and infiltrating, but also the other cells of the pigmented epithelium, which, however, under the changed conditions of this process lose for a short time their pigment. As strange as it may seem that the widely branched chromatophores should be equivalent to the basal epithelial cells, there are a number of facts in favor of the view that the chromatophores in the epithelium are only modified epithelial cells. Two facts, however, are in favor of the latter assumption: First, in the third stage of the regeneration of the pigmented epithelium, the epithelium has nearly the same appearance as described here, that is, chromatophores in the basal layer are the only pigmented cells present in the epithelium; and in the fourth stage the upper layers gradually gain their pigment. Hence in this situation what seems to belong still to the white epithelium, belongs in fact to the regenerating black epithelium if the second assumption is the right one. Secondly, one can sometimes see that the highest epithelial layers have pigment around the nuclei, so that these nuclei certainly must have come from the black epithelium.

So far it has been impossible to decide with certainty which of these two explanations is the right one, but in any case it may be taken as proved that the living white epithelium is substituted by the transplanted black epithelium by means of a process of infiltration. But it must be added that under these circumstances there are no signs of a phagocytosis by which the black cells destroy the white ones. And it results from this that we must take into account the possibility that there are also at other times in the epithelium not only growing movements upwards from below from the basal layer in the direction of the corneal layer, but that there can also be sidewards movements as in the case described. The distinction of color made it possible to recognize this kind of activity of the epithelial tissue. Without this distinction the recognition would have been very difficult, because the last described activity of the epithelial tissue is one that prceeds much slower than the migration described first.

I wish to express my especial thanks to Dr. Flexner, to whose kindness I am indebted for a carcinoma of the skin, and to Dr. Cullen for sections of a deciduoma malignum.

THE SUCCESSFUL TREATMENT OF EXTRA-PERITONEAL RUPTURE OF THE BLADDER, COMPLICATED BY FRACTURE OF THE PELVIS, BY OPERATION AND THE CONTINUOUS BATH. REPORT OF CASE.

BY J. F. MITCHELL, M. D., *Resident Medical Officer, The Johns Hopkins Hospital.*

Through the kindness of Dr. Bloodgood I am permitted to report the following case from the surgical service of the Johns Hopkins Hospital:

A. A., Lithuanian woman, age 52. Admitted May 20th, 1896, with the following history. On May 19th, about 11 p. m., 10 hours before admission, she was thrown from a wagon, the wheels passing over the hips and lower abdomen at the level of anterior iliac spines. On admission at 9 a. m., 10 hours after the accident, the pulse is 100–120; temperature, 100.8°. Mental condition seems to be one of stupor. There is frequent moaning, and when the left hip is moved she cries out with pain. Over the lower abdomen and thighs the skin has been scratched and is covered with gravel and dirt, the entire superficial epidermis seeming to have been brushed away, but at no point is the fat exposed. The abdomen is not distended nor tender except over the skin bruises, and there is no muscle spasm nor any evidence of intra-abdominal injury.

At 10.30 a. m. catheterization yielded 140 cc. of smoky urine with a sediment of blood corpuscles, and at 2.30 p. m., four hours later, 160 cc. of similar urine. On distending the bladder with 500 cc. of boric acid solution not more than 250–300 cc. could be withdrawn, and examination by means of a speculum showed the bladder to be quite empty, demonstrating conclusively a rupture. It was impossible to ascertain whether urine was passed before admission, but between admission and operation there was no attempt to void urine and there was no dribbling.

Operation by Dr. Bloodgood, 17 hours after the accident, under ether. On opening into the space of Retzius through the middle line, it was found filled with a large quantity of blood-stained urine which was not ammoniacal, and there was as yet no sign of inflammation. The peritoneum was pushed up to within 4 cm. of the umbilicus, and in the lumbar regions almost to the margins of the 12th ribs. This fluid was carefully sponged out and the peritoneal cavity opened in the middle line to examine the bladder for any intraperitoneal opening. As none could be found and there was no fluid in

the peritoneal cavity, the peritoneum was closed with a double row of silk sutures. The opening in the bladder was demonstrated by passing a silver catheter through the urethra. It appeared to be about 2 cm. to the left of the median line at the level of the pubes, that is, just behind the seat of fracture, which was in the ramus of the left pubes. The line of fracture was oblique, and two ragged points projected towards the bladder. The bladder wound was closed with silk sutures which did not include the mucous membrane. Lateral incisions were then made in both inguinal regions and the three wounds were packed with bismuth gauze, the upper half of the median incision being closed with two mattress sutures in the recti muscles and a continuous subcutaneous silver suture. There was no loss of blood, and the pulse was excellent at the end of the operation. Temperature, 100.2°; pulse, 106. Cultures and cover-slips from the extravasated fluid were negative and there were only a few leucocytes.

May 21st. Patient passed a fairly comfortable night. From 8 p. m. until noon she was catheterized 7 times, 12–35 cc. of urine being obtained each time, total amount being 162 cc. of bloody urine. The gauze on the abdomen is saturated with urine, showing that the sutures of the bladder have not held or that there is another rupture. Temperature, 102.2°; pulse, 106–110; respiration, 30–35; condition of stupor more marked than on admission. 3.30 p. m., patient placed in bath of water at 100° F. 8 p. m., patient has been in bath 4 hours. The pulse is 100 and better; respiration, 24 and decidedly improved; temperature, 100.8°. The condition of stupor has been replaced by a much brighter mental state and the patient looks a great deal better.

May 26th. The patient was taken out of the bath for 4½ hours, during which time no urine leaked from the wound. There was some pain and a little hemorrhage. The removal of the packing was followed by a rise of temperature to 102°, but no discomfort.

June 8th. The patient has been almost continuously in the bath since May 21st, being removed only for an hour at a time to clean the tub, and then she cries to be returned. The pulse has been good, but there has been continuous fever from 100.5° to 101°, and yesterday after examination and removal of two small pieces of bone from the fracture the temperature reached 103.5°. The packing has been out since May 26th (7th day). The lumbar wounds closed two days later and the superficial wound has entirely healed. The abdomen is soft and there is no evidence of infiltration beyond the suprapubic sinus. Appetite and general condition good.

June 27th. There has been more or less fever during the past three weeks, and in the last four or five days several shaking chills, the temperature in one instance reaching 107°. Examination of blood is negative and there is no leucocytosis. The urine shows a faint trace of albumin and many polymorphonuclear leucocytes. The abdomen is soft and not distended, and nothing can be found indicating any accumulation of pus. Spleen and kidneys not palpable. On irrigation the opening between the suprapubic wound and bladder is not large enough to prevent distension of the bladder and 250 cc. can be retained. On examination of the suprapubic wound a small cavity was found just to the left of the sinus and communicating with it by an opening 2–3 mm. in diameter. This was completely dilated with the index finger and packed with bismuth gauze. Extravasation of urine into this cavity may explain the chills and temperature; no other explanation has been found.

July 20th. Following the dilation of the above cavity the temperature fell rapidly and there were no more chills and no rise of temperature. The patient was removed from the bath on June 28th, 40 days after the accident. Since then the sinus and bladder have been irrigated daily with boric acid solution, and to-day gauze removed from the sinus is slightly moist with urine. The sinus is closing rapidly. Except for some swelling and pain in the left leg and hip, the patient has been fairly comfortable and for two days has been up in a wheel-chair. It is now two months since the accident.

Sept. 2d. The general condition is much improved. Her appetite is good and she rests comfortably. The suprapubic sinus is still open, its external orifice barely admitting the tip of the little finger, and a probe passed to the bottom strikes roughened bone. No mobility can be obtained at the seat of fracture. She voids urine without difficulty and the urine is greatly improved.

Sept. 29th. The sinus is about 2 cm. deep and does not communicate with the bladder or seat of fracture. The patient has been walking without any difficulty for some time, although there seems to be some motion at the seat of fracture. The urine contains only a few leucocytes and is acid.

Oct. 8th. Discharged. Sinus closed and urine clear.

Dec. '96. Patient returns with a small reducible hernia 2 cm. long in the scar in the right groin.

Feb. 13th, '97. Operation for hernia.

Mar. 3rd, '97. Discharged cured. Patient has recovered perfectly her normal state of health. She walks without difficulty and there is no evidence of mobility at the seat of fracture.

Considering the great number of surgical cases of all kinds treated in hospitals, neither fracture of the pelvis nor rupture of the bladder is a frequent occurrence; for statistics show that in Berlin in 10,867 surgical cases there were only 3 ruptured bladders, and in London in 16,711, only 2. In the Johns Hopkins Hospital among 7268 surgical patients there have been 5 ruptured bladders. It is generally stated that fractures of the pelvic bones compose about 1 per cent. of all fractures. Either is a serious lesion; but with the two combined the prognosis is always grave. According to its relation to the peritoneum, the rupture may be one of three varieties: intraperitoneal, subperitoneal, and extraperitoneal. To the last, in combination with fracture of the pelvis, we will confine our attention as bearing directly on the case just shown. We have collected 90 similar cases scattered through the literature of the past century, and on an analysis of these reports base the remarks which follow. In many instances the reports are very meagre and cause the statistician much trouble in collecting and analyzing cases.

The injury is met with much more frequently in men than in women, and most commonly between the ages of 20 and 60, that is, in the most active period of man's life when his habits

and occupation expose him to violence. Harrison, of Dublin, thinks the greater size of the pelvis and the protective pad offered by the uterus account for the greater rarity of rupture of the bladder in the female. In boys the bladder is not as likely to be allowed to become distended—an important factor in the causation of rupture—while after 60 a man has usually retired from active and dangerous service.

As might be imagined, the direct cause is traumatism of some violent character, for example the passage of a wheel over the body, as in the present instance. Fully one-third of all the cases are due to this cause alone. Many are caused by a fall from a height or a crushing weight received on the lower abdomen. An interesting case is recorded in which the man was thrown from his horse, landing rather forcibly on the ground in a sitting posture. The symphysis was separated and the bladder wall torn asunder. Another man while intoxicated stepped from a second story window which he mistook for the door. He alighted on one foot and sustained a fracture of the pelvis complicated by a ruptured bladder.

As a predisposing cause alcoholic indulgence ranks high, not only on account of greater exposure to violence in intoxicated persons, but owing also to the fact of the increased liability to distension of the bladder and the consequent loss of tone, elasticity and resistance of its walls.

As to the immediate causes of the tear in the bladder walls, opinions differ. Undoubtedly many are due to a continuation of the same crushing force that fractured the pelvis; but in a great number the cause is by no means so evident. A considerable proportion can be attributed to direct penetration of the bladder by a displaced or fractured bone. In 21 cases it is stated to have occurred, though from the position of the tear and the nature of the fracture in many other cases it must be much more common. Still others are due to concussion favored by a wall distended and weakened by chronic alcoholism. The bladder when empty lies behind and wholly protected by the pubic bones, and it would be difficult to conceive of a rupture of an empty bladder caused by actual pressure without penetration by bone, as in cases where there is simply separation of the symphysis without any antero-posterior displacement. Allis explains such a rent as being due to actual tearing apart of the bladder wall by the anterior ligaments which connect the front of the bladder with the pubic bones, one on either side of the symphysis. When the bladder is distended the walls themselves are weakened by a separation of the muscular fibres, and the anatomical position is much more favorable to rupture; for the bladder then rises above the symphysis pubis and in part loses the protection afforded by it. The opening is most often in the anterior wall communicating directly with the space of Retzius. It was situated here in 63 per cent. of the reported cases. Next in frequency comes the neck as a seat of rupture, while in a few instances the rent is in the side or base.

Fracture is oftentimes multiple, and by far the commonest location is in the pubic bones—49 cases thus recorded. Separation of the symphysis pubis is of frequent occurrence, while tearing apart of the sacro-iliac synchondrosis is not very uncommon. Fractures of other bones are not so numerous, the sacrum and ischium being about equally often and the ilium rarely involved—the latter only 6 times in our collection.

The symptomatology is quite definite. After the accident the patient is usually unable to walk or even to rise from the ground, and is often rendered unconscious, though accounts are given of patients walking some distance. Peaslee reports a case of a man who, with 7 fractures and a ruptured bladder, could actually walk a few steps. The subjects often describe a sensation as of something tearing within them at the time of the accident. They are brought to the hospital in a semi-stupid condition, complaining of intense pain in the hypogastric region or at the seat of fracture. Many go at once into a state of collapse or coma from which they never rally, dying in a few hours. A pretty constant and characteristic symptom is great desire to micturate, with either total inability to pass any urine, or the passage of a small amount of blood-stained urine or pure blood. Sometimes, however, urination is not interfered with and the patient voids perfectly clear urine; these are rare exceptions. Again, the patient may at first pass no urine, but after a time be able to do so. There may be one or repeated shaking chills.

The condition of the patient depends somewhat upon the time elapsed since the accident. Very commonly it is one of collapse with marked pallor, rapid and weak pulse, hurried and shallow respiration and high temperature. The body is bent forward and the legs drawn up. There may be vomiting and diffuse abdominal pain, with distension and tenderness and signs of general peritonitis; but this picture by no means always denotes involvement of the peritoneum in the rupture. Tumefaction, due to extravasation of urine and blood, may be seen in various localities according to the situation of the rupture of the bladder or the fracture of the pelvis, and there may be localized abdominal dullness. Extravasation of urine may be absent entirely, or may be extreme and yet overlooked, because on account of the violence necessary to the production of the lesion it has not followed the classical paths. It has been known to ascend as high as the shoulders, or to follow the psoas muscle, stripping up the peritoneum as far as the kidneys. In one case at the time of the accident a rounded and fluctuating tumor appeared on the thigh not far above the knee. This on being opened some two weeks later was filled with urine, pus and blood. If seen late, there is likely to be infection, especially if the patient has been catheterized.

From the signs given the diagnosis can generally be made, but there are certain aids which make the extraperitoneal rupture plainer and distinguish it from the intraperitoneal form. Catheterization yields important information. As a rule one obtains by the catheter only a small amount of urine and this is mixed with blood. Sometimes catheterization is impossible. In rare instances clear urine has been obtained, and quite frequently nothing at all, which latter condition Willard explained in his case as being due to suppression of urine rather than escape from the bladder.

Sometimes the catheter will pass through the rent in the bladder and then a large amount of bloody urine may be withdrawn. The ordinary procedure, and a very useful one, is to inject into the bladder a known amount of some mild solution

(in the present case half-saturated boric acid solution was used), and then measure the fluid withdrawn, any considerable decrease indicating leakage through a rupture. Sometimes the patient will feel the liquid escaping immediately from the bladder. This method has been opposed on the ground of being dangerous in case of intraperitoneal rupture; but as immediate laparotomy is here indicated, it is not an important objection, and with proper precautions the gravity of the case need not be increased. In locating the position of the tear during operation, this injection is also very useful. Walsham suggested that air be introduced by means of a hand-ball apparatus as a substitute for fluid. Rivington has advised a preliminary perineal incision and digital examination of the bladder as a means of diagnosis. Rectal, vaginal, and cystoscopic examinations occasionally give useful data in ruptures about the neck, and rectal and vaginal examinations are especially useful in the location of fractures.

The prognosis has always been grave, though with the progress of surgery the death rate has greatly lessened. Hippocrates thought rupture of the bladder necessarily fatal, while Galen admitted the possibility of recovery in extraperitoneal injuries. In 1878 Bartels collected 169 cases of rupture of all varieties, with a mortality of 89.3 per cent., and at that time there was only one recorded recovery in intraperitoneal rupture. Cramer in 1896 gave the mortality for all forms as 54 per cent. This drop in the death rate has been to a large extent due to the improved treatment of intraperitoneal cases. In our 90 reports there were 15 recoveries, making the mortality 83.3 per cent. Taking only those which have occurred in the last 15 years, we find 24 with 7 recoveries, *i. e.* a mortality of 70.8 per cent., so that under improved treatment the decrease in deaths has not been great, and it is still considered a very grave injury and one whose treatment has been rather unsatisfactory. When we consider how likely it is to have only recoveries reported it is not probable that this estimate is an exaggerated one. In the majority (55 per cent. of our collected cases) death occurred in the first four days, while in the first week 73 per cent. died. Those surviving the first few hours rally from the shock and later show signs of peritonitis or extravasation of urine; the lingering cases die finally of septicæmia.

At autopsy the space of Retzius and other seats of infiltration are found filled with a bloody urino-purulent fluid, and the tissues about are necrotic and sloughing. The sloughing may reach an extreme grade. General peritonitis may result, or the peritonitis may be more or less localized, according to the extent of the infection. Spontaneous cure is possible even in cases of extensive infiltration.

It is well known that perfectly sterile urine flowing over tissues has little effect except when absorbed in great amounts, and that it does not materially interfere with the repair of open wounds; but the flow, if continued for a long time, or dammed up without exit, does provoke irritation and lower vital resistance, so that we have a most favorable medium for infection. Strauss and Tuffier have done some interesting work to shed light on this point. They injected aseptic urine into the peritoneal cavity, the space of Retzius and the muscle of dogs, and found that the urine was absorbed and there was no reaction. On repeating these injections, using urine mixed with blood, ammonium sulphide or ammonium chloride, the same result was obtained. On cutting one ureter, however, and allowing the urine to flow into the peritoneal cavity, the dogs died in 8–20 days of uraemic poisoning and peritonitis. They conclude that sterile urine in itself has no action, but that prolonged exposure so irritates and lowers the resistance of the parts as to allow organisms to pass through the intestinal wall and set up a peritonitis. Unfortunately they do not state what organisms were concerned.

Urine is in itself, however, an excellent culture medium, and on account of the common practice of catheterization is rarely if ever sterile for any time after the accident with which we are concerned, and thus it acts as a carrier of infection.

The treatment therefore is plainly indicated, viz. immediate relief of the extravasated urine and prevention of reaccumulation by proper drainage and suture.

As far as the fracture is concerned little is to be done except to fix the parts, though it is sometimes necessary to remove spicules of bone or wire the fragments together. To get rid of the extravasated urine has been a simple matter, but the question of efficient drainage seems to have been a difficult one.

The earliest cases were treated by hot applications, leeches and bloodletting, and two recoveries are reported in 53 cases where no other treatment save these and catheterization was employed.

In all 37 cases were treated by various operative procedures, with a resulting mortality of 64.9 per cent. In many of the recoveries the convalescence has been slow and tedious, with a history of long-continued suppuration and the existence of one or more fistulous tracts for months or years.

Statistics show nothing as to the advantage of early operation, for there were more recoveries where the operation was in the second week. But we know that it is best to operate as soon as possible, and it is a question as to whether these late cases would not have recovered spontaneously by rupture of the abscesses and formation of fistulæ. The first attempt at operation amounted merely to incisions for extravasation plus a catheter retained in the urethra. Of 8 cases so treated, 3 recovered. The recoveries were cases which had gone on to abscess formation, and all that was done was to open the abscesses. In 1845, Walker, of Boston, first employed lateral perineal cystotomy in a case of ruptured bladder, and drainage through this incision was successful and the patient recovered. After that perineal incision with drainage was the favorite method, and in 16 cases there were 4 recoveries. Abdominal incision was employed 5 times with 1 recovery, and then suprapubic cystotomy with or without a counter incision in the perineum took its place and has been up to the present time the ordinary method of dealing with this injury; but of 8 patients treated in this way only 3 recovered.

In three cases, including the present one, the continuous bath has been used to prevent absorption and for better drainage, and all of these have recovered. While the bath treatment of wounds is in itself old and has been much used both in this country and abroad, its application to such cases as the present one seems to have been gradual, and its great value

should be insisted upon. In 1878 Bartels speaks of "giving baths" to a case in which there was extensive suppuration, and the patient got well, but he does not go into particulars as to the time in which the patient remained in the bath. In 1891 Rose after doing a suprapubic operation for rupture found that ordinary dressings were not sufficient, and says that "therefore the patient was every day put in a continuous bath for several hours without any dressing." This was continued for 20 days, and then the bath was used only every 2nd or 3rd day. The second case in which it was employed was in 1896 by Wiesinger. Here on the 17th day an abscess was opened over the seat of fracture and the patient put in a continuous bath. The abscess was healed on the 42nd day.

It would seem then that whether there be merely incisions for extravasation, or whether suprapubic cystotomy or perineal section be performed, the best results can be secured by placing the patient in a continuous bath. In view of a forthcoming report we will not go into the particulars of the management of the bath, but as far as the comfort of the patient is concerned little can be said against it. While at first patients may object to the bath, probably more from the thought of it than from actual discomfort, they soon grow to like it. As has been said, the present patient when removed from the tub cried to be returned.

Dr. Bloodgood has already reported a case of ruptured urethra with fractured pelvis in which the bath was used with excellent result. It has been used by Schede in cases of extravasation of urine, and last year Puzey, in London, reported two cases of ruptured urethra which recovered under the bath; so that it would seem to be especially adapted to this class of injuries, where efficient drainage is so important and so difficult.

ANALYSIS OF CASES.

Sex.—Males 84 = 94.4 per cent. Females 5 = 5.6 per cent.

Age.—1–10 years, 4; 10–20 years, 8; 20–30 years, 20; 30–40 years, 18; 40–50 years, 10; 50–60 years, 11; 60–70, 4; total, 75. Total from age 20–60 = 59 = 78.7 per cent.

Cause.—Crushed by weight falling on body, 23; run over, 25; fell from a height, 22; struck by engine or car, 4; crushed between wagons or cars, 9; total, 83.

Result.—Whole number of cases, 90; whole number of deaths, 75 = 83.3 per cent.; whole number of recoveries, 15 = 16.7 per cent.

Time of Death.—1st day, 9; 2nd day, 14; 3rd day, 7; 4th day, 10; 5th day, 5; 6th day, 5; 7th day, 3. 1st week, 53.

8th day, 2; 10th day, 1; 12th day, 3; 14th day, 3. 2nd week, 9.

3rd week, 2; 4th week, 4; 5th week, 1; 6th week, 2; 6th month, 1; 14th month, 1.

Time of Operation.—

Time after Accident.	Total.	Deaths.	Recoveries.	Mortality.
Within 24 hours,	11	7	4	63.7 per cent.
" 48 "	2	2	0	100.0 "
" 4 days,	5	5	0	100.0 "
" 2 weeks,	7	2	5	28.6 "
" 3 "	1	1	0	100.0 "
	26	17	9	65.4

Bones Fractured.—Multiple fracture, 42; os pubis, 49; sacrum, 9; ischium, 9; ilium, 6; separation of symphysis pubis, 31; separation of sacro-iliac synchondrosis, 10; penetration of bladder by bone, 20.

Position of Rupture.—Anterior wall, 41 = 63.2 per cent.; posterior wall, 1; neck, 12; side, 5; fundus, 3; base, 3.

Operation.	Total.	Died.	Recov.	Mort'y. Per c't.
Unoperated..	53	51	2	
" and catheterized	24	24	0	
" " hot applications	2	2	0	
" " retained catheter	5	4	1	
	53	51	2	96.2
Incision for extravasation	5	4	1	
" " " and retained catheter	3	1	2	
	8	5	3	62.5
Perineal incision	8	6	2	
" " and retained catheter	2	0	2	
" " " drainage tube	1	1	0	
" " " incision for extravasation	1	1	0	
Perineal incision and incision for extravasation and retained catheter	1	1	0	
Perineal incision and abdominal incision	1	1	0	
" " " suprapubic incision	1	1	0	
" " " " " lithotomy tube and drainage	1	1	0	
	16	12	4	75.0
Abdominal incision	2	2	0	
" " and retained catheter	2	1	1	
" " " suprapubic incision	1	1	0	
	5	4	1	80.0
Suprapubic incision	2	1	1	
" " and retained catheter	4	2	2	
	6	3	3	50.0
Bath and incision for extravasation	1	0	1	
" " suprapubic incision	1	0	1	
	2	0	2	00.0
Whole number operated upon	37	24	13	64 9

THE PHYSIOLOGICAL AND PATHOLOGICAL RELATIONS BETWEEN THE NOSE AND THE SEXUAL APPARATUS OF MAN.*

By John Noland Mackenzie, M. D., *of Baltimore, Clinical Professor of Laryngology and Rhinology in the Johns Hopkins Medical School and Laryngologist to the Johns Hopkins Hospital.*

"Balnea, vina, Venus corrumpunt corpora nostra,
Set vitam faciunt, b(alnea), v(ina), V(enus)."†

Οἶνος καὶ τὰ λοετρὰ καὶ ἡ περὶ Κύπριν ἐρωὴ
ὀξυτέρην πέμπει τὴν ὁδὸν εἰς Ἀίδην.‡

Mr. President and Gentlemen.—The limited time at my disposal this morning precludes an elaborate discussion of the propositions which form the text for these remarks. I shall, therefore, content myself with a brief statement of the conclusions which I have reached after a careful study of the subject, and shall not weary you with the arid narrative of individual cases.

The injurious effects of undue excitation or disease of the generative apparatus upon the organs of sight and hearing are matters of ancient recognition. That immoderate indulgence in venery may lead to derangements of the former was familiar to Aristotle,§ and that the fathers of medicine recognized some mysterious connection between the ear and the reproductive functions is evident from the testimony of Hippocrates.‖ Over two centuries ago Rolfinc¶ wrote: "*Qui partibus genitalibus abutitur, et sexto praecepto vim infert, male audit,*" a proposition which has been fully established by the clinical experience of to-day.

The intimate relationship between the genital organs and those of the throat and neck seems to have attracted the special attention of the ancients. Thus Aristotle** clearly defines the changes in the voice at puberty, and the effect of castration on its qualities.†† Its harsh, irregular and discordant character during the maturation of the sexual functions was furthermore affirmed to be more conspicuous in those who attempted the early gratification of the sexual appetite. The observation that, during coitus, the voice becomes rougher and less acute, led the phonasci or voice-trainers to infibulate their pupils, or confine the penis with bands and fetters, to preclude indulgence in wantonness,* whilst the popular idea of the injurious effect of repeated coition upon the singing voice is reflected in the epigram of the Roman satirist:

"Cantasti male, dum fututa es, Aegle,
Jam cantas bene; basianda non es."†

The supposed influence of sexual excitement upon the external throat is likewise apparent from the ancient nuptial ceremonial. Before the virgin retired on the wedding night it was customary to measure her neck with a tape and again on the following morning. If the neck showed an increase in size it was taken as a certain indication of defloration, whilst if the two measurements were equal she was supposed to have retained her virginity. This curious test, which has also been utilized to establish the fact of adultery, has been transmitted to us in the Epithalamium of Catullus:

"Non illam nutrix, oriente luce revisens,
Hesterno collum poterit circumdare filo."‡

Whilst, therefore, the above historical facts point to the early recognition of the relationship between over-indulgence of the sexual powers and morbid conditions of the eye, ear and throat, the special part which it plays in the production of nasal disease seems to have been heretofore overlooked.

My attention was first attracted to the investigation of the physiological and pathological relations between the nose and

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*Remarks made before the British Medical Association at its Montreal meeting, September, 1897.

† An old inscription found in the Campus Florae in Rome. See Buecheler's Antholog. Latin. Carmen. Epigraphic., Fasc. II, p. 705, No. 1499, Teubner edition, 1897. Also Corpus Inscript. Latin. VI, 15258, Gruter 615, 11, Orelli 4816, etc. It is attributed, however, by Scaliger to a modern poet.

‡ The supposed Greek original. See Antholog. Palatin. X, 112.

§ Aristot. Opera omnia graeco-latin. Parisiis, 1854. De animalium generatione, lib. ii, cap. 7.

‖ Opera omnia. Ed. Kühn, Lipsiae, 1827, tom. i, p. 562.

¶ Ordo et methodus generatione dicatarum partium, per anatomen, cognoscendi fabricam. Jenae, 1664, part i, cap. vii, p. 32.

** Op. cit., De animal. historiâ, lib. vii, cap. i.

Choking sensations in the throat and other hysterical manifestations have from time immemorial been regarded as signs of pregnancy. Shakespeare, in King Lear (sc. ii, act iv) thus gives expression to this idea:

"O, how this mother swells up towards my heart!
Hysterica passio! down, thou climbing sorrow,
Thy element's below."

†† Op. cit., De animal. generatione, lib. v, cap. 7.

*J. Riolani Anthropographiae, lib. ii, cap. 34, p. 303, Francofurti, 1626. Riolanus quotes from the *Musaeum* of Albertus Magnus the case of a girl, sent to fetch wine from a public house, who was seized and ravished on the road, and who found in attempting to sing on her return that her voice had changed from acute to grave.

See also Martial (lib. ix, Epig. 28):

"Jam paedegogo liberatus et cujus
Refibulavit turgidum faber penem."

Also lib. xiv, Epig. 215:

"Dic mihi, simplicitur, comoedis et citharedis
Fibula quid praestet? Carius ut futuant."

See also Juvenal, sat. vi, 73.

The gladiators and athletes were also subjected to infibulation:

"Dum ludit media, populo spectante, palaestra,
Delapsa est misero fibula; verpus erat."
Martial, lib. viii, Epig. lxxxii.

† Martial, Epig. lib. i, xcv, ad Aeglen fellatricem.

‡ Epithal. Pelei et Thetidos, lxiv. Catulli op. omn., Lond., 1882, p. 230. This phenomenon was variously attributed to the dilatation of the vessels of the neck by the semen, a portion of which, according to the Hippocratic doctrine, flowed down from the brain during intercourse, and to the general agitation of the vascular system, and especially the arterial and venous trunks of the throat, during the excitement of the sexual act.

the genital organs by the case of a patient in London, in 1879, who invariably suffered from coryza after sexual indulgence.

Stimulated by this observation I began the study of the subject, and five years later published the results of my investigations in the American Journal of the Medical Sciences for April, 1884, in an essay entitled "Irritation of the Sexual Apparatus as an Etiological Factor in the Production of Nasal Disease." In this thesis, which was the first attempt to reduce this curious relationship to, as far as possible, a scientific basis, I advanced the series of propositions which you will find embodied in the text of these remarks.

Several years later there appeared in France a thesis by Arviset,* a critical review by Isch-Wall† and an excellent article by Joal,‡ which dealt in a most interesting way with the topic under consideration. In Germany, Peyer§ in Munich, Endriss‖ in Goeppingen, and, in the present year, Fliess¶ in Berlin, have enriched its literature with their contributions. Fliess's elaborate monograph, written in apparent ignorance of the work done by me in this special field before him, is a model of painstaking labor, and is valuable as an independent contribution to the study of this important subject.

Before submitting for discussion the propositions which form the text for these remarks, let me briefly call attention to certain matters of historical interest which have seemed in olden times to have foreshadowed the physiological relationship between the nose and the genital apparatus.

In the Ayurvéda, the sacred medical classic of the ancient Hindus, a work of fabulous antiquity, the causes of common catarrh are thus tersely defined:

> "Uxoris concubitus, capitis dolor, fumus, pulvis, frigus,
> Vehemens calor, retentio urinae soecumque statim
> Catarrhi causae dictae sunt."**

Although indulgence in venery heads the list, it is highly probable that its real influence was unrecognized, and that it is given as an etiological factor simply in accordance with the seemingly prevalent idea that pervades the Indian Shastras, that venery and confinement of the bowels lay at the root of most diseases.

The earlier physiognomists laid great stress upon the size and form of the nose as an indication of corresponding peculiarities in the penis.* The nose, for example, that was large and firm was looked upon as an index of a penis acceptable to women, and hence it was that the licentious Emperor Heliogabalus only admitted those who were *nasuti, i. e.* who possessed a certain comeliness of that feature, to the companionship of his lustful practices.†

Johanna, Queen of Naples, a woman of insatiable lust, seems also to have selected, as her male companions, men with large noses, with a similar end in view.‡ Sterne, in Tristram Shandy, depicts with consummate humor the supposed sexuality of the nose in "Slawkenbergius's Tale," in which the city of Strasburg was captured by a handsome nose. Every one remembers the closing lines of that intensely amusing production: "Alas! alas! cries Slawkenbergius, making an exclamation—it is not the first, and I fear will not be the last fortress that has been either won—or lost by noses."

While the efforts of those who have selected men who were *nasuti* for sexual purposes were doubtless often crowned with success, history, alas! records some cases of bitter disappointment. Thus Henry Salmuth§ relates with great solemnity a case in point.

Christian Francis Paullini in his curious work‖ devotes a chapter, under the caption *Nasuti non semper bene vasati,*¶ to the subject. After alluding to the prevalent impression that a large nose indicated a corresponding increase in volume of the virile organ, he goes on gravely to state that he has known several "noble and pious" men in whom the rule did not hold good, and relates the following mournful tale: "Nobilissima ac venustissima Virgo, sed valde petulca, duos simul habebat procos, alterum bonae vitae, fortunataeque hominum, sed macilentum; alterum quadratum, et *insigni naso* conspicuum, hirconem, ac fruges consumere natum. Illa, temto isto, hunc sibi elegit ob peculium, quod sperabat, magnum et conditionem strenuam. Sed egregie decepta est. Hinc domi jurgia, foris rixae et summa viri aversio, ob sterilitatem quae thorum perpetuo comitatur."

It was possibly the supposed influence of an elegant and handsome nose as an incentive to illicit amours that led to the well-known custom of amputation of that organ in adulterers, "*truncas inhonesto vulnere nares,*"** whilst in women detected in the act†† the disfigurement thereby produced was intended as a perpetual reminder of their shame.

In astrology Venus was supposed to govern the nose.

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*Contribution à l'étude du tissu érectile des fosses nasales. Thèse de Lyon, août, 1887.

†Progrès Médical, Sept. 10 et 17, 1887. Du tissu érectile des fosses nasales.

‡Revue mensuelle de laryngologie, d'otologie et de rhinologie, févr. et mars, 1888. De l'épistaxis génitale.

§Ueber nervös. Schnupfen u. Speichelfluss u. den ätiologischen Zusammenhang derselben mit Erkrankungen des Sexualapparates. Münchener Med. Wochenschrift, Jahrgang 1889, No. 4.

‖Ueber die bisherigen Beobachtungen von physiologischen u. pathologischen Beziehungen der Oberen Luftwege zu den Sexualorganen. Inaug. Diss. Würzburg, 1892.

¶Die Beziehungen zwischen Nase u. weiblichen Geschlechtsorganen. Berlin, 1897.

**Susrutas Ayurvédas: id est Medicinae Systema, a venerabili D'hanvantare demonstratum a suo discipulo compositum. Translated from the Sanscrit into Latin by Franciscus Hessler, Erlangen, tom. iii, cap. xxiv, p. 44, 1850.

*See especially Ludwig Septalius: De Naevis tractatus, sect. 26, p. 18, in Bonet's Labarynthi medic. extricati, etc. Genevae, 1687.

†Vide Aelius Lampridius in vitâ Antonii Heliogabilis, in Hist. August. etc. Beponti.

‡Guidonis Pancirolli rerum memorabilium sive deperditarum pars prior, etc. Francofurti, 1646, lib. 2, tit. 10, p. m. 176.

§Ibid. p. 177.

‖Observat. medico-physiog. Cent. i, obs. xcvii, p. m. 141; Lipsiae, 1706.

¶Vasatus, post-classical.

**Virgil, Aeneid, vi, 497.

††Vide Diodorus Siculus in Bibliothecae Historicae, Paris edition, 1854, tom. i, lib. i, cap. lxxvii (5), p. 64. On the customs and laws of the Egyptians.

According to all the astrologers, the gentry who

> "... feel the pulses of the stars,
> To find out agues, coughs, catarrhs,"

Venus presides over generation and all the parts pertaining thereto. De la Chambre in his work *L'Art de Connoistre les Hommes*,* in alluding to this supposed influence, says that nothing is more convincing, at least to those who admit the influence of planets on the affairs of men, than that there is an intimate relationship (astrologically) between the genital organs and the nose. As the result of this sympathy the nose must receive the same influence which the planet Venus communicates to the genital organs and must submit to the same empire to which they are subjected. The astrological signs of the nose are reproduced in the genital organs, which, like the nose, occupy a prominent part in the center of the body.

The charlatans of those days pretended to establish the fact of virginity or defloration by astrological signs. William Lilly, the celebrated English astrologer and impostor of the seventeenth century, claimed never to have made a mistake.† It was doubtless this method of imposture that inspired the line of Butler in Hudibras, "detect lost maidenheads by sneezing,"‡ in the famous poem in which he smiled the pretensions of this fraternity of quacks away.

The idea of some occult relationship between the nose and the virile member seems, in days gone by, to have crept even into the darkness of teratology. Thus we find Palfyn§ describing cases in which in place of the nose were found masses resembling the male organs of generation.

To render the relationship to which I wish to call attention more intelligible it is necessary to recall the anatomical fact that in man, covering the whole of the inferior, the under surface of the middle, the posterior ends of the middle and superior, and, what is not sufficiently insisted upon by many writers, a portion of the septum, is a structure which is essentially the anatomical analogue of the erectile tissue of the penis. Like it, this body is composed of irregular spaces, or so-called erectile cells, separated by trabeculæ of connective tissue containing elastic and muscular fibers, the latter element being not as prominent and well-marked as in the cavernous bodies of the generative organs. Under a multitude of various impressions erection of this tissue takes place, the dilatation of its cells being, in all probability, under the direct dominion of vaso-motor nerves derived through the spheno-palatine ganglion. It is the temporary dilatation of these bodies that constitutes the anatomical explanation of the stoppage of the nostrils in coryza and allied conditions, and their permanent enlargement is the distinctive feature of chronic inflammatory states of the nasal passages. This erectile area is, moreover, especially concerned in the evolution of the many curious "reflex" phenomena which are observed in connection with nasal affections. Indeed, the changes which it undergoes seem to lie at the foundation of nasal pathology, and furnish the key not only to the correct interpretation of nasal disease, but also to many obscure affections in other and remote organs of the body. For practical purposes we may consider this erectile, or contractile, area, consisting, as it does, of myriad blood-vessels and blood spaces in wonderfully exquisite correlationship, bounded on the one side by mucous membrane, and on the other by periosteum, as an important organ, certainly of respiration and probably of other physiological functions, using the term organ in its highest physiological sense. Call these bodies by whatever name we may, erectile bodies, corpora cavernosa, nasal lungs, we have a definite, peculiar anatomical arrangement of tissues endowed with specific physiological function and serving a manifest and manifold destiny in the organism.

Physiological.

That an intimate physiological relationship exists between the sexual apparatus and the nose, and especially the intranasal erectile tissue, is sufficiently evident from the following facts:

I.—(*a*) In a certain proportion of women whose nasal organs are healthy, engorgement of the nasal cavernous tissue occurs with unvarying regularity during the menstrual epoch, the swelling of the membrane subsiding with the cessation of the catamenial flow.

(*b*) In some cases of irregular menstruation, in which the individual occasionally omits a menstrual period without external flow, at such times the nasal erectile bodies become swollen and turgid as in the periods when all the external evidences of menstruation are present.

(*c*) The monthly turgescence of the nasal corpora cavernosa may be bilateral, or confined to one side, the swelling appearing at first in one side and then in the other, the alternation varying with the epoch.

(*d*) The periodical erection may be inconsiderable and give rise to little or no inconvenience, or, on the other hand, the swollen bodies may occlude the nostril and awaken phenomena of a so-called reflex nature, such as coughing, sneezing, etc.

(*e*) In some cases there seems to be a direct relationship between this periodical engorgement of the nasal erectile bodies and the phenomena referable to the head that so often accompany the consummation of the menstrual act.

(*f*) As a natural consequence of the phenomena above described, the nasal mucous membrane becomes, at such periods, more susceptible to reflex-producing impressions, and is therefore more easily influenced by mechanical, electrical, thermic and chemical irritation.

(*g*) The conditions (engorgement and increased irritability of the nasal mucous membrane) indicated above, together with the phenomena that accompany them, are also found

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* L'Art de Connoistre les Hommes. Amsterdam, chez Jacques le Jeune, 1660. De la metoposcopie, p. 259.

† Life and Times of William Lilly, written by himself. London, 1829.

‡ Part ii, canto iii, 285. Bartholini (Anatomica Reformata, de naso; also Lond. ed., bk. iii, chap. x, p. 150) tells us that Michael Scotus pretended to be able to diagnosticate virginity by touching the cartilage of the nose.

§ Fortunus Licetus (Jean Palfyn), Description anatomique des parties de la femme, etc., avec un traité des monstres. Leiden, 1708, lib. ii, chap. 30, p. 142 and 144.

during pregnancy at periods corresponding to those of the menstrual flow. There is also reason to believe that similar phenomena occur during lactation and the menopause.

During the period of my original investigations I was unable, from poverty of material, to come to any definite conclusions in regard to the behavior of the nasal apparatus during pregnancy. I was familiar with the fact that in some women the presence of pregnancy was proclaimed by a cold in the head. Isolated cases, too, had led me to the belief that the changes such as I described in my first article occurred in some women, at least, during that period at intervals corresponding to those of the menstrual flow, but at the time of publication of my essay I was not as sure of the fact as I am now. Since my work first appeared I have been so busied with other things that I have given little or no time to the subject. Several cases have, however, offered themselves to me which have confirmed me in the belief that sometimes, at least, the phenomena described by me as occurring during menstruation also occur in pregnancy at periods corresponding to those of the monthly flux. Not to mention others, I have, for example, at present under my care a young pregnant married woman, without any disease of the nasal passages, who with great regularity during the time at which her menses are due (from the 13th to the 17th of every month) suffers from acute and complete obstruction of both nostrils, intense sensitiveness of the nasal mucosa and violent paroxysms of sneezing. These phenomena commence on the 13th, reach their acme by the 15th, and gradually subside, to disappear on the 17th of the month. During the intervals between the periods there is no abnormal condition of the nose present. Indeed, it was for this peculiar, disagreeable feature of her pregnancy that she consulted me, with a very accurate voluntary description of her symptoms. This condition of affairs has continued during three pregnancies. If other proof were wanting of the fact that menstrual phenomena referable to the nose occur during pregnancy, the question has been definitely settled by Fliess, who has shown that they not only occur during that period, but also during lactation. This author also reports several cases in which abortion was accidentally produced by galvano-caustic operations on the nose. In this connection I would call attention to the fact that Pliny* observes that the smell of a lamp which has been extinguished will often cause abortion, and that the latter ensues should the female happen to sneeze just after the sexual congress.

II.—The presence of vicarious nasal menstruation.

(*a*) It is a familiar fact that women are occasionally found in whom the menstrual function is heralded or established by a discharge of blood from the nostrils. This hemorrhage, which may be accompanied by other phenomena referable to the nose, such as sneezing, etc., may be replaced afterwards by the uterine flow, but sometimes continues throughout the menstrual life of the individual. In the latter case, some malformation or derangement of the sexual apparatus seems to be, usually, though not always, responsible for the nasal flow.

(*b*) Epistaxis also occurs, now and then, from the suppression of the normal flux. This was considered as a favorable sign by Hippocrates,* and by Celsus,† who followed closely in his footsteps.

(*c*) Hemorrhage from the nose may occur as the vicarious representative of menstruation during pregnancy; towards the close of menstrual life as the premature or normal herald of the menopause; or it may be observed as a recurring phenomenon after the establishment of the change of life or after the removal of the uterus or its appendages.

(*d*) These vicarious hemorrhages are, moreover, not confined to women, but make their appearance not infrequently in boys at or near the age of puberty, upon the full development of their sexual powers.

III.—*The well-known sympathy between the erectile portions of the generative tract and other erectile structures of the body.*

There is no reason why the sexual excitement that leads to congestion and erection of these organs, as for example in the case of the nipple, may not, under similar circumstances, cause engorgement of the nasal erectile spaces.

IV.—The occasional dependence of phenomena referable to the nose during sexual excitement (such as, for example, nose bleed, stoppage of the nostrils, sneezing and other reflex acts), either from the operation of a physiological process, the *erethism* produced by amorous contact with the opposite sex or during the consummation of the copulative act.

The nasal symptoms most commonly found associated with sexual excitement are sternutation, occlusion of the nasal passages (from erection of the corpora cavernosa), and epistaxis.

Sneezing is sufficiently common, particularly during coitus. Quite a number of such cases have come under my personal observation in persons in robust health and whose nasal organs were apparently free from disease. The reflex may occur before (from erotic thoughts), during, or after the consummation of the act. Many like cases have been since reported to me. Thus one physician of large practice, who became interested in the subject, found twelve cases among his clientele. It may be interesting to know that this form of sexual consensus, or sympathy, has been recognized for centuries. Thus in the sixteenth century, Amatus Lusitanus‡ reports a case of sneezing from the sight of a pretty girl; Bonet§ and Thomas Bartholini,‖ and later, Stalpart Vanderwiel,¶ relate cases of sneezing during coitus. In the last century Schurig,**

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* Nat. His. lib. vii, cap. 7.

* Op. omn. Ed. Kühn. Lipsiae, 1827, tom. ii, p. 174. De morbis lib. i, and Aph. sect. 5, art. 33.

† De medicina. Rotterodami, 1750, lib. ii, cap. 8.

‡ Curationum medicinalium cent. iv, cur. 4, Venet. 1557. See also Rahn. Exercit. phys. de causis physicis mirae illius tum in homine, tum inter homines, tum denique inter cetera naturae corpora sympathia, xvii, Turici 1788.

§ Sepulchretum. L. I, s. xx.

‖ Historiarum anatomic. et medic. rariorum, cent. v et vi, ed. Hafniae, 1761, v, p. 184.

¶ Gynaecologia historico-medica, etc. Dresden and Leipsic, 1730, p. 429.

** Observations rares de médecine etc. (quoted by Deschamps, Traité des maladies des fosses nasales et leur sinus. Paris, 1804, p. 88.)

following Bartholini, and at the commencement of the present, Gruner,* give sneezing as one of the signs of pregnancy. Gruner† states that the nose becomes warm and red in the hysterical, in women at the menstrual period and in the victims of onanism.

Isolated cases of sneezing at the menstrual period are found scattered here and there in older medical literature. Thus Garmanus‡ and Lanzonus§ report cases of this kind, Delius‖ a case of sneezing following the suppression of the menses, while Petzold¶ relates one in which sneezing occurred every day during the whole of pregnancy. Paullini** records a case in which the menses were brought on by sternutatories, and quotes Fabricius Hildanus as having noted copious menstruation follow violent and immoderate sneezing.

Sudden and complete occlusion of both nostrils sometimes occurs with regularity during coitus. This phenomenon, which may be accompanied by so-called "reflex" phenomena, such as, for example, asthmatic attacks, is doubtless due to sudden dilatation of the erectile bodies from paralysis of their vaso-motor nerves; for as Anjel†† has shown, during coitus the nervous shock is distributed to the whole vaso-motor system of nerves and is not confined to the erection center.

Cases have also been reported in which the act of coitus was accompanied by hemorrhage from the nose (Isch-Wall, Joal).

V.—The reciprocal relationship between the genital organs and the nasal apparatus is furthermore illustrated by the occasional dependence of genito-urinary irritation upon affections of the nasal passages. Retarded sexual development, too, may possibly depend upon the co-existence of nasal defect.* Unfortunately there are no authentic cases in literature in support of this latter hypothesis, but in this connection I would like to call attention to the remarkable case reported by Heschel (Wiener Zeitschrift für pract. Heilkunde, März 22, 1861), in which imperfectly developed genital organs were associated with absence of both olfactory lobes. The man was well developed, with the exception of the testes, which were the size of beans and contained no seminal canals, and the larynx, which was of feminine dimensions. All trace of olfactory nerves was absent, as were also the trigona olfactoria and the furrow on the under surface of the anterior lobes. There was scant perforation of the cribriform plate which transmitted the nerveless processes of the dura mater. There was also an absence of nerves in the nasal mucosa.

VI.—It is, finally, quite possible that irritation and congestion of the nasal mucous membrane precede, or are the excitants of, the olfactory impression that forms the connecting link between the sense of smell and erethism of the reproductive organs exhibited in the lower animals and in those individuals whose amorous propensities are aroused by certain odors that emanate from the person of the opposite sex.

Through all the centuries the season of flowers—the springtime—has been celebrated in amatory song and story as the season of love and of sexual delight. This conceit, handed down to us from the poets of antiquity, finds modern expression in the glorious verse of Tennyson:

> "In the Spring a fuller crimson comes upon the robin's breast;
> In the Spring the wanton lapwing gets himself another crest;
> In the Spring a livelier iris changes on the burnish'd dove;
> In the Spring a young man's fancy lightly turns to thoughts of love."

Woman, in all the ages, from the perfumed courtesan of ancient Babylon to her reflected image in the harem of the Sultan to-day, has appealed to the olfactory sense to bring man under her sexual dominion and to fire his passionate desire.

In the Song of Solomon, in the *Artes amoris* of the older writers, in the fetich worship of odor, in the picture of Richelieu surrounded by an atmosphere of dense perfume in order to stimulate his amorous feeling, is reflected the idea of the possible power of olfactory perception in awakening sexual thoughts. If you doubt that modern man has not forsaken this idea, read Zola,† Lombroso, Tolstoi, Nordau.

Rousseau has aptly termed olfaction the sense of the imagination, and if we reflect how intimately related it is to the impressions we form of external objects, how it affects our emotions and influences our judgment, the clever definition of the French philosopher becomes all the more striking and felicitous.‡

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*Physiologische u. pathologische Zeichenlehre, etc. Jena, 1801, p. 122.

†Ibid., p. 327. Several of the older writers refer to a case of "pituitous and serous catarrh" from coitus, reported by Georg Wolfgang Wedel (see Schurig, Spermatologia historico-medica etc., Francofurti ad Moenum., 1720, p. 280), but I have been unable to obtain the original account of the case. John Jacob Wepfer, Observationes medico-practicae de affectibus capitis internis et externis, Schaphusii, 1728, obs. lvii (see my essay, The Pathological Nasal Reflex, an Historical Study. Transactions of the American Laryngological Association, 1887; also N. Y. Medical Journal, August 20th, 1887), mentions a case of hemicrania, tinnitus aurium and vertigo associated with uterine trouble, sneezing and a nasal discharge, but few particulars are given.

It is interesting in this connection to recall the admonition of Celsus to abstain from warmth and women at the commencement of an ordinary catarrh. (Op. cit., lib. iv, cap. 2, § 4, "ubi aliquid ejusmodi sentimus, protinus abstinere a sole, a balneo, a venere debemus.") Hippocrates, on the other hand, relates the following case: "Timochari hieme distillatione in nares praecipue vexato, post veneris usum cuncta ressicata sunt, lassitudo, calor et capitis gravitas successit, sudor ex capite multus manabat." Op. cit., De morbis vulgaribus, lib. v (tom. iii, p. 574). The expression "bride's cold" would seem to indicate on the part of the laity the suspicion of a causal connection between repeated sexual excitement and coryza.

‡Ephemerid. nat. cur. Dec. ii, An. viii, obs. 152.

§Ibid., Dec. iii, An. ii, obs. 32.

‖Act. nat. cur., vol. viii, obs. 108.

¶Ephem. nat. cur. Dec. iii, An. v, vi, obs. 183. See also Rahn, op. cit., p. 34.

**Op. cit., cent. iv, cap. xlviii.

††Archiv für Psych., Bd. viii, Heft 2.

*See Elsberg, Archives of Laryngology, Oct., 1883.

†See especially a work by Leopold Bernard, Les odeurs dans les romans de Zola. Montpellier, 1889.

‡Of great interest is the influence which civilization exerts upon the development and impressibility of the olfactory sense. With-

While it is undoubtedly true that olfactory impression in man, under natural conditions, plays a subordinate part in the excitation of sexual feeling, while it may be also true that such intensification or perversion of the odor sense may indicate an abnormal condition and a reversion to the purely animal type, still the fact is incontestable that many persons are attracted sexually to each other through the sense of smell. Both history and fiction are full of such examples.

In connection with this part of the subject it is interesting to note the extraordinary degree of nervous sympathy that may be developed through the sense of smell. Millingen,* for example, relates the case of a pensioner in the Hospital for the Blind in Paris, called *Les quinze Vingt*, who by the touch of a woman's hands and nails and their *odor* could infallibly assert if she were a virgin. A number of tricks were played on him and wedding rings were put on the fingers of young girls, but he never was at fault.

As in the lower animals it is possible or even probable that the alternate inflation and collapse of the erectile bodies is, to some extent at least, the means by which the grateful or ungrateful odorous particles are excluded from, or admitted to contact with, the apparatus of special sense, so in men in whom this sense is sexually excited or perverted, either normally, or from defect in the subjects themselves, the reception or rejection of the sensuous odors may be accomplished by a similar mechanism.

These facts point conclusively to an intimate physiological association between the nasal and reproductive apparatus, which may be partially explicable on the theory of reflex or correlated action, partially by the bond of sympathy which exists between the various erectile structures of the body. That a relationship exists by virtue of which irritation of the one reacts upon the circulation and possibly nutrition of the other, is accordingly rendered highly probable by the evidence of clinical observation.

If this excitation be carried beyond its physiological limits there comes a time sooner or later when that which is a normal process becomes translated into a pathological state, according to a well-known law of the economy. Hence it is *a priori* conceivable and eminently probable, not only that stimulation of the generative organs, when carried to excess, may become an etiological factor in the production of congestion and transient inflammation of the nasal passages, and especially of their cavernous tissue, but that repeated and prolonged abuse of the function of these organs may, by constant irritative influence on the turbinated tissue, become the starting point of chronic changes in that structure.

PATHOLOGICAL.

The following data, derived from personal clinical observation, may possibly throw some light upon the subject.

I.—In a fair proportion of women suffering from nasal affections, the disease is greatly aggravated during the menstrual epoch or when under the influence of sexual excitement.

II.—Cases are also met with in which congestion or inflammatory conditions of the nasal passages make their appearance only at the menstrual period, or, at least, are only sufficiently annoying at that time to call for medical attention.

III.—Occasionally the discharge from a nasal catarrh will become offensive at the menstrual epoch, losing its disagreeable odor during the decline of the ovarian disturbance. In many cases of ozoena, the fetor is much more pronounced at times corresponding to those of the menstrual flow.

IV.—Excessive indulgence in venery sometimes seems to have a tendency to initiate inflammation of the nasal mucous membrane, or to aggravate existing disease of that structure. There are those, for example, who suffer from coryza after a night's indulgence in venereal excesses, and the common catarrhal affections of the nose are undoubtedly exaggerated by repeated and unnatural coition.

V.—The same is true in regard to the habit of masturbation. The victims of this vice in its later stages are constantly subject to nose-bleed, watery or mucous discharge from the nostrils, and perversion of the olfactory sense.

VI.—The co-existence of uterine or ovarian disease exerts sometimes an important influence on the clinical history of nasal disease. This fact has been shown in practice in cases in which the nasal affection has resisted stubbornly all treatment and in which it has only been relieved upon the recognition and appropriate treatment of the disease of the generative apparatus.

The recent researches of Fliess seem to indicate that the converse of this proposition is true.

The most commonly found conditions of the nasal apparatus following perverted sexual excitement, either from excessive venery or onanism, are: (1) coryza (generally of vaso-motor type), with or without reflex manifestations, such as asthma, paroxysmal sneezing, etc., (2) epistaxis, and (3) various forms of perversion of the sense of smell. In addition to these, Peyer has observed abnormal dryness of the nasal and pharyngeal mucous membrane, indicated by a feeling of dryness and burning in these regions and by complete cessation of secretion.

The coryza that follows intemperate venery resembles in character that seen in the disease falsely called "hay fever,"

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out enumerating, much less elaborating, the myriad conditions that conspire to produce such a result, we may safely lay down the general proposition that the physical and moral forces of civilization—the social and intellectual environment of the subject—exert a marked effect upon the olfactory faculty by inviting or encouraging disturbance of the sentient and perceptive apparatus; that the higher we ascend in the social scale, the more readily our judgments are unnaturally influenced or perverted by impressions derived through the sense of smell, and that the more we recede from the inferior orders, the less perfect and acute this faculty becomes, the more susceptible to irritation and the more predisposed to disease. In view, therefore, of the importance of olfaction as an avenue through which our mental impressibility is influenced—our imagination perverted—and in view of the relations of civilization to the sense of smell, we can readily understand why it is that this faculty is found more frequently deranged among the superior orders than in those lower down in the social scale and in the savage state.

*Millingen. The Passions, or Mind and Matter, etc. London, 1848, p. 102.

and, like it, is generally associated with more or less pronounced neurasthenia, or shall we say, localized hysteria. In other cases the nervous system is not apparently involved. The predominant temperament, however, in individuals thus affected is the neurotic. While they may not necessarily in some instances belong to the so-called "nervous" or "hysterical" individual, while they may give no outward and visible sign of a deranged nervous system, there will generally be found, on careful examination, a delicacy or sensitiveness of the nervous apparatus either in whole or in part.

It is conceivable that this sexual coryza may be associated with almost any of the so-called reflex neuroses. In one of my cases asthma was the central symptom. A young married woman, twenty-three years old, in otherwise apparently perfect health, consulted me for the relief of attacks of asthmatic breathing associated with stoppage of the nostrils. I could find nothing wrong at the time of consultation with the respiratory apparatus, and her other organs were in perfect condition. Reluctantly she confessed that every night for five years she and her husband had indulged in intemperate venery. Moderation in their sexual relations caused rapid disappearance of the symptoms, and in the nine years that have elapsed since she consulted me there has been no return of the disorder.

Interesting cases of asthma of nasal origin associated with, and due to sexual excitement have also been reported by Joal and Peyer. In this connection I would recall a case of periodic vaso-motor coryza reported by me at length elsewhere,* in which the attacks invariably appeared and were most severe at the menstrual period, appearing sometimes at its commencement, sometimes at its close. In the attacks coming on in the interval between the monthly periods pain was always felt in the left ovary. Residence at the seashore invariably gave relief, except during menstruation, when the attacks were as bad as when at home. The outbreak of the disease at the menstrual epoch in this case is readily explained by the physiological erection of the corpora carvernosa which occurs at that period. In this particular case the chief, and under certain circumstances the sole excitant of the paroxysm was the utero-ovarian excitement of the menstrual epoch.

Nose-bleed is not infrequently the result of onanism. Years ago Du Saulsay† called attention to the fact that enormous quantities of blood can be lost from the nose from the practice of this vice, and the accuracy of his observation is borne out by the experience of subsequent observers. Among others, Joal‡ has collected several such cases and reports three of his own. One of his patients informed him that he masturbated to excess to provoke nose-bleed, which relieved him from violent headaches from which he suffered.

Whether the hemorrhages in these cases—which by the way are not confined to the male sex§—come from simple acute distension of the intra-nasal blood-vessels, or whether definite chronic structural changes have taken place in the mucous membrane and in the vessel walls, are points which are as yet undetermined. The probability is that some intra-nasal lesion is responsible for them, for, as I have pointed out elsewhere,* the discharge from the nostrils and the perverted olfactory sense found in the later stages of onanism are often simply the outward expression of chronic nasal inflammation.

The nature of the perversion of the olfactory sense in onanists will vary with the character of the nervous condition produced by the vice—hyperosmia, hyposmia, parosmia and allotriosmia have all been observed in cases of immoderate sexual excitement.

The investigations of Fliess would seem to indicate that painful, profuse and irregular menstruation may in some instances depend upon an intra-nasal cause. He cites a number of cases to show that the pain of certain forms of dysmenorrhœa may be temporarily dissipated by the application of cocaine to the nasal mucous membrane, or permanently controlled by cauterization. According to him, only the inferior turbinated body and the tuberculum septi possess a special relation to the dysmenorrhoeic pains. These two localities he accordingly designates as κατ' ἐξοχήν, genital zones (Genitalstellen). If the tuberculum septi be cocainized, the sacral, if the inferior turbinated bodies be cocainized, the hypogastric, pains disappear. Cocainization of the right nostril causes disappearance of the pain on the left side of the body and *vice versa*.

In answer to the objection that these phenomena may be due to the general anæsthetic action of the drug, he points out the fact that cocaine absorbed into the blood does not produce a general analgesic effect, as is produced in the case, for example, of morphia. On the contrary, in small doses it acts as a stimulant. The fact that the pain ceases *only* when the genital zones are cocainized and that it may be permanently dissipated by cauterization of this area, does away, he thinks, with the assumption that the subsidence of the pains is a part of the euphoria produced by the drug. The fact alluded to above, that in cocainization of certain parts of the genital zones only individual pains disappear from the symptom complex, militates against the supposition of a simple, general narcotic effect.

I cannot vouch for or deny the accuracy of the above statements, as Fliess's monograph has just come into my possession and I have had neither time nor opportunity to put them to the test. Curiously enough, the genital zones of Fliess correspond exactly with the most sensitive portions of the sensitive reflex area mapped out by me in 1883.†

*A contribution to the study of coryza vasomotoria periodica, or so-called "hay fever." N. Y. Med. Rec., July 19, 1884.

†Comment. de rebus in med. etc., vol. xviii, p. 213. Michell, in Schlegel's "Sylloge selectiorum opusc. de mirabile sympathiae quae partes inter diversas corporis humani intercedit." Lipsiae, 1787. ‡l. c.

§See case of Lemarchand de Trigon (girl of 16), quoted by Joal.

*l. c.

†On Nasal Cough and the Existence of a Sensitive Reflex Area in the Nose. American Journal of the Medical Sciences, July, 1883. The results of these experiments were first brought before the Baltimore Medical Association in the early part of 1883, and subsequently before the Medico-Chirurgical Faculty of Maryland (April, 1883, *vide* Transactions), and the American Laryngological Association (May, 1883, *vide* Transactions). The conclusions reached from these investigations were as follows:

"(1) That in the nose there exists a definite, well-defined sensi-

I have on innumerable occasions* shown that phenomena widely different in character and anatomical sphere of operation may be produced at will by artificial stimulation of this area, and that they may be dissipated by local applications to, or removal of, the membrane covering the diseased surface. It is therefore not difficult to conceive that the phenomena referable to the uterus and ovaries during menstruation may be influenced in a similar manner. The specific relations of the two zones and the crossed action of the reflex, if such it be, are much more difficult of explanation. If such a condition of affairs exists, it is certainly a remarkable phenomenon.

These observations, therefore, encourage the belief, if they do not establish the fact, that the natural stimulation of the reproductive apparatus, as in coitus, menstruation, etc., when carried beyond its normal physiological limits, or pathological states of the sexual apparatus, as in certain diseased conditions, or as the result of their over-stimulation from venereal excess, masturbation, etc., are often the predisposing, and occasionally the exciting causes of nasal congestion and inflammation and perversion of the sense of olfaction. Whether this occur through reflex action, pure and simple, or as a sequel of an excitation in which several or all of the erectile structures of the body participate, the starting point of the nasal disease is, in all probability, the repeated stimulation and congestion of the turbinated erectile tissue of the nose. It is highly probable that this erectile area, or organ, so sensitive to reflex-producing impressions, is the correlative of certain vascular areas in the reproductive tract, and that the phenomena observed may therefore be explained by the doctrine of what we may call, for want of a better name, reflex, correlated action.

In these remarks I have attempted no thoroughgoing exposition of the subject, but simply laid before you the results of my personal labors. These no longer represent, I am glad to say, the result of solitary observation and isolated experience. I have not attempted, as Fliess has done, to touch upon the biological side of the question.

The study of the relations between the nose and the sexual apparatus opens up a new field of research, of pleasing landscape and almost boundless horizon, which bids to its exploration not only the physiologist and pathologist, but also the biologist. Above all it brings us face to face with a serious problem of life, an interesting enigma, whose significance it will be the task of the future to divine.

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tive area, whose stimulation, either through a local pathological process, or through the action of an irritant introduced from without, is capable of producing an excitation which finds its expression in a reflex act or in a series of reflected phenomena.

(2) That this sensitive area corresponds in all probability with that portion of the nasal mucous membrane which covers the turbinated corpora cavernosa.

(3) That reflex cough is produced only by stimulation of this area, and is only exceptionally evoked when the irritant is applied to other portions of the nasal mucous membrane.

(4) That all the parts of this area are not equally capable of generating the reflex act, the most sensitive spot being probably represented by that portion of the membrane which clothes the posterior extremity of the inferior turbinated body and that of the septum immediately opposite.

(5) That the tendency to reflex action varies in different individuals, and is probably dependent upon the varying degree of excitability of the erectile tissue. In some the slightest touch is sufficient to excite it; in others, chronic hyperæmia or hypertrophy of the cavernous bodies seems to evoke it by constant irritation of the reflex centers, as occurs in similar conditions of other erectile organs, as for example the clitoris.

(6) That this exaggerated or disordered functional activity of the area may possibly throw some light on the physiological destiny of the erectile bodies. Among other properties which they possess, may they not act as sentinels to guard the lower air passages and pharynx against the entrance of foreign bodies, noxious exhalations and other injurious agents to which they might otherwise be exposed?

Apart from their physiological interest, the practical importance of the above facts from a diagnostic and therapeutic point of view is sufficiently obvious. Therein lies the explanation of many obscure cases of cough which heretofore have received no satisfactory solution, and their recognition is the key to their successful treatment."

In calling attention to this area as containing the spots most sensitive to reflex-producing impressions, I did not, nor do I now (as has been wrongly inferred), desire to maintain that pathological reflexes may not originate from other portions of the nasal mucous membrane. Indeed, wherever there is a terminal nervous filament it *may* be possible to provoke sneezing, lachrymation and other reflex movements. My contention is simply this, that the area indicated in my original paper represents by far the most sensitive portion of the nasal cavities, and that pathological reflex phenomena are in the large majority of cases related to diseased conditions of some portion of this sensitive area. That all pathological nasal reflexes arise from irritation of this particular area is a proposition which I do not, and never have maintained. The determination of these sensitive areas is of special importance and interest in the solution of the pathology of the so-called nasal reflex neuroses. Whether a special sensitiveness in certain portions of the nasal mucous membrane exists or not, the agitation of the question has led to more rational methods of procedure in the treatment of a large class of nasal affections, and to more conservative methods in intra-nasal surgery. Before the location of the sensitive area or areas, the nasal tissues were destroyed with an almost ruthless recklessness that bade fair to bring intra-nasal surgery into the worst repute. (For an elaborate discussion of this whole subject see article by the author in Wood's Reference Handbook of the Medical Sciences, edited by Buck, Wm. Wood & Co., N. Y., 1887, vol. v, pp. 222–242.)

*My views upon this subject may be found in the following publications: A contribution to the study of coryza vaso-motoria periodica, or so-called "hay fever," N. Y. Med. Record, July 19, 1884. Coryza vaso-motoria periodica in the negro, with remarks on the etiology of the disease, N. Y. Med. Record, Oct. 18, 1884. Rhinitis sympathetica, essay read before Clin. Soc. of Md.; see brief abstract in Md. Med. Journal, April 11th, 1885, and in Internationales Centralblatt f. Laryngologie, etc., Sept., 1885. Observations on the origin and cure of coryza vaso-motoria periodica, Trans. Medico-Chir. Faculty of Maryland, 1885. Review of Morell Mackenzie's essay on hay fever, etc., The American Journal of the Med. Sciences, Oct., 1885, pp. 511–528. See also discussion of the subject before the American Laryngological Association (May 14th, 1884, vide Transactions, p. 113 et seq.). See also cases of reflex cough due to nasal polypi, Trans. of the Medico-Chirurgical Faculty of Md., 1884, and articles in Wood's Handbook already referred to

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of October 18, 1897.

On the Hæmatozoan Infection of Birds.—Dr. W. G. MacCallum. (See Bulletin, Vol. VIII, p. 235.)

Discussion.

Dr. Welch.—Everybody familiar with the literature of the subject knows that this communication is of the very first importance, not only of interest with reference to this particular organism, but of general biological interest. It clears up one of the most obscure questions in the biology of the malarial parasites. I have had the opportunity of seeing Dr. MacCallum's demonstration of the phenomena which he has described in the blood of the crow. I should like to ask Dr. MacCallum if he has any evidence that in the regular sporulating cycle of development any differences can be observed between male and female organisms.

Dr. Thayer.—Dr. MacCallum's communication is most refreshing. For nearly 20 years the question of the nature of the flagellate bodies has been one of the most keenly studied points in connection with the malarial parasite, and that this important discovery should have come from our laboratory is an honor to the institution.

Owing to my absence from America I have not seen the whole process as it takes place in birds, but a part of the process I have been able to follow out in man. The specimen was that which Dr. MacCallum has described, and the body which I observed was one which had just been penetrated by a free flagellum. This body was a large round form of the æstivo-autumnal parasite without evidence of any surrounding corpuscle. It contained a central ring of pigment. About this body there were two flagella which, though actively motile, did not disturb or agitate the round body. On careful observation, however, it was easy to observe that the flagella were quite free from the organism. These flagella which were very active would draw away from the parasite and then attack it, butting their heads against its periphery, struggling around it, and apparently making every effort to penetrate into the interior. Now this parasite represented a form which we have been looking at quietly off and on for these last seven years, considering it to be a flagellate body which for some reason or other was not agitated by the surrounding filaments, as is ordinarily the case. And yet after being taught by Dr. MacCallum to observe the picture before us, how perfectly simple it was to realize that the organism was not really possessed of motile filaments, but was a separate body attacked by free flagella.

These observations are, as I said, most refreshing and encouraging, and may well lead us to hope for more. It is particularly satisfactory to realize that Dr. MacCallum's discovery was not accidental, but was the result of intelligent and well-directed observations. It bids fair to be the most important contribution to our knowledge of the malarial parasite since the discovery by Golgi in 1885 of the ordinary cycle of development.

Dr. Barker.—The observations reported by Dr. MacCallum are of interest not only as settling the fact that fertilization occurs in connection with the life-history of the malarial parasites, but they also give us some information concerning the exact nature of the fertilizing process in its different stages. The processes of fertilization in the protozoa have been studied by many observers, and one naturally inquires in how far does the phenomenon as observed in the malarial parasite agree with the findings heretofore recorded concerning protozoan organisms in general. All zoologists believe that the important material substances underlying the process of fertilization are situated in the nuclei of the cells concerned. It would seem very likely then that the flagella of the malarial parasite contain nuclear substances, a view which is quite in accord with the ideas of Sacharov.

If the flagella do contain nuclear substances we have beautifully exemplified in the process of fertilization in the malarial parasite the well-known phenomenon of reduction-division. In the fertilization of all animals and plants, as far as the process has been studied exactly, reduction-division of some sort appears to be constant. Dr. MacCallum has shown that one only of the flagella of the aggressive organism enters the passive parasite. It will be of very considerable interest to find out whether or not any analogous process of reduction of nuclear substances occurs in the parasite into which the flagellum goes. In most instances in other organisms the reduction-division in the female element occurs before the entrance of the spermatozoon. In a few instances it is stated that the directive corpuscles are extruded after fertilization. Dr. MacCallum tells me that thus far he has been unable to make out any bodies resembling directive corpuscles thrown off from the passive parasite.

Dr. MacCallum.—I can hardly answer Dr. Welch's question because in the particular form which I examined, segmentation takes place only in the bone marrow, I believe. I recorded the temperature of an infected crow every three hours day and night for three weeks and found a rise in temperature of three to five degrees daily. There is, however, a similar daily rise in temperature in the normal crow. There seemed to be a higher rise about every fifth day in the infected crow, but I could not determine this definitely. The temperature of the crow is from 103° to 109°.

The Presence in the Blood of Free Granules derived from Leucocytes, and their Possible Relations to Immunity.—Dr. W. R. Stokes and Dr. A. Wegefarth. (See Vol. VIII, p. 246.)

Discussion.

Dr. Welch.—This has been a very painstaking research. Dr. Stokes' view that free granules in the blood are identical with or derived from the specific granules in the leucocytes is very suggestive, and he brings valuable, although not wholly conclusive, evidence in its support. Especially significant is his observation that free granules exist in the horse's blood apparently identical with the unusually large and characteristic granules in the eosinophiles of this animal. Dr. Stokes,

it will be observed, does not identify with the granules which he has studied the blood-plates, concerning whose structure and origin there is still much difference of opinion.

As to whether the bactericidal properties of blood are in fact derived from the free granules cannot be said to be demonstrated beyond all doubt. It is well known that filtration through porcelain not only filters out particulate matter, such as these granules, but likewise affects the composition of the fluid. Still the theory of immunity proposed by Dr. Stokes is supported by other observations, such as those of Kanthack and Hardy, and is a legitimate one to use as a working hypothesis.

Dr. BARKER.—When Dr. Stokes replies I should like him to state whether or not he has observed the granules in rows outside of the leucocytes. Many histologists believe that the granules in the leucocytes are really the cytomicrosomes embedded in the cytolinin threads of the cytoplasm.

Dr. STOKES.—In answer I would say that you can stain the free eosinophilic granules both by eosin and the triple blood stain in horse's and frog's blood. We have found numerous large granules in the horse's blood, but have not been very successful in staining the free granules of either variety in human blood. I have not seen the granules in rows.

I simply used the term neutrophilic to designate a leucocyte containing fine granules and having a polymorphous nucleus.

NOTES ON NEW BOOKS.

An Epitome of the History of Medicine. By ROSWELL PARK, M. D. (*Philadelphia: F. A. Davis Co.*, 1896.)

As Dr. Park in his introduction states, "the following pages represent an effort to bring the most important facts and events comprised within such a history into the compass of a medical curriculum, and at the same time to rehearse them in such a manner that the book may be useful and acceptable to the interested layman,—*i. e.* to popularize the subject." The work represents a series of lectures delivered to the medical students at Buffalo, and is interesting and thoughtful, as are all the writings of this author. There is no satisfactory history of medicine in the English language—perhaps there is none in any language—for the difficulties in writing it are very great. In this epitome Dr. Park has succeeded in presenting his subject in as attractive a way as possible, we think, and we have found it agreeable reading, although frequently, from the very necessity of the case, it is too encyclopedic in form to be altogether easy reading. To cover the entire history of medicine in 350 octavo pages and make it readable at all is a task in itself, but Dr. Park has done more than this. He has not only given us a history of medicine, but has shown us its connections with the other arts, and the influences brought to bear upon it through all time. And in addition he has set the example to other medical schools of giving a course in medical history, which, spite of the many branches of medicine that have to be studied, should certainly not be left by the leading medical schools entirely out of their curriculum. The only unsatisfactory part about the book is its index, which should be more complete.

It is perhaps in just such an epitome of history that one can grasp the whole subject better than in a larger history; in a certain sense it brings the different periods in the development of medicine into closer union, and one is able to judge more readily of the advances made in medicine since our earliest knowledge of it. There are many points of similarity between the conditions of medical practice to-day and those of the middle ages and later—we are no more free of false schools now than then—even to-day when the hold of pure science on the minds of men is greater than ever before, we find schools of homeopathy, osteopathy, bone-setters, faith-curists and Christian-scientists. Then again we have no doubt that when the history of medicine of the present era is written several hundred years hence, it will be shown that we shall have missed making discoveries, to which we are as close, as those discoveries made by us, which the practitioners of the 16th, 17th and 18th centuries almost made—they helped us to them. In fact most of our discoveries are not due to greater intellectual discernment, but to added tools of trade, which make the study of medicine easier for us every day, and at the same time tend to make most of us superficial thinkers—we rely on our instruments and not on our brains. It may fairly be argued whether we have any as great men-thinkers as existed during the middle ages. The breadth of knowledge attained by the leading men of those times is something very remarkable. True, there was not so much to know, not so many books to read, but nevertheless the great men were better informed for their times than those of to-day. Their very breadth of knowledge may have made them less able practitioners than are the physicians of to-day; it is certain that great knowledge in many branches of science often leads to a questioning spirit of mind, to one of less positiveness and directness, and thus to less readiness to act. We have advanced far in medicine during the past 100 years, but with all our new tools is the advance so great after all when in addition we take into consideration the enormous increase in workers? It is certainly an interesting comment that in the past 2500 years only two specifics for diseases have been found, quinine and mercury, and the latter is not so sure a specific as the former. Let us hope for better times to come in therapeutics.

Unscientific as Rademacher's doctrine was of three primary diseases with three universal medicaments, in its development it came closer than appears at first sight to a doctrine of the present day. He and his followers believed that besides universal diseases there were diseases of organs to be diagnosed by the efficacy of organ remedies, "thus abdominal diseases must be relieved by corresponding abdominal remedies," head diseases with "head remedies," etc. Are we not to-day doing just this with such remedies as cerebrine, ovarine, thyroidine, pancreatine, pepsin and many others, and, what is more, do we not believe to a greater or less extent in their efficacy, and are we not justified in our belief? Is it quite fair when Dr. Park says: "What is the most surprising about this absurd doctrine is that it found followers, some even quite capable in their way." Rademacher may have been a "quack," so to speak, but oftentimes the difference between the "quack" and the "regular practitioner" is rather in words than in deeds.

Have we any much better definition of hysteria than that of Thomas Willis (1622–1675), who accounted for this condition "by the union of the spiritus with imperfectly purified blood"; a most accurate definition of the cause in many cases of hysteria.

We cannot go further on this line. We merely wish to show how nearly connected we are with the past in many respects, and how interesting it is to follow the steps which have led us on so far; there are few broken links in the chain of gradual growth in medicine, although its development has been hindered at all times by various false doctrines.

Before we close this review there are still one or two points to which we would like to draw attention. The easiest way, we think, to make such an epitome interesting is to connect as many stories or discoveries with the names of the men introduced. Dr. Park has given us many, but there are others we miss which would add to the value and attractiveness of the volume without increasing its length materially. Although Scarpa, Pott, and Bigelow are mentioned, there is no mention of the triangle, disease of the spine, and *y*-ligament so closely associated with these names. The

discovery of the *y*-ligament is one which has quite revolutionized the treatment of dislocations of the hip and should certainly not be omitted. Other omissions of a like character might be spoken of, but these are enough to mark our point. One of the most striking stories in medicine, it seems to us, is the one connected with Boerhaave's name, of which we find no mention in Dr. Park's work. When he died he left behind him an elegant volume, the title-page of which declared that it contained all the secrets of medicine. On opening the volume every page except one was blank. On that one was written: "Keep the head cool, the feet warm, and the bowels open." We miss also the amusing verse connected with I. Lettsom's name (there are a number of variations of this stanza):

"When patients come to me
I physics, bleeds, and sweats 'em.
If after that they choose to die,
Why then of course
I. Lettsom."

We are surprised, too, at the slighting mention of Sir Thomas Browne, who is one of the very few literary lights in medicine. His work, the "Religio Medici," should be read by every student of medicine, and is a book which will always live; there is none other like it; it is a classic. Surely, too, the student of medicine should know that Thomas Dover (Dover's powder) was a buccaneer, and the discoverer of Alexander Selkirk, the original of Robinson Crusoe. There is a delightful paper by Dr. Osler on Thomas Dover. And, finally, the name of James Cesdaile, M. D., should not be entirely omitted. He wrote two works, one entitled "Mesmerism in India," 1850, and the other, "Clairvoyance and Practical Mesmerism," 1852. He performed a large number of major operations in India on patients under the influence of mesmerism or hypnotism, and had it not been for the discoveries of ether and chloroform just at this time, his work, which was admirable, would have obtained greater reputation than it has. He was an able surgeon and used mesmerism merely as a means of doing away with pain. He was not a believer in mesmerism in any false sense; he used it purely from a humanitarian point of view, and more extensively than any one who preceded him, and with very brilliant results.

In final conclusion we wish only to congratulate Dr. Park on this last work of his, which deserves much praise.

Practice of Medicine. By JAMES M. ANDERS, M. D. (*Philadelphia: W. B. Saunders*, 1898.)

Within the past eighteen months three books on the practice of medicine have appeared written by Philadelphia physicians; first came Dr. Tyson's, then the combination work of Drs. Wood and Fitz, and finally this one by Dr. Anders. In addition to these volumes from Philadelphia, a number of systems of medicine have appeared, so that there is at present no lack of text-books on medicine. These are the days of cheap printing and of superabundant writing. There have been many advances in the past ten years in diagnosis and treatment of diseases, but we do not think there is any call for this multiplicity of books on practice; and we hope that there will soon be a reaction against the production and publication of works all treating the same subject.

This last book compares favorably with its predecessors; it is about the same size as Dr. Tyson's, but larger than that of Drs. Wood and Fitz. Every author necessarily has views of his own on diagnosis, prognosis, treatment, etc., but these may not be either truly novel or suggestive. Much space in this work—too much, we think—is given to treatment; and with it all we have found important matters left out, and treatment suggested that we do not believe to be good. For instance, in typhoid fever Dr. Anders seems to be a strong advocate of rectal feeding and rectal irrigation, in spite of the fact that, as he states, ulcerations in the large intestine are found in nearly 33 per cent. of all cases; the dangers of perforating an ulcer with a rectal tube are not slight, and we believe such treatment should only be resorted to in the very gravest cases. We find no mention of the use to which the Roentgen rays may be applied in the diagnosis of obscure thoracic cases; the value of these rays has been ably demonstrated by Dr. Francis H. Williams, of Boston, and others. And again the author does not speak of the use of antistreptococcus treatment in ulcerative endocarditis. The value of this last method of procedure may be questioned, but it deserves to be noted, and has already proved efficacious in certain cases. Nothing is said also of the palliative treatment by hypodermoclysis in diabetic coma. This brings up one of those subjects of perennial interest to all practitioners, and one which was much discussed at the late meeting of the British Medical Association in Montreal, that is, the treatment of diabetes mellitus. Anders' treatment is practically that advised by the men who took part in the discussion, to cut off all starches at first, and then to admit them little by little to the dietary as the patients prove that they can digest them without harm, or prove as in some cases to be doing worse without them. We are glad to note that he advocates the free use of fats, which oftentimes are readily digested in large quantity, while the patient gains in strength and weight.

Another subject which was much discussed at Montreal was that of arthritis deformans; and here Dr. Anders differs from the general consensus of opinion as expressed at that meeting. He believes in the neuro-trophic theory as a cause of this disease, which it seems to us is a theory which does not stand a very thorough examination. As Dr. James Stewart, of Montreal, said in closing his paper on this subject, "the result of recent investigations points very strongly to its infectious nature." He also very strongly advocated the Tallerman method of treatment, *i. e.* baths of superheated dry air. This means is not spoken of by Dr. Anders.

In the chapter on malaria there are several confusing statements; speaking of the evolution of the æstivo-autumnal parasite the author says, p. 83: "For the differences in the period of evolution there is no satisfactory explanation, though the variation may be connected with the circumstance that it frequently (though by accident) penetrates into the red blood corpuscle." We do not understand what the author means by this. Again on p. 91, in speaking of malarial hæmaturia, he states: "The blood shows non-pigmented parasites (forming rosettes)"; the rosette-shaped figures are always pigmented, and we do not comprehend exactly what form of organism he means. On p. 93 we regret to note the term typho-malaria,—the author says "remittent fever must not be confounded with typho-malaria"; it is the use of this word which has already led to so much distracting confusion between typhoid fever and malaria, and it ought not to be used any longer. There is no mention in the differential diagnosis of malarial and other diseases of syphilis. Every now and then cases of syphilis will develop intermittent chills, almost identical to those seen in malaria. We have lately had under observation a very interesting case of right apical lobar pneumonia; the patient had contracted syphilis about a year previously for which he had received irregular treatment. On three successive occasions, on alternate days, during the height of the pneumonic fever, at about 4 o'clock in the afternoon there was a rise of from one to two degrees in the temperature, and this was seen on two occasions after the temperature was practically normal. The blood was examined on two occasions for malarial parasites, but none were found; the patient was treated with both quinine and mercury, so that no conclusions can be drawn from the effects of the medicine. It yet remains in doubt as to whether these peculiar rises of temperature were due to syphilis or malaria. We are inclined to attribute them to the former.

On page 602 it is stated of the diastolic murmur heard in aortic incompetency, that "from the xyphoid it is transmitted to the left as far as the spinal column." We believe there is some slip here.

There are many other points we should like to discuss in this review, but they would take up too much space. It seems to us that the prognosis of valvular lesions of the heart is too favorable as given by Dr. Anders, and that the relationship between increased tension in the arterial system, arterio-sclerosis following it, and disease of the valves of the heart is not clearly stated.

There are a few typographical errors, and while most of the illustrations seem to us satisfactory, yet there are some which might quite as well be omitted, for instance those on pp. 467, 472 and 476.

Notwithstanding all our criticisms the book is a good one, and for the average general practitioner will be of distinct service from its detail of treatment. It is not a great book. We could have got on without it, but we are glad to have it on our shelves. There is little that is new in it, but it is well to have the opinions of any man of large experience. The reliance of the author on Osler's work is marked by numerous references to his practice of medicine.

A Text-Book of Diseases of Women. By CHARLES B. PENROSE, M. D., Ph. D. 8vo, 529 pages. (*W. B. Saunders, Philadelphia*, 1897.)

After a brief introductory chapter, the author treats in detail the methods of examining the uterus and bladder, and in the examination of the rectum lays especial stress on the value of the knee-chest posture.

The illustrations demonstrating Emmit's operation for repair of a lacerated perineum are the best that have yet appeared, but the use of silk ligatures and shot instead of catgut in the angles is rather antiquated, as there is usually considerable danger of a breaking down of the external portions of the perineum during the removal of the deeply-seated sutures in the angles.

It is pleasing to see the word of warning against the stem pessary noted on page 119. On page 127 it is said, "in all old cases of retrodisplacement, endometritis is an accompaniment." This is very doubtful. In a number of cases of retroflexion where the uterus was densely adherent posteriorly and where both tubes were the seat of pyosalpinx, we have found a perfectly normal endometrium. On page 137 a very opportune warning is given against the use of pessaries where the uterus is bound down or the appendages are the seat of inflammation.

The operation for suspension is accurately described, and the author fully agrees with the lines previously laid down by Kelly when he says, "we do not wish to make a fixation of the uterus to the anterior abdominal wall."

Figure 98, labeled "left lateral laceration of the cervix with erosion," is misleading, resembling much more a typical early carcinoma of the cervix. It is refreshing on page 166 to note: "If the advice here given—to seek for the primary cause of the cervical catarrh and to cure it—is followed, it will be found that there are very few cases that depend for a cure upon local applications."

The articles on cancer of the uterus are well written, but we cannot agree with the writer when on page 212 he says that cancer of the body is rare in comparison with cancer of the cervix. Figure 118, which is marked Glandular Endometritis, shows an intact surface epithelium, typical glands lined by characteristic epithelium, and a normal stroma between the glands. Although this might according to general usage be called endometritis, there is not the slightest sign of any inflammation.

On page 205 one is advised to carefully wash out the uterus with a bichloride solution should the organ be perforated by the curette. This is hardly to be recommended, as the fluid would naturally flow out into the abdominal cavity. The author on page 247 claims that myomectomy is a dangerous operation and that it is applicable only when one fibroid is present. The experience of others has shown conclusively that several may be removed with little danger, and Kelly has removed as many as eighteen at one time.

The chapters on diseases of the tubes are clear and forcible, especially chapter xxvi, on tubal pregnancy.

Ovarian tumors are well handled, but it is surprising to learn that ovarian fibromata are very rare, as the literature contains reports of numerous cases; also to learn that the majority of solid tumors of the ovary are sarcomatous in character, in view of the fact that they are sparsely scattered throughout the bibliography.

Primary carcinoma of the ovary is by no means a rarity. Diseases of the urethra and bladder are brought up to date and due credit is given to Kelly for the work he has done.

The chapters on technique are to the point, but we believed that the glass drainage tube was a thing of the past.

The majority of operators will fully agree with the author when he says "more discomfort may be experienced after ventro-suspension of the uterus than after a hysterectomy," and with a subsequent remark, "catheterization should never be performed under any circumstances by the aid of the tactile sense alone. The nurse should always see what she is doing."

Preceding the discussion of each organ, a brief review of its anatomy is given. The illustrations both of the gross and microscopical specimens are well executed and the text concise and clear. The book was written for students and to them it can be recommended as the best we possess. T. S. C.

Crime and Criminals. By J. SANDERSON CHRISTISON, M. D. (*Chicago: W. T. Keener Co.*, 1897.)

It is very seldom that a series of newspaper articles are worth reprinting in book form, and this work is no exception to the rule. It is composed of a series of articles which appeared in the Chicago *Tribune* under the caption of "Jail Types," and we believe that they were undoubtedly meant to be "popular" articles. They are certainly not in any strict sense "scientific" papers, and are practically of no value to the thorough student of criminology. The histories of the cases as presented are very superficial, and no fair deductions can be made from the majority of them. We think that the book is practically useless, and that the moral tendency of such papers in daily journals is bad.

Transactions of the Chicago Pathological Society, from December, 1895, to April, 1897. Vol. II. (*Chicago: American Medical Association Press.*)

There are many cases of interest to both physicians and surgeons reported in this volume—too many, one may fairly say. The mere collection of cases or specimens at the present time is of comparatively little value; both must be "worked up" by all the many methods we have at our command. Especially is this true of pathological specimens, which without a most thorough microscopical examination are practically worthless. The value of such volumes of transactions lies wholly in their being books of reference for strange and rare cases. We have no doubt Volume II is an improvement on Volume I, but if the editors of Volume III would use more supervision in the selection of cases to be published next time, the third volume would be an improvement on its predecessors. Fewer cases should be reported, and more in greater detail; then the volume would become of permanent value.

Transactions of the Indiana State Medical Society. Forty-sixth Annual Session held in Indianapolis, Ind., June 6th and 7th, 1895. (*Indianapolis: Carlon and Hollenbeck.*)

This is a large volume of over 500 pages, nearly 400 of which are devoted to papers on medical and surgical topics, but there is little of permanent value to be found in this mass of material. A number of interesting cases are reported, but few of them with sufficient detail to make them of real value, and the papers on general topics, such as lithæmia, immunity, hypnotism, alcoholism, etc., present no original ideas. The volume can only be of importance to the members of the society and their immediate friends.

Compatibilities in Prescriptions. By Edsel A. Ruddiman, Ph. M., M. D. (*New York: John Wiley & Sons*, 1897.)

This work is divided into two parts as described by the author in his preface: "The object of the first part of this book is to present to him [the busy practionist] in a convenient and condensed form the more common incompatibilities .... The second object of the writer is to furnish the student of pharmacy with a list of incompatible prescriptions in such form that he may find out for himself what the trouble is and the best means of avoiding or overcoming it." The book is well arranged, the more ordinary drugs being taken up in alphabetical order, and in fact no fault can be found with it. But it requires very careful study, and is hardly adapted for the general practitioner unless he has a well-grounded knowledge of chemistry. As an exercise book for the student it will undoubtedly prove itself of value. We doubt whether any one but an expert pharmacist or chemist would recognize the errors in a number of the prescriptions given, which only go to show the numberless difficulties to be met with in combining drugs, and the gratitude which the ordinary practitioner should have for the makers of tablet triturates and other compounded drugs, which we believe have saved many errors in prescription writing, and also many lives. The multiplicity of new chemical compounds has added immensely to the probabilities of making errors in combining two or more drugs in a prescription, and we rejoice that it is becoming less and less the fashion to use more than two or three medicines in combination. It is better to use the active principles alone, if possible.

Exercises in Practical Physiology. By Augustus D. Waller, M. D., F. R. S. Part III. Physiology of the Nervous System. Electro-Physiology. (*New York: Longmans, Green & Co.*, 1897.)

In this volume, which forms the third in a series of exercises and demonstrations in physiology for medical students, the author has dealt with that difficult branch of medicine, the "electro-physiology" of the nervous system. The experiments are only intended for advanced students, and seem to us to cover the ground well. Every instructor would probably modify these exercises, or build up a new series for himself, but any student who has done these experiments should have a good understanding of this subject. The author takes up in order first some of the different kinds of electric cells and their adjuncts, as commutators, galvanoscope, rheostat, etc.; then follow a number of experiments on the stimulation of the muscle, its fatigue and contractions; on muscle and nerve currents; on the secondary currents; and these experiments in turn are followed by others on reflex time and action. In this manner Dr. Waller covers a broad ground with a comparatively small number of well-chosen exercises.

Rheumatism and its Treatment by the Use of the Percusso-Punctator. By J. Brindley James. (*London: Rebman Publishing Co. Ltd.*, 1897.)

The title of this work is both misleading and ambiguous. We opened the book thinking that the author had found a new treatment for acute articular rheumatism, but found ourselves entirely mistaken. The treatment is not new, and by "rheumatism" the author means all those vague pains which are included in such terms as "lumbago," "vertigo," "hemicrania," "brow-ague," etc. The "percusso-punctator" is nothing more nor less than a modified form of acupuncture, and an instrument very like many of the old "wet-cups." The cures which the author professes to have wrought by means of this tool are frequently obtained by other physicians with simpler methods; we have seen the insertion of a long hat-pin in the lumbar muscles rapidly relieve an attack of lumbago. Another chapter in this superficial work is taken up with the treatment of sciatica by hypodermatic injections of sulphuric ether; the writer states that he has cured a number of cases by this method, and we have no doubt of its use in certain cases, but his treatment was supplemented by the daily use of salicylate of soda, so that it is quite impossible to judge to which of these two drugs the honor is due. There are two chapters given to "nevrose" or neurasthenia which deserve special condemnation; the use of numerous French words and italics is resorted to most unnecessarily and lends no strength to an otherwise feeble production.

The conceit of the author is astonishing, as may be judged from the following: "It is, however, only in strict accordance with this sublunary world's order of things that the discoverer and inventor, from Galileo with his telescope to Stephenson with his locomotive, should at first—often a terribly prolonged 'at first'—resign themselves to encounter, not active persecution in our times, but at all events hostile opposition, scepticism and contemptuous derision." The author believes he has been most unjustly treated by the world at large, but when he compares his discovery (?) to those of Galileo and Stephenson we can but smile and leave him to his merited fate.

Transactions of the Michigan State Medical Society. 1897. Vol. XXI. (*Grand Rapids: Published by the Society.*)

Were it not for the address on surgery in this volume by Roswell Park, these transactions might be laid on a back shelf. But this address, like all of Dr. Park's, contains thoughts of more than passing value. The subject of it is "the problems which most perplex the surgeon," but it is devoted almost entirely to a very interesting discussion of the question of cancer in many of its various relations. Besides this paper there are only two or three to which attention might be drawn—one on a case of purulent pericarditis, by F. W. Garber; a second on cancer of the stomach, by J. H. Kellogg, and thirdly, report of a case of lead-poisoning, by H. Gibbes; but except as cases they deserve no special mention—the histories are meagre.

The Diseases of Women. A handbook for students and practitioners. By J. Bland Sutton, F. R. C. S. Eng., and Arthur E. Giles, M. D. (*Philadelphia: W. B. Saunders. London: Rebman Publishing Co. Ltd.*, 1897.)

This little book of 436 pages is written in a way to be "useful to students for examination purposes," and is not calculated to increase the reputation of its distinguished authors. It contains nothing new. It is well printed and profusely illustrated.

BOOKS RECEIVED.

Crime and Criminals. By J. Sanderson Christison, M. D. 1897. 12mo. 117 pages. The W. T. Keener Co., Chicago.

Rheumatism and its Treatment by the Use of the Percusso-Punctator. By J. Brindley James, M. R. C. S. Eng. Second edition. 1897. 12mo. 39 pages. The Rebman Publishing Co. Ltd., London.

Transactions of the Michigan State Medical Society for the Year 1897. Vol. XXI. 8vo. 526 pages. Published by the Society, Grand Rapids.

A Practical Treatise on Sexual Disorders of the Male and Female. By Robert W. Taylor, A. M., M. D. 1897. 8vo. 451 pages. Lea Brothers & Co., New York and Philadelphia.

Selected Essays and Monographs. Translations and reprints from various sources. 1897. 8vo. 436 pages. The New Sydenham Society, London.

Thirty-third Report of the Trustees of the Boston City Hospital, with Report of the Superintendent, etc., for the year Feb. 1, 1896, to Jan. 31, 1897, inclusive. 8vo. 194 pages Municipal Printing Office, Boston.

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GENERAL STATEMENT.

The Medical Department of the Johns Hopkins University was opened for the instruction of students October, 1893. This School of Medicine is an integral and coördinate part of the Johns Hopkins University, and it also derives great advantages from its close affiliation with the Johns Hopkins Hospital.

The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter.

Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have acquaintance with Latin and a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry, and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, beside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the

REGISTRAR OF THE JOHNS HOPKINS MEDICAL SCHOOL, BALTIMORE.

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BULLETIN

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CONTENTS.

INFLATED RUBBER CYLINDERS FOR CIRCULAR SUTURE OF THE INTESTINE.*

By W. S. Halsted, M. D., *Professor of Surgery in the Johns Hopkins University.*

Until ten years ago every one who had written on the subject of intestinal suture believed that the Lembert stitches, which were then almost universally used in circular and other sutures of the intestine, included only the peritoneal coat of the intestine; and many surgeons evidently still believe this. The notions of Jobert and Lembert as to the structure of the intestinal wall were still accepted by all surgeons. The submucous coat of the intestine, the coat which, I am convinced, should most concern the surgeon when he is sewing the intestine, was ignored or unknown. In my first article on suture of the intestine† in 1887 I quoted from Madelung‡ as follows: "The needle now penetrates in the usual manner the two ends of the intestine, passing between serosa and muscularis"; and from Reichel,§ who insists upon the "accurate adaptation of the two edges of the wound, particularly of the two serous coats," and having described the manner of taking the first row of stitches, continues, "over this then comes the external suture, which includes only the serosa." Maydl, Kocher, Czerny and others were quoted to show that the submucous coat had not been recognized, and how universal was the opinion that intestinal suture should be performed by stitches which included only the peritoneal coat. When we know that the wall of the intestine must be magnified to a thickness of 4 cm. to enable us to represent the peritoneal coat by a fine pencil-stroke, we find it hard to understand that surgeons should ever have supposed that they were including nothing but peritoneum in their stitches. Hardly less remarkable is the fact that the intestinal wall had, for the surgeon, only three coats: the serous, muscular, and mucous coats. Not only were the qualities of the submucosa unknown to surgeons, it was also an unknown quantity. Only five years ago Schimmelbusch,* describing with some detail the manufacture of the so-called catgut, tells us that it is made from the longitudinal muscular coat. He says, "If the intestine be laid on a towel and scraped with a dull instrument like the back of a knife, the muck ('Schmutz'), so called by the artisans, is removed. This is nothing else than the mucous membrane of the gut. In the same manner the circular muscular coat is rubbed off, so that only the very thin tube composed of longitudinal muscle-fibres remains, an intact, very delicate and pipe-like structure which may be distended with air. The threads are manufactured from this by twisting, and conformably to the thickness desired, either the entire tube or only strips of

* Remarks before the Johns Hopkins Hospital Medical Society, December 13, 1897.

† Halsted: Circular Suture of the Intestine. An Experimental Study. Am. Jour. Med. Sciences, October, 1887.

‡ Madelung: Arch. f. klin. Chirurgie, Bd. xxvii, p. 321.

§ Reichel: Deutsche Zeitschr. f. Chirurgie, Bd. xiv, pp. 268 and 270.

* Schimmelbusch: Anleitung zur aseptischen Wundbehandlung, Berlin, 1892, p. 104.

it are twisted together like hempen cords." The muscular pipe referred to is, of course, the tube of the submucosa, the sausage-skin, etc.

The following suggestions, emphasized among others, in my article on intestinal anastomosis,* are equally relevant to circular suture of the intestine:

"1. It is bad surgery to employ stitches which enter the lumen of the intestine.

"2. It is impossible to suture the serosa alone.

"3. It is impossible to suture unfailingly the serosa and muscularis alone, unless one is familiar with the resistance offered to the needle by the submucous coat of the intestine; furthermore, stitches which include nothing but the serous and muscular coats tear out easily and are not to be trusted.

"4. Each stitch should include a bit of the submucosa. A fine thread of this coat is much stronger than a considerable shred of the entire thickness of the serosa and muscularis. It is not difficult to familiarize one's self with the resistance offered to the needle by the submucosa, and with a very little practice one learns to include a bit of this coat in each stitch.

"5. The mattress-stitches are to be preferred to Lembert's, because one row of them is sufficient, because they tear out less easily, oppose larger surfaces and more evenly, and constrict the tissues less than the Lembert stitches do."

6. In circular suture of the intestine, only one row of stitches should be taken, and the entire row should be applied before a single stitch is tied; otherwise it is impossible to preserve a straight line in the taking of the stitches, and the stitches taken last may be never so much farther from the cut edge than those taken first, and the flange turned in may be so broad as to occlude the intestine's lumen.

7. Before the intestine is resected, its blood-supply should be most carefully studied, with reference not only to the placing of ligatures, but also of the stitches, and the stitches should be so placed that the circulation, up to the very edge of the parts to be sewed, shall be as perfect as possible.

The results obtained by adhering strictly to the foregoing rules have been so perfect† that we have employed no other methods in our practice.

Edmunds and Ballance in their valuable contribution‡ to intestinal surgery, give the results of their measurements to determine the relative thickness of the submucous and muscular coats in the dog and in man. They state that the muscular coat is very much thicker in the dog than in man, but that the submucous coat is somewhat thicker in man than in the dog, and they too find it perfectly feasible to engage a thread of the submucosa in each stitch without perforating the lumen of the intestine.

The objection to Neuber's* decalcified bone-bobbins, Senn's decalcified bone-plates, and Murphy's button, probably the best of the mechanical aids to intestinal suture, I will not dwell upon at this time. The method of each of these surgeons has its advantages, particularly in the hands of those who have not practised the intestinal sutures on animals.

I believe that the license to practice general surgery should be withheld from those who have not practiced on animals the operations for circular suture of the intestine and intestinal anastomosis.

Not so very long ago a surgeon requested me to assist him to perform a circular suture of the intestine (end to end anastomosis) upon one of his patients. He readily consented to practice the operation upon dogs. At first his dogs died. He finally succeeded in saving more than 50 per cent. of the dogs operated upon. The operation upon his patient required five hours, but was successful. It is not difficult to predict what the result would have been if the practice on dogs had been omitted.

Experts in intestinal surgery, almost without exception, prefer to perform circular suture of the intestine without the use of mechanical devices.

But my operation was not by any means a satisfactory one, notwithstanding the very perfect results which attended its employment in the hands of others as well as myself.

The disadvantages of my original method and of all similar methods (methods without mechanical aids) were as follows:

1. They required about twenty minutes to perform the operation.

2. One or two assistants at the wound were indispensable.

3. Clamps or the fingers of an additional assistant were necessary to prevent the escape of intestinal contents.

4. The vermicular action of the intestine (particularly in dogs) was a great annoyance, for it prevented an accurate disposition of the stitches; stitches applied as near together as possible during intestinal contraction might be too far apart in the stage of relaxation.

5. If the pieces of intestine to be united were not of the same size their adjustment might be very difficult.

6. The rolling out of the cut edges of the intestine prevented in places recognition of the precise edges, and hence

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* Halsted: Intestinal Anastomosis. Demonstration at a meeting of the Johns Hopkins Hospital Medical Society, December 1, 1890. Johns Hopkins Hospital Bulletin, January, 1891.

† Amer. Journ. Med. Sciences, October, 1887.

‡ W. Edmunds and Charles A. Ballance: Observations and Experiments on Intestinal and Gastro-intestinal Anastomosis. Medico-Chirurg. Trans., Vol. 78, London, 1896.

* A few weeks ago Dr. Mitchell discovered in the *Medical and Surgical Reporter* for July, 1896, a description by Dr. A. J. Downes, of collapsible rubber bobbins for all forms of intestinal approximation. These bobbins resemble Neuber's bobbins very closely and were designed with the same end in view, viz. to accommodate the inverted ends in circular suture of the intestine. My rubber cylinders were made in June, 1897, and were suggested to me by the success attending the employment, experimentally, of aluminum rods in suture of the common bile-duct. I intend to describe these rods at another time. Dr. Downes' bobbins have spherical ends, which are filled with water. When a larger is to be sutured, end to end, to a smaller intestine he uses a bobbin especially designed for the purpose, with a large sphere at one end and a small sphere at the other end of the connecting shank. I should suppose that this modification of the bobbin would defeat the very end for which it was constructed.


Presection-stitches—Left.
Presection-stitches—Right.
M. Brödel
del.

FIG. 1.

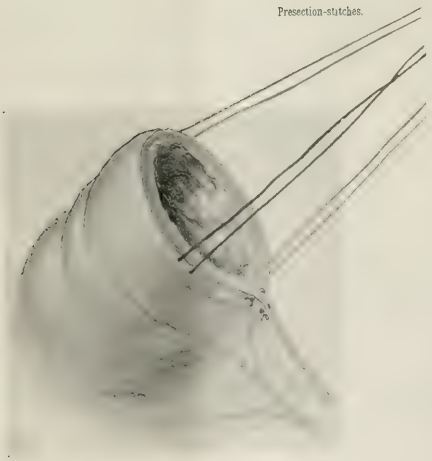
Presection-stitches.

FIG. 2.

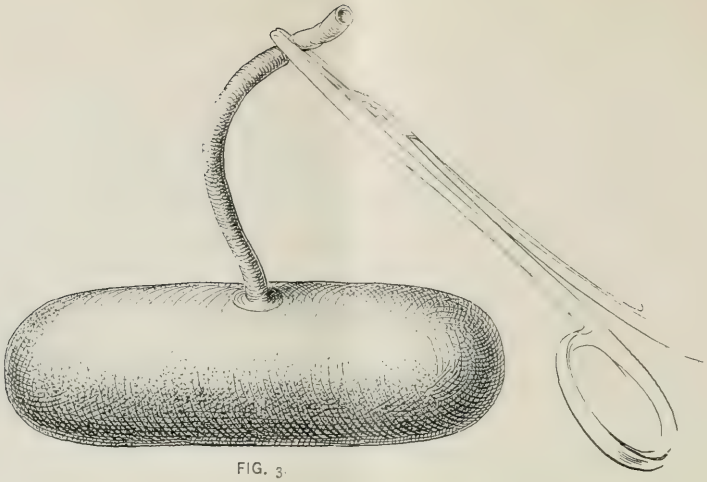

FIG. 3.

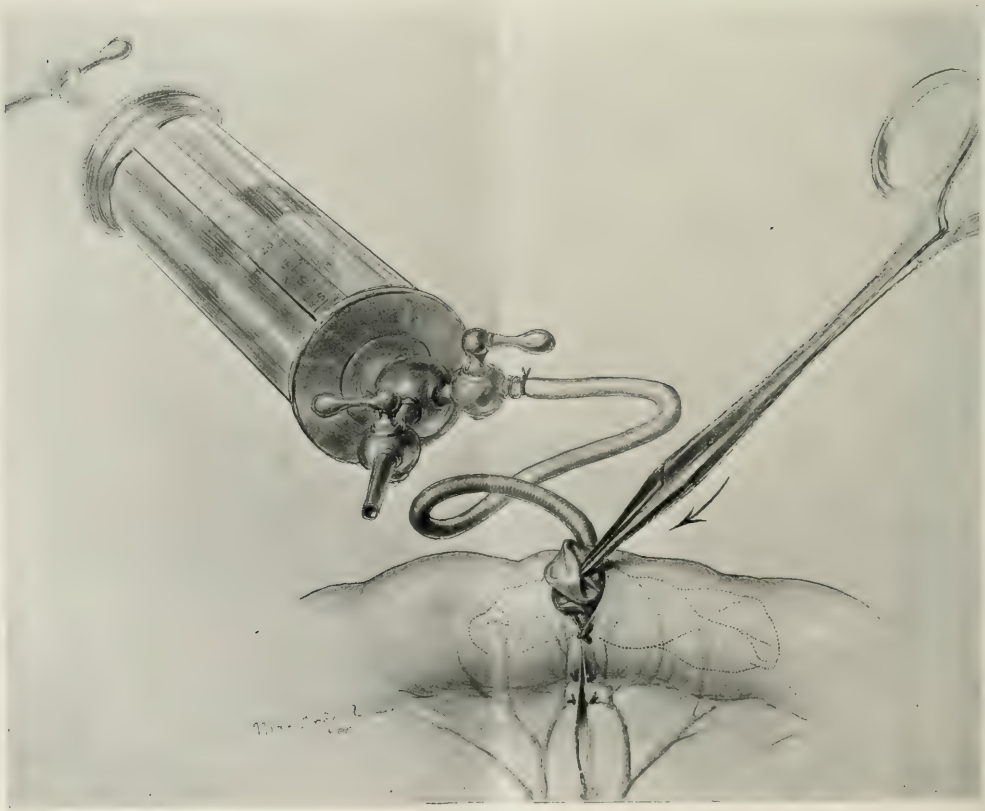

FIG. 4.

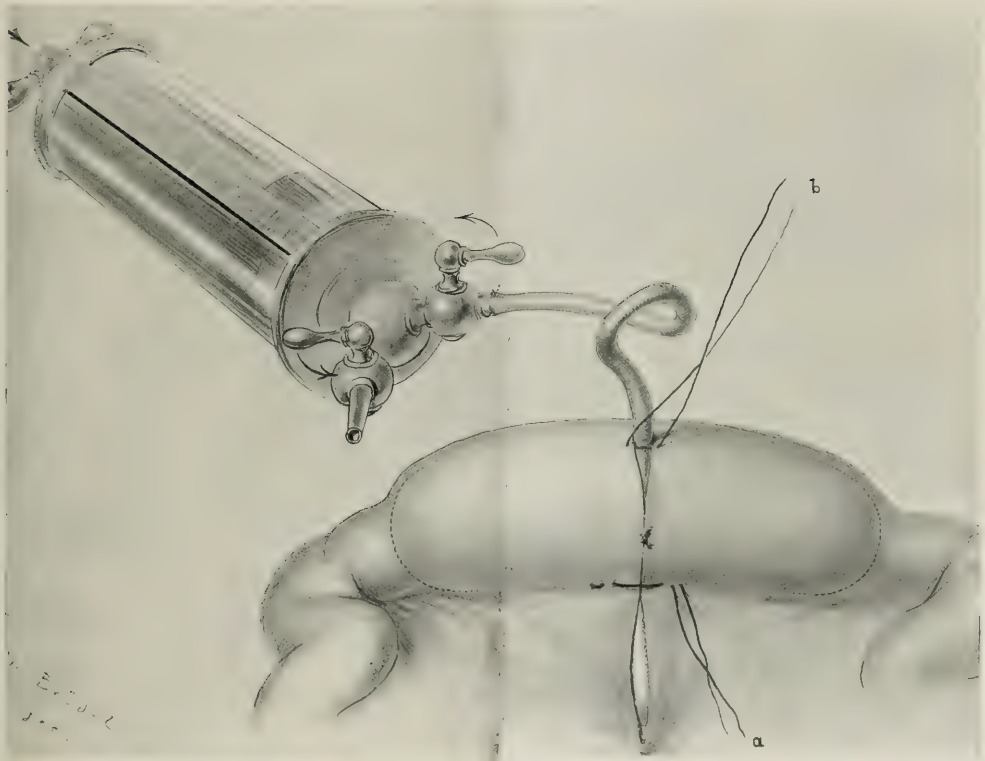

FIG. 5

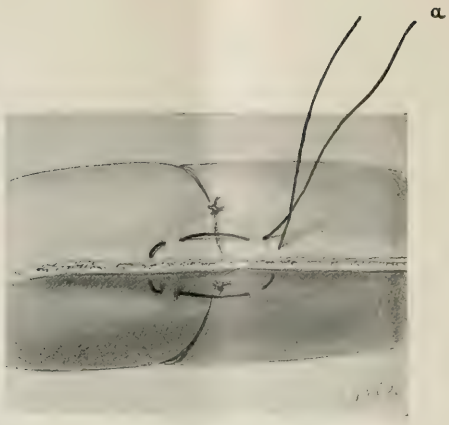

FIG. 6.

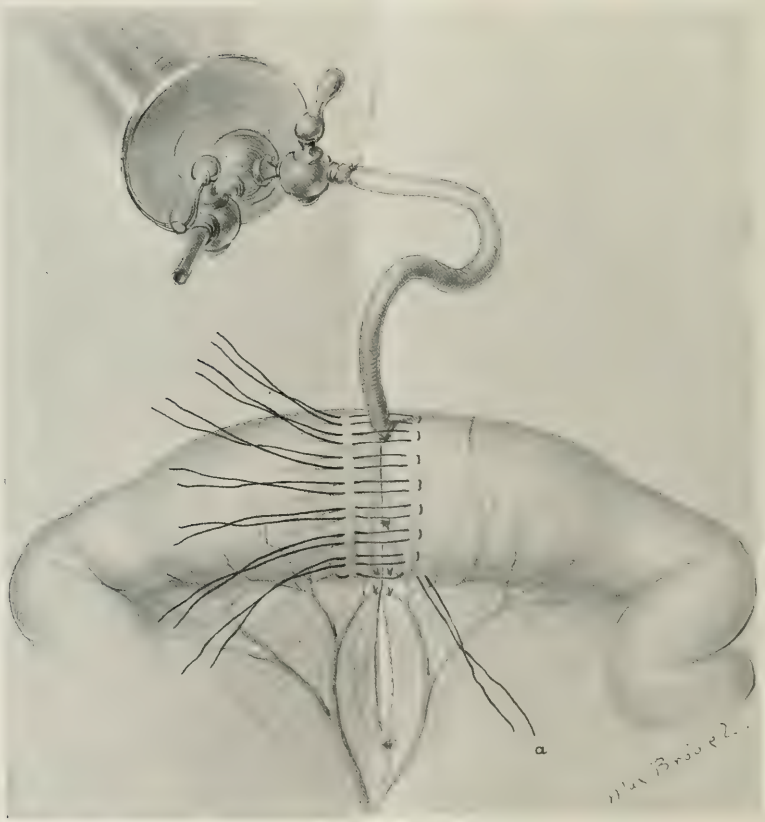

FIG. 7.

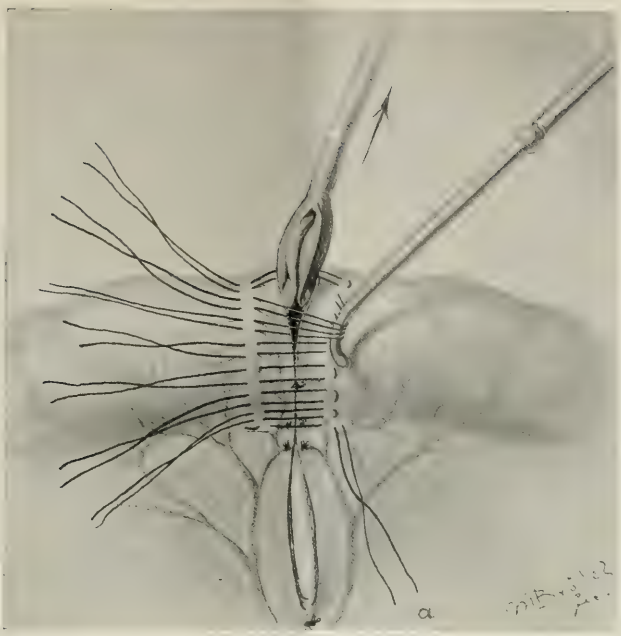

FIG. 8.

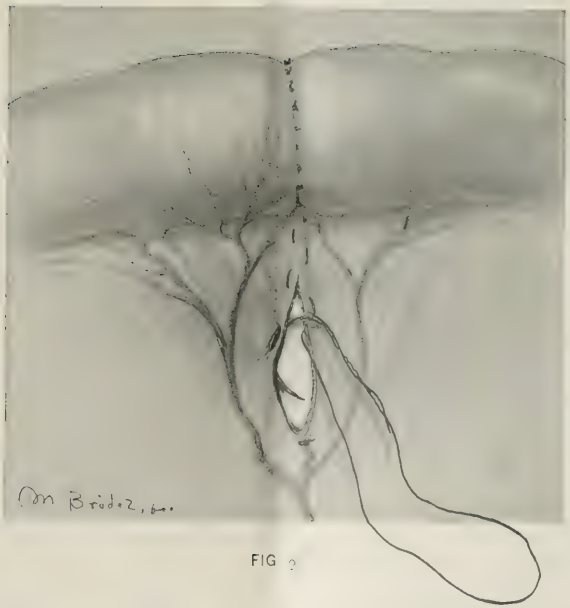

FIG 9

the operator might not know just how far from the edge he was placing his stitches nor just how much intestine he was turning in.

7. The handling of the intestine by assistants who act as clamps or who hold parts in place during the stitching must be injurious to the tissues and predispose to infection.

Every one of these objections is disposed of by the employment of the rubber cylinders in the manner indicated in the plates. The drawings are so excellent and illustrate the method so graphically and accurately that a description of the procedure is almost superfluous.

Figs. 1 and 2 show the presection-stitches applied. It is immaterial whether these stitches perforate the wall of the intestine or not, for they are cast off eventually into the bowel. The method of ligating the mesenteric vessels is also accurately shown in Figs. 1 and 2, which were drawn from life. The intestine should be divided carefully with scissors as close to the presection-stitches as possible. No visible blood-vessels are occluded by these stitches.

Fig. 3. The rubber cylinder inflated. For the human small intestine the diameter of the cylinder is from 1¼ to 1½ inches. It would be better to have cylinders larger than necessary rather than too small.

In Fig. 4 two of the presection-stitches have been tied, and the collapsed rubber cylinder is being pushed into the bowel with a forceps.

Fig. 5. The three presection-stitches have been tied. They are supplemented by a fourth stitch, *b*, which is removed later to facilitate the withdrawal of the bag. The bag has been inflated with air by the syringe. Water might, of course, be used instead of air; but a bag distended with air would, perhaps, more quickly reveal a prick from a faulty stitch than a bag distended with water.

The stitch *a* (Fig. 6 and also Figs. 5, 7 and 8) is the first and most important of the mattress or permanent stitches. The submucosa is picked up four times by this as by all the mattress stitches, and the mesentery is twice perforated by it (Fig. 6). This stitch insures the proper turning in of the mesenteric border. It was devised by Drs. Mitchell and Hunner, and I shall call it the Mitchell-Hunner stitch.

Fig. 7. The bag is still distended, and all of the mattress stitches have been placed. From seven to nine of these stitches suffice in operations upon the small intestine of the dog, and from ten to twelve in operations upon the human subject. The first stitch to be drawn home and tied is *a*. The mesenteric border is turned in by it infallibly. *Not a single visible vessel is occluded by the stitches* (Figs. 7 and 8). On the right side the stitches pass under one vessel and over another, without interfering with either, and on the left side a vessel lies under the stitches, uninjured.

Fig. 8. Two mattress stitches drawn aside on a hook; the temporary stitch has been removed and the collapsed bag is being withdrawn.

Fig. 9. The circular suture is completed; the slit in the mesentery is being sewed in such a way that its circulation is not interfered with.

Advantages of the Inflated Rubber Cylinder in Circular Suture of the Intestine.

1. The vermicular action of the bowel is arrested over the bag, and the stitches can, consequently, be placed at regular and proper intervals.

2. The distended bag unrolls and spreads out to a fine edge the everted raw edge of the intestine (Fig. 4), and enables the operator to place the stitches with great precision at the desired distance from this edge.

3. If distended intestine is to be sutured to collapsed intestine (in strangulated hernia, ilius, etc.), or intestine of larger to intestine of smaller lumen (jejunum to ileum, duodenum to esophageal end of the stomach, etc.), the smaller may easily be expanded to fit the larger piece.*

4. Very little handling of the intestine itself by the operator is necessary. The tube from bag to syringe is used as a handle to rotate and elevate the parts to be united.

5. The cylinder takes the place of at least two assistants. The operation could readily be performed without an assistant.

6. It prevents escape of intestinal contents and hence dispenses with the injurious clamps or the fingers of assistants.

7. The entire operation, exclusive of suture of the abdominal wall, can be performed on dogs in five or six minutes and probably in less time.

The results should, I believe, be better than by any method hitherto devised.

CEREBRO-SPINAL MENINGITIS.†

By W. T. Councilman, M. D., *Harvard University.*

Cerebro-spinal meningitis has prevailed in Boston in the form of an epidemic during the past winter and spring. One hundred and eleven cases of the disease were treated in the Boston City Hospital, the Massachusetts General Hospital, and the Children's Hospital, between June, 1896, and October 1, 1897. At the time of the appearance of the first case in June there had been no case of this form of meningitis in the hospitals for a number of years. The first case occurred in June, 1896, one in the following September, and three cases in December. In 1897 there was one case in January, ten in February, 23 in March, 29 in April, 21 in May, 14 in June,

* I have recently had occasion to unite a distended paper-thin jejunum to a collapsed ileum. The rubber cylinder worked like a charm. The patient, a very old and feeble woman, convalesced without interruption for 16 days. She died quite suddenly from peritonitis due to complications which cannot at this time be discussed. So far as the stitching was concerned the result was perfectly satisfactory.

† Presented to the Johns Hopkins Medical Society, November 15, 1897.

7 in July, and 3 in September. At the present time the disease continues to prevail and many more cases have been seen this autumn than in the autumn of 1896.

The disease has been epidemic in Boston a number of times. The first appearance of the disease in Massachusetts was in 1806, one year after its appearance in Geneva in 1805. It has been generally supposed that this was its first appearance, but it is more than possible that many of the early epidemics were this disease, although in the absence of clear clinical records and post-mortem examinations it is impossible to be certain of this. The first epidemic of the disease prevailed in the New England States and lasted until 1816. There was another epidemic between 1864 and 1866, and still another in 1874.

A table of the ages of the 111 cases shows that the disease prevailed principally in young adults. Only one case was seen in a child under one year of age. A table of ages of our 111 cases agrees almost exactly with the table of the same number of cases given by Leichtenstern in his report of the epidemic in Cologne in 1885. A great deal of stress should be laid on the rarity not only of epidemic meningitis but of all forms of meningitis in children under one year of age. Nothing more clearly shows the inaccuracy of general mortality tables than the ages given in the cases of meningitis. In nearly all of these tables a large percentage of cases are attributed to children under one year of age. In looking over these mortality tables one receives the impression that errors in the diagnosis of meningitis are not uncommon.

The mortality of the 111 cases was 68 per cent., which is comparatively high. Hirsch gives the mortality as varying from 20 to 75 per cent. The greatest actual and relative mortality was found in the cases in April and May. Most of the epidemics of cerebro-spinal meningitis reported in the literature have appeared in the late winter and spring, although there have been a number of exceptions to this general rule. A map of the city giving the distribution of the cases shows them to have been pretty well scattered over the city, there being only two localities where they were especially numerous. Generally but a single case came from the same family, although there were several exceptions to this, in one case three coming from the same family, and in another two.

A great deal of interest attaches to sporadic cases of cerebro-spinal meningitis. We can only be certain that these sporadic cases are the same as the epidemic form when the organism associated with the epidemic form has been found in them. So far we have only been able to find one instance in which the diplococcus intracellularis of Weichselbaum, the organism of epidemic cerebro-spinal meningitis, was found in a sporadic case. In most of the sporadic cases no cultures have been made, but so far as we can judge from the clinical and anatomical descriptions many of these represented the true epidemic form. Almost all observers who have been acquainted with the epidemic form of the disease speak of the presence of sporadic cases occurring both before and after the epidemics. The single cases seen here in June and September may be considered as sporadic. We think it may be generally assumed that cases of sporadic meningitis which recover are of the epidemic variety. So far we have not been able to find a case which from its association with other conditions could be regarded as due to the pneumococcus or streptococcus which has recovered. Certainty with regard to the sporadic cases can only be known by careful anatomical and bacteriological investigation. The bacteriological examination of the fluid removed by spinal puncture is of special importance.

The first description of an organism which might be regarded as the diplococcus intracellularis was given by Leichtenstern in 1885. He found in the exudation in the meninges a few diplococci, sometimes single, sometimes in groups, similar in arrangement to gonococci, enclosed in white corpuscles. Schwabach found diplococci in the pus cells in a case of otitis media secondary to meningitis.

Most of the bacteriological examinations made on cases of meningitis up to the past few years have seemed to show that the pneumococcus was the cause both of the epidemic and most of the sporadic cases. This was probably due to the fact that the pneumococcus is very frequently found in sporadic meningitis, and in the epidemic form the diplococci may either be mistaken for the pneumococci, or an accompanying pneumococcus infection mask the diplococci.

The first definite description of this organism was given by Weichselbaum in 1887. The organism was described by him as a diplococcus which in the lesions is found almost solely within the cells. In cultures the organisms grow singly, in pairs and in tetrads. Both in cultures and in the tissue they were decolorized by Gram. There were few confirmations of the discovery of Weichselbaum until 1895, when Jäger found the same organism in 12 cases of epidemic cerebro-spinal meningitis which occurred in the garrison at Stuttgart. Jäger's description added but little to the previous description of Weichselbaum.

Post-mortem examinations were made in 35 of the 111 cases, and the diplococcus intracellularis was found in cultures, on microscopic examination of the exudation, or in sections of the tissues, in all but four cases. In most of the cases they were found in all three methods of examination.

In one of the four negative cases they had previously been found in the fluid withdrawn during life by spinal puncture. Two of the other cases were very chronic, and the fourth was a chronic case of mixed infection with tuberculosis. In a certain number of cases cultures failed to give the organisms, although they were abundantly present, as shown by cover-slip examination of the meninges and microscopic sections. The organism is very difficult to grow, and from a number of tubes inoculated, in many cases only one or two tubes would show a few single colonies. We have found the Loeffler's blood serum mixture best adapted for its growth. Had agar been used for the primary cultures there is no doubt that in many cases no growth would have been obtained. There is considerable irregularity in staining, some organisms being brightly stained, others more faintly. Sometimes these differences in staining are seen in a single pair of organisms, one being more brightly stained than the other. There may also be considerable variation in size, and the larger organisms stain more imperfectly. In these swollen organisms there is often a brightly stained point in the centre, while the remainder of the cell is but slightly colored. This condition may have been mistaken by

Jäger for a capsule around the organism. These variations in size and staining appear to be due to degeneration and are more common in old than in fresh cultures. In the tissues the diplococcus is almost strictly confined to the interior of polynuclear leucocytes. It has no definite position in the cell and is never found in the nucleus. The number of organisms found in the cells varied from a single pair to such numbers that the nuclei of the cell were frequently obscured. In no case were the diplococci found except in connection with the lesions of the disease. So far as could be learned from cultures of the blood, liver, spleen and kidneys, the organism does not produce septicæmia.

Lumbar puncture was performed in 55 cases, and in a few cases several punctures were made in the same individual. In the fluid obtained diplococci were found on microscopic examination or in cultures in 38 cases; in 17 of the cases they were absent. The average duration of time from the onset of the disease before spinal puncture was made was 7 days in the positive cases and 17 days in the negative. The longest time after onset in which a positive result was obtained was 29 days.

The character of the fluid obtained by spinal puncture varied greatly. In some cases, even when diplococci were found in it, it was almost clear, showing only a slight turbidity when examined against a dark background. In most cases where the puncture was made early in the disease the fluid was turbid, and in 24 hours a large amount of sediment formed at the bottom of the tube. The amount of fibrin in the exudation varied greatly. In a few cases so much was present that the fluid coagulated and the tube could be inverted. In one chronic case of marked intermittent character three punctures were made, one before, one after and one during the exacerbation. In the fluid obtained before and after the exacerbation no diplococci were found. The fluid obtained during the exacerbation was more cloudy and contained diplococci. This would seem to show that in the intermittent cases the exacerbations are due either to a fresh growth of the organisms or to a fresh invasion of the parts which had been previously comparatively free. In the fluid obtained in the early punctures almost the only cellular elements were polynuclear leucocytes. Later, large epithelioid cells and lymphoid cells were found among the pus cells. No ill effects were seen from spinal puncture.

Too much cannot be said of the importance of spinal puncture in making the diagnosis of the disease. As a diagnostic measure it ranks in value with the examination of the sputum. A microscopical and bacteriological examination of the fluid should always be obtained in order to ascertain what organism is present. In no other way will it be possible to arrive at certainty with regard to the nature of the sporadic cases.

In all of the post mortem examinations careful microscopic examination was made of the tissues. For general histological purposes portions of the brain and cord and other organs were hardened both in Zenker's fluid and in alcohol. For the study of nerve degeneration small pieces of tissue were hardened in Müller's fluid, or in formaldehyde followed by Müller's fluid, preparatory to staining by Marchi's method. The amount of the exudation varied in the acute and chronic cases. In the most chronic cases there was general thickening of the meninges and only small masses of degenerated cells were found in the place of the former exudation. In cases dying two or three days after the onset but a slight amount of purulent exudation was found. The amount of fibrin in the exudation varied and was never so great as is found in cases of meningitis due to the pneumococcus.

In addition to the acute inflammation found in the meninges of the brain and cord, lesions of the tissue were found. In places there was a circumscribed infiltration of the tissue with pus cells which extended from the infiltration in the meninges. The vessels were dilated, and the spaces around the vessels filled with pus cells which extended into the surrounding tissue. In two cases there was extensive softening with purulent infiltration and hemorrhage in the cortex of the cerebellum. Lesions were found in both the white and gray matter, consisting principally in foci of fine hemorrhages with some purulent infiltration. There was a definite increase in the cells of the neuroglia both in connection with the acute lesions and at a distance from them. The neuroglia cells were swollen, their nuclei large and vesicular and contained much chromatin. Around these large nuclei there was a faintly stained irregular mass of granular protoplasm. Many of the cells contained two nuclei, and in places there were groups of four or more nuclei with a considerable amount of protoplasm around them. In all of these places nuclear figures were found. They presented the same form as other nuclei, and in some cases both spindles and centrasomes were distinguished. In addition to the changes in the neuroglia, proliferation was found in the connective tissue of the brain and cord around the blood-vessels. The inflammation of the meninges extended along the cranial nerves and along the anterior and posterior spinal nerve roots.

The cranial nerves most affected were the 2nd, 5th and 8th. The examination of the eyes in two cases showed a choroidoiritis which was due to a direct extension along the sheath of the optic nerve. Diplococci were found here and in the purulent exudation within the eye. The same thing was true of the ear. Secondary otitis media was found in a number of cases, some of which recovered. In all of these numbers of diplococci were found in the pus.

The nasal secretion in 19 of our cases was examined by means of cover-glass preparations, the material being taken from high up in the nasal cavities with the aid of a platinum loop. Of the 19 cases 10 showed the presence in the nasal secretion of diplococci, decolorized by Gram's method and identical in morphology with the diplococcus from the brain. Similar Gram decolorizing diplococci were also found within leucocytes in the nasal secretion of two cases of convalescing meningitis. Attempts were made to isolate this organism in cultures in 10 cases in which microscopic examination showed them to be present, but without success.

With reference to the occurrence of this organism in the nasal secretion of patients not affected with meningitis twelve hospital patients chosen at random were examined. In the nasal secretions of two among these twelve, diplococci like the preceding were found by cover-glass examination. They were not cultivated. From the results of these examinations it

would seem either that the diplococcus intracellularis may be met with in the nasal secretion of patients who have not meningitis, or that other species of diplococci identical with this morphologically and in staining peculiarities may be found.

It is greatly to be regretted that it was not possible to obtain cultures of the organisms from this locality, for their identity can only be established by this method combined with inoculations. At any rate it is impossible to regard the presence of diplococci in the nose, decolorizing by the Gram stain, as of much diagnostic value as claimed by Scherrer.

Degenerations were shown by the Marchi method in the nerves of both the brain and cord. The spinal ganglia were affected in all cases, and in four cases in which the Gasserian ganglion was examined an acute inflammation, sometimes to an intense degree, was found in this. Degeneration was shown by the Nissl method in the ganglion cells of the brain and cord. The studies of this degeneration have not been completed.

The condition of the lung is interesting on account of the relation which has very generally been supposed to exist between epidemic cerebro-spinal meningitis and pneumonia. In 13 cases there was merely congestion with more or less œdema. In 7 cases there was broncho-pneumonia, more marked in the lower posterior portion of the lung. In two cases there was characteristic croupous pneumonia; one in the stage of red hepatization bordering on gray. Pneumococci were found in these cases in cultures and on microscopic examination. In 8 cases pneumonia due to the diplococcus intracellularis was found. Nearly all of these cases came from the last part of the epidemic. It is very possible that some of the earlier cases in which the lesions were described simply as broncho-pneumonia, were really due to the diplococcus intracellularis.

These lesions consisted microscopically of areas of consolidation in various parts of the lung, more particularly in the lower lobe, and they were most numerous beneath the pleural surface. The foci varied in size from a pin's head up to that of a pea, and on section some of them resembled small hemorrhages in the tissue. In other cases the periphery of the area was distinctly hemorrhagic and the centre opaque and yellowish. In one case the consolidation of the lung was so extensive that it might easily have been regarded as croupous pneumonia, particularly as the pleura over it was covered with a definite fibrinous exudation. On section this large area was composed of a number of irregular grayish foci, with softened centres, and with hemorrhagic and œdematous tissue between them. The lung tissue in the yellowish centres was frequently broken down and pus oozed from it. On microscopical examination the central areas showed in most cases a purulent infiltration of the tissue, with beginning abscess formation. The alveoli contained large numbers of pus cells; their walls were found infiltrated with pus and in places entirely broken down. The foci of consolidation did not appear to be bronchial in origin. The bronchi in the vicinity often contained pus cells, but their walls were not infiltrated.

The duration of the disease in the cases in which diplococcus pneumonia was found was: in 2 cases, 3 days; in 2 cases, 2 days; in 2 cases, 5 days; in 1 case, 9 days; in 1 case, 23 days, and in 1 case, 74 days. It will be seen from this that the lung complications due to the pneumococcus can take place in almost any period of the disease. In the case of 74 days' duration the lesions in the brain and cord could be regarded as almost completely healed and the lesions in the lungs were acute. In one case in which the apparent history of the disease was of only two days' duration, the lesions were so advanced that they seemed possibly to antedate those of the brain, providing the history as given by the patient's relatives was correct. Immense numbers of diplococci were found in the pus cells in the lung. They were most numerous in the cells in the centres of the foci where softening was taking place. In the centre of one of the foci a small branch of the pulmonary artery occluded by a thrombus formed of pus cells containing large numbers of diplococci was found. It seems probable that this thrombus may have come as an embolus from the meninges and may have produced an infection of the surrounding tissue.

There was great variation in the size of the spleen. In general it was not much enlarged and was probably smaller than in most of the acute infectious diseases. In only three cases it was found considerably enlarged. The average weight in the adult cases was 163 grms. The lymphatic glands in the uncomplicated cases were never found enlarged.

The liver presented no change beyond acute degeneration. In two cases extensive acute lesions were found in the kidneys. In one of these the acute lesions had no connection with the meningitis, but were due to an accompanying infection with diphtheria. In the other case there was an acute hemorrhagic nephritis. In this there was an accompanying acute pericarditis, the organism causing which could not be ascertained. The only lesions found in the kidney which could be properly attributed to the meningitis were acute degenerative lesions which were always present.

The intestinal canal was found normal in every case.

In two cases there was acute pericarditis, accompanied in one case with foci of necrosis and purulent infiltration of the myocardium. In several other cases in which the myocardium was examined histologically it was found normal.

Lesions of the skin were found in but one of the cases on which an autopsy was made. In this case, over upper and lower extremities, chest and abdomen, there were numerous small dark purplish spots in the skin, varying in size from a pin's head up to that of a pea. On microscopic examination of these areas there was intense congestion and dilatation of the blood-vessels of the skin, with small and diffuse hemorrhages immediately beneath the epithelium. In some of the larger areas there was some purulent infiltration in the centre. No diplococci were found in these lesions.

There is no doubt that acute meningitis may be produced by the entrance into the meninges of a number of infectious organisms. These forms are rarely primary. The organisms enter the meninges either by the formation of a communication between the meninges and some cavity where they may be accidentally present (as in the middle ear and nose), or by the extension to the meninges of an infectious process in the vicinity (mastoiditis, erysipelas), or they are brought to the

meninges by the blood from some other focus in the body (pneumonia, endocarditis). In tuberculous meningitis we have never found a single case in which the lesions in the meninges could be regarded as primary. We believe that all infections of the meninges other than the diplococcus intracellularis are fatal, but this can only be determined by microscopic and bacteriological examination of the exudation obtained during life by spinal puncture. If tubercle bacilli, pneumococci or streptococci are found with the evidences of meningitis in a case which recovers, it would settle the point; clinical evidence, without spinal puncture, will not.

Discussion.

Dr. Welch.—It is a great pleasure to have Dr. Councilman with us upon this occasion, and we are all very much indebted to him for his instructive presentation of this subject and the report of his extensive and valuable studies. As he has not dwelt upon the historical development of our knowledge concerning the meningococcus intracellularis, I may be permitted to say a few words about the steps leading to the recognition of this organism as the cause of epidemic cerebro-spinal meningitis.

It is not a little remarkable that the organism first described by Weichselbaum in 1887 as the diplococcus intracellularis meningitidis did not come to be accepted as associated especially with epidemic cerebro-spinal meningitis until the publication of Jaeger's article in 1895. This was not due to an imperfect or faulty description of this micrococcus by Weichselbaum, for its essential morphological and biological characters were fully and correctly described by him. Weichselbaum, in the article referred to, reported the results of his bacteriological examination of eight cases of cerebro-spinal meningitis not secondary to pneumonia. All of these cases he regarded as sporadic forms of meningitis. In two he found the lanceolate pneumococcus and in the remaining six the diplococcus intracellularis meningitidis. He concluded that each of these two bacterial species may be the cause of primary acute cerebro-spinal meningitis, but he expressed no definite opinion as to whether either was concerned with epidemic cerebro-spinal meningitis, although he thought it probable that the pneumococcus might cause epidemic forms of cerebro-spinal meningitis with or without pneumonia. With the exception of the confirmation in 1887 in a single case by Goldschmidt of Weichselbaum's discovery, and of Edler's microscopical examinations in 1888, nothing more is heard of the presence of the meningococcus intracellularis of Weichselbaum in meningitis until Jaeger's report already mentioned.

During these eight years the results of bacteriological examinations of cases of meningitis were reported by a number of observers. In 60 to 70 per cent. of these cases the pneumococcus was reported as present, and in about 13 per cent. the streptococcus pyogenes. Some of the cases in which the pneumococcus was reported as present were of epidemic cerebro-spinal meningitis. The attempts of Bonome and of Foà to separate as distinct varieties or species from the pneumococcus cocci which they found in cerebro-spinal meningitis received merited criticism from Bordoni-Uffreduzzi, who showed that these organisms were in all probability genuine pneumococci. Bordoni-Uffreduzzi at the same time expressed the opinion that not only Bonome's streptococcus meningitidis and Foà's meningococcus, but also Weichselbaum's diplococcus intracellularis meningitidis, are varieties of the diplococcus pneumoniæ. This opinion acquired support as we became familiar with the remarkable variations in all of the characters, morphological, cultural and pathogenic, of the pneumococcus. Hence the view came to be generally entertained that, although various species of bacteria may be the cause of cerebro-spinal meningitis, the pneumococcus is the most common cause not only of meningitis secondary to pneumonia but also of primary cerebro-spinal meningitis, including the epidemic form.

The great merit of Jaeger's publication in 1895 lies, not in adding materially to Weichselbaum's description of the meningococcus intracellularis, but in directing attention to the special association of this coccus with epidemic cerebro-spinal meningitis. He denies any relationship between the pneumococcus and this disease. Most of those who have investigated the subject during the two years following the appearance of Jaeger's article have come to the same conclusion, and the confirmation of this view by Dr. Councilman in his report of a larger number of cases of epidemic cerebro-spinal meningitis than have been previously studied bacteriologically by a single observer is an important contribution to our knowledge.

The question naturally arises whether those who before Jaeger's publication reported the presence of the pneumococcus in the exudate of epidemic cerebro-spinal meningitis have all been mistaken in the diagnosis of the organism. As some of these reports are by highly competent bacteriologists, it is difficult to admit this supposition. Several possibilities suggest themselves: (1) It is possible that the meningococcus intracellularis is not the sole specific cause of epidemic cerebro-spinal meningitis, but that the pneumococcus is likewise the cause of a certain number of cases. (2) There may have been mixed infection or secondary infection with the pneumococcus; the intracellular meningococcus, on account of its scarcity or failure to grow in the cultures, or absence of pathogenic power by subcutaneous inoculation, being overlooked. (3) It is probable that in some cases at least the intracellular meningococcus has been mistaken for the pneumococcus. Further investigations are needed in order to determine how much value attaches to these various suppositions.

Another question of interest is as to a possible relationship between the meningococcus intracellularis and the micrococcus lanceolatus, in the sense that the former may be a variety of the latter. All of those who have worked with the meningococcus appear to agree upon the independence of this organism as a bacterial species, and especially upon its separation from the micrococcus lanceolatus. This view seems to me probable. Nevertheless, the great variability of the lanceolate coccus as to form, cultural characteristics and pathogenic properties renders this question still a debatable one, as is shown by the position assumed by Lubarsch in his discussion of the relations of this organism to the streptococcus pyogenes

on the one hand and to the meningococcus intracellularis on the other hand.*

Baltimore seems to have enjoyed remarkable immunity from epidemic cerebro-spinal meningitis. In New York I used to see every year at least a few sporadic cases of primary cerebro-spinal meningitis.

It may not be out of place if I say a word in this connection concerning the disease in horses commonly called cerebro-spinal meningitis. Through the kindness of Dr. Clement I have had the opportunity of making autopsies upon horses in Maryland which have died with the symptoms commonly attributed to this disease, and I have been informed by him of his investigations upon the same disease which has prevailed in this State during the past summer and autumn. In none of the cases which we examined was there any meningeal exudate. The disease was not cerebro-spinal meningitis in the anatomical sense, nor were we able to find any lesions competent to explain the symptoms. While I would not be understood to deny the occurrence of genuine cerebro-spinal meningitis in horses, I believe that the disease which usually passes by that name among veterinarians is not a true meningitis. We did not obtain evidence even of a meningitis serosa, as claimed for these cases by Siedamgrotzky and Schlegel.

Dr. Flexner.—One appreciates all the more what the investigations of Dr. Councilman have involved if he has had an opportunity of studying an epidemic of cerebro-spinal meningitis. Many of you will recall that Dr. Barker and myself, through the courtesy of the State Board of Health, were permitted to study an epidemic of this disease which prevailed in the year 1893 at Lonaconing and other places in the George's Creek valley in this State. As Dr. Councilman proceeded to develop the symptomatology and the pathological anatomy of his cases I was impressed more and more with the idea that we had been working with the same disease-process. In one respect only do our results differ; Dr. Councilman has become convinced through the study of the large material at his command that the causative micro-organism is the meningo-coccus intracellularis of Weichselbaum, while we believed that we isolated from our cases the diplococcus pneumoniæ. In regard to this disparity, of which I shall speak more at length, it is worth while noting that Dr. Councilman stated that he did not distinguish the two organisms in his first post-mortem examinations.

The epidemic at Lonaconing was perhaps larger than the one at Boston, but its investigation was much more difficult. Dr. Barker and I spent some days in this place and the adjacent country in which the disease prevailed, at a time when the epidemic was on the decline. We had therefore to rely for our statistics upon the reports of the local profession scattered over twenty miles of rough mining country. Our conclusions were that there had occurred within this area about 200 cases of cerebro-spinal meningitis and the mortality had been about 48 per cent., a figure somewhat lower than the Boston epidemic and somewhat higher than some of the reported European epidemics.

*Lubarsch-Oestertag. Ergebnisse der allg. Pathologie u. path. Anat., 3ter Jahrg. I, p. 169.

Our studies were both clinical and pathological. While we had the opportunity of visiting many cases, we succeeded in obtaining two autopsies only. These were of great interest to us as they were examples of two different types of the disease. I wish to recall to you briefly these cases.*

Case 1. Girl 9 years of age; died on 3rd day of disease; autopsy two hours post mortem. There were no adhesions between the dura and skull-cap, the dura and pia arachnoid were free from adhesions to each other. The soft meninges were swollen, but no considerable quantity of fluid escaped from them; they were opaque, especially over the convexity of the brain, and in the depressions between the sulci heavy opaque white streaks and bands were visible. The exudation into the meninges was confined to the convex surface of the brain, the base being free from it; but the ventricles were dilated and contained an excessive amount of clear serum.

The dura covering the spinal cord, especially in its inferior part, was wide and bulging. On incising it near the middle of the lumbar region about 40 cc. of turbid fluid escaped. In the meshes of the pia arachnoid was an exudate which was not uniformly distributed, but was most abundant posteriorly, and corresponded for the most part with the lower cervical and dorso-lumbar region. The exudate resembled that present in the brain.

The bacteriological examination by means of cover-slips showed the presence of what was regarded as the micrococcus lanceolatus without admixture with any other organism. The micrococci occupied pus cells and were also present in the fluid among the cells.

Case 2. Girl 16 years old; death in third week of disease; autopsy 12 hours after death. The dura was strongly adherent to the skull-cap, and on removing it about 200 cc. of turbid fluid containing white flakes escaped from the posterior fossa. The fluid in the pia over the cortex, which was increased in amount, was turbid. In the membrane covering the pons and upper part of medulla was a firm white deposit which was intimately adherent to the underlying tissues. Over the base, from the pons to the optic chiasm inclusive, there was a turbid fluid exudate. The fourth ventricle and the lateral ventricles contained greenish-yellow, gelatinous pus; indeed the former was completely filled with it. Both the lateral ventricles were dilated, and the choroid plexuses covered with an opaque exudate. A similar exudate extended along the sheath of the auditory nerve into the bony canal. The pia arachnoid, throughout the whole length of the cord on the posterior surface, contained an opaque exudate fully two millimetres in thickness, the exudate on the anterior surface being less marked. From the pus in the ventricles and from the exudate over the base of the brain diplococci were obtained on cover-slips. The organisms were present in much smaller numbers than in the previous case.

The cultures made from the brain and other organs did not grow. Those made from the first case, which was most promising, included the cerebro-spinal exudate and organs

*Abstracted from report in American Journal Medical Sciences, 1894.

generally. Cultures from the exudate were made at once on exposing it by drawing back the dura. Additional cultures were made an hour or so later. It is necessary to state that the second set was made in a carriage-house next a stable in which horses were kept. The first cultures, made *at the time of the autopsy*, showed a very feeble growth of diplococci; but on transplantation no further growth could be obtained. All other tubes from the brain or cord showed either no growth or an abundant one, a tolerably coarse bacillus, doubtless a contamination. Culture tubes from the organs remained sterile with the exception of those from the spleen. From this a pure growth was obtained of streptococci. The cultures from the second case could not be made until Baltimore was reached, 14 hours after the autopsy. Various media inoculated from the exudate and solid organs remained without growth; mice and rabbits were inoculated without effect. In view of the negative results in cultivations and animal experiments, we regarded it as questionable whether the organism found by us in the exudate was really the micrococcus lanceolatus. But as it is regarded as characteristic of the lanceolate diplococci to show a variable vitality and great variation in pathogenic effect on animals, we were therefore the more disposed to consider the bacteria found by us as probably identical with this organism. In interpreting the studies of Dr. Councilman and comparing them with those of Dr. Barker and myself, it must be remembered, as Dr. Welch has just pointed out, that it was not until Jaeger's studies, which appeared in 1895, that the meningococcus intracellularis was sharply differentiated from the pneumococcus. There remains, moreover, the disparity in behavior of the bacteria found by us and the organism obtained by Dr. Councilman towards Gram's stain. Recent studies have shown the Gram's method of staining to be a feeble reed and one perhaps unworthy of the confidence placed in it as a means of differentiation of bacterial forms. All these facts taken together, and especially the histological details of Dr. Councilman's study, which agree so well with our findings, dispose me to the belief that the Lonaconing and Boston epidemics have not improbably been caused by the same micro-organism.

In our studies of the histological changes in the central nervous system, Dr. Barker and myself were impressed with the large phagocytic cells which Dr. Councilman also found, and we regarded them as forming a considerable portion of the exudate in the acute case. The figure No. 3 in the reprint (passed around) which I brought with me will show you the relative size and numbers of these cells in a portion of the exudate in the meninges of case 1. These cells were regarded as being derived by proliferation from the pia mater. In the chronic case the exudate looked more like the caseation of a tuberculous meningitis than an ordinary inflammatory exudate, and the stained preparations showed extensive degeneration of all the morphological elements composing the exudate. We found in our cases a tendency for the exudate to pass along the sheaths of the nerves (optic and auditory; spinal nerves) leaving the cerebro-spinal cavity, and we attributed the disturbances of sensation in part to the involvement of the posterior roots of the spinal nerves. Dr. Councilman has not mentioned the occurrence of abscesses within the substance of the brain and spinal cord; we encountered several small accumulations of leucocytes in the spinal cord, and it may be recalled that Zenker, Klebs and Strümpell have shown that abscesses of comparatively large size may exist.

I have been most interested and instructed by Dr. Councilman's presentation of the subject, and I desire to add to the sentiments already expressed my sense of obligation to him.

Dr. BARKER.—I was much impressed with what has been said with reference to the presence in the nose in cerebro-spinal meningitis of the organism which gives rise to the disease. It is certainly anatomically proven that relatively free communication exists between the nose and the intracranial cavity, but it is just as reasonable to assume that the organisms pass from the cerebral meninges to the nose as to believe that the path followed is in the opposite direction.

Concerning the lesions in the nervous system Dr. Councilman states that he has found marked alteration in the ganglion cells and in the white matter of the spinal cord and brain. In the report made by Dr. Flexner and myself of the autopsies at Lonaconing, considerable attention was paid to the nerve lesions. Since then better methods of studying alterations in the nerve tissues have been developed. In view of this fact I undertook last year to restudy the spinal cords of our cases, some portions of which had been preserved, and in them it has been possible to make out some interesting changes not referred to in our article. The results were communicated to the Pathological Section of the British Medical Association, held this autumn in Montreal, but it may not be out of place to refer briefly to the main points.

As is now well known, the cells of the anterior horn of the spinal cord, when stained by the method of Nissl, show inside them what appear to be three distinct substances: (1) In the dendrites and cell body (except in the area whence the axone arises) the stainable substance of Nissl, here arranged chiefly in the form of spindle-shaped masses, the latter in turn tending to be arranged in stripe-like rows; (2) the achromatic substance occupying the regions between the Nissl bodies, and constituting the whole of the axis cylinder process and its hillock of origin; (3) the so-called "pigment" of the anterior horn cells.

In the Lonaconing material, though the tissue was not perfect for work with Nissl's method, it was easy to make out two distinct types of change. The first, briefly stated, consisted in a disintegration in the stained section of the individual Nissl bodies, especially in those of the dendrites and of the periphery of the cell body. In the second type the anterior horn cell presented an entirely different appearance. Whereas the Nissl bodies at the periphery of the cell and in the dendrites were sometimes tolerably well preserved, in the centre of the cell the achromatic substance was entirely broken down, this portion of the cell being either pale in sections stained by Nissl's method, or pervaded by minute dust-like particles of the stainable substance. In addition, the nucleus of the cell was displaced to the periphery, sometimes to such an extent as to cause a distinct bulging at the margin of the cell.

In the light of the more recent work bearing upon the pathology of the nerve cells it is not difficult to bring forward plausible

explanations of these lesions. The researches of Nissl, Marinesco, Flatau, Lugaro, van Gehuchten and others have demonstrated that in many forms of poisoning the action of the toxic substances upon the cells tends to be exerted chiefly upon the periphery. It is but natural that poisonous substances circulating in the blood and lymph should affect the dendrites and periphery of the cell before leading to alterations in its central portion. My own studies on ricin poisoning and diphtheric intoxication support the observations just mentioned. On the other hand Nissl was the first to call attention to the fact that if a given axis cylinder be severed or seriously injured, the cell body of the neurone to which it belongs undergoes curious and typical alterations, and the nucleus is dislocated from its usual position. Thus if the root of the n. facialis be cut, the cells in the nucleus of origin of the same side situated in the pons undergo the alterations described; the nucleus is displaced to the side of the cell; the Nissl bodies in the cell, more particularly in the central regions and especially near the axone hillock, are disintegrated or even wiped out. Nissl further proved that the application of common salt to the nerve trunk without actual section of the fibres would yield the same result. The experiment has been repeated by many neurologists and in the Anatomical Laboratory here by J. Erlanger. Nissl's results have received manifold confirmation.

It is obvious, if you compare the two types of changes which I have described as occurring in the anterior horn cells in cerebro-spinal meningitis, with the two classes of changes mentioned in the bibliography, that there is a striking agreement. The first type corresponds to the primary alteration consequent upon direct insult of the cell bodies and dendrites by a poisonous solution bathing them, while the second type corresponds to the secondary changes occurring in the cell body after insult to its axone at any point between the cell and the peripheral ramifications of the nerve fibre—in other words, to the "reaction at a distance" of Marinesco.

The first series of lesions, not strongly marked in the specimens, are probably to be accounted for by the slight toxæmia which we may assume accompanies a meningitis; for although the causative micro-organism does not lead to a severe general intoxication of the body, at least under ordinary circumstances, there is evidence (from the occurrence of leucocytosis and changes in the urinary secretion) that some poison is absorbed. That the lesions of the first type are so little marked is probably directly attributable to the fact that the disease is relatively non-toxic.

The other lesions, those designated as "secondary," were in contrast with the "primary" or "toxic" lesions very marked in the anterior horns. The explanation is not far to seek. In the Lonaconing cases, and as Dr. Councilman has stated in those coming to autopsy in Boston, a very common finding was involvement, in the meningeal inflammation, of the anterior and posterior roots of the spinal nerves. Swollen axis cylinders, accumulations of small round cells and of leucocytes were met with, the changes varying in degree and extent in different nerve roots. That the cells in the anterior horns then should show the alterations so characteristic of axone lesion is not surprising; indeed, from what we now know their existence could have been prophesied, and their absence would have been extremely difficult to account for. The variation in the number of cells affected in different segments of the cord doubtless depends upon the varying degree of involvement of the corresponding nerve roots.

The explanation of the condition of the cells of the nucleus dorsalis Clarkii met with on studying the thoracic cord was temporarily puzzling. An examination of sections showed that almost every cell in this nucleus on each side showed alterations quite like those following axone lesion. The axones of these cells enter neither the anterior nor posterior roots of the spinal nerves. Some other explanation than nerve root involvement had to be sought; for although the experiments of Warrington in England and van Gehuchten in Belgium make it seem probable that a lesion apparently precisely similar can be called forth in a nerve cell by depriving it of the cellulipetal impulses reaching it, it is scarcely conceivable that there could have been, through the irregular involvement of the posterior roots, sufficient interference with the passage of impulses along collaterals and terminals into the nucleus dorsalis to account for the involvement of almost every one of the cells contained within it. If, on the other hand, one inquires as to the course followed by the axones of the cells of this nucleus, there comes into view a much more plausible explanation for the lesions. While, so far as I know, no one has ever actually demonstrated the connection of the axones in the tract with the cell bodies of the nucleus by means of the method of Golgi, still the study of secondary degenerations by Mott and of the embryonic cord by Flechsig leave but little reason for doubting the view now generally held that the axones of the cells of the nucleus dorsalis Clarkii are also the constituent axis cylinders of the fibres in the fasciculus cerebellospinalis (direct cerebellar tract).

The exact position of the direct cerebellar tract in the spinal cord, and in the medulla oblongata where it passes into the corpus restiforme, is well known. The fibres occupy an extensive area immediately adjacent to the surface of the cord, being intercalated between the lateral pyramidal tract and the periphery. A reference to the description of the gross appearances of the cord in cerebro-spinal meningitis will show that it is precisely in this region that the meningeal exudate is most abundant. Is it any wonder then that axones running practically on the surface of the cord all the way from the thoracic region to the corpus restiforme, exposed throughout this whole distance to the direct action of the meningeal inflammation, should undergo injury? Would it not be more surprising to learn that some fibres had escaped insult? I am of the opinion therefore that the lesions of the second type met with in the nucleus dorsalis in cerebro-spinal meningitis are in reality "secondary" to injuries of the axones in the direct cerebellar tract, and afford another example of the so-called "reaction at a distance."

Dr. Theobald.—There are two points I would like to allude to. Dr. Councilman has spoken of the belief that the disease is comparatively rare in young children. I have seen from time to time a great many cases of deaf-mutism from cerebro-spinal meningitis, at least the history indicated this, and most of these had the disease in infancy or early childhood. So it

would seem, if this view is correct, that when the attack occurs in early childhood it is more apt to affect the ears than it is later in life. Again, Dr. Councilman spoke of the labyrinth being involved through extension of the inflammatory process along the auditory nerve. While this is one way by which the labyrinth may be reached, another, not improbable, route would be through the aqueductus cochleæ and the aqueductus vestibuli which connect the lymph spaces of the labyrinth with those of the brain.

Dr. RANDOLPH.—I had the opportunity of examining the eyes of about forty cases in the epidemic of cerebro-spinal meningitis which has just been described by Drs. Flexner and Barker, and of these the fundus was normal in only seven cases, and out of these seven cases one had divergent strabismus and dilated pupils, another had marked nystagmus, and still another had greatly dilated pupils. I found neuritis optica in six cases. There was one case of retinitis with which was associated *thrombosis of the central vein of the right eye.* The other cases were (as regards the fundus of the eye) characterized especially by great venous engorgement and tortuosity, and more or less congestion of the optic disk. In the eight cases of divergent strabismus it was the right eye that diverged. In four cases the right pupil was dilated and the left unchanged. In three cases the neuritis was more marked in the right eye. I can give no satisfactory reason why the right eye more often showed abnormal conditions than the left.

The type of eye symptoms peculiar to this epidemic seems to have been a remarkable tortuosity and distension of the retinal veins and more or less congestion of the optic disk. The degree of venous engorgement in some of the cases was, in my experience, a unique condition, the blood appearing almost black and as though actually stagnant. The tortuosity of the veins, too, was striking. The turning points of the veins were so abrupt that they resembled small hemorrhages, and as such I regarded them in one case till I was enabled later to make a more thorough examination, when I found that what I took to be hemorrhages were very abrupt turns in the veins where the circulation must have been almost at a standstill. These conditions are quite analogous to what was discovered in the brain in every case where a post-mortem was made. I regard the existence of eye symptoms, especially those where the fundus is involved, as indicating a particularly grave case. Wherever I found the condition I have described very pronounced I felt justified in speaking positively as regards the prognosis. I think that this type of eye symptoms is of more value as indicating the condition of the brain than the symptoms described by other writers, such as panophthalmitis, suppurative choroiditis and keratitis, affections which in my opinion would be likely to have their origin in general infection, and not likely to be the direct result of purely cerebral changes.

I have been interested in Dr. Councilman's account of the bacteriology of the disease, and it may be worth while mentioning that the Fraenkel-Weichselbaum diplococcus, which has been regarded till lately the specific organism of epidemic cerebro-spinal meningitis, has been identified as the causative agent in more than one eye affection. Recently Uhthoff and Axenfeld have reported 34 cases of serpent ulcer of the cornea, where they found this diplococcus in every case, and in the majority of cases in pure culture. These observers go so far as to call this affection of the cornea the pneumococcus ulcer. Not a year ago Gifford reported an extensive epidemic of "pink eye" in Omaha and its vicinity, and he was able to identify the pneumococcus of Fraenkel-Weichselbaum as the specific organism. In conclusion it may be said that this same organism is the predominating one in the majority of cases of chronic suppurative inflammation of the middle ear.

THE DIAPHRAGM PHENOMENON—THE SO-CALLED LITTEN'S SIGN.

BY NORMAN B. GWYN, M. B., *Assistant Resident Physician.*

In an indirect way the movement of the diaphragm is well recognized by its displacement of underlying organs or masses, and in this direction its value in the diagnosis of certain conditions is thoroughly established; but the fact that this movement normally gives indication of itself seems until lately to have escaped the observation of clinicians.

Stokes first, in 1837, incidentally mentions that in some cases of emphysema the diaphragm stood so low that its line of contact could be seen as a transverse furrow, moving downwards with inspiration, between the hypochondria, and that there was a similar occurrence in pleurisy.

Gerhardt, in the second edition of his "Lehrbuch der Auscultation," quotes these words of Stokes, and adds that in similar cases at the beginning of a short and deep inspiration he has seen this furrow move first a little upwards, then downwards. Gerhardt further states that "occasionally the movement of the diaphragm at a higher level can be seen on the intercostal spaces of very wasted people, a slight horizontal furrow separates in these cases the upper concave part of the diaphragm from the lower flatter part, and moves up and down. Artificially overfed sucklings give the first sad examples for the demonstration of this occurrence."

The deformity known as Harrison's groove, marking the early position of the point of contact of the diaphragm with the chest wall, may be mentioned as one way of determining by inspection alone where this muscle stands or has stood in earlier years.

Except Stokes and Gerhardt, physicians do not seem to have observed any direct visible movement of the diaphragm, and they definitely limited it to certain abnormal conditions, and seem to have regarded it as an accidental occurrence. Stokes says "in some cases of emphysema." Gerhardt expressly says "in similar cases," and "in extremely wasted conditions." These references do not take into consideration a constantly visible movement, which was first recognized and described by Litten in 1892.

His account appears under the title of "The visible movements of the diaphragm which are normally seen on the thorax with every respiration," and he states particularly that it is a description of a constantly visible movement of the diaphragm, which up to this time had been described as a very rare condition, or as one occurring only in pathological conditions. As a preliminary he dwells upon the action of the diaphragm, its position as determined by percussion, and the extreme value of the ascending and descending movements of this muscle in the physical examination, and in contrast to all previous methods of estimating the movements he insists upon the possibility of so doing by direct inspection of the thoracic walls.

Previous to a full description the references of Stokes and Gerhardt are discussed, which are altogether to *pathological* conditions; then the statement is made that "in contradistinction to these the author has made this observation," namely, "that one can see the movements of the diaphragm as a constant physiological appearance, returning with every respiration on the thorax of every sound person, and also on those patients who have no grave respiratory disturbance."

The phenomenon is described as an undulating movement or shadow which begins on both sides at about the level of the sixth intercostal space, and descends with inspiration as a distinct line or furrow for several spaces, reaching sometimes the costal margin, returning to its point of origin with expiration, and crossing the ribs at an acute angle.

With a deep inspiration the visible movement or play of the diaphragm travels 2-3 spaces. In superficial, this is reduced to 1–1½. The movement may cover the whole width of the side of the thorax, so that the visible line of departure of the diaphragm reaches from axillary line to the sternal margin on same side. In other cases one may not see it in this full extent, but perhaps only between the axillary and parasternal or mammillary lines, or only in one or other intercostal space. The movement on the right side is usually more marked than on the left, but often the reverse is true; it can also be well demonstrated on the back. The costo-abdominal type of respiration seen in men favors the occurrence of the movement, which is not so constantly present or so well marked in women and children.

To see well this movement of the diaphragm the recumbent position, either on back or abdomen, is required. The lateral position is unfavorable. A thick chest wall does not necessarily hide the movement. Full daylight, with the bed near a window, the observer in front and to the side, complete the requirements. Artificial light is useless unless concentrated on the side examined.

This comprises the description of Litten's sign, as it is now commonly called. Litten mentions that he has known of its occurrence for some time, and that so far he has not failed to find it in any case, provided there was no marked respiratory disturbance. The principal importance attached by him to this movement is that it gives an absolute method for determining at a glance the exact position of the diaphragm and its mobility, and having fixed the position of this muscle the inferior border of the lungs is also found. It gives also an idea of the depth of respiration, and finally in the left front the heart's lower limits can be mapped out by this movement.

Chief among respiratory disturbances which interfere with the production of this movement are emphysema and pleural effusions; other processes are pericardial adhesions, tumor masses underlying the diaphragm, and paralysis of the diaphragm itself. Litten states that pleural effusions cause partial obliteration of the movement on the affected side, and in addition that the level of the effusion may be influenced by the rise and fall of the diaphragm. Emphysema and hypertrophy of the right ventricle, by depressing the diaphragm, may give indication of its visible movement as a transverse furrow below the xiphoid between the costal margins.

A year after the appearance of Litten's article, Becher of Berlin admitted the normal character and value of the sign and sought to determine its cause. This was the first notice of Litten's original communication, which seemed to have attracted so little comment that in 1894 he again called attention to the subject. Following this second article came a statement from Martius that Litten had entirely overlooked the fact of Gerhardt's description several years before, to which Litten replied, pointing out the differences already referred to.

In the Wiener Klin. Wochenschrift, 1895, Litten returned to the question, and deplored the fact that so little attention had been given to his original paper. In this article he added several points of interest. The cause is stated to be the peeling of the vertical portion of the diaphragm from the chest wall by the inspiratory contraction, and the subsequent replacement in expiration. In looking for the sign behind, the knee-elbow position is recommended. The observer should stand three or four feet away from the patient, at an angle of 45 degrees with his body. Both patient and observer should be turned from the light, which should come from a window directly adjacent to the bed. Three essential requirements are given: horizontal position, good light and full deep breath. From 6 to 7 cm. are given as the normal limit of descent of the movement; anything less than this is considered abnormal. By comparing the descent of the abdominal organs during the descent of the diaphragm it is considered that we have a valuable confirmatory accessory sign. Should the diaphragmatic movement not be observed on one side or other, palpation should show that underlying organs are not depressed as they normally are.

The sign is valuable in differentiating subphrenic abscess from a small pleural effusion. In the former the line at which the movement begins is elevated, while in the effusion the line of movement, if present, is depressed. In the Verhandlung der Berliner Med. Gesellschaft a case of subphrenic abscess is reported in which the line of origin was pushed up to the third rib.

According to Litten, small pleural effusions do not obliterate the movement entirely,-but show it at a lower level, which indicates that a small effusion does not sink into the complementary space, or that it is unable to separate the adjacent diaphragm and chest wall. Tumors in the thorax also depress the line of origin, while abdominal tumors elevate it, but do not obliterate it; only one case of sarcoma of the liver, thirty-six pounds in weight, having been observed to do so. With tumors are included pregnancy, tympanites, moderate ascites. Litten further states that if the visible movement reaches the

costal margin (an occurrence which is never normally the case) one must consider the existence of emphysema.

Generally speaking, processes which limit the breathing to the costal type obscure the diaphragm phenomenon; with these is to be included pneumonia of the lower lobe, a point not mentioned in the first article. Pleural adhesions and retraction of the chest give an impaired or restricted movement.

From this review of the 1895 article it is seen that Litten not only confirms his previous views, but elaborates them, and insists on the physiological and clinical value of the sign. His observations, which dated from 1891, numbered nearly 6000, and he asserts that nothing has so far come up to disprove the occurrence of the diaphragm phenomenon in every normal chest.

There are very few confirmatory references to Litten's sign. Eichhorst* says "the movements of the diaphragm are often visible in people not too fat, as a light shadow which especially on the right side descends with inspiration, ascends with expiration; the extent of this shadow is 5–7 cm. Litten has called this the diaphragm phenomenon, and places much value thereon as marking the lower border of the lungs." In the second edition of Musser's diagnosis there is also a note upon it.

Elkan† reviews the subject and insists on the value of the sign in diaphragmatic hernia; its retention at a higher level than normal, and the tympany above it from the distended intestines being the marked features.

Staby‡ gives the diaphragm phenomenon considerable diagnostic value.

Rumpf§ in studying the diaphragm phenomena in beginning pulmonary apical tuberculosis, shows that when the apex is involved to a certain extent the sign is lessened perceptibly on the affected side.

The diaphragm phenomenon is generally held to represent the peeling off of the vertical part of the diaphragm from the chest wall and its subsequent replacement. This is Litten's view, and it seems most reasonable. Two other views are advanced in Becher's article of 1893. Gad thinks it due to the atmospheric pressure around the infundibula of the lungs, which is increased by the beginning descent of the diaphragm, the negative pressure not being immediately neutralized from the upper air passages. As the lungs descend, the diaphragm preceding them, this line of atmospheric pressure follows the line of the lower border of the lungs downward, and makes the shadow or undulation of descent. He does not explain the shadow of ascent.

Becher holds that the abdominal contents, feeling the direct pressure of the diaphragm downwards, attempt to neutralize the negative pressure at the point where it is most marked, *i. e.* at the meeting of the horizontal with the vertical part of the diaphragm. The pressure to which the contents are subjected and their attempts to neutralize the negative pressure result in a protrusion against the point of meeting, making the visible sign descending with inspiration. As reason for this view Becher gives Hinke's description of the diaphragm. This is that the diaphragm has two parts, a vertical, rising from the attachment at the costal margin and lying in contact with the chest wall as high as the sixth or seventh rib, and a horizontal part stretching directly across, meeting the vertical at a distinct angle. The close apposition of the vertical to the chest wall allows the pressure results to be easily transmitted through it.

We might well question whether, as Litten supposes, the mere separation of one smooth surface from another is capable of producing the phenomenon. Could we include the influence of atmospheric pressure, Litten's view would be strengthened, for often the phenomenon is marked as a distinct narrow furrow, a depression which looks as if pressure were exercised from without. One can see in many chests on sudden stoppage of inspiration a similar furrow momentarily made along the lower pulmonary borders. Harrison's groove, which represents this in a chronic form, seems to point to the occurrence of a negative pressure within and a counteracting external pressure.

Against Becher's view it can be primarily said that the phenomenon does not appear in the form of bulging, but, as has been stated, is more to be compared to a furrow; the result seen in sudden stoppage of inspiration and in Harrison's groove both seem at variance with his idea.

The result of increased abdominal pressure on the right side must act directly through the liver. One would expect some modification therefrom; the reverse, however, is more often found.

The descent of the expanding lung is not considered especially as being a factor in producing the diaphragm phenomenon, though it must be in very close relation thereto; one could look for a sign produced thus wherever the free border of the lung is influenced by inspiration, as, for example, the covering of the cardiac area.

The production of the shadow seen returning with expiration seems more in accordance with Litten's idea of the replacement of the diaphragm against the chest wall. Neither Gad nor Becher discusses this part of the phenomenon.

To study and familiarize myself with the sign I have made observations upon 100 consecutive cases in the wards, seeking to confirm Litten's statements.

The patients were all examined in the recumbent posture. The position in every case was such that daylight fell directly upon the side to be examined, forming an angle of 90 to 120 degrees with the line of the observer's vision. The observations were made on clear days before 4 p. m. There was no selection of the cases. In order to expose the sides fully the hands were placed on the head and the patient brought to the edge of the bed, and the examination made first during quiet breathing and then during deep inspiration. The limits of the movements were marked in pencil on the chest wall, and the depth of the excursion measured in centimeters. To clearly make out the movement an ordinary deep inspiration is necessary, as only in very thin subjects does a quiet respiratory movement bring out the sign. In very stout subjects

* Lehrbuch Klinische Untersuchungen Methoden innere Krankheiten, Ed. 1896.

† Berlin Thesis, Aug. 1896.

‡ Berlin Thesis, February, 1896.

§ Berliner Klin. Wochenschr., Feb. 8th, 1897.

deep inspiration is always necessary. The following are the results in 100 cases examined:

In every patient not too fat or excessively developed, or who had had no serious pulmonary disorder, the sign was found. In one very fat subject, Case 52, there was only a suspicion of the phenomenon on one side. In five cases there was no indication of the sign on either side. In four cases the phenomenon was present on only one side. In the cases in which it was absent one was a colored boy of eleven, with double adhesive pleurisy, the autopsy showing a diaphragm firmly attached to chest wall on both sides. Case 62 was a short, stout, well developed man. Case 38 was a colored man with ascites and general anasarca. Case 49 was a man with extreme emphysema. Case 6, a very stout woman.

Of those showing the sign on one side only, Case 39 was a well built negro with much effusion into the left pleura, on which side the sign was absent. Case 46 had pneumonia of the right lower lobe. Case 52 was the very stout man above referred to. Case 85 was a colored man with chronic pleurisy on the right side.

The remaining 91 cases showed the phenomenon more or less equally on both sides. Thin subjects furnished the most satisfactory examples, giving usually more sharply defined and regular outlines to the shadow. The most favorable field of motion for the shadow lay between the parasternal and posterior scapular lines. It sometimes reached as far as the spine behind and the nipple line in front. In the axilla the sign was always the most marked. The extent of visible movement from behind forwards measured from 2 to 29 cm., the average being about 15 cm. In all instances it was a continuous line without interruption. The vertical excursion varied from 1 to 9 cm., the average distance being about 4½ cm. It did not reach the costal margin in any case. The beginning of the descent does not coincide accurately with the beginning of the movement of inspiration. One can see the shadow begin a fraction of a second after one has perceived the inspiration to have begun. Erect posture occasionally gave a small sign, while the line of origin would often be seen as an oblique line approaching the costal margin behind, and sometimes reaching it at the finish, when the subject lay on his side. The light seems to be the essential condition. Two cases in which the absence of the sign on one side could not be explained showed on re-examination that the sign was present. Artificial light under some conditions of position gave fair results.

The shadow ascending with expiration moved accurately in the same field as the descending shadow, ending quite abruptly at the line of origin. It was never so marked as the descending shadow, and never showed the marked furrow-like appearance observed often in this.

On either side the lines of origin as determined by inspection were at a very nearly equal distance from the costal margin; a difference of ½ to 1 cm., however, was quite common. It was not apparent that the line stood higher on the right side over the liver. The descent on both sides was never so equally marked, differences of 2 to 3 cm. being quite often seen where no affection of respiration was suspected or found. This difference was noted both on right and left.

The position and extent of the phenomena in a majority of the cases was within the same lines, but occasionally one side would show a sign several centimeters longer from behind forward, and perhaps situated more towards the back or front than the other.

Litten's sign may be regarded as a normal phenomenon. The absence in 9 of the 100 cases in this series could be reasonably accounted for. Litten states that in his enormous number of observations, amounting now to many thousand cases, it was present in every normal thorax. It is certainly a matter of very great value to be able to see at a glance the inferior border of the lung, and it is certainly true, as Litten says, that the student has now a valuable and accurate method of proving the correctness of his percussion, and a rapid and easy way of ascertaining a fact that previously had to be laboriously and perhaps only indefinitely determined.

As yet the value of the phenomenon in diagnosis is unsettled. So long as one may see in apparently normal chests differences of several centimeters, it would be hard to say what might be considered abnormal. The complete absence of the sign in large effusions and emphysema is an interesting and natural fact, but the presence in small effusions might be misleading. Cases of subphrenic abscess and diaphragmatic hernia, in which rather striking modifications of the phenomenon have been observed, are rather few to establish any fixed rule. Only adhesions of the diaphragmatic and costal pleural layers directly below the infundibula of the lungs would interfere with the diaphragm's descent enough to obliterate the sign.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of November 1, 1897.

Dr. Barker in the Chair.

Cases of Aneurism.—Dr. Hunner.

Case I.—W. T. G., æt. 27, a printer, with a definite family history of tuberculosis, was sent to the hospital on October 26 by Dr. Norton of Washington, with the diagnosis of abdominal aneurism.

Since a boy he has always been accustomed to holding type in his mouth. He has carried heavy "forms" of type resting against his abdomen, and has lifted heavy weights in the gymnasium. He has had several attacks of gonorrhœa, and about seven years ago an attack of acute arthritic rheumatism which he thinks was synchronous with one. No definite history of syphilis. He has been a pretty heavy drinker of alcoholics since a boy.

His present trouble dates since May or June of this year, when he began having a "dull dragged-out feeling" and

occasionally sharp pains across the abdomen, which caused him to lie doubled across his printer's stool for the pressure benefit. At this time he often vomited after eating, but has not vomited for the past two months.

The pain and weakness have increased since May and he has lost about forty pounds in weight. During the past month he has been obliged to sleep on the left side or in the erect posture, because of pain when in any other position. Pain is referred to the pelvic region, at times shooting into scrotum, at times extending even to the knees. In walking the street a sudden jar gives great pain. He walks slightly bent forward to avoid pain. He first noticed pulsation in abdomen one month ago.

On physical examination he is found to have greatly sclerosed arteries; a markedly accentuated second aortic sound; no blue line on the gums or other evidence of plumbism.

On inspection of the abdomen a diffuse pulsation over the whole upper abdominal region, most marked in the left epigastrium, is seen. This region is prominent, and the left costal margin over the sixth and seventh cartilages is bulged slightly forwards. The pulsation is felt to be limited to the upper half of the abdominal aorta, over which a globular expansile mass the size of a very large orange can be outlined. A purring systolic and diastolic thrill is felt over the mass. Percussion gives dullness everywhere over the mass, but later, during observation, stomach tympany is found on percussion over its lower left quadrant. On auscultation a loud double murmur—a systolic, loud, harsh, and short—a diastolic, fainter, prolonged, and almost musical in character—is heard. In the back a soft blowing systolic murmur is heard over an area to the right of the vertebræ extending from the eleventh dorsal to the first lumbar. The knee kick is greatly exaggerated.

Case II.—O. G., a German, æt. 47, was first admitted to hospital, Oct. 22, 1896, complaining of pain in the back and left side. He has an excellent family history and has always been a healthy and hard-working man. He served through the Franco-Prussian war in the artillery; has always been a steady drinker of alcoholics; twenty years ago he had a hard chancre, and one year later was treated five weeks for secondary symptoms at the Königsberg hospital. In 1894 he was at the Johns Hopkins dispensary for eye trouble; was told that it was syphilitic in origin, and after two or three weeks' treatment he was well.

His present trouble began in March, 1896, with pain in the right side under the costal margin extending down to hip. This grew gradually worse, and about August, 1896, the pain began in the mid-lumbar region, and on first admission in October, 1896, it was described as only on the left side, beginning in the left iliac region and running back to the spine. The pain was of varied character, a dull aching being almost always present, and several times a day, lasting for a second or two, very sharp pains like the cutting of a knife ran across the abdomen.

The patient improved greatly during a three months' rest in the Hospital, and in February, 1897, went to work, at first doing light work on a dairy farm, and then heavy work grading roads. He soon had to cease work because of great pain in the left side beneath the ribs, and returned to the Hospital in March, 1897.

His pains grew more severe and frequent during a second stay of three months, but being ambitious to get to work he left the Hospital in June and was able to work about half-time during the summer. He remained under supervision of the Hospital and kept up treatment with iodide of potassium, nitroglycerine, and cathartics, being obliged to take as high as four grains of morphia per diem for pain. He lost weight and grew weaker, and on October 23 was obliged to enter the Hospital for the third time.

Physical examination on his first admission revealed an aortic and a mitral insufficiency. On careful inspection there was seen a good deal of throbbing over the manubrium. No localized pulsation. The epigastrium showed a marked pulsation, and on palpation a heaving up and down stroke with an occasional palpable thrill. No positive tumor could be outlined. On auscultation a very loud systolic bruit was heard over the course of the abdominal aorta. This thrill was intense and rough in the left upper quadrant of the epigastrium. In the back a murmur could be faintly heard about opposite the tenth dorsal vertebra and for a distance of six centimeters below.

On his second admission in March, 1897, the pulsation, the thrill and bruit were all increased in intensity, and on deep pressure just below the ensiform it was thought that a throbbing expansile tumor could be felt; not, however, as a globular mass.

Before his discharge in June a pulsation could occasionally be detected in the back; and during a paroxysm of pain, with one hand under the ribs in front and one under the ribs behind, a definite expansile pulsation could be obtained. On his last admission in October a diffuse epigastric pulsation is seen, although the region shows a depression rather than an elevation as before. The pulsation and displacement of the hand is limited to the upper half of the abdominal aorta. On auscultation over this area a loud blowing systolic murmur is heard, followed at times by a higher pitched blowing diastolic.

Inspection of back shows a widely diffuse pulsation at the outer edge of the erector spinæ muscle just below the twelfth rib. This is more evident on palpation. On auscultation over this area a very faint distant systolic murmur, followed by a sudden diastolic shock, is heard. Examination of the tendon reflexes shows that of the right rectus femoris to be apparently normal, while the left seems diminished.

Dr. BARKER.—The possibility of the healing of aneurisms has interested me especially, for I have met with one case in which an aneurism of the aorta of considerable size healed spontaneously. In 1891 a colored man applied to the dispensary for treatment, complaining of cough, shortness of breath and some swelling of the legs. His personal history showed that he had been a hard worker and had seen the rough side of life; he had indulged in alcohol to excess and gave some evidence of having had lues. On examination of the chest a globular swelling was found in the parasternal region on the right side, extending from above the sternal clavicular articulation to the level of the third rib. The swelling pulsated

with the heart's beat, yielded a marked systolic impulse and evident diastolic shock. It was dull on percussion, and the aortic second sound over the area was accentuated. Tracheal tugging was well marked. No difference could be appreciated in the pulse at the two wrists; the radials were thickened. There was no distinct bruit over the tumor, nor was there any valvular lesion of the heart. A diagnosis was made of general arterio-sclerosis with aneurism of the ascending portion of the aortic arch. In 1893, a little less than two years after I had first seen him, he entered the medical ward with œdema of the legs, complaining of shortness of breath; the urine was albuminous, and a few granular and hyaline casts together with blood corpuscles were present in it. In the thorax there was found an area of dulness, and on deep palpation a firm resistant mass could be felt in the episternal notch. There was no pulsation of the tumor nor was there any distinct tracheal tugging. The character of the thoracic lesion was puzzling until his previous history in the dispensary was consulted, when it seemed clear that the aneurismal sac had been slowly filled with clots. Dr. Osler suggested that the case be shown at that time to the medical society as one of healed aneurism, and a description of it is to be found in the proceedings of this society published in the March number of the BULLETIN for 1894. Some hesitation was felt in concluding during the life of the patient that his aneurism had really healed. The case, however, came later to autopsy in the pathological laboratory, when it was found that the diagnosis made *intra vitam* was correct. The aneurism was filled with firm lamellated clots and presented as perfect a picture of healed aneurism as one is likely to meet with. The individual died from causes entirely independent of the aortic disease.

Dr. FLEXNER.—I recall the case of aneurism of the abdominal aorta which was operated upon by Dr. Halsted. The condition found at autopsy was a very interesting one, and the case as a whole is impressed upon my mind because it served as an example of rapid post-mortem development of the bacillus aerogenes capsulatus, the source of which was easily traced to the intestinal contents.

The autopsy was made 21 hours post mortem in the last week of April, 1896. Man æt. 33, well nourished. The peritoneal cavity contained blood-stained fluid in the dependent parts. On the left side a large swelling existed which proved to be a hæmatoma. It occupied one-half of this side of the peritoneal cavity. The serous covering of the splenic flexure of the colon, the meso-colon and the tissues about the pancreas were all deeply infiltrated with blood and contained numerous gas blebs. The meso-colon of the sigmoid flexure, the meso-rectum and the splenic portion of the transverse colon were enormously thickened by recently clotted blood and measured on an average 3 to 3.5 cm. in thickness. The mesentery of the descending colon and sigmoid flexure formed a part of the anterior wall of a large aneurismal sac, the lower boundary of which was formed by the infiltrated cul-de-sac between the bladder and the rectum, which had about the same thickness as the meso-colon. The infiltration extended posteriorly to the vertebral column. The posterior boundaries of the sac were formed by the sheaths of the psoas and iliacus muscles, the infiltration with blood having extended below Poupart's ligament into the thigh along the sheaths of these muscles and the tissues of Hunter's canal. The sac of the false aneurism, which in its extreme dimensions measured 22 cm. in length and 26 cm. in transverse circumference, was filled with dark, fairly recent clots. Similar clots gave to the wall of this sac its thickness, upon removing which the anterior portion of the sac was shown to be covered by the peritoneal layer alone. The infiltration with blood passed upwards into the diaphragm and left peri-renal tissues.

The opening in the aorta which communicated with the large sac was nearly circular and measured 2.5x3 cm. in size. This opening led directly into the true sac of the aneurism, which was situated posteriorly, extending to and eroding the vertebral column, and reached a pool-ball in size. The communication with the larger sac already described was through this sac, the opening in the latter admitting four fingers.

The aneurism sprang from the aorta to the right of and about on a line with the cœliac axis; all the vessels leading from the abdominal aorta were preserved intact. The intima of the aorta generally was smooth, but in the beginning of the ascending arch and in the transverse portion several elevated nodular patches free from calcification existed.

There can be, I think, no doubt that at some time, perhaps a week or more prior to the operation, the rupture of the aneurism took place, permitting a gradual escape of blood into the tissues described. Death followed the rupture of the secondary sac thus formed at the time of the operation.

The bacteriological examination of the frothy, blood-stained fluid in the peritoneal cavity showed many capsulated bacilli agreeing in morphology with the bacillus aerogenes capsulatus. The liver, pancreas and heart's blood yielded small numbers of similar micro-organisms. Cover-slip preparations made from the large intestine (colon and cæcum) showed among many bacteria having the morphology of the bacillus coli communis, not a few of the larger forms agreeing with the gas bacillus; while films from the small intestine showed the presence of the latter in practically pure culture. The bacillus aerogenes capsulatus was isolated in pure culture and shown by inoculation of a pigeon to be pathogenic.

Diabetes in the Negro.—DR. PANCOAST.

Dr. Osler has asked me to report the following case:

Henry Roy; colored; aged 50 years; driver. On admission he complained of a severe cough and of weakness and pain under the sternum. His family history is unimportant. Excepting diphtheria and whooping-cough he has had no severe acute infectious diseases. He had a sore about 25 years ago and apparently no secondary symptoms. The patient has had a slight hacking cough at intervals for years, and says that eight years ago he had night sweats for two weeks. Until five years ago he drank whiskey to some excess. He had noticed no change in frequency of micturition or in amount of urine voided, but as long as he can remember he has risen once or twice at night to pass his water.

About nine weeks ago he was taken with a severe paroxysmal cough which has increased in severity. His appetite has gradually failed and he has lost in strength and weight. He then weighed 188 pounds and now weighs 139. For a week

before admission his scanty expectoration has at times been blood-tinged, and he has suffered from dull pain beneath the sternum. He has had some shortness of breath; has vomited once and has been quite thirsty after meals. His skin has been dry.

Examination shows a rather light-colored negro, much emaciated. In the left axilla we found quite evident dullness on percussion and increased transmission of vocal fremitus and voice sounds. Moist crackles were found at the left apex. He has the Argyle-Robertson pupil and has lost the patellar reflex. He has congenital phimosis and a large scar on the penis. The sputum is moderate in amount and shows numerous tubercle bacilli and bands of elastic tissue.

Urine in 24 hours, 2300 cm.; specific gravity 1028; a trace of albumin; 122 grams of sugar. On the ward diabetic diet, which is not sugar-free, he passed from 20 to 50 grams of sugar in 24 hours. After three days of Van Noorden's standard diet the urine was sugar-free.

The patient is shown because diabetes in the negro is rather rare and because he illustrates a common complication (pulmonary tuberculosis). Of particular interest, however, is the fact that his blood and urine give the reactions described by Bremer of St. Louis as diagnostic of diabetes. The slides I exhibit were prepared by Mr. Herrick of the Fourth Year Class and show the difference in staining by Congo red very well indeed. I also exhibit two specimens of urine, the patient's and a control specimen. Mr. Herrick has added eosin and gentian violet to each and the difference in color is very marked. The articles of Dr. Bremer which describe this reaction are in the New York Medical Journal, Vol. 63, page 301 (1896) and Vol. 65, page 360 (1897); also in the Medical Record, Vol. 52, page 495 (1897).

Dr. FUTCHER.—Diabetes is a rare disease in the colored race. This is the sixth case we have had in the Hospital. Up to May, 1897, there had been 69 cases of diabetes, five of which were in the colored race, making a percentage of 7.2. Saundby credits Dr. Tyson with saying that he had never met with a case of diabetes in the colored race in America, which shows that it is very rare. Tyson, however, in his Practice of Medicine, 1896, states that the disease is rare in the negro race, but that he has seen several cases.

The proportion of males and females in the white race who suffer from diabetes is about 3 to 2. In children, however, the ratio is not the same; girls have it more frequently than boys. In the colored race our experience has been that the cases occur more frequently in women than in men, four of the six cases being in women.

In regard to Bremer's reaction in the urine he claims that it is also present when the urine is temporarily free from sugar. This case is contrary to that belief. It has been claimed by Lépine and Lyonnet that the blood reaction is due to the variable alkalinity of the blood serum. Bremer believes that it is due to qualitative changes in the corpuscles, and thinks that the test supports Spitzer's view that the glycolytic ferment is contained within the red blood corpuscles. Lépine and Lyonnet have found that the reaction is present in leucæmic blood, while Bremer claims that if his technique is strictly adhered to leucæmic blood reacts like normal blood. He has found it present in cases of experimental phloroglucin diabetes.

Exhibition of Specimen of Round Ulcer of the Stomach. Erosion of Gastric Artery; Post-mortem Perforation.—Dr. FLEXNER.

The specimen which I present this evening came from a negro man about 60 years of age who came to the Hospital for tuberculosis of the elbow joint. The clinical notes state that on October 24th, while in the hospital for the above trouble, he was seized with hæmatmesis. There is no record of a previous attack of this sort. The patient, who was already very weak and much emaciated, died on October 27th. The autopsy was performed six hours post mortem.

The peritoneal cavity contained about 200 cc. of dark, turbid fluid which was collected in the fossæ. The omentum was almost devoid of fat; no unusual adhesions between the several viscera.

The stomach itself was moderately dilated and its contents were fluid and dark in color. The mucous membrane was covered with sticky mucus which was streaked with dark lines, the surface presented a coarsely mammillated appearance and there was absence of the normal velvety surface. There existed on the posterior wall, 6 cm. from the pylorus, just at the limits of the lesser curvature, a deep almost circular ulcer 4.5 x 3 cm. in extent, the edges of which were for the most part rounded in form. The ulcer extended to the peritoneal coat, and at one place (perhaps two places) it had penetrated this coat and communicated with the peritoneal cavity. Through this break fluid passed from the interior of the stomach into the abdominal cavity.

The base of the ulcer, as you can see, is not quite smooth, but it presents a somewhat convoluted appearance. This is brought about chiefly by its relation to the branches of the right gastric artery over which it lies. It may be seen that the elevated lines in the under (widest) part of the ulcer correspond to the secondary and tertiary branches of this vessel. Over one such prominent ridge there was a small dark clot; on removing this a slightly elongated erosion was brought to view in a secondary branch of the right gastric artery. A probe can be passed through this opening into the main vessel. All the branches and the main stem of the artery show thickening of the intima.

Between the ridges described the ulcer, in its lower part, extends to the serous coat; the upper half has not passed beyond the muscular tunic. The least manipulation brings about breaks in the thin tissue mentioned.

My object in bringing this specimen before you is as follows: In the first place, ulcer of the stomach is not a common condition with us. As you know, the large statistics collected by Drs. Welch and Brinton would seem to prove that simple ulcerations or cicatrices are found at autopsy in about 5 per cent. of persons dying from all causes. Our experience is quite different, and while I have not collated our autopsies from this point of view, yet I venture to say that our percentage is far below this estimate. The present instance cannot be said to shed any new light on the cause of such round ulcers, but as the sclerosis of the gastric arteries was so

much more marked than of the other arteries of the body, it tends to support the vascular origin of the condition. But I wish to ask your attention especially to the possibility of rapid post-mortem digestion of the stomach, with the production of perforation in places where the walls are already greatly thinned, which is not to be confounded with ante-mortem perforation. In this case the evidences of perforation were found at once on opening the abdominal cavity; the dark fluid was evidently derived from the stomach contents; but the absence of all signs of inflammation is taken to indicate that, although the autopsy was made only six hours after death, yet the remaining barrier between the cavity of the stomach and that of the peritoneum was in this time digested away.

NOTES ON NEW BOOKS.

A Treatise on Surgery by American Authors. Edited by ROSWELL PARK, A. M., M. D, Professor of Surgery in the Medical Department of the University of Buffalo, etc. Volume II. 804 pp., 451 engravings, 17 plates. (*Lea Brothers & Co., Philadelphia and New York*, 1897.)

The second volume of this interesting work fully sustains the high expectations raised by the appearance of the first, the only disappointment being the smaller extent to which the hand of the editor appears in its contents, and the further extension of that process of condensation which, impossible as it is of dissociation from a work of this encyclopediac range nowadays, interferes with the flow and beauty of the style and diminishes our pleasure in reading it. The illustrations are again remarkable both for their abundance and freshness, although a few of them again show the "defects of the virtues" of the camera.

Of the twenty chapters, three are by the editor, the one upon Surgical Diseases and Injuries of the Head being especially notable as an eminently concise and practically helpful treatment of an extremely complicated subject. His brief chapter at the close upon Skiagraphy, with its full description of apparatus and methods and its interesting series of radiographs, adds much both to the completeness and to the interest of the volume.

The names of Bradford, upon Diseases and Injuries of the Spine; of Dennis, upon the Surgery of the Chest; Gerster, upon Plastic Surgery; and Blake, upon the Surgery of the Ear, are sufficient guarantees for the ability and authoritativeness of the treatment of these subjects. And the method of presentation is equally admirable, with the exception of those omissions which are of course absolutely necessary for reasonable brevity in chapters of a general work, and the occasional baldness and disjointedness of style which almost necessarily accompany this.

The question, however, suggests itself most forcibly whether in this twentieth century age it is any longer necessary to cumber a work of this description with even a nominally complete discussion of such highly specialized subjects as the diseases of the eye, the ear, and the female reproductive organs. Nearly every practitioner, and certainly every graduate nowadays, is compelled to have in his library at least one work treating upon each of these subjects. Works are written upon these subjects especially intended to meet the needs of the general practitioner, who is beyond the reach of a specialist, and such treatment as can possibly be afforded to them in from thirty to sixty pages of a work upon general surgery can from the very nature of the case and the necessity of naming and classifying all the more important disturbances, hardly have that degree of preliminary detail and logical connection which is absolutely indispensable to a rational introduction to the subject, while as a work of reference it would be mainly a source of irritation if not of exasperation.

Of course we are well aware of the long-standing feud which exists between the general surgeon upon the one hand and the gynecologist proper upon the other, and it is unquestionably fully within the rights of the former to have a chapter upon this subject inserted in his formal text-book, as a sort of assertion of his rights within this domain. But we think that any one who would attempt to perform any of the special operations, particularly in the region of the eye or ear, without any further knowledge than that which could be obtained from the chapters upon this subject, admirably definite and condensed as they are, would be a man to whose boldness a somewhat less complimentary term might not be improperly applied. As extracts and condensations they are admirable, but life cannot long be maintained upon Liebig.

The absence of our old friend "the opisthotonos man," of which we complained in the former volume, is more than compensated for by the group of old friends which greet us in the chapter upon the diseases of the eye. But with that exception, as we have before stated, the illustrations are striking for both their freshness and appropriateness.

One of the most admirable and interesting features of the entire volume is the full treatment accorded to those deformities and disturbances which result from errors and defects in embryonic development. This is particularly noticeable in the editor's own chapter, and also in the excellent chapter by Arthur Bevan upon the Mouth, Teeth and Jaws, in which a brief but admirably clear and vivid description is given of the development of these parts, without which, as the author very happily says, no rational understanding of their deformities can possibly be had. It is one of the most suggestive and promising signs of the times that we are beginning to trace a developmental and morphological basis for such a large and rapidly increasing class, not merely of surgical but also of medical disturbances. The cysts and bronchial fistulæ of the neck, the forms of hare-lip and cleft-palate, the coccygeal sinus, the dermoids of the tongue, and many other conditions are treated here from this point of view, and with a most refreshing gain in point of clearness and interest. We regret, however, that in his otherwise excellent chapter upon the Surgery of the Abdomen, Maurice Richardson has not seen fit to distinctly class the appendix in this group and to treat its etiology and pathology from that point of view. Etiology is dismissed in a single ten-line paragraph which is characterized by the last sentence, namely, that it is obscure. And this we are the more surprised at because from the pen of the editor have come some of the clearest and most convincing statements of the essentially morphologic and ancestral basis of this interesting disturbance. The human appendix is clearly an atrophying vestige of a more voluminous and functional, intestinal pouch, such as is seen in some of the herbivora, and is intermediate between these and the small rounded cæcum of the carnivora, in which the distal two-thirds, or "appendix," as we term it, has entirely disappeared. Not only is it degenerate ancestrally, but it rapidly undergoes involution in the individual, from a direct continuation of the cæcum in early fœtal life up to its occlusion after adult life, which, as Ribbert has shown, is completed in no less than twenty-five per cent. of all persons by the age of forty, so that the diminishing frequency of appendicitis after this age is to be accounted for upon developmental grounds. In short, we think that a full recognition of the fact that appendicitis is simply a "short-circuiting" or accelerating of a process of elimination and atrophy which is normally being carried out in the human species, to reach its completion somewhere about the fortieth year, will of itself afford an almost complete rational basis for the etiology and pathology of the disease.

Dr. Bradford's brief but adequate treatment of the coccygeal dimple and sinus is not only interesting and thoroughly scientific, but of great practical importance, as disease of this structure is far

commoner than is generally supposed. We have seen three or four cases which have been mistaken for *fistulæ in ano* and determined efforts made to cause the probe to pass through into the rectum.

The pathology, as a rule, throughout the volume is admirable, clear, and up to date. We cannot help regretting, however, that at some point in the treatment of cancer the editor's well-known and most interesting views upon its dependence on the ancestral or individual senility of epithelial tissue could not have been developed. This view, it appears to us, throws such a valuable light upon the carcinomata of the uterus and breast, organs which are functionally senile long before the remainder of the body tissues, and which are in consequence the site of nearly seventy per cent. of all cases of carcinoma in the female sex. The atrophying lips of the toothless old man, the remains of the invertebrate grinding stomach at the pylorus, and the vestiges of the crop in the middle third of the œsophagus, seem to display the same fatal tendency.

In fine, the entire volume displays, with the exception of a few chapters, that combination of scientific thoroughness with concise and eminent practicality in treatment which so favorably impressed us in the former part of the work. And our chief criticism takes the form of regret that in some instances the "boiling-down" process has been carried so far as to result in the precipitation of a rather irritating mass of crystalline facts. Especially is this the case with the chapter upon Injuries of the Face, anywhere in the first five or six pages of which paragraphs may be picked out which contain a description of a new condition to every line. The result is that the pages read like quotations from a medical dictionary, and are just about as interesting and satisfactory, while they fall short of it in point of accuracy. For instance, the extraordinary statement is made that "long-continued proper specific treatment will improve" the opacities of the cornea, malformations of the permanent teeth and fissures at the angles of the mouth due to hereditary syphilis, all of which well-known symptom group is dignified with the extraordinary title of "congenital syphilitic hypertrophy of the face," while the changes due to leprosy are persistently referred to under the title of "elephantiasis."

The paragraphing of the work and the use of display type have been most skilfully carried out, and with the admirable index, make the tracing down of any particular subject or paragraph a positive pleasure. W. H.

A Manual of Clinical Diagnosis by Means of Microscopic and Chemical Methods, for Students, Hospital Physicians and Practitioners. By CHARLES E. SIMON, M. D., Baltimore. Second edition, revised and enlarged. Philadelphia and New York, Lea Bros. & Co., 1897. Pp. i to xx and 17 to 563, with 133 illustrations on wood, and 14 colored plates.

The fact that a second edition of this book has been called for within one year is the best index to the reception given it by the profession. It differs from the majority of text-books on clinical diagnosis in that it limits its sphere almost entirely to the consideration of microscopical and chemical methods as applied to diagnosis and the results yielded by these. The exact ground which it attempts to cover may perhaps be best understood if we say that it deals with those materials (other than excised portions of tissue) which can be obtained from a living patient and can be removed from his bedside for careful examination. It is in fact a manual for the clinical laboratory of the diagnostician.

The book consists of 13 chapters with the following headings: (1) The Blood; (2) The Secretions of the Mouth; (3) The Gastric Juice and the Gastric Contents; (4) Fæces; (5) The Nasal Secretion; (6) The Sputum; (7) The Urine; (8) Transudates and Exudates; (9) The Examination of Cystic Contents; (10) The Examination of Cerebrospinal Fluid: (11) The Semen; (12) The Vaginal Discharge; (13) The Secretion of the Mammary Glands.

Under each of these headings the general characters, chemical constitution and microscopical appearances in health and disease are discussed at considerable length. One has only to consult the list of sub-headings in the table of contents to realize the dimensions which the subject has in recent times assumed.

The second edition of this book has been revised and extended. It is not, however, entirely free from error. The illustrations of stained malarial parasites, for example, are not in accord with what one actually sees in the preparations, and we have noticed a few other mistakes which we hope will be corrected when another edition appears.

It is now a matter of general recognition that the successful penetration of research into new fields in almost every department of knowledge is dependent in large measure upon the invention of methods which supplement the activities of our sense organs; that is to say, methods which extend the domains in which the eye, the ear and the tactile surfaces can be utilized in gaining information concerning the objects to be studied. Whereas, with regard to the urine, for example, the physician of the olden time gathered what information he could from the naked eye appearances, odor, and possibly the taste, the modern clinician helps out his eyes by means of (1) chemical tests yielding color reactions or visible precipitates, and (2) images obtained by the intercalation of microscopic lenses, and the prisms of the spectral apparatus and the polariscope, between his eye and the object. Instead of judging of the condition of the blood solely by a glance at the color of the visible mucous membranes, the latter supplies himself with accurate data concerning the exact holding in hæmoglobin, the presence of abnormal hæmoglobin compounds, the number of red and white blood corpuscles, the relative proportions of the different varieties of the latter, the presence of protozoa or of bacteria, the existence of chemical abnormalities and of certain specific qualities sometimes possessed by the serum, by using the hæmoglobinometer, the spectroscope, the hæmocytometer or the hæmatokrit and the microscope, and by chemical and bacteriological technique. Nowadays rather than rely upon shrewd guesses as to the condition of the cerebrospinal meninges founded upon the symptoms manifested by the patient, the examiner prefers in many instances to study the cerebrospinal fluid directly in order to determine the presence or absence of pus, blood, the tubercle bacillus, the meningococcus or other abnormal element.

It may be urged by the "ultra-practical man" that these methods are of but little service and that he gets along very well without them. He would relegate such refinements with the sphygmographs, æsthesiometers, phonendoscopes, and perhaps also the stethoscopes, to the limbo in which he mentally confines all physicians who strive for scientific accuracy, or what he would probably choose to designate "highfalutin poppycock."

In sciences as new as clinical bacteriology and clinical chemistry, the doors to which may scarcely be said to be fully open, the threshold barely crossed, very many experiments have to be made, and often enormous numbers of new methods tried before one is found which is really of permanent practical value. Undoubtedly in books like those of Simon and von Jaksch, procedures are described which are of no practical significance and which will sooner or later be discarded. On the other hand, a knowledge of the principles which underlie them and the power of intelligently applying the majority of them to the study of clinical cases is just what distinguishes the physician of the "better sort" from the "ordinary" practitioner.

The scientific physician takes advantage of every possible means to establish his diagnosis on a firm basis; he is analytical; he seeks an explanation for every symptom; he takes account of all likely complications; he endeavors to avoid every source of error. He may sometimes, it is true, be led astray. A well marked Widal reaction may, if he forgets that its presence does not necessarily indicate typhoid ulceration of the intestine, lead him to overlook a local infection of some part in which the typhoid bacillus is the

exciting cause. Or again he may be trapped into making too favorable a prognosis on finding malarial parasites in the blood should he chance to deal with a case in which the malarial invasion is associated with general streptococcus infection, with amœbic abscess of the liver or with typhoid fever. But he learns by his mistakes; another time he avoids them. If he is magnanimous he acknowledges them and warns his fellow-practitioners of possible pitfalls. The true significance of new tests by this means gradually comes to be understood and medicine is advanced.

The "ordinary" doctor says he "does very well without these tests," and indeed he does probably better without them than with them. If he attempted to apply many of them, having no knowledge of the principles upon which they rest, he would obtain false results, or, to be more accurate, falsely interpret the results he obtains and deceive not only his patient but also possibly himself. The only methods which he is capable of using satisfactorily are those so reduced to a "rule of thumb" that mistake is practically impossible. When a test has been so thoroughly sifted by trained men that it comes in this category it is said to have undergone the "crucial test of clinical experience." It is then on a par with the examination of measly pork by factory girls, or the making of ordinary agar-agar by the laboratory *Diener*.

The newer researches of the clinical laboratory are and must continue to be based upon advances in anatomy, physiology and pathology in the same way that these three sciences are in turn dependent for their progress upon the application of the newer results in chemistry and physics. It is almost trite to say that the better founded the physician is in these fundamental branches the further he can extend his clinical researches. The clinical investigator of fifty years from now will be sadly at a loss if he depend upon the anatomy and physiology, the chemistry and physics of to-day. The clinician of ten or twenty years from now must be well versed in these subjects, at least as they are at present understood. But how many students beginning the study of medicine have any adequate knowledge of modern physics and chemistry? Relatively few of them know enough to read intelligently even the articles of Gruetzner, Wütrich, Hamburger, Kahlenberg and True, Loeb, Heald, Krönig and Paul and Koránvi, to mention some of those who have been writing recently upon the application of physical chemistry to the solution of certain problems in medicine and biology. And what is worse, they do not know enough mathematics to permit them to familiarize themselves with the laws to which the processes of electrolytic dissociation, the velocity of anions and kations, or the passage of substances through semi-permeable membranes conform.

A student contemplating medicine as a career and capable of *looking ahead* will shape his course very differently from that generally followed. He will lay a foundation in mathematics which reaches wider than arithmetic, two books of Euclid and simple quadratic equations. It will be all the better for him if do not stop short of Calculus and the Theory of Equations. He will study physics and chemistry until he is not only capable of understanding the forward movements going on in these branches, but until he is capable of taking part in their advance. He will especially thoroughly master the principles of the new physical chemistry, seeing that the human body itself consists of a mass of units bounded apparently (the majority of them at any rate) by semi-permeable membranes, and bathed by fluids in which not only simple but extremely complex substances are present in aqueous solution. The manuals of clinical chemistry and microscopy such as that of Dr. Simon may seem complex to-day; their contents are, however, only fragments of an alphabet out of which the textbooks of coming generations will be constructed. L. F. B.

High Altitudes for Consumptives. By A. Edgar Tussey, M. D. (*Philadelphia: P. Blakiston, Son & Co.*, 1896.)

Although the author seems to have but little belief in the bacillus tuberculosis as a cause of phthisis, yet there is much good sense in this volume, and had it been cut down one-half or more we would praise it without hesitation. Its fault lies in an unbounded tendency of the author to moralize. This is all very well in its place, but its place is not properly in what is meant to be a scientific production addressed to the medical profession. There are too many quotations which seem to us out of place and merely an effort to impress the reader; the author's style is verbose, and the attempt to write "elegant" English is continually thrust before one.

The object of the author to impress on the general practitioner the use of much greater care than is ordinarily employed in the selection of climates for consumptives is a worthy one, and the end would have been much better attained were the work more condensed. The general practitioner is oftentimes criminally careless in sending phthisical patients away to high climates without a previous careful examination of them. Many a practitioner thinks that a patient with the tubercle bacilli in his sputa should at once be sent off to Colorado. No more serious mistake could be made; such advice may cause much distress in many ways, or may hasten the death of the patient. If more care was exercised in these cases, the medical profession of this country would to-day have less slurs cast upon it by the middle class (if such a class exist in America) and there would be less heard of quack consumptive cures.

The work which the author has done in estimating the capacity of the chest is valuable, and spite of its defects we recommend this work to all interested in the proper treatment of consumptives.

Guy's Hospital Reports, Vol. LI. (*London: J. & A. Churchill*, 1895.)

No volume of reports ever appears from this hospital without containing one or more articles of real value, and this volume has a number of special interest both to the surgeon and physician. The paper by Theodore Fisher on "Hypertrophy of the Heart without Gross Organic Lesion," is one we were very glad to see, for although this condition has been recognized by the leading medical men in all countries within the past few years, it has not yet met with the general recognition which it deserves. The question of alcohol and overwork as productive causes of this lesion is here well discussed. There are other interesting papers on empyema following lobar pneumonia, in which the value of the course of the temperature curve is specially noted; on scarlatinal nephritis and its complications—this paper brings out clearly the difficulty in making a proper classification of the various forms of nephritis which may occur in scarlatina, in spite of the numberless articles on just this topic. There is a long and important paper on the question of amputation in senile gangrene, and another on the extremely rare lesion of bilateral paralysis of the facial and auditory nerves.

BOOKS RECEIVED.

Genito-urinary Surgery and Venereal Diseases. By J. W. White, M. D., and E. Martin, M. D. 1898. 8vo. 1061 pages. J. B. Lippincott Co., Philadelphia.

Index-Catalogue of the Library of the Surgeon-General's Office, United States Army. Authors and Subjects. Second Series. Vol. II, B-Bywater. 1897. 4to. 954 pages. Government Printing Office, Washington.

A Clinical Text-book of Surgical Diagnosis and Treatment. By J. W. Macdonald, M. D. 1898. 8vo. 798 pages. W. B. Saunders, Philadelphia.

The Physiology and Pathology of the Cerebral Circulation. An Experimental Research. By Leonard Hill, M. B. 1896. 8vo. 208 pages. J. & A. Churchill, London.

Saint Thomas's Hospital Reports. New Series. Edited by Dr. Hector Mackenzie and Mr. G. H. Makins. Vol. XXV. 1897. 499 + 119 pages. J. & A. Churchill, London.

The British Guiana Medical Annual. Edited by J. S. Wallbridge and C. W. Daniels. Ninth year of issue. 1897. 8vo. 87 + 73 pages. Printed by Baldwin & Co., Georgetown, Demerara.

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Men and women are admitted upon the same terms.

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BULLETIN

OF

THE JOHNS HOPKINS HOSPITAL.

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LEPROSY IN THE UNITED STATES, WITH THE REPORT OF A CASE.

By William Osler, M. D., *Professor of Medicine in the Johns Hopkins University.*

[*Clinical Lecture delivered at the Johns Hopkins Hospital, Wednesday, Feb.* 2, 1898.]

To no disease perhaps has attention been more actively called of late years than to leprosy, one of the oldest and most dreaded scourges of the race. In great part this has been due to the activity in England of a Leprosy Commission, and to the establishment of a National Leprosy Fund. Through the energy of Dr. Lassar a Leprosy Conference has recently been held in Berlin, two volumes of the proceedings of which I pass about for your inspection. They contain an immense amount of valuable information with reference to the present status of the disease throughout the world, and the best means for its prevention.

I take this opportunity of again showing to you the case which has been in Ward I for some months, and of speaking upon the present condition of the disease in the United States and the prospects of its spreading. First let me refresh your memories about the patient before you. Her history is as follows: She is now 30 years old. She was born in Baltimore, of French-German parents; her father was a native Frenchman who came here when young; he served in the army, was a very healthy man and had no skin eruption. He died at the age of 50. Her mother, who died at the age of 40, appears to have been a healthy woman. When 16 years old the patient visited an uncle in Demerara, remaining only a few months. This uncle, a native American, is at present in Baltimore, and neither he nor any member of his family has ever had a serious skin disease. On returning to this country she lived in Baltimore, one year in Norfolk, and for the last five years in Alleghany City, Pa. She returned to this city in April, and was admitted to the hospital as a case of obstinate lues.

Her personal history is as follows. She was healthy as a young girl; she married when 20 years old, had one child at 23, which died shortly after birth; she has had one miscarriage since. Her present illness began six years ago. Here is a photograph taken two years prior to the onset of the trouble, from which you can judge of the terrible changes the disease has wrought. She noticed first two brown spots over the elbow, and then several spots on the wrist. She was pregnant at the time, and had with their appearance a little fever and slight indisposition. These spots remained stationary until after her confinement, when they increased in size and became nodular. The disease spread rapidly, the feet being attacked next, beginning on the ankles nearly five years ago. Ever

since there has been a steady appearance of lumps and nodules on the skin of the face, legs and arms. Only during the past year have they appeared above the elbows. Two years ago she lost the eyebrows and lashes; the hair of the head is not falling out. The voice began to get hoarse a few months ago, and eight months since she noticed the formation of scabs in the nose.

Her condition at present is very characteristic of tubercular leprosy. She looks a great deal older than her age; the swollen appearance of the eyebrows and cheeks, the rounded outlines of the nose and of the ears, the absence of eyelashes, and the brownish pigmented discoloration, give a picture that is perfectly characteristic. The neck is only slightly involved, showing only a few pigmented areas. The hands, feet and legs are very much involved, the hands showing scars of erosion and ulceration; the finger-nails are not attacked, but in the left hand are fresh punched-out ulcers. On the arms are scars of several very deep ulcers. On the upper arm the earlier stages are shown, the brownish discoloration, and the skin looks raised and infiltrated, and on palpation one can feel that beneath the skin there is a nodular infiltration. The forehead shows a uniform infiltration. She has little or no disturbance of sensation; she feels touch everywhere and feels pain.

She has been under our care since April last, and has improved in very many ways. The general nutrition is much better. The open ulcers and sores which were present on admission have, as you see, almost entirely healed. During the months of June, July and August she had a great deal of fever, but now for some time the temperature has been normal. She has gained in weight, and is in every way very much more comfortable. She is a very tidy, neat woman, and now is able to look after her own room. I may add that it has been to both physicians and nurses of our staff a great pleasure to be able to care for her and make her comfortable.

Where did this patient contract leprosy? You noticed in the history that she had resided in Demerara in the West Indies, a colony much afflicted with the disease. True, it is now fifteen years since she left there, and it was eight years before the first appearance of the disease. It is well known that the period of incubation may be very much longer, even as long as twenty or thirty years. It may be said that without exception all cases of leprosy met with in the Eastern States are persons who have lived for a shorter or a longer time in countries where the disease prevails. The experience in Great Britain is very instructive in this respect. Abraham estimates that within the past ten years the number of cases has been about one hundred, and so far as is known there has been but one instance in which the disease has been transmitted. This was the well known case reported by Benson, of an Irish soldier who returned from India with leprosy. His brother slept in the same bed with him for at least a year and a half, and after his death he wore the leper's clothes. Three years later the brother became leprous.

You will find in these volumes of the Transactions of the Leprosy Conference—of which by the way there is a very good abstract in Nos. 2 and 4 of the Philadelphia Medical Journal by Dr. Nuttall—a very full discussion of all the problems relating to the disease. Of these by far the most important relates to the method of infection, whether by inoculation, contagion, or hereditary transmission.

The possibility of successful inoculation must be recognized, though Hansen, the leading living expert on leprosy, declares that as yet all attempts at reproducing the disease by direct inoculation have been unsuccessful. He does not regard Arning's experiment on the Honolulu convict as satisfactory, since this man had leprous relatives. A number of observers, including some of the best students of the disease, have inoculated themselves with negative results. The direct hereditary transmission must be excessively rare, more so indeed than in tuberculosis. As lepers have, as a rule, very few children, heredity can only play a very small part in the spread of the disease. Alverez stated at the recent Congress that he had never seen a new-born leper child; the youngest patient he had met with was three and a half years old.

The highly contagious character of leprosy has been a fixed belief for centuries, and much of the popular dread is based upon the highly colored views as to the extreme risk of contact with the disease. For a full discussion of the question I must refer you to the Proceedings of the recent Congress. The opinion was universally in favor of its contagious nature, though the greatest difference of opinion existed as to the methods by which the disease is conveyed, and on this question we really need much more information. An important point was brought out at the Congress as to the much more widespread distribution of the lepra bacilli, particularly in the secretions. In modern times one of the strongest points in favor of the contagious nature of the disease is the manner in which it has spread in the Sandwich Islands. Europeans residing in leprous regions occasionally contract the disease, and with scarcely an exception, as in the patient I have just shown you, cases occurring in leprosy-free regions have a history of a residence for a longer or shorter time in localities in which the disease prevails. On the other hand there are a great many facts which would indicate that it is very difficult to catch the disease. It is true that Father Damien at the leper settlement at Molokai, and Father Boglioli (whose portrait I here show you) in New Orleans, contracted the disease in the discharge of their ministerial duties, but it has been the almost universal experience in the leper settlements and lazarettos that the nurses, physicians and attendants are not attacked. At the Tracadie settlement, which I visited a few years ago, the head Sister told me that during the forty years no Sister or servant had contracted the disease, though the accommodations are rather contracted. Not one of the Sisters who have nursed in the Trinidad Asylum, for now nearly thirty years, has contracted the disease.

A very important question is whether there is any possibility that leprosy will again spread in the more civilized districts of the earth. A good deal of uneasiness has been fostered by sensational newspaper reports. The practical question for us here is, is leprosy spreading in the United States? I have here letters from most of the infected districts, the contents of which I will briefly summarize. Including the two districts in the Dominion of Canada, there may be said to be five foci in which the disease at present prevails.

In the northern part of New Brunswick leprosy has existed in a couple of counties since the early part of the century. The cases as recognized are segregated in the lazarette at Tracadie. Dr. Smith, the physician in charge, writes under date of January 17, 1898: "The number at present in the hospital is twenty-four, eighteen males and six females. . . . Of the above number three are Icelanders whom I brought from Manitoba. Leprosy in Cape Breton has almost died out. With us in New Brunswick segregation is stamping out the disease. The cases have dwindled from about forty in the early history of the disease to about half that number. One of our inmates is a negro I brought recently from St. John, N. B. He had strayed from Bermuda. Leprosy is not on the increase in Canada." In British Columbia the disease has been introduced by the Chinese, but I have recently heard from Dr. Hannington, of Victoria, that there are only eight cases at present in the settlement on Darcy Island. Dr. Hannington does not think that the disease is spreading. Among the Icelandic immigrants in Manitoba there are a few cases, but the strong probability is that it will gradually die out.

In the United States there are three important centres. To "New Scandinavia," as parts of Minnesota and Wisconsin have been called, the disease was introduced by the immigrant Swedes and Norwegians. Altogether more than 150 cases were known. The disease has not spread, and Dr. Bracken, the Secretary of the State Board of Health, wrote January 19, 1898, that there are in Minnesota, so far as is known, only twenty-seven cases, and some of these have probably died since the last return. All of them contracted the disease before coming to America. A very encouraging fact is that no instance of leprosy has been known to be contracted from any of these Norwegian settlers. In California leprosy has been introduced by the Chinese, and in a few instances by native Americans returning with the disease from the Sandwich Islands. The total number of cases, however, is not large, certainly not more than a dozen, and the likelihood of the disease progressing in the native American population is very slight.

By far the most extensive focus of leprosy is in Louisiana. Dr. Isadore Dyer, who was the delegate from Louisiana to the Leprosy Conference in Berlin, has reported fully on the history of the disease in that State, where it has been known since 1785. Dr. Dyer writes under date of January 12, 1898: "My paper on endemic leprosy in Louisiana, read before the Lepra Conference in Berlin, has not yet been published. It is to appear in the third or fourth volume of the Transactions of this meeting. Full tables are given of all recorded leprosy in Louisiana since 1785, the existing acknowledged cases being separately tabulated. This last table contains 118 cases, in addition to which I have seen six within the past four months, making a total of 124 positive living cases to-day." Dr. Dyer thinks that this does not represent by any means all the cases, but says he believes it is quite justifiable to calculate the number of lepers in this State as not less than 300.

A few cases of leprosy are met with in Florida, South Carolina and in others of the Southern States. Now and again cases occur in the eastern cities, invariably imported, as in the patient at present in the hospital. So far as we know, with the exception of the single case recorded by Dr. I. E. Atkinson of this city, there has not been an instance in which the disease has been transmitted from one of these imported cases to a native American.

I believe the danger of the disease spreading and becoming in any way a serious menace to the country is entirely fanciful. In the question of the annexation of Hawaii the danger of leprosy has also come up. This really would not be a serious objection. I have seen a letter from Dr. Day, from Honolulu, in which he claims that the disease is progressively diminishing, and that the statement made by Dr. Prince A. Morrow, of New York, that every one in ten individuals in the Sandwich Islands is leprous is entirely unwarranted. He quotes figures to show that the number of cases segregated in Molokai has progressively diminished in the past few years. In a recent letter to the San Francisco *Chronicle* the President of the Board of Health states that barely one per cent of the population of the Sandwich Islands has leprosy.

The means for combating the existing cases of the disease are perfectly plain and well understood. The Norwegian method of segregation should be enforced in Louisiana and in the State of California. Remarkable results have followed this plan in Norway. In 1856 there were nearly 3000 lepers in Norway; now there are not more than 700, and most of them are in asylums. The segregation should be compulsory in all instances except when the friends can show that they have ample provision in their own home for the complete separation and proper care of the patient.

In the case of the patient you have just seen, as her husband is not in a position to look after her, it is the duty of the city to care for her in a proper way. She should be removed to Bay View, where a room should be provided with a separate arrangement for washing the clothes and disinfecting the body linen. From a humanitarian standpoint we have been very glad to care for her and to do what we could to check the disease in its active and progressive state. Now that she has improved so much I feel that we are no longer bound to keep her, and as she is a free agent, I shall take an early opportunity to discharge her from my care.

NOTICE.

All inquiries concerning the admission of free, part pay, or private patients to the Johns Hopkins Hospital should be addressed to Dr. Henry M. Hurd, the Superintendent, at the Hospital.

Letters of inquiry can be sent, which will receive prompt answer, or personal interviews may be held.

Under the directions of the founder of the Hospital the free beds are reserved for the sick poor of Baltimore and its suburbs and for accident cases from Baltimore and the State of Maryland. To other indigent patients a uniform rate of $5.00 per week has been established. The Superintendent has authority to modify these terms to meet the necessity of urgent cases.

The Hospital is designed for cases of acute disease. Cases of chronic disease are not admitted except temporarily. Private patients can be received irrespective of residence. The rates in the private wards are governed by the locality of rooms and range from $20.00 to $35.00 per week. The extras are laundry expenses, massage, the services of an exclusive nurse, the services of a throat, eye, ear and skin or nervous specialist, and surgical fees. Wherever room exists in the private wards and the condition of the patient does not forbid it, companions can be accommodated at the rate of $15.00 per week.

One week's board is payable when a patient is admitted.

SECONDARY MELANO-SARCOMA OF THE LIVER FOLLOWING SARCOMA OF THE EYE.

By Louis Philip Hamburger, M. D., *Resident Medical Officer, The Johns Hopkins Hospital.*

In an article written in 1889 Litten called attention to the inadequacy of the accounts of melano-sarcoma of the liver following a primary growth in the eye. With the exception of Virchow's classical work on tumors, the condition had not been presented in the text-books of medicine or of pathological anatomy in a manner befitting its importance, and Litten writes, "Even the best special works on diseases of the liver, in German, French, and English, scarcely mention it."

Litten's case was that of a man aged 34 years, whom he saw in November, 1884, with a tumor of the liver. He did not see him again until March, 1888. The man was then cachectic, the tumor had increased in size, and in some places showed fluctuation. The possibility of echinococcus cysts was discussed and one of the fluctuating points was aspirated. A black fluid was withdrawn containing polymorphonuclear cells filled with pigment and many pigmented polygonal cells—the pigment being dark brown and even black in some cells—and finally, a few red blood corpuscles. The patient wore a glass eye, and upon referring to the ophthalmological records it was discovered that the right eye had been removed in January, 1884, for a melanotic sarcoma of the choroid. Thereupon the urine was carefully examined and melanuria was demonstrated. The history of a choroidal tumor, an enlarged and nodular liver and melanuria rendered the diagnosis clear; it was subsequently confirmed at the autopsy.

Since the publication of the above-mentioned paper many cases of liver metastasis following primary melanotic tumor of the eye have been reported, but even now the clinical picture has not received the attention which it deserves. Within a year two patients have presented themselves at the Johns Hopkins Hospital with this condition.

Case I. C. B., male, white, age 42; admitted August 21, 1896, complaining of pain in right side.

Family history unimportant. Patient has never had any serious illness. Five years ago, upon the day he sailed from England to this country, his right eye without apparent cause became inflamed. He received no medical attention and at the end of the voyage the eye was quite blind.

His present illness began six weeks ago with a stabbing pain in right side. He then for the first time noted a small lump over the lower ribs on the right side, which was so painful upon any exertion that he gave up work.

There is anorexia; no vomiting; bowels irregular; he has lost 35 pounds in weight since onset.

Physical Examination. Patient is sparely nourished and rather pale. Right eye atrophied; on seventh rib just outside the right mammillary line there is a hard fusiform enlargement 6½x4 cm. and about 1 cm. in depth. It is firm and seems attached to the rib; the overlying skin is not discolored. Examination of heart and lungs negative.

Abdomen. With the exception of a slight bulging in the right hypochondrium, the abdomen looks natural. Liver flatness begins at the sixth rib in right mammillary line; its edge is palpable 10 cm. below the costal margin; it is less distinctly felt as one reaches the median line. Surface is smooth and firm; edge a little irregular. In the epigastrium are four small flattened prominences which feel like subcutaneus fibro-cartilaginous nodules. Spleen not palpable; no general glandular enlargement. Rectal examination negative. Urine, light amber, acid; specific gravity 1020–26; no albumin or sugar; diazo-reaction present.

September 4th, Dr. Mills removed the atrophied globe, and at its posterior portion a small melano-sarcoma, evidently arising from the choroid, was discovered. The patient remained in the hospital a month. Subsequently, on October 8, 1896, he was readmitted, looking paler and more emaciated, and complaining of pain in right and left sides, epigastrium, right shoulder.

The lower right chest is bulging; abdomen is markedly distended, especially in right hypochondrium. On palpation the edge of the liver is felt about 14 cm. below costal margin in right mammillary line; in right and left hypochondrium the edge feels sharp and normal, but below and to the right it is very hard and nodular. Surface is slightly irregular. The patient remained under observation two weeks, and at his own request was discharged; his subsequent history is not known. During these weeks the liver rapidly increased in size; a small swelling similar to the one on the seventh rib, but about one-third its size, appeared on the fifth rib, right side, at junction of its osseous and cartilaginous portions; lymphatic glands became palpable in right inguinal and left posterior cervical regions.

The second case we were able to study more thoroughly.

Case II. P. W., male, white, age 38 years, admitted July 26, 1897, complaining of pain in the lateral regions of abdomen and in the back on right side. Family history unimportant. Patient has had smallpox and rheumatism, otherwise always healthy. About December, 1890, he was struck in the right eye by the branch of a tree. At the time he paid little attention to the incident, but in the course of the winter the eye began to give him pain and his head ached a great deal. During 1891 his vision began to fail, and in January, 1892, a physician whom he consulted enucleated the eyeball.

Present Illness. Began between two and three years ago, that is, about three years after the enucleation, with pain in the abdomen. For the past year has not been able to do much work, for the pain, which extends all over the abdomen and is of a "burning" character, is rendered more severe by any exertion. During last six months little nodules have appeared over the chest. Does not think complexion is darker than formerly; no jaundice; appetite variable; vomited once last week; three years ago weighed 185 pounds, now 117 pounds; has grown weak. At present he has a great deal of frontal headache. He has had cough for three or four days; slight whitish expectoration.

Physical Examination. Patient is an emaciated man; swarthy complexion; lips and mucous membranes of fair color. He wears a glass eye in the right orbit, and when it is removed a moist glistening brown mass is visible in the posterior portion of orbital cavity. Scattered over arms, thorax, abdomen and back are nodules varying in size from one-half to three and a half cm. in diameter, bluish-green in color, and not adherent to the skin or deep tissues. Percussion note over front of chest resonant. In the supra-clavicular fossæ expiration is prolonged, elsewhere of normal relative length. Percussion note over right half of back below middle of scapula lacks resonance; in this area many medium-sized râles are heard; a few over base of left lung. Elsewhere the lung is clear on percussion and auscultation. Heart sounds feeble but free from murmurs.

Abdomen. Full; costal grooves obliterated. Right costal margin considerably more prominent than left; right half of abdomen is more distended than left; veins are prominent over its surface.

Respiratory movements slight. On deep inspiration a large mass descends in the right half of abdomen. Hepatic flatness begins at the sixth rib in the right mammillary line and extends 5½ cm. below costal margin and 13½ cm. below ensiform cartilage in the median line. On palpation a large firm mass occupies an area the limits of which correspond to those obtained on percussion. The mass (evidently the enlarged liver) is extremely firm and distinctly nodular; its edge is rounded. There is general tenderness over abdomen. Spleen not palpable. No general glandular enlargement. Rectal examination negative; urine showed reactions of melanuria. One of the subcutaneous tumors was removed and proved to be a spindle-cell sarcoma with brown pigment within the cells as well as about them; there was some alveolar arrangement.

Blood. Red blood corpuscles 4,480,000; white blood corpuscles 10,300; hæmoglobin 40 per cent. Differential count: Polymorphonuclears 71.6 per cent.; small mononuclears 17.4 per cent.; large mononuclears 9 per cent.; eosinophiles 2.8 per cent.

After admission the patient had attacks of vomiting and diarrhœa, occasional elevations of temperature, now and then paroxysms of coughing during which he expectorated frothy blood-stained sputa. The abdominal tumor and the growth in the orbit rapidly increased in size, new subcutaneous nodules appeared here and there, he suffered great pain in the abdomen, especially on defecation, became progressively weaker and more emaciated, and finally died on October 13, 1897.

Autopsy. The autopsy, performed by Dr. Flexner, showed the most extensive metastases involving the liver, kidneys, lungs, pancreas, thyroid gland, stomach, intestine, gall-bladder, the abdominal, mediastinal and thoracic lymph glands. The right optic nerve showed a grey degeneration and was atrophied; the meninges were œdematous.

The first case is evidently one of primary sarcoma of the choroid with liver metastases; the second, one of general dissemination following what was presumably a melano-sarcoma of the uveal tract, although an account of the condition of the eye at the time of enucleation could not be obtained.

In each case the loss of an eye, the subcutaneous tumors and enlarged liver contributed to form the characteristic picture of melano-sarcoma; indeed, in the second patient the loss of an eye, the pigmented nodules and the colossal nodular liver descending visibly with each inspiration, enabled one to make the diagnosis *de visu*. In addition to emphasizing the clinical aspect of this condition, the cases serve to illustrate many features of pigmented sarcoma of the eye and its sequelæ.

Following the classification of Virchow, pigmented sarcomata of the eye are divided into three classes: 1. Primary external melano-sarcomata which arise at the scleral border. 2. An orbital variety, springing most probably from the adipose tissue of the orbit. 3. Primary internal melano-sarcomata. It is to this division that the first and probably the second of the present series belong. These are the sarcomata arising from the uveal tract; the great majority have their point of origin in the choroid, and as in our case most frequently from its posterior portion. They are composed of spindle cells, or they may contain besides spindle, round and stellate cells.

The disease is not a common one. With the exception of early childhood, it occurs at all ages. Most of the patients are between forty and sixty years of age; a case has been observed as late as the 84th year.

In each of the above histories one's attention is attracted to certain incidents preceding the development of the tumor. It will be recalled that in the one case there is an account of a trauma one year preceding removal of the globe, and in the other, of an inflammatory trouble coming on five years before the new growth was detected, which had caused meanwhile an atrophy of the eyeball. Now, the association of simple inflammatory conditions, with or without antecedent trauma, and the development of melanotic sarcoma of the eye, has often been commented upon and is frequently so striking that it cannot be dismissed as a chance coincidence. Virchow quotes a number of examples. Thus, Rosas reports the case of a woman who lost her sight through an injury received four years previously while splitting wood. Cooper narrates the case of a woman whose cornea had been cloudy two years as the result of an inflammation. Bowman and Mackenzie each gives an example of the growth developing in an eye in which there was present a condition quite similar to that found in our first patient, namely, *atrophia bulbi*. Particularly instructive is a case reported by Raab, inasmuch as imbedded in the tumor could still be demonstrated a portion of the splinter of wood which a year previously had caused the trauma. In 103 cases Lawford and Collins obtained the history of injury in 6.79 per cent.

Perhaps no other ætiological factors in the domain of new growths have been more discussed than those we have just been considering; the details of this discussion need not be rehearsed. It is particularly interesting, however, in this connection to note the recent endeavor to associate the development of malignant growths of the alimentary tract with trauma.* Once the ocular sarcoma becomes established a metastasis sooner or later occurs. All the organs may contain tumor masses, but certain of them are more prone to involvement than others. When there is a widespread dissemination, the distribution is much the same as that presented by our autopsy.

Almost all of the organs as above stated were involved. The spleen, bones, bladder, prostate and testicles were free from metastases. The pleuræ were extensively involved, but in the parenchyma of the lungs there were only two or three nodules about the size of a walnut and a few smaller masses just beneath the pleura. The tumor masses varied in color from a mottled grey to a deep black; the former usually firm, the more deeply pigmented portions almost diffluent.

Sections prepared from the abdominal lymph glands showed microscopically a pigmented large cell sarcoma.

The liver seems to offer a most favorable soil for the development of secondary growths, and it may be the only organ affected. Some of the largest livers on record belong to this group.

The liver of Litten's patient weighed about 10 kilo (27 pounds). In our second case the organ weighed 8.3 kilo (22 pounds). The capsule was tense and congested. Pigmented nodules projected from its surface, pushing the capsule out. At about the level of the umbilicus there was a fresh deposit of fibrin as well as old adhesions between the liver and the abdominal walls. There were similar deposits on the superior

* Boas. Deut. med. Wochenschr., No. 44, Oct. 1897.

surface of the right lobe and adhesions to the œsophagus. Projecting from the inferior surface of the right lobe near its lower margin was a pedunculated tumor 5 x 4 x 6 cm.; soft, lobulated and grey on section. Many nodules of various sizes were scattered through the substance of the liver; the largest about the size of an orange, black, and almost diffluent; the smaller variety usually greyish or slate color. Microscopically the pigmented tumor cells had an alveolar arrangement with scanty stroma intervening.

Assuming as we do that dissemination takes place through the blood, what determines the localization of metastases in certain organs and the escape of others is not at all clear. The same difficulty is met with in some cases of multiple lympho-sarcomata, and here it has been suggested that the process is really not to be regarded so much as a metastasis in the usual sense, but rather as an infectious disease, the result of the diffusion of a virus through the body (Schulz, Flexner). Efforts have been made to detect the materies morbi in the blood, but the results have not been encouraging. Pigment granules and pigmented leucocytes have been found, but actual tumor cells, as far as I know, have not been discovered.

The urine in cases such as we have been discussing often presents the condition known as melanuria. The urine of the second of our patients may be taken as an illustration of these phenomena.

On an average 1100 cc. were voided daily, of a brandy-brown color, with a specific gravity varying from 1008–1027; reaction, acid; neither albumin nor sugar present. At times polymorphonuclear cells and calcium oxalate were present in the flocculent sediment. Allowed to stand exposed to the air the urine became much darker, and the same change immediately ensued on the addition of an oxidizing agent (nitric acid, potassium bichromate). A solution of ferric chloride added to a specimen also caused it to turn black; diazo-reaction present.

The fact that the urine in melanosis is occasionally black has been long known, but it was not until 1858 that Eiselt accurately described the condition of melanuria in the case of a man suffering with "carcinoma" of the liver and eye. The urine darkened on standing, and the same change was produced by addition of nitric acid. The observation was verified, and from the character of the urine the opinion was ventured that the neoplasm was of a melanotic variety, an opinion which was later confirmed at the autopsy. To the hypothetical pigment the name melanin was given. The subject at once engaged the attention of the Prague school and many publications followed Eiselt's. In 1865 Dressler obtained an iron containing pigment from a melanotic growth of the liver, and about the same time Pribram separated by precipitation with neutral lead acetate a similar pigment from a melanuric urine. He concluded that the two pigments were probably identical. But later, in a brown pigment isolated from the urine of a patient with a melanotic growth in the orbit, Hoppe-Seyler could not demonstrate iron. In 1889 v. Jaksch added another reaction for melanuria, showing that ferric chloride even in dilute solution colored the urine black. He, like Pribram, found iron and also sulphur in the lead acetate precipitate. Almost simultaneously and independently of v. Jaksch, Pollak recommended a solution of ferric chloride as a delicate test for melanin. His analysis of the precipitated pigment showed besides sulphur and nitrogen, iron.

While melanuria was being investigated, attention had also been directed to the pigments of the sarcomata themselves. The results are not entirely in accord. The presence or absence of iron in the pigment is considered to have an important bearing on the question as to whether they take their origin from the blood. Whereas Berdez and Nencki report the pigment of sarcoma of liver and spleen as free from iron (phymatorhusin), Mörner reports an appreciable quantity. In this connection it is of interest to note that in their recent work on the pigment of negro's skin and hair, Abel and Davis point out that the difference of opinion regarding the iron content of melanin may be due to the fact that the distinction between the pigmentary granule and the pigment itself has not always been made. The granule contains iron, the pigment a steadily diminishing amount as it is more and more purified, so that finally only the faintest trace remains; from which they conclude that iron is not a constituent part of the melanin derived from the negro's skin. *A priori*, knowing that the choroid is so often the primary seat of melanotic sarcoma, one might expect a correspondence between the composition of "phymatorhusin" and the melanin of the choroid. But the fact is that while the former is rich in sulphur, in the pigment of the choroid there is neither sulphur nor iron.

Whoever has approached the subject of the melanins must have been impressed with the present unsatisfactory state of our chemical knowledge regarding them. In composition they approximate the proteids, and like them they present similar difficulties in separation and purification. The point of clinical importance, however, is that in melano-sarcomatosis the urine, as in Finkler's case, is sometimes black. More often, as in our case, it is clear when voided and becomes dark on exposure to air or on the addition of oxidizing agents. In the first class a melanin is excreted; in the latter group it is assumed that the melanin or phymatorhusin of the neoplasm is absorbed into the blood, is converted in the tissues into a colorless body melanogen, which is then excreted only to be reconverted into a melanin by oxidation. At what period in the course of the disease melanuria appears is not certain, but it is usually stated that a previous metastasis is necessary. We must look to the ophthalmologists for further information. Its diagnostic value, which might be considerable in an obscure case, is somewhat lessened by the fact that reactions similar to that of melanin-containing urine have been observed in some cases of peritonitis, of simple carcinoma of the stomach and liver, and following administration of tannic acid.

Finally, the question of the prognosis of melano-sarcoma of the uveal tract demands consideration. Left untreated, a metastasis sooner or later occurs. It is difficult to estimate the duration of the disease, for the ocular tumor is characterized at first only by ophthalmoscopic changes and its presence is not evident. Usually, after a period of one or two years, during which there have been more or less pain and functional disturbance of the eye, the tumor ruptures externally

and a metastasis occurs. The secondary deposits often grow with frightful rapidity and death soon ensues. Litten's case, in which the patient with a metastasis survived four years, is probably unique. The average duration of life is about three years. Widespread dissemination may have taken place before the neoplasm of the eye is suspected, and tumor masses in the liver, as in Litten's case and in Case I, may for the first time lead to a careful examination of the bulb. Early enucleation of the diseased globe has a certain prognostic import. In a study of 79 cases of sarcoma of the uveal tract whose after history could be followed, Lawford and Collins regarding patients apparently free from the disease more than three years after operation as well, report 25 per cent. of recoveries. Unfortunately, as they point out, no such limit can be fixed. Thus in Case II, although there was some evidence (abdominal pain) that metastasis may have taken place three years after the enucleation, yet it was not until nearly five years had elapsed that the patient presented himself with a local recurrence and an enlarged and nodular liver. Jonathan Hutchinson, Jr., cites a case in which the first evidence of metastasis appeared eleven years after the diseased globe had been removed. Such cases illustrate the gloomy outlook in melano-sarcoma of the eye, even when early enucleation is carried out; they make it impossible to say when an individual having had a primary ocular sarcoma can be considered safe from future trouble. It is comforting, however, to know that patients have been followed as long as sixteen and eighteen years after early removal without presenting signs of the disease.

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Discussion.

Dr. Abel.—The melanin, or black pigment, making up so large a part of the tumors in the case presented by Dr. Hamburger, is a substance of no little chemical interest. I wish merely to bring out two points relative to this pigment. First, the term melanin should be applied only to the black or brown pigments of the melano-sarcomata of the retinal and choroid coats of the eye, of the hair and skin, of the secretion of the cuttle-fish, etc.; in short, to a large class of substances which have been isolated by chemists, which are known to be stable and highly resistant compounds, possessing certain definite characteristics. The term should not be applied, as it sometimes is by histologists, to every brown or black particle which may be seen as a more or less temporary stage in the breaking down of red corpuscles in pathological conditions. A true melanin has not yet been isolated from an area where there has been an extensive disintegration of red corpuscles. We have no proof that the dark particles in such an area contain a genuine black pigment like the melanins.

My second point concerns itself with the origin of the melanins. Are they derivatives of hæmoglobin or of some other substance? Histologists have laid great stress on the iron content of a melanotic pigment, holding that the presence of iron lends great probability to the view that the pigment in question is derived from hæmoglobin. Now a micro-chemical iron reaction merely shows that iron is present in or on the *little particle* examined; it does not prove that iron is present in the *molecule* of the pigmentary substance to which the color of the particle examined is due. Iron may be present in the molecule of a pigment and yet micro-chemical methods may not be able to detect it, as in hæmatin, for example. Again, the pigmentary granule as deposited in cells is a very different thing from the pigment considered as a chemical individual; the former is a complex anatomical unit, containing many other substances in addition to the pigment. Confusion has resulted because this point has not been borne in mind. Davis and I showed that the pigmentary granules in the negro's skin and hair contained much iron, while the isolated and purified pigment contains none, and we have every reason for believing that this holds for every particle of melanotic pigment in the body. The fact is that much more than the presence of iron must be established before we can say that a pigment is derived from hæmoglobin. Some of the colored derivatives of hæmoglobin, as hæmatoidin, hæmatoporphyrin and biliribin, contain no iron, while the well-known hæmatin contains this element. Now all of these natural derivatives of hæmoglobin differ so widely in both their physical and chemical characteristics from the melanins, as thus far isolated, that no chemist can suggest a plausible theory for the derivation of these latter from the color-yielding complex of atoms in the hæmoglobin

molecule. To point out only one great obstacle, the melanins, with few exceptions, contain sulphur, the amount varying from 2 to 12 per cent., while the colored derivatives of hæmoglobin, like those already referred to, contain no sulphur. A theory of the origin of melanins must account for this difference and also for the difference in the carbon, hydrogen and nitrogen content, not to speak of physical differences as shown by the spectroscope. My own observations have led me to think of the sulphur-containing melanins, such as the sarcomelanin of this case, as highly altered proteids, as compounds that must still be classed in a broad way with the proteids. If, therefore, hæmoglobin is to be made the precursor of these pigments, it is the proteid part, or globin of the blood pigment, from which they are derived. But we can as easily suppose some proteid of the parenchymatous juices to be decomposed as that the proteid moiety of hæmoglobin should serve this purpose. We could assert with equal force that all the keratin in the body is derived from hæmoglobin.

Schmiedeberg has recently published the results of an elaborate research on the nature and origin of the melanins which bear out this view. I cannot go into the chemical details of the question, but can only give you his conclusions, to which I subscribe most heartily. The immediate precursor of the melanin is a product derived from a genuine proteid, say serum albumin, by a fermentative process; it is a highly resistant, modified proteid of the character, we will say, of an antipeptone which has lost carbon-containing groups, perhaps also leucin and tyrosin. This substance would therefore be richer in sulphur than the original proteid. It is further modified by having ammonia and water split off from it, its hydrogen content being further diminished by oxidation. These deductions are based on a careful comparison of the elementary formulæ of many proteids and of all of the melanins hitherto isolated and analyzed, and they harmonize entirely with the chemical processes known to occur in the body. No other rational theory of the origin of the sulphur-containing melanins, like those found in these tumors, in the hair and skin, etc., can be offered at present. I may remark in closing that the formation of the dark pigments seen in decaying vegetable matter, and which are called humus substances, presents many points of analogy.

ON INFECTION WITH A PARA-COLON BACILLUS IN A CASE WITH ALL THE CLINICAL FEATURES OF TYPHOID FEVER.

By Norman B. Gwyn, M. B., *Assistant Resident Physician, Johns Hopkins Hospital.*

Bacterial infection, or the intoxication caused by bacteria, gives to the blood the property of paralyzing and clumping the specific organisms. This is the principle of the Widal reaction, now so well known in connection with typhoid fever, and the same applies to other well-known organisms, such as the pyocyaneus and the bacillus of hog cholera. From this we may infer that a serum test is a valuable or certain proof of an organism's specificity. No better suggestion of this can be found than that shown by the colon family, in which Durham has shown that the serum of an immunized animal agglutinated decidedly only the organism used for the immunization, other colon organisms being but feebly affected. Widal infers from this that, especially in an infection caused by one of a group like the colon, the serum reaction is only of value as affecting that particular colon organism which has produced the infection.

For the production of this serum reaction in the blood of an individual, something more than the mere presence of the organism in the body is required. There must be a definite infection or intoxication produced before the blood will acquire its specific property. The presence of the colon bacillus in the normal intestine does not make it presumable that the blood of all persons will agglutinate the colon bacilli.

Based on the theory of specificity of the serum reaction, Widal* reports a case which he thinks (from the behavior of the patient's serum towards the organism isolated from his body) must be considered as an instance of infection by a para-colon bacillus, and the case he considers as one of para-colon infection.

The name para-colon is given to the organism as showing its resemblance to the colon family, but Widal gives it a place more properly between the bacillus typhosus and the colon bacillus, as its properties are closely allied to both.

The history of his case of so-called para-colon infection is as follows: A phthisical patient developed, after three weeks in the wards, an abscess in the neck about the œsophagus, showing at the same time some slight constitutional symptoms. From the pus at operation an organism was obtained in pure culture, actively motile, decolorizing by Gram; it did not liquefy gelatine, clouded bouillon without making a film, and formed a few gas bubbles in glucose agar; grew on potato as a yellowish green film.

The two most essential points distinguishing it from the colon family were that it produced no indol and did not ferment lactose, while the fermentation of glucose distinguishes it from the typhoid bacillus. Further reactions confirmed the fermentation of glucose and mannite, and the absence of the same in lactose and saccharose.

The main feature of the organism, however, was its serum reaction, and on this its claim of specificity rests. The serum of the patient had a marked agglutinative action on the organism in as high dilutions as 1–1000, the reaction diminishing steadily with convalescence.

To confirm this result various other organisms were com-

* Semaine Médical, Aug. 4, 1897.

pared. The different cultures of colon bacillus were affected by the patient's serum no more than by normal sera. Another para-colon bacillus isolated from the mouth agglutinated at 1–150; the bacillus psittacosis responded at 1–50. The serum of a guinea-pig inoculated with the particular para-colon organism gave no result with two colon bacilli, a typhoid bacillus and the other para-colon organism mentioned above. Conversely various normal sera and sera from patients with various affections. Sera of animals inoculated with different organisms had little or no effect upon Widal's para-colon bacillus, with the exception of typhoid sera of very high agglutinative power obtained by experimental inoculation. The sera of animals inoculated with colon bacilli, with the psittacosis organism and the other para-colon, gave little or no reaction on the organism.

Widal concludes from these serum reactions that the bacillus isolated was the cause of the patient's infection. The other para-colon bacillus referred to, isolated from a person's mouth, differed from that isolated from the abscess in fermenting saccharose in addition to glucose and mannite.

These two so-called para-colon bacilli, the psittacosis organism, a bacillus called the bacillus of calf septicæmia of Thomasson, Widal considers to form a family or group, in much the same way as the colon organisms are classified as a family. The individuality of the members is shown suggestively, though not absolutely, in the serum reactions mentioned above, and by differences in fermentation of the various sugars.

Recently we have isolated an organism which from its cultural properties seems to belong to this so-called para-colon group, and is possibly identical with one of Widal's para-colon organisms. It was found, moreover, that the patient's serum had a specific agglutinative power on the organism, and the conclusion was reached that the organism isolated had caused the infection. The case is of further interest as one of typical typhoid fever, and the question arises whether or not the organism found had produced a secondary infection during the disease.

Louis S., admitted Oct. 11th, 1897, had been ill since Sept. 17th with headache, fever and weakness, and later with vomiting, diarrhœa and pain in abdomen. On Oct. 14th noisy delirium set in; on Oct. 16th the patient had three hemorrhages from the bowel; he slowly rallied and went out in five weeks.

Rose spots were present; the spleen was palpable; the urine showed the diazo reaction; there was no diarrhœa. The temperature was that of a severe typhoid fever. There was never any Widal reaction found. Blood cultures on Oct. 12th gave a small, actively motile bacillus suggesting the bacillus typhosus. It decolorized fairly well by Gram, grew on agar as a grey blue moist raised film, clouded bouillon, giving no scum on surface and no precipitate. Milk was only faintly acidified, resuming original tint in course of ten or twelve days. Potato showed a brown yellow moist layer of growth. There was no liquefaction of gelatin, slight stab and surface growth. Plates of gelatin and of gelatin diluted with bouillon gave same circumscribed blue grey colonies, about ¼ mm. in diameter; by microscope light brown regularly outlined granular colonies with no nucleus. The fermentation reactions showed fermentation of glucose, slight in saccharose, lævulose and mannite, but none in lactose. Sugar-free bouillon, to which in tubes 3 per cent. of various sugars was added, was used. There was no production of indol. By Van Ermengen's flagellar stain, from two to four flagellæ could be made out. No peritrichal arrangement as in the bacillus typhosus was seen.

The serum reactions were as follows: The patient's serum at different dates during his illness gave a rapid, complete agglutination in low dilutions, and showed reaction in dilutions up to 1–150 to 1–200, the highest being at date of discharge. On Dec. 18th, two months after date of culture, there still remains a slight reaction.

The same serum was without action on the bacillus typhosus in any dilution above 1–1 or 1–5.

Two varieties of colon were agglutinated by patient's serum as high as 1–50 and 1–60, but two normal sera agglutinated the same organisms in dilutions running from 1–60 to 1–100.

Typhoid sera of agglutinative strength ranging from 1–300 to 1–1100 were without effect on the bacillus in dilutions over 1–1 and 1–5. One typhoid serum, strength 1–900, with bacillus typhosus, gave an incomplete reaction as high as 1–30. Several of these sera had little or no effect even in dilution 1–1. One normal serum affected the bacillus rapidly at 1–1, failing at 1–5. A typhoid bacillus was affected similarly; a colon was agglutinated as high as 1–120; another normal serum had little or no effect at 1–1, while rapidly and completely agglutinating the colon organisms.

One other test mentioned by Widal for the distinction of the para-colon organism, is that called the scraped tube reaction, which consists in scraping off the surface growth of an organism from an agar slant and reinoculating with other or the same organisms. A fresh transplant of the same organism will not grow on the scraped surface; other different organisms will. Both colon and typhoid grow on the supposed para-colon tubes, and the para-colon grow on scraped tubes of them. Widal considers this an absolute distinction, stating that by it the different colon members can be distinguished.

The approach of the organism on the one hand to the typhoid bacillus and on the other to the colon family is well shown by the cultural properties. The effect on milk and the non-production of indol are like the typhoid bacilli; in the fermentation of glucose it resembles the colon family, from which again the non-fermentation of lactose and the negative indol test clearly exclude it. Its place really seems to lie between these two important organisms.

By comparing the cultural properties of our bacillus with those previously described, it can be seen that with the exception of the fermentation of saccharose the organism is precisely similar to Widal's para-colon isolated from the abscess; the resemblance to the one isolated from the mouth is more exact, as the latter had some effect upon saccharose. In the colon family, however, the fermentation of saccharose is a variable characteristic and may not occur with every member, so that this slight difference in fermentative quality may perhaps be a feature in the para-colon family as well. From these reactions and characteristics we think that the organism

here described may be considered a para-colon bacillus and may be identified with Widal's organism. Our infection unfortunately cannot be so clearly defined as his, occurring as it did in the course of typhoid, but if a serum reaction is a specific test, such an infection must have undoubtedly occurred. Of great interest, we think, is the fact that at no time, even up to the present, Dec. 18th, 1897, has the patient's serum given a Widal reaction, he being the only typical typhoid of 48 cases to fail therein, while his serum still shows after two months the result of the infection by the supposed para-colon organism.

THE MANAGEMENT OF SOLID TUMORS OF THE OVARIES COMPLICATING PREGNANCY, WITH REPORT OF A SUCCESSFUL CASE.

By William E. Swan, M. D., *Assistant Resident Gynæcologist in the Johns Hopkins Hospital.*

A careful examination of the literature shows that although solid tumors of the ovaries are not uncommon, their occurrence as a complication of pregnancy is sufficiently rare to justify a detailed report of every additional instance. Inasmuch, also, as the proper treatment of this condition is of the utmost importance, the following case offers certain points of interest.

A. R., single, white, domestic servant, aged 22, born in the United States, was admitted to the gynæcological wards of the Johns Hopkins Hospital, June 13, 1893. In the February previous (five months before) she had noticed an increase in size of the abdomen, which had gradually increased. Except for this enlargement of the abdomen, and amenorrhœa since January 1st, she had had no cause for complaint.

Family History. Paternal grandmother died of a new growth in lower abdomen. Maternal grandfather had a cancerous growth on arm; family history otherwise negative.

Personal History. Does not remember having had any serious sickness before. Menstruation began at fifteen; was irregular up to the 17th year, since then regular till 5½ months ago, of the 28-day type and of 5 to 6 days' duration; flow free; slight dysmenorrhœa.

Present Illness. Has always been healthy up to January, 1893. Early in February she first noticed a slight increase in the size of the abdomen, and absence of the menses, which have not returned since. The enlargement progressed in a symmetrical manner, and at the present time (June 3) the abdomen presents the appearances belonging to a five months pregnancy. The patient has had no morning sickness and has not noticed anything which could be interpreted as fœtal movements. There has been no increase in the size of, or pain in the breasts; no swelling of the feet or ankles. Sleeps well; appetite good; bowels constipated; slight giddiness; some dyspnœa on exertion; otherwise no inconvenience. No pain anywhere.

Physical Examination. General condition good. The patient is a well nourished, healthy-looking young woman; eyes clear, tongue slightly coated, mucosæ of a good color. Heart and lungs negative.

Abdomen symmetrically distended. Line of pigmentation from umbilicus to pubes marked. On light palpation a rather yielding, slightly resistant mass is felt extending from two inches above the umbilicus to the symphysis pubis, and from 3 to 4 inches to either side of the median line. On palpating deeply and quickly ballottement is obtained over this area, showing the presence of a layer of fluid. The abdomen over the same area is dull on percussion; on auscultation a placental bruit is heard in the right lower quadrant of the abdomen; no fœtal heart sounds are heard; no actual movements made out, but indefinite "lumps" are felt through abdominal wall which "retreat" from the examining hand.

The measurements of the abdomen were as follows: Girth at umbilicus, 30 inches; girth midway between umbilicus and symphysis, 31 inches; from the ensiform cartilage to umbilicus, 7¾ inches; from the umbilicus to the symphysis, 7¼ inches; from anterior spine of ilium on either side to umbilicus, 6½ inches.

Vaginal Examination. Vaginal mucosa dusky violet in color; outlet considerably relaxed; cervix high up, soft, shortened, patulous. Behind the cervix and occupying a large part of the pelvis is a hard, nodular, fixed mass, about 5x7 cm. in diameter, adherent to sacrum posteriorly. The breasts contained colostrum.

Diagnosis. Pregnancy, associated with solid tumor of the left ovary.

Abdominal section by Dr. Kelly, June 21, 1893.

Incision 18 cm. long through stretched and thinned abdominal walls. The uterus, which was of the size belonging to a five months pregnancy, was forced out by compression made on the sides of the abdomen by the hands of an assistant, the operator meanwhile making direct traction on it and throwing it forward so that the body rested on the pubes. By these means there was brought into view a tumor of the left ovary, lying behind the uterus in the pelvis but not attached to it. It presented a whitish appearance, was hard, irregularly oval, and about the size of two clenched fists placed closely together. Pressure upon it had caused some flattening of the surface adjacent to the sacrum. The tumor, which was attached to the left broad ligament by a narrow pedicle, was raised and tied off together with the left tube by means of four intermediate silk ligatures, a few extra silk ligatures being inserted to stop some slight oozing from the severed pedicle. The uterus, which had all this time been protected by means of a large piece of gauze kept constantly saturated with warm salt solution, was now returned to the abdomen. The peritoneum was united by means of a fine silk suture; the remaining layers of the abdominal coverings with silk-

worm gut and silk; gauze dressing, edges rendered adherent with collodion; iodoform and boric acid powder dusted over same; cotton; Scultetus' bandage.

Time of operation 46 minutes.

The convalescence was rapid and uneventful; the highest temperature reached was on the second day, when it rose to 101° F., after which it soon became normal; the bowels moved on the fourth day. On July 2, 1893 (12th day), note reads: "For the first few days after operation a slight bloody vaginal discharge was observed; patient complained of sharp pains through the abdomen. This symptom soon subsided under a moderate use of morphine. Abdominal dressings removed; wound united throughout *per primam;* general condition excellent."

July 10, 1893 (20th day), "Patient sat up in bed; did not feel weak nor tired afterwards."

July 22, 1893 (4 weeks after operation), "Patient discharged; has had no setbacks; wound nicely healed; patient feels well; abdomen increased in size."

Pathological Report. Mass consists of a large tumor developed from left ovary, with about 4 cm. of normal tube, with clear mesosalpinx; tube patulous. Tumor 12x7 cm., density of cartilage, with clear smooth fibrous capsule, which strips off moderately easily. On outer surface is an umbilication about 3 cm. deep, containing a small mass of similar consistence, with broad flat pedicle. Vessels on surface small but injected. Section of mass reveals a dense fibrous structure, yellowish and translucent, with numerous deeper pinkish areas corresponding to umbilication on surface; tissue much softened, and upon pressure exudes a clear fluid.

Frozen sections reveal fibrous tissue with fine points of fatty degeneration.

Sections hardened in alcohol. The specimen consists of dense fibrous tissue with spindle-shaped nuclei. The tumor is richer in cells in the larger portion. The capsule is much thickened. Vascular supply scanty, especially around the umbilication. Diagnosis: Fibroma of ovary.

From the after-history it would seem clear that premature labor was artificially induced after the patient returned home. When she left our care she was certainly well, and had nature been left to herself there was nothing in the patient's condition to prevent the continuance of the pregnancy to term, and there was no indication that in this case delivery would have been accompanied with any more danger than that belonging to a normal labor.

Considerable confusion seems to exist in the minds of authors regarding the classification of tumors of the ovaries associated with pregnancy. In many reports of cases of ovariotomy during pregnancy, only incidental reference or none at all is made to the nature of the growth removed. Thus, J. Dsirne[1] (Liveland) collected from the literature 135 cases of pregnancy associated with ovarian tumors in which ovariotomy was performed, the diagnosis in 42 of these being tumor ovarii, and in the remainder cystoma. None are distinctly specified as being solid tumors.

Most tumors of the ovary, including those complicating pregnancy, are cystomata, and of these dermoids form a considerable number, as is shown by the following table:

Name of operator.	Total number of cases operated on.	Cysts, including dermoids.	Number of solid tumors.	Fibromata.	Sarcomata.	Carcinomata.
1. Billroth	86	78	8	..	3	5
2. Schroeder	102	97	5	..	5	..
3. Thornton.....	338	328	10	3	..	7
4. Hildebrandt..	37	27	10	..	..	..
5. Weber.....	123	72	51	..	..	..
6. Krassowoski..	128	128	..	..	..	..
7. K. Von Brann.	81	71	10	1	2	5
8. Thos. Keith ..	200	183	17	..	..	..
9. Olshausen	193	267	26	6	9	5
Totals	1388	1251	137	10	19	22

The figures in the above table give, as we see, 9.9 per cent. solid tumors. But Olshausen[2] holds that this is too large a proportion. Weber, whose statistics tend materially to raise this percentage of solid neoplasms, has probably counted as solid tumors many which other authorities would class among the cystic variety. With Weber's cases omitted we should have only 6.8 per cent. of solid tumors, which is probably more correct.

The same table shows the relative frequency of the different varieties of solid tumors to be as follows:

Fibromata	are	present	in	the	proportion	of	.72	per cent.
Sarcomata	"	"	"	"	"	"	1.36	"
Carcinomata	"	"	"	"	"	"	1.58	"
All others	"	"	"	"	"	"	.057	"

The investigations of Jetter[3] have shown that any form of ovarian tumor may complicate pregnancy. Of his collection of 166 cases, 97 were cystomata, 37 dermoids, 11 carcinomata, and 21 uncertain. In this small number of cases the proportion of undoubted solid tumors to all others is only 6.6 per cent.

Solid tumors of the ovaries may be classified as follows:

- Solid
  - Desmoid
    - Fibromata,
    - Sarcomata,
    - Myxomata,
    - Endotheliomata,
    - Enchondromata.
  - Epithelial
    - Carcinomata,
    - Papillomata.

The lines between these several varieties of tumors are not always distinctly drawn, and almost any two forms may be found associated. The benign forms of epithelial tumors of the ovary are always cystic in nature (Olshausen[4]).

Ovarian neoplasms do not preclude the possibility of conception so long as the ovaries contain healthy ovarian tissue. Indeed, rare instances have shown that the removal of both ovaries is not an absolute safeguard against conception. In such cases there are undoubtedly rudimentary masses of ovarian tissue or supplementary ovaries left behind (Montgomery[5]).

It is difficult, if not wholly impossible, to arrive at any accurate conclusions as to the frequency of conception in women who are the subjects of ovarian neoplasms. S. Remy[6] finds, however, that in 257 women with tumors, 321 pregnancies occurred, with 266 normal deliveries; so that some of the

mothers became pregnant at least twice during the existence and probable growth of the same tumor.

Montgomery, in commenting on the frequency of ovarian tumors complicating pregnancy, says he is able from a very cursory investigation of the literature to present tables of over 150 cases. It is evident that he refers to cysts of the ovary associated with pregnancy.

Several authors, as Kleinwächter, Spencer Wells and Rokitansky, have observed pregnancy in connection with unilateral ovarian fibromata. During labor the tumor may obstruct the birth canal, and thus render Cæsarean section necessary, as happened in Kleinwächter's case; the tumor may be contused and become gangrenous, as has been described by Rokitansky.[7]

After a careful examination of the literature we have been able to find but fourteen cases of undoubted solid growths of the ovary in association with pregnancy. These are here presented in chronological order with brief histories.

Case I. Breit[8]. In this case an ovarian tumor of stony hardness and adherent to the rectum was removed; no details given.

Case II. Spiegelberg[9] (reported by Bourgonin). Patient was aged 37 and had borne two children. Immediately after the birth of the second child a rapid enlargement of the abdomen was noticed, which pursued a slowly progressive course and ended in death. At autopsy a fibroma of the left ovary weighing 60 pounds was found, with considerable ascites. Size of tumor 51x23 cm.

Case III. Spiegelberg[10] (reported in 1867). The woman died nine days after her second labor, aged 36. Tumors of both ovaries were found at autopsy which microscopic examination showed to be myxosarcomata which had undergone cystic degeneration. One tumor measured 20x12x4 cm.; the other 15x10x4 cm. Death was due to rupture of one of the tumors, apoplexy of both, and peritonitis.

Case IV. Kleinwächter[11] reported in 1872 the following case. Age of patient 31 years; month of pregnancy not stated, probably full term; pains began on May 25, and on May 29 were very severe. Patient was brought to the hospital by midwife, who got away before giving any further information. Head presenting. Examination revealed a bony tumor, about the size of a fist, in the pelvis. Cæsarean operation performed on May 31, 1868, and a healthy female child weighing 3010 grammes safely delivered. Twenty-five hours afterwards the mother died of general peritonitis.

Diagnosis. Peritonitis after Caesarean section; ossified fibroma of the right ovary.

Case V. Spencer Wells[12] (reported by Cayla). The patient, aged 29, who had had one child, presented herself in March, 1872, with a tumor in right suprapubic region. She was three months pregnant. One month later laparotomy was performed, and a tumor weighing five kilograms was removed. This tumor had been held in place by the epiploon to which it was adherent. The structure of the tumor was that of an œdematous fibroma. The patient recovered and the child was born at term.

Case VI. Hempel[13] in 1875 reported the case of a patient aged 42 who died four weeks after her 11th labor. At autopsy both ovaries were found enlarged to more than the size of a child's head. The surfaces of the tumor masses were hard and irregular. The tumors proved to be carcinomata, probably secondary to cancer of the stomach.

Case VII. Schroeder[14] (reported by Cayla). Woman aged 22, six months pregnant; operation May 25, 1876; solid tumor removed from left ovary. Labor at term; cure.

Case VIII. Spencer Wells[15] (reported by Cayla.) Woman aged 41, four months pregnant; operation October, 1876; tumor weighed 7 pounds. Labor at term; cure. Diagnosis: Round cell sarcoma of left ovary.

Case IX. Spencer Wells[16] (Cayla). Woman aged 28, four months pregnant; operation November, 1877. Fibroma of right ovary removed, weighing 10 pounds. Labor at term; cure.

Case X. Casati[17]. Large fibro-sarcoma of left ovary. Pregnancy at fourth month. Ovariotomy; abortion, partial suppurative peritonitis; cure. Patient was 29 years old. Menstruated at 18; married at 25; ten months later had first child. In March, 1881, had second child; labor normal. Two months after this noticed tumor in left groin. Four months after labor menses recommenced; milk stopped at 5th month. On January 4, 1882 (ten months after birth of last child), the patient was examined and the following diagnosis made:

Completely solid tumor (probably sarcoma) of left ovary; partial peritonitis and pleurisy. At operation the woman was found to be four months pregnant. The tumor weighed 1850 grammes, and measured 13x48x36 cm.

Case XI. Dr. J. H. Carstens,[18] of Detroit, Michigan, in 1889 reported a case almost identical with our own. The patient, aged 26, white, four years married, without having had children or miscarriages, had had frequent micturition and pain for the year previous. She had noticed a hard lump in lower abdomen, which had increased rapidly during the last four weeks. The menses, which had formerly been regular, ceased February 24, 1889. General health and family history good. Examination showed the pelvis to be filled with a hard growth which seemed movable. The uterus was found a little to the left of the growth. The os was soft, velvety. Pregnancy suspected. Examination under ether warranted a diagnosis of pregnancy of two months duration and a pelvic tumor, which was thought to be a uterine fibroid with a long pedicle, a sarcoma, or some other hard tumor of the ovary. Operation May 27, 1889. When the peritoneum was opened a very hard nodular tumor came into view. It was movable, slightly adherent to the bladder, intestines and omentum, but not adherent to the uterus. The long narrow pedicle was tied off together with the right Fallopian tube, which was also removed. The left ovary was found to be healthy and was left untouched. Patient made a good recovery. The pregnancy continued and was of seven months duration at the time the case was reported. The tumor was very hard and nodular, 20 cm. long and 12 cm. in diameter; in the middle was a constriction in which the uterus had rested. A microscopical examination by Dr. George Duffield showed only pure fibrous structure. The ovary had entirely disappeared in the growth.

Case XII. Münchmeyer[19] (reported in 1890). Patient aged 30. Third pregnancy. Month of pregnancy not stated, probably full term. Normal but small pelvis. Enormous elastic tumor (spindle-cell sarcoma) occupied the pelvis. Head presenting. Shortly before the delivery of fœtus the colossal swelling of the tumor was noticeable. The absence of any symptoms pointing to malignancy of the tumor was noted. The child being already dead, the skull was crushed and the fœtus delivered. The tumor remained for four weeks after the delivery, but shrunk to about the size of a goose egg(?). Ovariotomy was then performed; the patient made a good recovery, and was discharged three weeks subsequently.

Case XIII. J. Murphy.[20] Abdominal section during pregnancy (reported in 1895).

"A lady 32 years old was sent into the Sunderland Nursing Institute, under my care, to have an ovarian tumor removed, she being about six months pregnant. The operation was performed at noon, April 20, 1893. The tumor proved to be a solid round-cell sarcoma, weighing two pounds, with somewhat numerous adhesions. The labor pains commenced 24 hours after the operation and became severe at 10 a. m. The patient soon gave birth to a boy, who lived for 12 hours. The convalescence was uneventful. She left the Institute in three weeks. Her highest temperature was 99.5° F."

Case XIV. P. Ruge.[21] Woman aged 36; six months pregnant. Myxo sarcomata of both ovaries; no details.

From an examination of the results in the above fourteen cases we find that eight of the patients were submitted to operation before labor, with the death of one mother and with loss of but two children from miscarriages and one by craniotomy, four children going to full term and one being delivered by Cæsarean section. Three mothers were not operated on; of these, two died soon after labor as a result of complications due to the tumors, and one lived; in three cases no details are given.

The incompleteness of the above collection of cases is painfully apparent. A glance at the various dates of their publication—1861 to 1895—would suggest at once that many similar cases must have occurred previous to the former and probably also subsequent to the latter date. Their non-appearance either in the Index Catalogue of the Surgeon-General's Library or the Index Medicus, would lead to the conclusion that such instances were either not reported at all, or that the accounts of them did not possess sufficient detail and clearness to enable the cases to be recognized as belonging to this category. So-called solid dermoids and all other tumors not distinctly specified to be solid have been rejected from our list.

Influence of Pregnancy on the Growth of Ovarian Tumors.

In this connection two main theories may be cited: (1) That the increased blood flow increases the growth of the tumor (Spiegelberg and Olshausen). (2) That a decrease in the size of ovarian tumors during pregnancy occurs, owing to lack of space and inactivity of the ovaries (Koeberle). The former of these two views is generally accepted (Dsirne).[22]

Wernicke suggested that benign tumors are apt to become malignant during pregnancy. There are no observations which tend to support this view (Olshausen).[23]

Löhlein[18] in 1895 published a comprehensive article dealing with ovarian tumors complicating pregnancy. His views may be summarized as follows:

(1) He dissents from Wernicke's view and holds that benign tumors of the ovary do not tend to become malignant during pregnancy. (2) He doubts if tumors enlarge much during pregnancy and cites cases to support this position. He quotes many observations to show that the ovaries are in a state of rest during pregnancy.

The recognition of the co-existence of pregnancy with a solid ovarian tumor or tumors is of the greatest importance, and often presents a difficult problem. The limits of this paper forbid more than a brief discussion of the main characteristics of this condition.

Solid tumors of the ovaries are often bilateral, though there are many exceptions to this rule; they are seldom larger than a man's head; the general form of the ovary is maintained; adhesions are rare, but ascites is usually present (Olshausen).[24]

Although the signs and other evidences of pregnancy, in association with solid tumors of the ovaries, are sufficiently characteristic, it is a noteworthy fact that many experienced and able operators have recognized the pregnancy only after the abdomen has been laid open. It is therefore not out of place to emphasize the importance of keeping in mind the possibility of the existence of such a condition in making our examinations.

In this connection it is interesting to note that Napier,[25] after reporting a case of ovarian cyst in which he successfully performed cystectomy at the third month of an unsuspected pregnancy, quotes from Barnes' "Diseases of Women," as follows: "Ovariotomy during pregnancy has been performed several times, the operator not suspecting the existence of pregnancy before the operation. What should be done when a pregnant uterus is discovered during some stage of ovariotomy? Wells says let it (*i. e.* the uterus) alone. Dr. Atlee performed ovariotomy in the second month of an unsuspected pregnancy. Dr. Marion Sims performed ovariotomy in the third month of pregnancy, not suspecting its existence, with good results to mother and child."

The prognosis in cases of ovarian tumor complicating pregnancy is by no means favorable. The great danger to the mother will be appreciated from the figures in the following statistics.

Litzmann has collected 54 cases with 24 maternal deaths; Jetter, 215 deliveries in 165 mothers with 64 deaths; Playfair, 57 deliveries with 23 deaths; Braxton Hicks, 6 deliveries with no deaths; Rogers, 5 deliveries, no deaths; Spencer Wells, 11 deliveries, one death; Fritsch, 4 deliveries, one death. In all, 355 deliveries are reported with 114 maternal deaths, or a maternal mortality of about 32 per cent. The mortality to the children from either abortion or premature labor is, according to Engstrom, much greater. In 216 cases he finds it to be about 48 per cent. (Fenger).[26½]

Heiberg[26] has collected 271 cases of pregnancy with ovarian tumors and found that over one-fourth of the mothers and two-thirds of the children perished; while Dsirne[27] says that only 60 per cent. of the pregnancies complicated by ovarian tumors terminated without accident to mother or child.

The situation and size of the tumors are of marked significance in determining the prognosis. Most solid tumors, especially during their early growth, remain in the true pelvis. When small they may be overlooked, and the hindrance which they offer to delivery may be unsuspected or attributed to pelvic narrowing (Montgomery).[28] Large tumors rarely hinder the engagement of the fœtal head, unless a part of them occupy the pelvis; whereas small tumors, especially dermoids, often retard the descent of the head, so that operation is necessary (Hohl).[29]

Greigg,[30] from his post-mortem researches upon puerperal septicæmia, shows that it is possible that some cases of this disease arise from injury, during parturition, to unrecognized ovarian tumors. We must consider not only the mechanical difficulties in the way of delivery, but also the cachexia due to the presence of malignant new growths (Müller).[31]

Complications of pregnancy may arise owing to the presence of solid ovarian tumors.

1. The stem of the tumor may become twisted and thus give rise to the presence in the abdominal cavity of a necrotic foreign body. This accident occurs in 9.1 per cent. of all cases (Dsirne).[32]

2. Infection of the peritoneum is more likely to occur.

3. The tumor by direct pressure on the intestines may

cause intestinal obstruction, or indirectly twists of the gut or hemorrhoids (Barsony).[33]

The mortality in ovarian tumor cases complicating pregnancy, treated by the expectant plan, is frightful. In 75 cases (cysts included) collected from the literature, 31, or 41 per cent., were fatal to the mothers, while but 22 children, or 29 per cent., are reported as having been saved (Montgomery).[34]

Litzmann[35] gives the maternal mortality as 43 per cent., and the fœtal as 83 per cent.; while Dsirne, as stated above, reports that but 60 per cent. of these cases when left alone terminate without accident to mother or child.

Such a death rate urgently demands renewed investigation and the adoption of a definite plan of treatment. When we come to the consideration of ovariotomy during pregnancy, we find far better results.

Of cases of ovariotomy during pregnancy, Dsirne finds that abortion followed in 22 per cent., and death in only 5.09 per cent. Breit[36] (1861) reports results of operation on tumors of the ovary in pregnancy during labor, or the puerperium, as follows: In 215 cases, 140 mothers recovered, 64 died; in 11 the results were unrecorded. Of the children, 81 lived, 53 died, of 61 there was no record; 21 abortions occurred.

So far as the chances of maternal recovery from ovariotomy during pregnancy are concerned, they are fully as good as when no pregnancy exists. As regards the continuance of gestation, if the operation is performed in the early months the prospect is usually also favorable (Mundé) [37]

In this connection Kreutzmann[38] states the facts clearly when he says: "The bringing about of abortion would be in order (1) if it is proved that ovariotomy during pregnancy is always followed by abortion; and (2) if the statistics show that the results of ovariotomy in pregnant women are much less favorable than in non-pregnant women. The fact that the percentage of abortions following operation is only about 20 per cent. is an answer to the first proposition. As concerns the second, statistics have demonstrated that with most operators the mortality in ovariotomies performed during gestation is less than those in non-pregnant women."

Since ovariotomy, then, can give such good results, the advisability of operative procedures must be taken into consideration in each individual case. Surgeons of wide experience, as Spencer Wells, Tait, Cauchois, Olshausen, and the late Carl Schroeder, are agreed in commending ovariotomy as the best means of dealing with all cases of ovarian neoplasms associated with pregnancy. Again, in view of the fact that Cohn[39] has proved every sixth ovarian tumor to be probably malignant, the early removal of the diseased structures is of vital importance.

The most favorable time for operation is at some period during the first half of pregnancy. In the later months the increased hyperæmia and engorgement of the broad ligaments increase the danger of untoward results (Montgomery).[40]

Kelly has published statistics which go to show that all tumors of the ovary should be extirpated as soon as recognized, no matter how small or inoffensive they may appear. His experience with cysts of the ovary has clearly demonstrated that it is not safe to allow them to remain, inasmuch as many apparently innocent cysts (papillary cystomata) may at any time become highly malignant, and if not removed sufficiently early, may prove rapidly fatal.

According to Olshausen,[42] from 60 to 70 per cent. of all patients with proliferating cystomata (cystoma ovarii proliferans papillare) die within three years from the time of the first symptoms, and a further 10 per cent. die during the fourth year.

This surgical law which insists upon the early extirpation of all ovarian tumors applies with still more force in cases of solid ovarian neoplasms associated with gravidity.

Time for Operation. The elective time for the operation seems clearly defined, as all agree that the lowest mortality to both mother and child is secured by operating between the second and fourth months of gestation. There is one apparent exception to this rule. Dsirne[43] states that in intra-ligamentary tumors, owing to the danger of hemorrhage, it is often better to produce abortion before extirpating the tumor. It may, however, be asserted that the results in these particular cases will be determined largely by the skill and operative dexterity of the surgeon, and that under favorable conditions these cases can also be successfully operated on without previous interference with gestation.

When the case is not seen before labor, and when the tumor interferes with the engagement of the head in the true pelvis, one or both of the following procedures are indicated:

(a) Attempts may be made to replace the tumor in the abdominal cavity under anæsthesia.

(b) As a last resort, celiotomy.

In the puerperium Hohl[44] says that we should operate not later than the second week. Others hold that if the labor is normal it is better to wait several weeks longer.

In summarizing the results of a thorough search of the literature dealing with the subject the following deductions would appear to be justifiable:

I. Solid neoplasms of the ovary complicating pregnancy are exceedingly rare.

II. The diagnosis of this rare combination of a physiological and pathological process may be very difficult. In certain cases much help can be obtained from recto-abdominal palpation under narcosis, using Kelly's method to gently produce artificial descensus of the uterus. The physical examination with the signs of pregnancy, and those which belong more particularly to solid ovarian growths, will generally enable us to make at least a probable diagnosis and one sufficient to warrant an exploratory section.

III. The prognosis in cases of solid growths of the ovary complicating pregnancy is much worse, both for mother and child, than in those of cystic neoplasms of these organs. This is to be explained by the fact that the former are usually smaller and remain in the true pelvis and obstruct the parturient canal, while the latter, owing to their bulk and consistence, rise above the pelvis, and the dystocia, if produced at all, is of a less serious nature.

Abdominal section and extirpation of solid tumors during the early months of pregnancy produce equally good results, so far as the life of the fœtus is concerned, as in the case of cysts; the ultimate result in the case of the mother depending,

of course, on the malignant or benignant nature of the new growth.

IV. In the management of these cases we have seen that if the extirpation is undertaken during the elective period of gestation (second to fourth month) the maternal mortality was but 5 per cent., due to hemorrhage, shock, sepsis, and other causes; whereas the fœtal mortality due to abortion is only 20 to 22 per cent. as compared with 40 per cent. for the former and 80 per cent. for the latter when these cases are left to unaided nature.

The general rule, then, should be to operate on all cases between the second and fourth months of gravidity. It would be hard to find a stronger argument in favor of the elective operation for extirpation of these ovarian neoplasms than is furnished by a comparison of the statistics of the best authorities.

V. The compulsory operation (during the latter half of gestation, during labor, or the puerperium) will rarely be required. One then should be guided by the suggestions of Hohl, preference being given to the procedures in the order above mentioned.

In conclusion I desire to express my deep sense of obligation to Professor Kelly for permission to report this unusual case; to Dr. Cullen for much encouragement and assistance in obtaining references; and to Dr. Bardeen for valuable aid in abstracting literature.

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THE CATHETERIZATION OF THE URETERS IN THE MALE THROUGH AN OPEN CYSTOSCOPE WITH THE BLADDER DISTENDED WITH AIR BY POSTURE.

By H. A. Kelly, M. D., *Gynecologist-in-Chief to The Johns Hopkins Hospital.*

The difficulties and the dangers of the various devices for electric cystoscopy with the source of illumination introduced within the bladder are so great that I feel sure urologists everywhere will welcome and test carefully any new method of examination which bids fair to limit or to supplant these methods by one which is simpler, more direct and more satisfactory in its results.

I have succeeded in devising such a method and in demonstrating its utility in the presence of an audience of expert urologists and surgeons at St. Luke's Hospital, New York City, Feb. 4th, 1898, through the kind invitation of Dr. L. Bolton Bangs, consulting surgeon, and the courtesy of Dr. Robt. Abbe, visiting surgeon, who offered me his clinic hour.

Among the visitors present were Drs. Robt. F. Weir, Willy Meyer, Clement Cleveland, Robt. A. Murray, Farquhar B. Curtis, F. Tilden Brown, and others.

I was greatly indebted to the house staff of the hospital for their warm, intelligent interest and assistance throughout.

Dr. Otto G. Ramsay accompanied me from the Johns Hopkins Hospital and aided me skilfully at every step of the investigation.

The cystoscope used was a straight metal nickel-plated tube 15.5 cm. long, 7 mm. in diameter, the caliber being equal from end to end, except at the conical external orifice, which measured 2.7 cm. at its outer border and was blackened on the inside to prevent the reflection of the light from obscuring the field. A stout handle 10 cm. long was attached to the outer end.

The source of illumination was a small electric headlight, deriving its current from the house supply, reduced by a Vetter controller.

The patient, a young man, was put under Schleich's anesthetic, when I introduced the cystoscope armed with its obturator as far as the prostate, and then guided it easily over the prostate and into the bladder by raising and guiding the end with one finger introduced into the rectum. The penis, of average size, shortened on the cystoscope to a length of about 5 cm.

He was then carefully turned over and placed in the knee-chest posture and brought to the edge of the table and the obturator withdrawn; air at once entered the bladder and the investigation was made.

The light was good and the base of the bladder at once came clearly into view; the posterior wall was seen by elevating the handle a little, then by turning it to the right and to the left the left and right lateral walls were clearly seen. I then withdrew the speculum until the internal urethral orifice began to close over it, and then pushed it in a little, turned it about 30 degrees to the left and dropped the handle, when the right ureteral orifice came clearly into view, as clearly as I have ever seen it in a woman.

Dr. Willy Meyer looked through the cystoscope and agreed it could not have been seen clearer or more unmistakably if it had been on the surface of the body.

Dr. Ramsay then handed me one of my renal catheters, 50 cm. long and 2 mm. in diameter, armed with a stylet, and this was guided, after two attempts, up into the ureteral orifice, and easily stripped of the stylet, into the ureter, ascending up to the pelvis of the kidney. Dr. Abbe now looked through the cystoscope and saw the catheter entering the bladder wall.

The patient was then put to bed with the catheter in position, and before leaving the hospital I had the satisfaction of knowing that half a test-tube full of slightly cloudy urine had been collected.

By this method of cystoscopy not only is the diagnosis of vesical lesions simplified, but simpler and direct plans of treatment, such as curetting, cauterizing and making applications to localized areas are made possible. Small tumors may also be easily excised or snared.

A preliminary note has been published in the *Annals of Surgery* (Jan. 1897), where a fuller account will shortly appear.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of December 20, 1897.

Dr. Barker in the Chair.

On Super-Arterial Pericardial Fibroid Nodules.—Mr. Knox.

In 1866 Kussmaul and Maier reported an instance of the development upon many of the smaller visceral arteries, of nodules, to which condition they applied the name of peri-arteritis nodosa. Since this time additional cases of a similar disease have been described by Chvostek and Weichselbaum, Meyer, Fletcher and Von Kahlden. This rare condition is characterized by the presence upon the smaller arteries, except those of the brain and spinal cord, of small grayish-white nodules, which microscopically are found to be associated with hypertrophy of the internal and adventitial coats of the affected vessels, and with weakening or even rupture of the middle coat. The origin of this affection is conceived to be either some form of infection or intoxication.

Some months ago my attention was directed, through the kindness of Dr. Flexner, to a heart which showed upon its surface, over the arteries, opaque elevations suggesting those of

peri-arteritis nodosa. Later, at the autopsies, several other hearts affected in like manner were found, and I was permitted to study the specimens in the Pathological Laboratory.

The extent of the process varied, from tortuous, more or less uniform elevations over the arteries, to whitish dots, minute in size and few in number, which almost escape attention.

The elevations may be separated from each other by wide intervals, may be quite close, resembling beads strung along the vessel, or they may coalesce throughout the entire length of the artery.

The nodules were found exclusively upon the ventricles and the interventricular septa; never within the heart muscle, upon the auricles, nor over the veins. They were never noticed elsewhere in the body.

On microscopical examination there were no constant alterations to be made out in hæmatoxylin and eosin stained specimens in any of the arterial coats, but between the adventitia of the vessel and the surface there was a marked fibrous thickening projecting beyond the level of the pericardium and producing the nodules seen in gross specimens. At the base of the nodule and at the sides lymphocytes and a small number of polymorphonuclear leucocytes were accumulated.

The appearance in cross-section was as though a compact mass of firm connective tissue, convex on its inner surface, had been placed upon the artery in the loose pericardial tissue.

The nodule may be only a small oval patch over a portion of the artery, or it may extend a considerable distance upon each side.

The earliest stages of the process met with showed simply a serous infiltration and an accumulation of small round cells superficial to the artery on its outer side.

In no case was any tendency to fibrous formation noticed on the inner side of the vessel, next to the heart muscle, nor in the heart muscle itself.

The constant relationship of the fibrous thickenings to the arteries suggested that the nodules were in some way associated with changes in the arterial walls not brought out by the stain in hæmatoxylin and eosin, and a representative number of the sections were stained for elastic tissue by the fuchsin method described by Manchot.

There were of course variations in the sections, but the results were sufficiently uniform to be quite suggestive. In a few sections there were distinct breaks in the inner elastic coat just opposite the nodule, but the most noticeable alteration and the one present in most of the preparations was a diminution in the strength of the *outer* elastic coat between the muscle and the adventitial layers.

This membrane was well represented on the inner side of the artery often by a heavy dark red band, but as one approached the outer half it became thinned, the fibers looser and separated from each other until usually just beneath, at times a little to one side of the fibrous thickening, only a few straggling strands of the elastic fiber remained.

In no instance was this change accompanied by an increase in the thickness of the inner elastic coat. Occasionally only were defects in either elastic layer seen on the inner side of an artery. In these cases no alterations corresponding to the nodule under discussion were present in the remaining layers nor in the surrounding tissue.

The change described was not seen in arteries not surmounted by the fibrous patch.

These findings would suggest at least some association between the nodules on the surface and the weakening in the arterial wall beneath.

The affection, as far as can be ascertained, was discovered incidentally in every case, and produced no symptoms as far as can be known.

From the above description there can be no doubt that the condition found in the epicardium of these cases is entirely distinct from peri-arteritis nodosa. There was, too, nothing in the histological appearances that was suggestive of a primary bacterial or toxic action upon the tissues leading to the fibrous formation, and the bacteriological studies of the cases at autopsy did not support such an assumption.

In considering the histological appearances one is tempted to regard the changes in the elastic coat as the primary alteration. Moreover, a number of facts in the protocols lend support to this idea, for the individuals in whom the condition was found were subject to unusual strains put upon their cardio-vascular system.

Of four cases in which the nodules were present, three showed heart hypertrophy. In one, lesions of the valves existed; in another, arterio-sclerosis. Three of the cases suffered from nephritis; in three there was œdema, and in one case aneurism. Three of the four patients gave histories of heavy work, irregular life, and the ingestion of large amounts of alcoholic beverages.

Discussion of Dr. Hunner's Cases of Aneurism (*continued*).
See February Bulletin, p. 38.

Dr. Osler.—The most interesting thing about this case relates to the diagnosis. This patient was under observation last year, and there were several points of great interest at first which made us doubt whether he really had aneurism of the aorta. We could not grasp a very positive tumor. There were well-marked pulsation and a definite thrill and murmur, but these, in the absence of a tumor, when you have reached a certain grade in your experience, are insufficient. He had aortic regurgitation, but that also made us hesitate, for you know how frequently, particularly in young persons, great dynamic pulsation is present. He was under observation for many months, and several additional features came out which made the diagnosis of aneurism of the aorta reasonably certain. In the first place the characters of the pains, that had kept up in a very persistent way and required a great deal of morphia to relieve. Then he developed a loud bruit at the back; but what really clinched the diagnosis was a pulsation at the back which could be both seen and felt. Another suggestive point was the fact that the abdominal pulsation was altogether above the infra-costal line. It did not extend the entire length of the abdominal aorta. You can feel the thrill, but you do not feel a very positive tumor, which is evidently deep-seated, probably in the ciliac axis.

In the second case the pulsation is more evident and very visible. Here the tumor is much more evident, the thrill is

very intense, and there is a loud systolic and also a diastolic murmur. He has no bruit behind. His pains are not nearly so intense. The situation of the pulsation, its very wide area, the very pronounced character of the tumor, and its expansile pulsation, are features that make the diagnosis certain. One of the most important points in this case is its onset in early life; he is only 27, very early for aneurism.

The possibility is that lead, in which he worked for so many years, had caused the sclerosis of his arteries. In the first case the aneurism is probably in contact with the lower ribs on the left side. In this case I do not think the aorta has eroded the vertebræ to any great extent. He has not had the boring pains such as are almost always present when the aneurism is eroding the vertebræ.

We have had five instances of abdominal aneurism in the Hospital, out of a total of 57 aneurisms of the larger vessels. It is very much less common than aneurism of the thoracic aorta.

Some of you remember the man, Lee Kenny, who had a singularly movable tumor in the upper part of the abdomen, which was aneurismal, which pulsated with considerable force and which you could grasp in the hand. Dr. Halsted did a laparotomy, thinking it was possibly not in the aorta but in one of the branches, but it proved to be in the aorta. He was somewhat improved after the operation, but we lost sight of him.

In a certain number of aneurisms of the abdominal aorta a cure has been effected. The celebrated case of Murray was the first; the aneurism was seated low, just above the bifurcation, and digital compression for an hour caused cessation of pulsation in the sac, and patient lived for nine or ten years. The autopsy showed a healed aneurismal sac. There have been several other instances where compression either by fingers or the clamp cured the aneurism by filling the sac and securing consolidation.

In this first case I think operative procedures would be out of the question. In the second one the possibility of wiring has to be considered. In several cases this has been done successfully. In this man the operation would be justifiable.

Discussion of Dr. Pancoast's Diabetes in the Negro (*continued*).
See February Bulletin, p. 40.

Dr. Osler.—This case illustrates a point that was brought to my mind a few weeks ago. A woman with diabetes went to Europe in the middle of June. She had a slight cough at the time which had not attracted the attention of her physicians. In July the cough became worse, and her doctor in Ireland found extensive disease of one lung. On her return she refused to see her old physicians, as she blamed them for overlooking a serious condition of affairs and permitting her to go abroad. She persisted in this point, though I tried to explain that her trouble had developed very rapidly.

Here is a case in point. This man developed tuberculosis within a period of nine weeks and lost in weight from 180 to 130 pounds. The loss of weight and the rapid downward progress are well recognized features in some cases of diabetic phthisis.

NOTES ON NEW BOOKS.

Pathological Technique. A Practical Manual for the Bacteriological Laboratory. By Frank Barr Mallory, A. M., M. D., and James Homer Wright, A. M., M. D. (*W. B. Saunders, Philadelphia*, 1897.)

The manual which bears the above title comes to us from the pathological laboratories connected with the Harvard Medical School, and while it is offered as a practical guide for workers in pathological laboratories, we shall be much mistaken if it does not find a much wider sphere of usefulness. The volume, which is well made and of convenient size, is subdivided into three parts; the subject-matter of each, while closely connected with that of the other two, being treated in detail separately.

Part I, in which the technique of autopsies is outlined, contains a full and satisfactory presentation of the best recognized procedures in making post-mortem examinations. The authors have adhered to no one authority, but have chosen from several sources methods which they regard as the most useful and practical. While, as might naturally have been expected, the Virchow method is mainly followed, the authors have not felt themselves bound to follow it in all its details and do not hesitate to recommend the employment of certain procedures which have emanated from the Austrian school of pathologists. Many of the illustrations in this part of the work are borrowed from the little manual of Nauwerck, and the authors are to be commended for reproducing and making available for the English-speaking student these excellent drawings. In the part devoted to the section of the brain the method of Virchow is justly criticized as causing too much disturbance of the relations in the cortex, while that of Pitre, which is also given in detail, is not commended. In the light of our present knowledge the authors would seem to consider the hardening of the entire organ in formalin as affording the best means for future accurate study of the topography of focal lesions, while at the same time the tissue is preserved so as to be available for the finer histological methods. The demands of modern neurology, the growth of the knowledge of cerebral localization and the importance of following closely the various tracts have rendered it evident that the customary time which can be devoted to an autopsy is every day becoming more and more unsuitable for the examination and description of lesions in this organ.

On page 26 a typographical error has slipped into this part of the work. The statement that "The greenish discoloration seen earliest over the abdomen is due to *sulphate* of iron," is evidently intended to read, *sulphide* of iron.

Part II, which treats of the general methods of bacteriological examinations, is subdivided into (1) Bacteriological apparatus; (2) Culture media; (3) Bacteriological examinations at autopsies; (4) The methods of studying bacteria in cultures; (5) Bacteriological diagnosis; (6) Clinical bacteriology.

This section of the work is all that can be desired in a book of the scope of the present one. The directions for the preparations of media and cultures and the isolation of micro-organisms in pure culture and their identification, which is the ultimate purpose of bacteriological study, are clearly and succinctly stated. We fail, however, to notice any allusion to the autoclave for the sterilization of culture media. There is, in our opinion, no more valuable piece of apparatus for the bacteriological laboratory. Besides its other advantages it enables the time element in the preparation of such media to be greatly reduced. But, however convenient it may be to obviate the loss of time consumed in fractional sterilization, and whatever the advantages in having the media ready to use at once after their preparation, the chief value of the autoclave lies in the certainty with which, at a single exposure, even the most resistant spores (*e. g.* of the bacillus subtilis) are destroyed. The atmosphere of Boston or its climate may be unfavorable to the prevalence of epidemics of hay-bacillus infection, or perchance the city water

supply is free from contamination with this organism; but in the latitude of Baltimore, especially in the fall season, it constitutes a pest to the bacteriologist, against the ravages of which the autoclave alone has been found to furnish a sufficient protection. With the exception of blood serum we do not hesitate to put all culture media, including even gelatine (which is exposed for 6 or 8 minutes), through the autoclave at a pressure of two atmospheres and at a temperature approaching 120° C.

The routine examination by cultures and films or cover-slips is recommended in post-mortem examinations. We are glad to find this point emphasized. The day is perhaps not far distant when this procedure will be regarded as essential to the proper conduct of an autopsy, so that every examination will be deemed incomplete unless the bacteriological study has been carried out. Not a few problems in the causation of disease and of death have already received their solution through the systematic search for pathogenic bacteria in human post-mortem examinations. No modern physician, and still less a pathologist or bacteriologist, regards bacteria as the only living agents which cause the infectious diseases, and we are therefore bound to exercise due caution and a chariness in drawing conclusions based upon negative results from the bacteriological study in suspicious cases. It is not too much to hope that the near future will make amenable to cultivation and study the group of protozoa, just as the bacteria, by the introduction of solid culture media and the invention of a few simple mechanical processes, have been rendered so easy of observation. And when this feat shall have been accomplished, may not the whole group of exanthematous fevers be "resolved" and fall into their natural nosological places?

It is quite natural that differences of opinion should arise, especially regarding details, as to the best or most generally useful method to be employed in the systematic bacteriological study of autopsies. The authors of this manual advise as the best medium coagulated blood serum, which by their method of preparation is easily accessible for routine work. Of its suitableness as a culture medium there can be no question, but there remains the objection that where a mixture of bacterial forms or species prevails in the original material, their isolation can be most easily effected before the existing proportions are disturbed, and data of the relative numbers of each species present can be obtained only by an immediate separation. For this purpose the "plate" method, using preferably agar-agar, would seem to be the only one applicable. In the end, special cases will dictate special methods of procedure, and the rarity or frequency of departures from the rule will depend on circumstances, among which should perhaps be placed first the readiness with which the operator appreciates the unusual and his capacity to deal quickly with special problems as they arise. In carrying out a post-mortem examination in what is now regarded a proper manner, so many details have to be considered, that unless the time factor is to be entirely neglected, dexterity in operation and quickness in decision are faculties which are especially to be cultivated and by no means to be despised.

As regards the "time factor" the improvements in histological technique allow no free latitude. If the pathological histology of the future is to keep pace with its younger brother histology, and is to advance beyond the achievements of the period which ended with the semi-centennial just celebrated by Virchow's Archives, and which marks the era of the influence upon medical science of the cellular doctrine of organized nature, then minutes must replace hours in the time elapsing after death before autopsy in order that the organic tissues may be suitable for histological research.

The statement that the micro-organism causing actinomycosis has not as yet been proved to belong to the bacteria (fission-fungi) is made with due conservatism, but it seems hardly justifiable to place it provisionally among the cladothrices. If it is a bacterium it belongs, according to our present classification, among the streptothrices.

The differentiation of the smegma bacilli from the bacillus of tuberculosis is not quite so simple a matter as one little experienced in this undertaking might conclude from the remarks on pages 92 and 93. As the question is often an important one in diagnosis, it might not have been out of place to mention some of the difficulties and to have supplied other methods of distinction, especially the use of an alcoholic solution of methylene-blue, as recommended by Grethe.

Part III, which is devoted to the enumeration and description of histological and clinical microscopic methods, gives an excellent account of the processes employed in hardening, imbedding, sectioning, staining and mounting microscopic sections of tissues. The examination of sputa, blood, fæces, gastric contents and urine is also dealt with. Where so much is attempted it is not to be expected that all the headings will be treated of with equal completeness. The chief value of this chapter will be found in the pages devoted to histological methods, and it goes without saying that the special works dealing with clinical microscopy will need to be consulted by those who require more than a brief outline of matters relating to any one subject, for the minute details of which the authors could not spare space.

Drs. Mallory and Wright have given to the English-speaking student an excellent laboratory guide in the methods of modern pathological, histological and clinical study and research.

S. F.

BOOKS RECEIVED.

Twentieth Century Practice. An International Encyclopedia of Modern Medical Science, by Leading Authorities of Europe and America. Edited by Thomas L. Stedman, M. D. Vol. XIII. Infectious Diseases. 1898. 8vo. 621 pages. W. Wood & Co.

Biennial Report of the Department of Health of the City of Chicago, being for the Years 1895 *and* 1896. 1897. 8vo. 397 pages + 51 + 30. Press of Cameron, Amberg & Co., Chicago.

Case of Carcinoma of Descending Colon; Excision and Anastomosis; Recovery. By John H. Musser, M. D., and Thomas S. K. Morton, M. D. Reprinted from the University Medical Magazine, July, 1896.

Angina Pectoris: Its Relation to Dilatation of the Heart. By John H. Musser, M. D. Reprinted from the American Journal of the Medical Sciences, September, 1897.

A Case of Lucæmia. By John H. Musser, M. D., and Joseph Sailer, M. D. Reprinted from the Transactions of the Association of American Physicians, 1896.

On the Disappearance of Endocardial Murmurs of Organic Origin. By John H. Musser, M. D. Reprinted from the British Medical Journal, October 16, 1897.

A Clinical Study of Widal's Serum Diagnosis of Typhoid Fever. By John H. Musser, M. D., and John M. Swan, M. D. Reprinted from the Journal of the American Medical Association, August 14, 1897.

A Text-Book of the Diseases of Women. By Henry J. Garrigues, A. M., M. D. Second Edition. Thoroughly Revised. 1897. 8vo. 728 pages. W. B. Saunders, Philadelphia.

Elements of Latin. For Students of Medicine and Pharmacy. By George D. Crothers, A. M., M. D., and Hiram H. Bice, A. M. 1898. 12mo. 242 pages. The F. A. Davis Co., Philadelphia.

ERRATA—JANUARY BULLETIN.

In footnote, page 12, read 1629 instead of 1829.

In footnotes on page 13, the references to Vanderwiel and Schurig should be reversed.

On page 16, line 12, the word nasal should be inserted before reflex neuroses.

THE JOHNS HOPKINS MEDICAL SCHOOL. SESSION 1897-1898.

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J. M. LAZEAR, M. D., Assistant in Clinical Microscopy.
J. L. WALZ, Ph. G., Assistant in Pharmacy.

GENERAL STATEMENT.

The Medical Department of the Johns Hopkins University was opened for the instruction of students October, 1893. This School of Medicine is an integral and coördinate part of the Johns Hopkins University, and it also derives great advantages from its close affiliation with the Johns Hopkins Hospital.

The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter.

Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have acquaintance with Latin and a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry, and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, beside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the

REGISTRAR OF THE JOHNS HOPKINS MEDICAL SCHOOL, BALTIMORE.

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BULLETIN

OF

THE JOHNS HOPKINS HOSPITAL.

Vol. IX.—No. 85.] BALTIMORE, APRIL, 1898. [Price, 15 Cents.

CONTENTS.

MINIATURE HAMMERS AND THE SUTURE OF THE BILE DUCTS.*

By W. S. Halsted, *Professor of Surgery in the Johns Hopkins University and Surgeon-in-Chief to the Johns Hopkins Hospital.*

The surgery of the common bile duct is still in its infancy. "Suture of the thickened duct is difficult enough, and suture of the normal duct out of the question," says one. "It is not worth while to exercise such great care in sewing up a slit in the common bile duct, for it is almost impossible to prevent leakage, and a little additional leakage can do no harm if one drains," says another. "Wait until the common bile duct dilates and thickens before venturing to open it," say all surgeons.

"Ein normaler Ductus choledochus ist ein ausserordentlich dünnwandiges Gebilde; eine Längswunde in demselben exakt zu vernähen, durfte technisch ausserordentlich schwierig sein, zumal man durch Einstülpung der Wundränder leicht das Lumen des Kanales zu sehr verengen kann. Zum Glücke erweitert sich der Ductus choledochus bei Eintritt von irgendwie grösseren Steinen alsbald, seine Wandung wird dicker, so dass Incision und Naht meist leicht gelingen."†

"Beim dritten Act, habe ich die Schwierigkeit des Nahtverschlusses der Incision des Choledochus, welche in 2 Fällen überhaupt unmöglich war, kennen gelernt, die Nützlichkeit der Tamponnade eingesehen, sobald die Choledochotomie für sich allein ausgeführt oder mit der Cystectomie verbunden wurde."* "Eine Choledochotomie rechnet er [Kümmell†] zu den technisch schwierigsten Operationen."‡

To close an incision in the normal ductus communis choledochus has been considered so impracticable, not to say impossible, and the result of the suture, so far as the suture itself is concerned, even of the abnormally thickened duct so uncertain, that it is the practice of all surgeons to wait weeks or months or even years for the duct to dilate and thicken rather than interfere promptly in cases of obstruction of the common bile duct by stone.

It is perhaps justifiable to "give nature a chance" to expel the stone, but the operation should never be postponed solely for the sake of giving the duct time to become thicker. I know from operations upon dogs and man that the normal bile ducts can be sutured easily, accurately, almost infallibly, and without danger of leakage or constriction.

We are all more or less acquainted with the more evident dangers of postponing choledochotomy when it is indicated; the deep jaundice, the retarded blood coagulation and the consequent danger from hemorrhage, whether an operation is performed or not; the cirrhotic hypertrophy of the liver and the concomitant hemorrhages into stomach and intestines, the

* Presented at the Johns Hopkins Hospital Medical Society, December 13, 1897.

† Riedel. Chirurgische Behandlung der Gallensteinkrankheit, p. 115. Handbuch der Speciellen Therapie innerer Krankheiten, Bd. iv.

*K. hr. Ein Rückblick auf 209 Gallensteinlaparotomieen. Arch. für Klin. Chirurgie. Bd. liii, Heft 2, p. 375.

† Mittheilungen aus den Hamburgischen Staatskrankenanstalten, 1897, Bd. 1, Heft 2.

‡ Ref Tschmarke, Centralblatt für Chirurgie, 1898, No. 5, p. 134.

acute or chronic inflammation of the bile passages; toxæmia, cholæmic or infectious, and the interference with metabolism, more serious, perhaps, in its remoter consequences than we have estimated. And when at last the operation is resorted to the patient is perhaps so weak that the surgeon might well wish that he had interfered earlier.

The duct lies in a deep hole, at a great distance from the surface, and is covered by the liver, which is usually enlarged in the cases which we are considering, and which, if very large or very small, may embarrass the operator exceedingly. The suggestion of Dr. Fred. Lange to cut through one or two ribs and the diaphragm when the liver is very large we have found invaluable. And not only when the liver is large have we profited by this hint; for once when it was small and high up under the ribs, the duct, carried up with it, was perhaps even less accessible than in the cases complicated with large liver.

Once then because of a small liver, and several times because the livers were large, have I divided ribs and diaphragm, and each time with gratifying results. When operating upon the bile passages of dogs I divide two or three ribs and the underlying diaphragm as a matter of routine. Cutting through a few ribs and the diaphragm on the left side enabled me to remove a large and very adherent tuberculous kidney.

With the little hammers which I am describing, or with a similar contrivance, I have five times sutured the common bile duct in dogs, and twice the common duct and once the cystic duct in the human subject. Two of the dogs referred to were operated upon last spring and observed during the summer and part of the autumn.

Dog 1. June 24, 1897. Long incision in common bile duct sutured over an aluminum rod with six mattress sutures of fine black silk. The wall of the duct was so thin that all of the stitches necessarily penetrated it. The silk itself was thicker than the wall. I intentionally turned in a great deal of the wall, wishing to temporarily occlude the lumen of the duct; and having withdrawn the rod and tied the sutures, I was impressed with the thread-like appearance of the duct and thought that I had perhaps totally occluded it. The dog was apparently as well as usual in a day or two and was observed all summer. At no time was he jaundiced, nor did he seem to be in the least inconvenienced by the operation.

Oct. 1st. Dog killed with ether. Autopsy. Except for the few silk threads in the tissues there was little to evidence the operation.

Dog 2. June 24, 1897. Through an incision into the ductus communis choledochus a small shot not quite large enough to occlude the lumen of the duct was introduced. The duct was sutured with mattress sutures over an aluminum rod as in the preceding case.

The aluminum rods, of several sizes, were flexible and were bent to suit the case just before using. I was very much pleased with the rods, because they made not only possible but very easy what hitherto had been considered too difficult to attempt. The rods suggested to me the rubber bags for intestinal suture which I have already described.*

* Philadelphia Med. Journ., Jan. 8, 1898, and The Johns Hopkins Hospital Bulletin, Feb., 1898.

The little hammers which I now use answer the purpose better than the rods. Within the past three weeks I have twice used the hammers on the human subject. If properly employed they convert one of the most difficult operations in surgery into quite a simple one. The hammers are of sizes (vid. Figs. 4 and 5) to meet all cases, from the normal duct in a dog to a much dilated human duct.

To Use the Hammer in Suture of the Common Bile Duct.

It is not necessary to dissect the duct from its bed, but the wall of the duct should be clearly exposed at the site selected for the incision. I usually incise the common bile duct near its duodenal end because the diverticulum of Vater can be more thoroughly explored through an incision at this end of the duct, and because it is easier to suture this end than the other or cystic end of the common bile duct.

Before incising the duct, two presection stitches, to serve as retractors, should be taken. These stitches, which are subsequently removed, should enter the lumen of the duct. They are placed close together and the incision into the lumen of the duct is carried between them (vid. Fig. 1).

The stone having been removed and the gall passages thoroughly searched with probe and fingers, the retractor threads are drawn apart and a hammer of the proper size introduced (vid. Fig. 2).

The duct is then gently raised from its bed and drawn towards the operator (vid. Fig. 3) by the hammer, the head of which is of course longer than the incision.

Mattress stitches are then applied as shown in Fig. 3; one over the heel behind the handle of the hammer, and the others in front of the very delicate handle. This beautiful drawing was made from the subject and depicts accurately the parts concerned in this stage of the operation.

Although the finest possible needles and silk are used the stitches necessarily perforate the wall of the normal duct. No harm results from this perforation, however, for the normal duct practically always and the thickened duct usually is sterile, and the stitches very soon cut their way out of the lumen and out of the wall of the duct and lie free in the adventitious tissues.

The silk which we use is very much finer than the artist supposed when he made the drawings, and the needles, made for us by Wülfing-Luer, of Paris, have a split eye and are almost as fine as the silk itself. One should have a needle-holder especially made and reserved for these needles. If such a needle-holder is used for coarser work it will soon be ruined.

I have been asked why the handle is not placed in the middle of the hammer. It is placed as near one end as practicable, to enable the operator to introduce the hammer through as small an incision as possible, an incision not longer than about half the circumference of the hammer.

The Advantages of the Hammer.

1. The duct to be sutured can be drawn towards the incision in the anterior abdominal wall and within easy reach of the operator; it can also be manipulated nicely by the hammer.

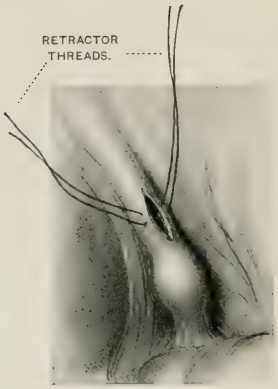

FIG. 1.

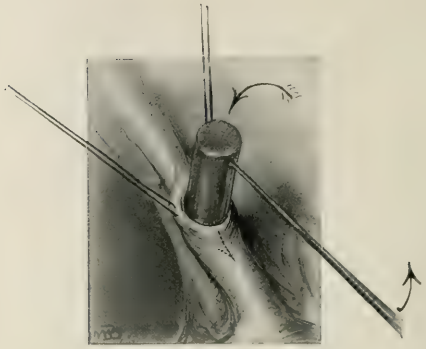

FIG. 2.

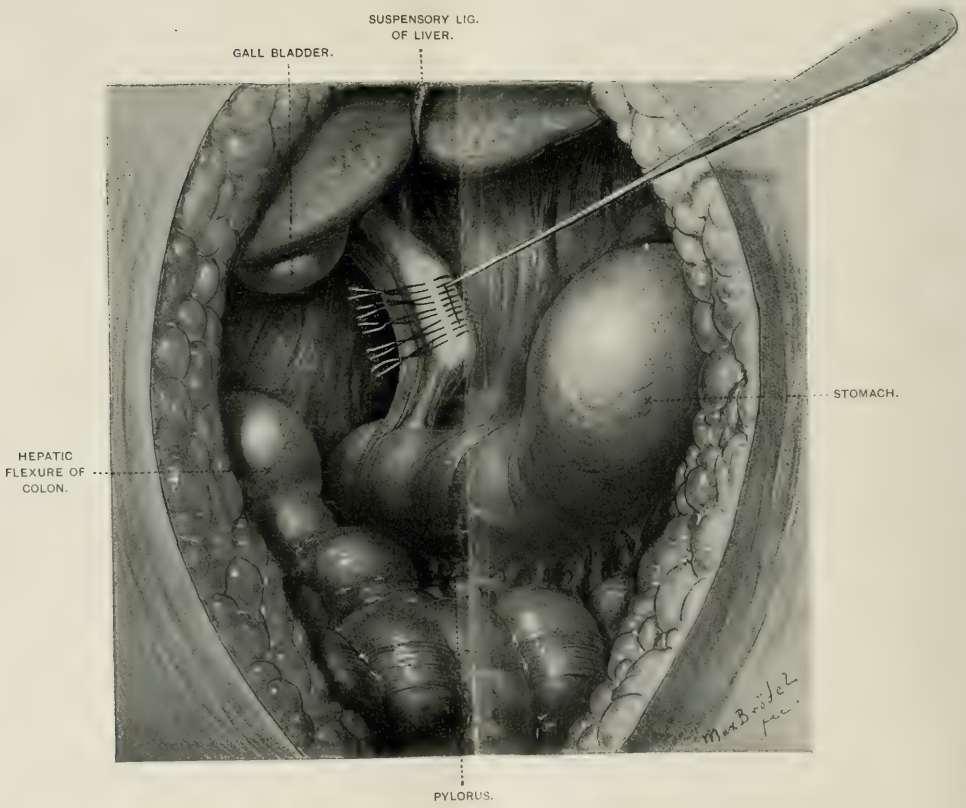

FIG.

ACTUAL LENGTH.

FIG. 4.

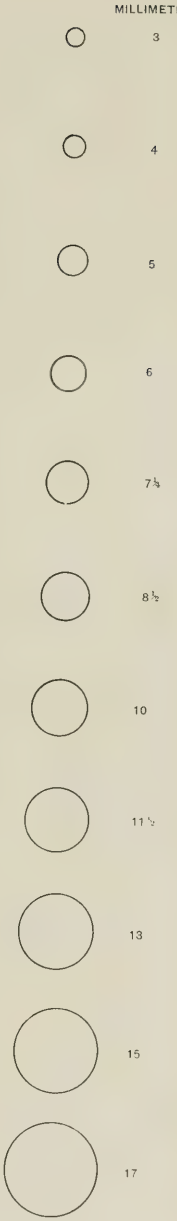

FIG. 5.

2. The duct, whether normal or thickened and dilated, is gently expanded by the hammer; hence the stitches can be taken with great accuracy and without fear of including the opposite wall or of occluding the lumen of the duct.

3. The operation is a very clean one, because the hammer blocks the duct and this prevents the escape of its contents and the contents of the gall bladder.

4. With the hammer, wounds of thin normal ducts can be easily and almost infallibly sutured, and hence the surgeon may, if he chooses, fearlessly operate upon the common duct as soon as the obstruction takes place.

The sewing of the thickened and dilated ducts is also greatly facilitated by the employment of the hammer.

UNIVERSITY EDUCATION.

By Michael Foster, *University of Cambridge, England.*

[*Address delivered at the Johns Hopkins University, Baltimore, October* 11, 1897.]

[President Gilman introduced Prof. Foster in the following words: "I have the pleasure of presenting to this assembly the distinguished physiologist, Dr. Michael Foster, Professor in the University of Cambridge, England, and one of the secretaries of the Royal Society of London. He comes at the invitation of the Medical Faculty of this University, and it is an auspicious opening of the year that brings him here; auspicious not only by his presence, but by the beautiful weather that has favored us and by the large number of students now enrolled in the medical department.

I can say of him that though his face is not familiar, a very large number of the young men and ladies present feel that they have already taken him by the hand, as his manual of physiology has been in use among us from the beginning of the Johns Hopkins University. You will be glad to be reminded that when biological studies were introduced here it was through the agency of Dr. H. Newell Martin, who had been a pupil of Dr. Foster's, first in London and afterwards in Cambridge. During the past score of years by correspondence we have maintained the most friendly relations, and we rejoice in this favorable opportunity to hear what he may say upon University Education."]

The Johns Hopkins University, which has done me the honor to ask me to say a few words on this occasion, is, although already distinguished, a new and young university. I can remember well its beginning, and as Dr. Gilman has hinted, I may claim to have taken some small part in its birth. When I moved in 1870 from London to Cambridge, I took with me a bright lad of whose ability and industry I had already taken notice. At Cambridge he became my right hand man, and I had some hopes that I should long have his help; but President Gilman appeared upon the scene, and his influence was so strong that I felt that my own interests were not to be considered, and that I ought to send that favorite across the waters to occupy the first chair of biology in this new university. Although the memories of him whom I need scarcely name, Henry Newell Martin, are tinged with melancholy, still I feel that this university must always look back with pride and affection on the work which he has done in this country, and in this affection and pride I claim a small share for myself.

Your university is a new one. I come from a very old one; one which was founded six hundred years ago, which has lived through all those centuries, and which, though it has some of the charms, has also some of the evils of antiquity. The traditions of the past weigh heavy upon us. When we attempt to stretch our limbs to meet the new needs of new times we find some old written law, some well established prejudice, some vested interest preventing our full development. You are a new university; and although I have purposely refrained from refreshing my mind as to the exact status of your regulations and as to how far you may have already entangled yourselves in the toils of enactments, still I will take it for granted that you differ from us in the freedom with which you can move forward towards the needs of the coming times; and I think perhaps I could not do better at the present moment than to use the opportunity offered me to take my old university as a text and to draw from it and its history some few plain reflections which I hope may be practical and useful with regard to the conduct of universities. Although I understand that I have been especially invited by the medical faculty, I will take leave to treat only of general things, since the welfare of the medical faculty is bound up in that of the whole university.

The morphologists tell us we can learn much by studying the embryo, and something perhaps may be learned by looking back at this old University of Cambridge in the days of long ago—in the days when it too was a relatively young university. Things were very different then from what they are now. The dimly lighted streets or alleys in which the students lived were an emblem of the whole university. There was little outward show of glory then, there were no beautiful buildings, few books, and each student's duty was, in part, to listen to the lecture, to the reading of something which was written, but which he could not see with his own eyes. In spite of all these difficulties there were certain features of the university of that time which I trust I may say have been, with some little wavering here and there, maintained since, and which I cannot help thinking have contributed in very large measure to make it what I may venture to call it, a famous and great university.

One of the most striking features of the attitude of both students and teachers at that early time was that they recognized in the training of the university a preparation for practical life. There were at that time three main occupations in which learning was of practical use; and in correspondence to those three occupations there were established the three great faculties of the university, the faculty of theology, the faculty of law and the faculty of medicine. And, if one reads what those men of old wrote concerning what they thought ought

to be done in the university, one is very much impressed by the conviction which they had that the teaching should be an earnest preparation for practical life. If it soon became necessary to establish a fourth faculty, the faculty of arts, that was simply as a faculty preparatory to the others, as one supplying the first steps for and leading up towards the knowledge which should be of use in practical life; and it is worth noting that although they called that faculty the faculty of arts, and although the acquisition of the Latin language was one of the chief studies of that faculty, necessarily so because all the instruction which could be given was given in that tongue, among what they called the arts were the beginnings of the kind of knowledge which we now call science.

Another feature of the university life of those early times was the very strong feeling that the work of the university consisted not in the mere acquisition of knowledge, but in the training of the mind. The amount of knowledge which they had for distribution was very limited; but they used that small stock of knowledge to the very best of their ability, as the means of awakening the minds of the students and training them for thinking and arriving at conclusions. This is seen even in what they called at that time examinations, though the word then had a very different meaning from what it has now; there were then no written examinations, there was not that demand on paper so characteristic of modern times, and that great necessity of modern civilization, the waste-paper basket, was unknown. The examiners went quietly to work to ascertain in the most sure way whether a student had profited by what he had listened to. Instead of having two examiners for some hundreds of students, they appointed nine to each student; and these went in with him and out with him until they satisfied themselves that he knew something and had gathered something from what had been told him. And then as a final test they put him on the "stool" and made him debate in public, the test being used in such a way as to bring out his stock of knowledge, and especially his power of using it and of showing that his mind had been trained at the same time that he had gathered in a certain number of facts.

There was another feature of the university which we sometimes find it difficult to realize: the spirit of inquiry was rife among them. At that time the ways of thinking were devious; but still within the limited circle in which they moved, along the only lines then open to them, the thinkers used their minds in the spirit of free inquiry. When one reflects upon the circumstances in which they worked, one cannot help realizing that their long-drawn-out discussions were at bottom an expression of the love of inquiry, and that if they had had the advantages which we enjoy now, that which we call their subtlety would have broken out into discovery and invention.

Lastly, it was a feature of the university at that time that it was willing to take into its bosom any one who showed that he had any promise of benefiting by the instruction there given. It was an open home for all who wished for learning.

These are some of the features of the University of Cambridge in the olden times, and may we not, using them as a text, attempt to draw some conclusions as to what are the proper and essential functions of a university and what ought to be some of its guiding principles? As I said just now, the knowledge which they possessed was extremely limited, the facts with which they had to deal were very few. What can we say of knowledge at the present time? May we not say, if theirs was too little for them, ours threatens to be too great for us; that we are entering upon an age in which the facts which have to be learned and the various kinds of knowledge which have to be acquired are becoming too many for us? It is or it may be perfectly true that one of the advantages of learning is that it enables the learner to learn more rapidly; but is not this true, notwithstanding that the increment of knowledge is increasing far more rapidly than the increment of the power to learn? Is it not a serious matter for consideration that the things that the university has to teach are rapidly becoming far too numerous for the learner to learn? Is it not true that we cannot do now as they did in those old times, teach the student all that was known? We are compelled to make a choice, we must teach to the student some things and omit to teach him others. That is a necessity which it seems to me is increasing as the years go on. Nevertheless that position is a cruel one; for it may be truly said that every kind of knowledge has a value of its own; each kind of knowledge has for the learner a value which can be given by no other kind, and he who fails to gain any one kind of knowledge is thereby a loser. For building up the student into the full and complete man, the best course would be to take in all the knowledge which can be offered by a university; but as I said just now, a choice must be made, and the consideration of the principles which should guide the decision as to what should be chosen and what should be left demands the most serious attention. Here I think we may venture to follow the example of the old university. Admitting that each kind of knowledge is particularly fitting for a particular calling, that for every particular calling in life there is a knowledge, or there are kinds of knowledge which are suited or fitted for that calling and without which that calling can not be pursued with success, in the necessary choice which must be made between this study and that is it not a wise course to take that which best serves the future calling of the student? I cannot but think that in this choice of which I am speaking, the arguments for what are sometimes called technical education are unanswerable; that one of the principles of most importance in determining the choice of the studies to be taken up by the student lies in the fitness of the study for giving him power in the calling which he proposes to adopt. We must, however, remember that the knowledge which is thus to be imparted to him must be not merely a knowledge of facts, but bring with it the power of thinking. If technical education is understood in this way, not as a mere accumulation of facts, not as the mere heaping up of knowledge, but as the training of the mind in some particular kind of knowledge, the dangers, I venture to say, which some fear, will prove unreal, and it will be seen to be a true principle of university education.

There is another aspect in which we may look at university duties. May we not say that the tendency of modern civilization is to smooth down individual differences, and that the whole tendency of the environment of man is to make each

man increasingly more like his brother? There was a time when one could tell by the dress where a man came from, but this has become less and less easy, and it is not in dress alone, but in his very nature that man all over the world becomes more like his fellows. I myself during the short time I have been in this country have felt it more and more difficult to tell what are the differences between an American and an Englishman, and I trust that these differences are equally difficult to you. This may be a favorable aspect, but there is an unfavorable side to this continual influence of things about us. Mr. Francis Galton has shown that there is a great tendency in things to make men more and more alike in stature, and there seems a corresponding tendency to make men all alike in the stature of their minds. We seem tending in many ways to a monotonous mediocrity of intellect. This influence is especially strong among young people. I see for myself in the University of Cambridge that when one young man does one thing they all do it; they go astray like sheep, and they also go straight like sheep. Surely it ought to be a function of the university to counteract this tendency and so to bring the influences of learning upon the young as to develop individual differences. That I take it is one of the most important functions which a university can exercise, but one which is not always kept in view in university enactments. Here I can speak of my own university, and in doing so can lay the blame for the present condition of things on the traditions of the past. I find in my own university discouragement for the development of individual power. Every lad who comes to the University of Cambridge is compelled to pass through the same examination, to know the same things to the same extent, whatever may be the nature of his mind. He must know a little Latin, a little Greek, a little mathematics, a little history and one or two other subjects. Each one who comes, whatever his previous history, must pass through this one gate; the whole university has been pushed through this one common gate. Now I know that this may be defended; it may be said for instance that it is a bad thing not to know Latin. I quite agree with that. I think it a very bad thing not to know Latin, but I also think it a very bad thing for a lad to be thrown into life, it may be to go through life, without any clear idea whatever of the fundamental laws which govern the phenomena of living things. It may be said that it is a bad thing not to know Greek; I agree with that. Not to know Greek is to my mind worse than not to know Latin, but I think also that it is a bad thing for a lad to go through life ignorant of the fundamental laws of chemical action. If you go along in that line of argument you end by compelling a lad to know everything before he enters the university. If I had my way and could wipe out the traditions of the past I should vary that entrance examination. I should hold on to the old tradition of the university that it was ready to receive everybody who was likely to profit by its instructions. I should make the examination look, not backward as it does now, but forward, and should only insist that the lad must give such proofs of intelligence and industry as to lead to the hope that the years of university life would not be spent in vain. When the lad has really entered the university (at times he does not do so until he has spent two or even three years at the place in preparation, and sometimes goes away from the place without having really been admitted), it seems to me there should be a still wider scope for his studies. He has even now, it is true, an opportunity to take a degree in one or other of several branches of learning, but in each case he must follow out a particular schedule which has been laid down and which compels him to walk along a particular path and no other. If he wishes, for example, to study mathematics with philosophy, he would find that he could not do so, for in the examinations mathematicians have nothing to do with philosophy, and philosophy nothing to do with mathematics; and so in other things. I venture to think that this is not a satisfactory condition of things, and that throughout the whole academic course there should be a freedom of the young mind to develop in the line in which it was intended to develop. When I urge this upon my friends they all say, "It is very good, but it is impossible, the examination machinery would become so complicated as to break down." But I would ask the question, Are examinations all in all? were the examinations made for universities, or were universities made for examinations? I myself have no doubt about the answer. I trust that this new university, which can walk with freedom along new lines, will find some way of so arranging studies and examinations that the two will not conflict, and that anybody coming here will find that the particular gifts that have been given to him and which it was intended should be developed will meet their fullest expansion.

Lastly, there was another feature which the old university possessed and which I may also call an essential feature of a university, that is, the spirit of inquiry. No university can prosper as a university that not only does its best to favor special inquiries when these are started within it, but also in the whole course of its teaching develops, or strives to develop the spirit of inquiry. Now here again I fear that examinations—such at all events is my experience—are antagonistic to inquiry; and I would suggest that in arranging examinations one ought always to look ahead to see how far one can possibly order those examinations so as to favor the teaching which teaches in the real and true way, teaching by regarding each bit of learning as in itself an act of inquiry, and so as to favor in the highest degree actual inquiry when it is taken in hand. This of course is antagonistic to one function of examinations, namely, that of putting young men to compete against each other. You cannot so judge inquiries as to put the inquirers in any class list or in any order; the most you can do is to give an inquiry the stamp of approval of the university, a testimony that the inquiry has been carried out in a satisfactory way. It is true that in this way you lose that which is sometimes thought to be of great value, emulation between the scholars; but if you take away that kind of emulation you substitute for it another one far more strong and effective, that emulation that comes of striving with nature. I take it that the good which is done to a lad in starting him upon an inquiry is infinitely greater than any which can be gained by competition with his fellow students. Here I am glad to say a good word for my own university; for we have in a very quiet way, and unobserved, secured the adoption of an enactment which allows a lad to enter the

university and obtain his degree and all which follows upon that without entering into a single examination. At the present moment it is possible for one, it is true under exceptional circumstances, to come to the University of Cambridge in England, and if he convinces a competent body of judges that he is a person likely to carry on inquiry in a successful manner he can enter the university as a student, and if he satisfies another body of men after a time that his inquiries have resulted in a real contribution to knowledge he can secure his degree. He can get that without ever having touched a written examination paper, and I am proud that we are able to offer that to the world; for it has happened again and again that a man who had real genius for a particular line of inquiry stumbled over the preliminary studies of which I have spoken, knocked at the door of our university in vain and was sent way. Now such an one would be admitted, and I venture to say that in the long run the university will be the gainer.

These then are some few thoughts concerning universities and their methods. I say I have purposely learned nothing about your enactments, but from what I know of your short past I feel confident that this university will in the future be conspicuous for progress. May I hope that it will carry on education along some of the lines which I have indicated to-day, and perhaps some day we in the old country may mend our ways after your pattern.

THE RESULTS OF THE INTRA-TRACHEAL INOCULATION OF THE BACILLUS DIPHTHERIÆ IN RABBITS.

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I.

The interest which was aroused by the discovery of Frosch,[1] Kolisko and Paltauf,[2] Wright,[3] and others, that the bacillus diphtheriæ not uncommonly invades the internal organs in diphtheria, was further stimulated by the publication of the work of Kutscher, which dealt with the relation of the bacillus diphtheriæ to the pneumonic processes that are associated not infrequently with pharyngeal and laryngeal diphtheria. The studies of the foregoing writers, which will be examined more in detail hereafter, led to the supposition that, contrary to the previously expressed views concerning the ætiology of the pneumonic processes in diphtheria, it was probable that in many cases the diphtheria bacillus might itself be the causative agent. In the winter of 1894 we presented to the Johns Hopkins Hospital Medical Society a preliminary communication on the subject of the effects of the injection of pure cultures of the bacillus diphtheriæ into the tracheæ of rabbits. We were then able to say that by this means a definite and wide-spread pneumonic process could be provoked, which led in many instances to the death of the animal. These experiments seemed therefore to be more conclusive than the previous observations upon human beings with reference to the probable action of the diphtheria germ in this respect, for the reason that in the former subsidiary or secondary micro-organisms were definitely excluded from any part in the production of the pathological lesions. Our studies carried us incidentally into a consideration of the fate of the introduced micro-organisms, as it soon appeared that even after considerable numbers of diphtheria bacilli in pure culture had been inserted through the trachea into the lung, their recovery from these situations was often attended with much difficulty and sometimes was impossible.

Although the credit of the demonstration of the invasion of the internal organs by the bacillus diphtheriæ has usually been given to Frosch, it is an undoubted fact that Loeffler[4] had previously encountered these organisms certainly in the lungs and perhaps in the liver, in human beings. In the light of our present knowledge it is interesting to note how Loeffler endeavored to explain away these observations on the supposition that the bacilli had entered these organs post mortem and not during life.

In briefly reviewing the literature we shall confine ourselves to a consideration of those instances in which the organisms have been isolated either alone or together with other bacteria from the lungs, more particularly in association with pneumonic processes.

In the communication in which Frosch[1] pointed out the common invasion of the internal organs by the specific bacillus in cases of diphtheria he states that the organisms were present in the lungs and elsewhere. Without giving any particular details, he adds that as compared with the remaining viscera they were found most often in pneumonic areas, the spleen and the lymphatic glands. Whether they existed there alone or in association with other micro-organisms he does not say. One is led to believe, however, that in a majority of instances at least other micro-organisms were present, inasmuch as he states in conclusion that in almost all of his cases he found a mixed infection with various kinds of bacteria, but generally with streptococci and staphylococci.

Kutscher[5] investigated the invasion of diphtheria bacilli into the lungs in human beings and their relation to the broncho-pneumonias of diphtheria. For this purpose he studied the lungs of ten children who came to autopsy, and in whom the diagnosis of diphtheria had been made during life. Cultures were made in a part only of the cases; sections of the organs, however, were studied in all. The cases included examples of pharyngeal and laryngeal diphtheria with extension into the bronchi. The results arrived at by Kutscher indicated that in a small number of instances the

bacillus diphtheriæ may be contained alone within the consolidated patches in the lungs, but that there is likely to be an association of bacteria, the chief accompanying forms being the pyogenic streptococci and staphylococci. Diphtheria bacilli were absent from the lung tissue not the seat of hepatization; not so, however, the streptococci. In some instances the consolidation was entirely microscopic, and in these cases streptococci were found without lesions being present about them, while, on the other hand, the diphtheria bacilli were discovered only in the broncho-pneumonic foci.

As a result of these studies Kutscher[6] expressed himself to the effect that the lungs must be considered as the organs most often and most severely implicated in the secondary invasion of the diphtheria organisms. He regards the commonest mode of invasion to be by aspiration, which certainly must be the most usual way, and places next in order of frequency an infection through the lymphatic channels on the ground that bacilli were found in the perivascular lymphatics. Kutscher further pointed out that in not a single instance was he able to demonstrate the presence of these micro-organisms within the blood-vessels themselves. The question whether the bacilli in the internal organs may themselves be the cause of lesions he believes must be answered affirmatively with reference to the lungs. In support of this belief he urges that the bacilli have been found not only in advanced lesions, but often and alone in the earlier ones, and that they occur in bronchi which are little affected, as well as in those filled with a cellular exudate in which the epithelium has been largely destroyed. The probability of the bacilli being secondary invaders after the pulmonary lesions had been brought about in other ways is therefore excluded.

Although in a few cases diptheria bacilli had been demonstrated in the lung by Johnston,[8] Strelitz,[9] Booker[10] and one of us (Flexner[11]), the next series of examinations comprising a larger number of cases, and therefore of more conclusive significance, was furnished by Wright, who, in studying fourteen fatal cases of diphtheria, isolated this organism from the lungs in thirteen. For the most part there existed broncho-pneumonic areas in which these bacilli were found, although they were associated, as a rule, with the usual pyogenic cocci. In ten of the fourteen autopsies there were distinct lesions of broncho-pneumonia, but the occurrence of the Klebs-Loeffler bacillus in the lung seemed to be independent of the coincidence of these lesions, for, as Wright points out, it was absent in at least one instance of broncho-pneumonia, and present in the tissues in the absence of these lesions. The diphtheria bacillus was associated with the streptococcus in nine cases, in seven of which pneumonia was present.

In a subsequent report by Wright, associated with Stokes,[6] an analysis of thirty-one cases of diphtheria is given, in which cultures from the lungs revealed the presence of the Klebs-Loeffler bacillus alone or in combination in thirty out of the thirty-one cases examined. Of these thirty-one cases broncho-pneumonia was present in nineteen.

Their series of cases also shows that the diphtheria bacillus may be present in the lungs independently of the occurrence of broncho-pneumonia, for in twelve cases in which no pneumonic condition was demonstrable, cultures from the lungs showed the presence of these micro-organisms.

Belfanti studied a series of 26 cases of broncho-pneumonia associated with diphtheria and found the Klebs-Loeffler bacillus in 21. Of these 21 cases it was present alone in four, and combined with other bacteria seventeen times.

The most recent contribution to this subject has been furnished by Kanthack and Stephens,[12] who report that of twenty-six fatal cases in which the lungs were examined for their presence, the Klebs-Loeffler bacilli were found in every one with ease and in large numbers. In comparing these results with those obtained from a similar examination of other organs of the body, these authors conclude, and on this point agree with Frosch and with Wright, that the Klebs-Loeffler bacillus escapes most readily into the lungs; indeed they urge that in these organs the bacilli are found not in small numbers, as had been previously considered, but are very numerous. Of the twenty-six cases examined, Kanthack and Stephens describe the lesions of broncho-pneumonia in fifteen, and state that they must take exception to the statement frequently made that the broncho-pneumonia in diphtheria is of pyococcal origin, maintaining that it would rather appear to be a veritable diphtheritic complication. It is worth mentioning that the broncho-pneumonias of diphtheria are according to them most frequently encountered in those cases in which the invasion of the larynx by the membrane had taken place. Of twenty-four laryngeal cases which they describe, broncho-pneumonia existed in thirteen.

In interpreting the results of the observations upon the relation of the pyogenic organisms to broncho-pneumonic areas in the lungs with or without the coincidence of the Klebs-Loeffler bacillus, we must take exception to the statement made by Kanthack and Stevens[12] that "staphylococci, pneumococci and streptococci are normal inhabitants of the bronchi, bronchioles and alveoli; and therefore on cultivation must of necessity appear on the agar-agar surfaces." We think a sufficient answer to this statement is found in the frequency with which such cultures from perfectly normal human lungs at autopsy give negative results. We are far more inclined to regard the pyogenic organisms as not without pathological significance, notwithstanding the fact, as we hope to show, that the diphtheria bacillus is quite capable alone of causing definite pneumonic processes.

II.

The results derived from our studies of the intra-tracheal inoculation of fluid cultures and suspensions of the Klebs-Loeffler bacillus were unmistakable in their significance. We were able in quite a number of cases to provoke an inflammatory process within the lungs which varied in extent, involving sometimes a small area, even a fragment of the lobe, and at others the greater portion of one lung, or considerable parts of both. In the course of these studies attention was directed to some other points, more or less in dispute, and especially to the question of the fate of the introduced micro-organisms and the length of time during which they were demonstrable within the substance of the lungs.

The method pursued in conducting these investigations was

quite simple, and after a few preliminary failures uniformly successful. It consisted of exposing the trachea above the clavicles in half and full-grown rabbits, the precaution having first been taken of carefully removing the hair over the site of operation. The only real difficulty which was encountered was the avoidance of infection of the tissues about the trachea. In the early experiments this was not always successfully overcome, but later, by introducing the needle through a small pledget of sterilized cotton, placed in contact with the exposed trachea, and withdrawing it through the pad, we were able as a rule to avoid infection of the soft tissues. The wound was sutured and covered with a celloidin dressing.

The amount and the character of the injected material varied with the different cases and are recorded in the individual protocols. The duration of life succeeding inoculation also varied considerably, and the extent of lung involvement seemed to depend more or less upon the period of incubation. For the study of the pneumonic process in its entirety inoculated animals were allowed to live as long as possible, while for the study of the fate of the introduced micro-organisms, as well as the time required for the development of the pathological lesions, the animals were killed at intervals varying from one to twelve hours after inoculation.

Our attention was attracted in the early experiments to the frequency with which, in the hepatized lungs, the introduced bacilli were missed in cultures, in cover-slip preparations, and in the tissues, so that it became necessary to search elsewhere for them, or to discover the manner of their destruction *in situ*.

Exp. 1. Full-grown white rabbit received Feb. 10, 1895, .5 cc. of a bouillon culture of the bacillus diphtheriæ reinforced by the addition of five drops of the condensation water of a serum culture two days old. It lived about 65 hours.

Autopsy. Practically no reaction about the local wound; the lymph glands neither enlarged nor congested. The mucous membrane of the trachea near the larynx showed a few small points of congestion. The trachea and bronchi contained frothy serum. The lungs were voluminous and completely consolidated excepting the edges of the lower lobes, which contained air. The pleural surfaces showed points of ecchymosis and had a moist, somewhat glutinous appearance. The consolidated portions presented a peculiar semi-translucent gelatinous appearance, and on section an œdematous fluid in small quantities escaped. The remaining organs showed nothing remarkable.

Bacteriological examination. Trachea; no diphtheria bacilli found. Pleuræ; no bacilli found. Lungs; films were examined from various portions, and no distinct bacilli could be found. What may have been pale and perhaps degenerated organisms, two or three in number, were found on one cover-slip. Many pus cells containing amphophilic granules were present.

Cultures on Loeffler's blood serum from the consolidated portion of the lungs, the heart's blood and liver were perfectly negative.

Exp. 2. Full-grown Maltese rabbit received .5 cc. of a 48-hour old bouillon culture on Feb. 7th. Death in 47 hours. Autopsy immediately after death. Heart still beating slightly, but irregularly. Trachea filled with frothy serum. The lungs, with the exception of the edges of the bases and apices, which contained air, completely consolidated. They were voluminous and completely filled the pleural cavities. Beneath the pleura were small hæmorrhagic points. Upon section the smooth gelatinous appearance described in the previous animal was observed. The trachea showed slight congestion at the point of entrance of the needle.

Bacterioscopic examination. In the trachea in the neighborhood of the puncture a few diphtheria bacilli were found, both free and enclosed in epithelial cells. Examination of the pleura was negative. In the lungs what may have been a few extracellular degenerated forms.

Cultures from the lungs and heart's blood negative.

Exp. 3. Half-grown rabbit received .5 cc. of a slightly turbid suspension in condensation water of a blood-serum culture. Died in 27 hours.

Autopsy. The trachea much congested throughout and covered with punctiform hæmorrhages, but without visible membrane. The œsophagus also much congested. The local wound somewhat swollen and œdematous. The superior lobes of the right lung were almost completely consolidated, the remainder contained air.

Bacterioscopic examination. From the exudate about the trachea a small number of diphtheria bacilli. From the lungs and pleura, negative; from the œsophagus, typical bacilli.

Cultures. Heart's blood and lungs on Loeffler's blood serum negative.

Exp. 4. A white half-grown rabbit received .5 cc. of a bouillon culture reinforced by the addition of five drops of the condensation water of a serum culture two days old. The animal succumbed on the seventh day. There was absolutely no pneumonia; the lungs appearing somewhat congested, but contained air in all parts.

The cultures were negative. Cause of death not apparent.

Exp. 5. Full-grown rabbit received at 3.15 P. M., June 22nd, .9 cc. of a turbid suspension. Died during the night.

Autopsy. Trachea, no membrane; somewhat congested.

The lungs much congested; no definite consolidation.

Bacterioscopic examination. From trachea numerous bacilli, both free and within cells.

Lungs. Upon cover-slips many polymorphonuclear cells, but no bacilli.

The cultures showed Klebs-Loeffler bacilli in the congested portion of the lungs, the bone-marrow (femur) and the heart's blood.

This series of cases shows in the first place that the diphtheria bacillus by itself is capable of provoking a definite and often wide-spread pneumonic process when introduced directly into the lungs of rabbits; but that in certain cases, notwithstanding the entrance of numerous bacilli into the lungs, a pneumonic process fails to be provoked. Further, it shows that when the number of bacilli is great the animal may succumb, presumably to the intoxication induced by these organisms, before an outspoken pneumonia has developed, thus illustrating anew the effects of the absorption of the poisonous products from the lung substance. Again, Experiment 5 shows that in addition to the invasion of the body presumably by the toxic products of the diphtheria bacillus, we may have a more or less wide distribution of the organisms themselves, and that they may be found in very distant situations. Finally, this series of experiments proves that after the provocation of the pneumonic process the bacilli may themselves either disappear completely, or be so reduced in numbers as to be incapable of demonstration in cover-slips, or that their vitality may be either destroyed or interfered with to such an extent that any attempt at cultivation, even on favorable media, will be followed by negative results.

Exp. 6. A full-grown rabbit received 1.3 cc. of a turbid suspension in bouillon of the bacillus diphtheriæ. The animal was killed by a sharp blow on the back of the neck one hour after the inoculation.

Autopsy. The lungs were voluminous and slightly mottled. Hæmorrhages were not discovered beneath the serous membrane.

Bacterioscopic examination. Cover-slips from the lower lobes of the lungs showed, besides a few polymorphonuclear leucocytes containing amphophilic granules, and some few epithelial cells, bacilli singly as well as in small and in large clumps, chiefly existing free among the cells. Occasionally enclosed within an epithelial cell there was to be found a single bacillus, and more rarely several bacilli. The cells which contained the bacilli stained in the same normal manner as the remaining cells, and the bacilli themselves showed no variation in staining properties as compared with the extracellular forms.

Cultures. From both apices and bases of the lungs a variable number of colonies of the introduced bacilli; from the pleural membrane a single colony of the same organism. The heart's blood, spleen and bone-marrow gave negative results.

Exp. 7. A black, nearly grown rabbit received 1.3 cc. of a turbid suspension similar to the last; the animal was chloroformed after the lapse of one hour.

Autopsy. The lower lobes of both lungs were swollen, slightly congested, and the serous membrane covering the lungs showed here and there punctiform ecchymotic spots.

Bacterioscopic examination. The cover-slip preparations from the various parts of the lungs showed essentially the same appearances as those described for the previous experiment, but it seemed as though the cells containing bacilli were perhaps a little more numerous in this case. The polymorphonuclear amphophiles appeared to be about as numerous as in the preceding experiment, and as in that case the introduced bacilli were never found within these cells. An examination of the bronchial epithelium showed a complete absence of bacilli within the columnar epithelial cells, even when they were quite numerous between them.

Cultures. From the lungs, considerable growth of the introduced bacilli. From the heart's blood, bone-marrow and spleen the cultures remained sterile.

Exp. 8. A nearly full-grown rabbit received on Feb. 26th 1 cc. of a turbid suspension of the bacillus diphtheriæ. The animal was killed at the end of 3½ hours.

Autopsy. Lungs voluminous. In the superior and inferior lobes of both lungs considerable hæmorrhages existed beneath the pleura, which on section could be seen to extend into the lung substance. Admixed with the blood there was much frothy serum; elsewhere the lung tissue was pale and moderately dry.

Bacterioscopic examination. Films prepared from the hæmorrhagic areas showed large numbers of epithelial cells enclosing diphtheria bacilli. The bacilli were often arranged in the same parallel rows which one observes in the cover-slip preparations from the cultures themselves. The bacilli stained in all respects normally; rarely there appeared within the cells specks of chromatin which had the same staining property as the bacilli and might have been fragments of the latter, but they were hardly more numerous than one occasionally finds in cultures of the same organism. The cells containing these bacilli themselves appeared entirely normal. The bacilli were very rarely found to have invaded the nuclei of the cells. Leucocytes with typically polymorphous nuclei were present in the cover slips, but they were never seen to contain the inoculated bacteria. The free bacilli were seen only exceptionally among the cells; when found here they were usually single and rarely in clumps.

Cultures. The lungs and spleen gave growths of the bacillus diphtheriæ. From the heart's blood the cultures were sterile.

Exp. 9. Nearly full-grown rabbit received .5 cc. of a faintly turbid suspension of the bacillus diphtheriæ. Killed after six hours.

Autopsy. Lungs partly collapsed; the pleura covered with small hæmorrhages. The lower lobes of the lungs were congested and œdematous; no definite consolidation.

Bacterioscopic examination. The films from the superior and middle lobes were negative. From the congested and œdematous lower lobes bacilli in small numbers were obtained, occurring singly and in small groups, extracellular and enclosed within epithelial cells. The polymorphonuclear cells, which showed an increase in number as compared with the two previous cases, did not contain the introduced micro-organisms.

Cultures from the lungs and spleen were positive; from the heart's blood no growth was obtained.

Exp. 10. Full-grown rabbit received .75 cc. of suspension of a culture on blood serum two days old. Animal killed at the end of six hours.

Autopsy. The trachea at the seat of inoculation showed some congestion but no false membrane. The bases of the lungs were congested, the pleura covered with minute hæmorrhages.

Bacterioscopic examination. (a) Smears from the mucous membrane of the trachea at the site of inoculation showed diphtheria bacilli in considerable numbers, all extracellular, and among these polymorphonuclear cells. (b) From the base of the lungs mononuclear, epithelial and polymorphonuclear cells, the former containing bacilli. Similar micro-organisms, although in smaller number, also existed between the cells.

Cultures. From the lung a large number of colonies. From the spleen, bone-marrow, heart's blood and liver, smaller numbers of colonies of the introduced micro-organisms.

Exp. 11. A rabbit received .75 cc. of a turbid suspension of a growth of the bacilli upon blood serum. Killed at the end of twelve hours.

Autopsy. Trachea about the site of inoculation showed much congestion, which extended above and below the point at which the needle had been introduced, but no false membrane existed. The caudal lobes of the lungs were much congested, and beneath the pleura minute hæmorrhages appeared. The spleen appeared enlarged.

Bacterioscopic examination. Smears from the trachea showed numerous polymorphonuclear cells, but no bacilli. From the lungs (bases) bacilli extracellular and polymorphonuclear cells.

Cultures. From the heart's blood, spleen and bone-marrow the introduced bacilli were cultivated. From the tracheal glands and lungs the tubes were negative.

Exp. 12. Was a repetition of the previous experiment and gave similar results, with the exception that the bacilli were cultivated from the congested and œdematous lower lobes of the lungs. It is therefore probable that in the previous case the absence of the bacilli from similar situations is to be regarded as an accidental occurrence.

Exp. 13. Full-grown rabbit received .80 cc. of a suspension of the bacillus diphtheriæ. Killed in 18 hours.

Autopsy. The trachea appeared very much congested, but there was an entire absence of false membrane. The caudal lobe of the lung on the right side was dark red in color, but not frankly consolidated, whereas on the left side a definite consolidation in the corresponding lobe had taken place. The spleen was decidedly enlarged and congested.

Bacterioscopic examination. Cover-slips from the trachea showed many polymorphonuclear cells, fewer epithelial cells, no bacilli. From the lungs many polymorphonuclear cells and epithelial cells with single nuclei, but no bacilli.

Cultures from the lungs and heart's blood, positive; from the spleen, liver and bone marrow, negative.

Exp. 14. A large rabbit received 1 cc. of a bouillon culture. Killed after 24 hours by breaking up the medulla.

Autopsy. The middle lobe of the right lung contained a consolidated patch the size of a silver dollar, over which the pleura was congested and contained small hæmorrhages.

Bacterioscopic examination. Films from the consolidated portion of the lung showed many polymorphonuclear leucocytes, some epithelial cells, but no bacilli.

Cultures from the lung as well as heart's blood, spleen and bone-marrow were negative.

Exp. 15. Full-grown rabbit received .75 cc. of a turbid suspension derived from a blood-serum culture. Killed in 24 hours.

Autopsy. The caudal lobe of the right lung and the lower part of the cephalic lobe on the same side were congested and consolidated as well. In addition the caudal lobe of the left lung contained several smaller areas of consolidation. The spleen was much enlarged. The trachea over the site of inoculation and at a distance from it was much congested. There was an entire absence of false membrane.

Bacterioscopic examination. Smears from the consolidated portions of the lung, trachea, spleen, bone-marrow and heart's blood were all negative.

Cultures from the same sources remained entirely sterile.

The object of this group of experiments was two-fold, namely, to determine, if possible, the manner in which the introduced bacilli so completely disappeared, and in the next place to consider the length of time necessary for the development of the pneumonic processes and the nature of the inflammation provoked.

Animals which had received large numbers of the Klebs-Loeffler bacilli showed at the end of one hour changes in the lungs, which, however, were not very marked. They consisted simply of an œdema of the tissues, together with more or less mottled congestion. Of greater significance, however, was the fact that an emigration of leucocytes had already taken place, and that some, although few, of the introduced bacilli were enclosed within cells, these being exclusively the epithelial cells of the alveoli. At the end of 3½ hours the pathological process was much more advanced, the first expression apparently resulting from changes in the blood-vessels, to judge from the definite hæmorrhages, often of considerable extent and very numerous, which were discoverable both in the pleura and in the substance of the lung. By this time, although large numbers of the bacilli had been introduced, comparatively few were now free, the overwhelming majority of them being enclosed either within the protoplasm or the nuclei of cells. In this short time the bacilli might be found to have extended their invasion beyond the thoracic organs; and whereas at the end of one hour they were still limited to the substance of the lungs, at the end of 3½ hours they were found in the spleen as well. It should be mentioned here that owing to the small size of the bronchial lymphatic glands, cultures from these were not very satisfactory, and were therefore not regularly made. At the end of 6 hours the effects of the inoculation were still more noticeable, and the distribution of the micro-organisms more extensive, as they were demonstrated by the culture method at the end of this time in the heart's blood, spleen, bone-marrow and liver. The bacilli were still capable of cultivation from these distant organs as well as from the lungs at the end of twelve and eighteen hours, while after the lapse of twenty-four hours, at which time a frank consolidation of the lung substance had taken place, they could not be cultivated either from the lungs or from the remaining organs mentioned. We should like to emphasize that, although the inclusion of the bacteria by cells takes place so rapidly and extensively, in no instance did we succeed in discovering the bacilli within the substance of the polymorphonuclear leucocytes.

The foregoing experiments serve to confirm the observation upon human beings relating to the existence of a purely diphtheritic broncho-pneumonia, and lend support to the view that the laryngeal cases are specially prone to the development of such pathological conditions, as they present the most favorable opportunity for the direct aspiration of the infectious agent. That an actual increase of the introduced micro-organisms takes place is proven, we think, by the observations made upon human beings which have been given in detail in an earlier part of this paper; in view of which fact the disappearance of the introduced bacteria in cases of experimental inoculation is all the more perplexing. The interpretation of this phenomenon is indeed not at once apparent. On the other hand it is worth considering whether in those cases of human diphtheria in which the bacilli have not been found in the local pathological processes, it may not be also unjustifiable to conclude that the bacilli never were present there, and were not concerned in their causation.

It is certainly interesting to observe that there may take place from the lungs a rapid distribution of the introduced bacilli throughout the body, so that at the end of from four to six hours they may be found widely distributed throughout the organs. It has appeared to us as if the opportunities for such distribution are greater in cases of intra-tracheal inoculation than in the ordinary modes of subcutaneous inoculation, where, as is well known, the bacilli are not found extensively distributed through the viscera. However, there is at least one difference between the observations in the two sets of cases, for in the course of the ordinary subcutaneous inoculation a longer time as a rule elapses between the inoculation and the death of the animal, which may account for the absence of the bacilli in the internal organs. As an illustration of this point we may mention that in animals which were either killed after the lapse of twenty-four hours or died spontaneously later, we failed to obtain the introduced bacilli from these viscera.

The experiments which we have conducted justify us in considering for a moment the question of the action of the lungs as an infection atrium into the body of pathogenic micro-organisms, and they would lead us to agree with Hildebrandt,[13] who showed, contrary to the previous belief of Flügge,[14] that the alveolar epithelium is not a perfect barrier to the invasion of pathogenic bacteria from the interior of the lungs. At the time that the bacilli are already well distributed through the body the alveolar epithelium still appears entirely normal, although containing many bacilli within its substance. The supposition that bacilli are capable of passing from the bodies of the epithelial cells in some way into the general blood current or into the lymphatics, without leaving behind them obvious evidences of injury to these structures, would therefore appear to be justifiable. As to the mechanism of this procedure one can only deal in conjectures, when it is remembered that in this case we are dealing with non-motile organisms which must be transported from place to place by a force not resident within themselves.* The capacity of the alveolar epi-

* Ultimately, of course, this is the same problem as that dealing with the mode of passage of inert particles, such as soot, india ink

thelium to take up living foreign matter in the manner similar to what is observed in dust inhalation had been previously observed by Muskatblüth[15] in his experiments upon the effects of the intra-tracheal inoculation of anthrax spores. He observed that in animals which had been killed on an average sixteen hours after inoculation, the greater majority of the bacilli were contained within epithelial cells corresponding with the so-called "staubzellen." Even when the englobing cells were free in the alveoli they gave every indication of having been derived from the pre-existing epithelium of these parts, and indeed were often found to be still in connection with the latter. As in our observations, he found that the leucocytes, the phagocytes *par excellence*, had no part in the inclusion of the bacteria. He was neither able to detect evidence of injury to the cells containing the bacteria, nor that the bacteria within them were undergoing disintegration.

It must not be forgotten that after the introduction into the lungs of such numbers of bacteria as were inoculated into these animals a portion at least of them may have been thrown off through the bronchial secretions. In this way not an inconsiderable number may have been finally disposed of, and this possibility is rather strengthened by the observation of Case 3, in which an inflammation of the œsophagus was noted and the Klebs-Loeffler bacilli were found in considerable numbers in this situation. Muskatblüth regarded the reaction on the part of the lungs, with the pouring out of inflammatory products, as favoring the destruction of the anthrax organisms *in situ*, a conception which could, with more or less justice, be applied to the cases in which at autopsy in the pneumonic areas we failed to obtain the introduced micro-organisms. It is, however, probable in the light of our present knowledge of the mechanisms employed by the animal body to dispose of pathogenic and other micro-organisms, that no inconsiderable action must be attributed to the spleen, liver and bone-marrow.

It appears to be worth while to direct attention to the fact that in not one of our animals was a pseudo-membranous tracheitis observed, although evidences of inflammation were more or less common. This is probably to be explained by the assumption that the injury to the mucous membrane was too slight to afford a favorable opportunity for the development of the organisms in that situation, rather than that the animals did not live, or were not permitted to live, long enough for the membrane to develop.

III.

In order to study the development of the pathological lesions in the lungs, sections of these organs were studied in the following manner: Beginning with the lungs of the animals killed one hour after inoculation, the succeeding ones were examined in a consecutive series. Sections were prepared from different parts of the organs; in those in which consolidation was apparent the hepatized portions were always included. The staining agents employed consisted of hæmotoxylin and eosin, safranin in aqueous solution, and Weigert's fibrin stain. The last sufficed for staining the bacteria, as well as fibrin, when present or when capable of retaining the dye, which was by no means always the case.

The histological lesions in the animals killed after one hour were very inconsiderable and consisted of dilatation of the alveolar capillaries, extravasation of a few red blood corpuscles, the appearance of polymorphonuclear leucocytes in occasional alveoli and in the bronchial walls, more rarely in the lumina of the bronchi in small numbers, perhaps an increase in the flat epithelial, nucleated cells within the alveoli, and more or less œdema. At the end of three and a half hours, on the other hand, the pathological condition was well advanced. Small vessels, apparently arteries, contained fibrinous and leucocytic thrombi; the congestion of the alveolar capillaries and larger interlobular vessels was a striking feature; the blood within the vessels contained an increased number of white elements, and both red and white blood corpuscles had begun to leave the vessels in relatively large numbers. The alveoli contain many cells of an epithelial habitus, and the fact of desquamation of the alveolar epithelium is made directly apparent. There exists at this time a definite purulent bronchitis. Branches of the bronchial tree which are still lined with columnar ciliated epithelium contain many polymorphonuclear leucocytes, and similar cells may be discovered working their way through the walls of the bronchi to reach the lumina. The lining epithelium of these structures was never found to have suffered severely; no defects existed in this layer. A few cell fragments were seen amid the increasing cellular accumulations.

The animals which were permitted to live six hours showed much more advanced lesions. Up to this time the pathological changes have been limited to the interior of the bronchi and alveoli; but now the stroma of the lungs begins to show changes. As a whole it is thickened, partly owing to œdema and partly to an increase in the cellular constituents. Many of the new cells are polymorphonuclear leucocytes, but among these are many cells with round, solidly staining nuclei which may have been derived from such leucocytes or have had a different origin. Fragments of cells begin to be more common in this situation and karyokinesis begins to be apparent. The capillaries, chiefly those in the alveolar walls, show large, somewhat diffusely staining, nucleated protoplasmic masses resembling giant cells. That these masses are the results of the fusion of intravascular white elements seems highly probable. The endothelium of the capillaries and small veins is swollen, but no actual injury was observed. The number of cells within the alveoli is much increased; they still consist of polymorphonuclear and epithelial elements in about equal proportions. Definite mitotic figures begin to be fairly common within the alveolar epithelium, and an occasionally non-nucleated (necrotic?) cell of this kind makes its appearance.

and red blood corpuscles, through the alveoli. Arnold in particular has investigated this question and found that these substances are transported to and deposited within the neighboring lymphatic glands. Baumgarten[17] regards the transportation of bacteria and spores of fungi to be likewise of a purely mechanical nature. Moreover, he found that pathogenic bacteria were capable of being mechanically taken up in the same manner, in the absence of lesions of the alveolar lining; for the intra-tracheal injection of tubercle bacilli, killed by boiling, was followed by their passage in a few hours through the alveolar walls into the intra-pulmonary lymph follicles.

The bronchi contain much exudate, consisting chiefly of leucocytes with irregular nuclei, but mononuclear epithelial cells are also present, and a large amount of detritus derived by fragmentation from cell nuclei. Evidence of cell destruction to a slight extent is to be observed in the walls of the bronchi, and it not infrequently extends into and involves the lymph nodes imbedded in their walls. The lining epithelium shows little or no injury. As regards the origin of the cells composing the exudate within the bronchi it may be said that the bronchial mucous membrane furnishes but few of the elements. They come almost exclusively from below, from the terminal bronchioles in which the lining epithelium is almost or quite flat, and from the adjacent atria and air-sacs (Miller).[16] Specimens twelve hours old show still more clearly that the contents of the larger bronchi are excreted from below, inasmuch as the terminal structures give every evidence of a rapid filling up with cells, while the high epithelium of the former is quite perfect and the bronchial walls but little infiltrated with wandering cells. It is not alone the lumina of the bronchioles, the atria and the air-sacs which give evidences of increased cellular invasion; this is also apparent in the stroma as well. The much thickened stroma is overloaded with cells, having as a rule irregular and fragmented nuclei, and showing in addition, here and there, karyokinetic figures, some of which certainly would appear to be within the capillaries. Moreover, the air-cells springing from all these structures, terminal bronchioles, atria and air-sacs, are now more or less completely filled with cells, partly emigrated, partly desquamated from the walls. Fibrin is present in the form of fine fibrils, too fine apparently to retain the Weigert stain, but yet evident upon close inspection. The consolidation of the lungs at this early stage is partial only, and more microscopic than macroscopic in form. Œdematous foci and small areas of extravasated blood are intermingled. The pleura is still intact. The succeeding stages, that is, after 24, 47 and 65 hours, show appearances similar to those described, with such modifications only as involvement of larger areas and more perfect solidification might be expected to introduce. Adjacent to hepatized foci others of compensatory emphysema or insufflation exist, and the cellular infiltration of the stroma, always a prominent feature after twelve hours, may involve the emphysematous parts. Hæmorrhages are never entirely absent and may become considerable in the cases of longer duration; fibrin, never a very prominent feature, increases more or less;* multiplication of cells resembling the offspring of epithelial cells may be so rapid as in some places to be the sole elements within certain alveoli; the pleura becomes the seat of small leucocytic accumulations upon its surface which are derived from the lung substance, the cells of which may be seen wandering through the endothelial layer, which itself remains intact. Fibrin was never discovered upon its surface. The extent of destruction of nuclei within the bronchial as well as in the alveolar exudates grows until in many places fragmented nuclei alone compose the consolidating material. In this respect the exudate differs from most of those with which we are familiar in the lungs in acute disease. Even where a whole lobe, or indeed a whole lung, apparently is hepatized, the consolidation is not complete; the effect is brought about by the imperfect approximation of many foci of lobular consolidation.

The experimental pneumonias following the intra-tracheal inoculation of pure cultures of the bacillus diphtheriæ in rabbits are lobular or pseudo-lobar in character; they are cellular pneumonias for the most part, fibrin playing a relatively inconsiderable rôle in their production; they are rapidly developed and originate in the bronchioles, atria and air-sacs; the bronchi are but little affected in the early stages, and even later are hardly more involved than in the acute lobar pneumonias of human beings. The bacillus diphtheriæ and its toxic products when introduced directly into the lungs exert their action primarily upon the blood-vessels; very soon, however, the alveoli themselves are deleteriously affected, and within the brief period of six hours the entire framework of the lungs feels the injurious influence. The expression of these effects is seen partly in the exudative and partly in the proliferative changes which ensue. Among the latter the appearance of cell division by mitosis after the lapse of only twelve hours seems worthy of special mention.

The relation of the bacilli to the lung structures is a simple one. Sections stained in Weigert's fibrin stain show, in those cases in which the duration of life of the animal did not exceed twelve hours, many of the characteristic bacilli. They were almost never free, but enclosed in cells, which were either distinctly mononuclear in character or large, flat and scale-like, without demonstrable nuclei, and certainly not of the nature of vascular leucocytes. That they have come from the alveoli is certain, for similar cells crowded with bacilli may at times be found still attached to the walls. The study of the relation subsisting between the micro-organisms and the lungs shows conclusively that the invasion takes place from the bronchioles, and very soon the bacilli are discovered within cells in the stroma. Whether or not they were contained within definite vessels could not be determined with certainty.*

Within the bronchi the bacteria appear amid the cellular exudate sometimes enclosed within the scale-like cells mentioned, and again, but not certainly, within polymorphonuclear leucocytes. If actually englobed by the latter the process is not a very active one. That the polymorphonuclear leucocytes at times take up the bacilli in cases of human diphtheritic pseudo-membranous bronchitis we have already shown in our studies of the broncho-pneumonia of this disease.[11]

After the lapse of 18 hours the bacilli are found only with difficulty in sections, and in instances of still longer duration

* The lungs of the animal which lived 65 hours (Experiment 1) showed the greatest quantity of fibrin observed. The tissue which had been hardened in Flemming's osmic acid solution and stained in safranin was best adapted for the study of this material. The fibrin was found in fine threads and convoluted masses within the alveoli and the intralobular lymphatics. It was perhaps most abundant where the cellular accumulations were least marked.

* In this connection Miller's observation that lymph-vessels are not found in the structures of the lungs beyond the terminal bronchus is significant. The atria and air-sacs have no lymphatics in their walls.[18]

not at all. We did not discover the bacilli in animals which had lived 24, 47 and 65 hours respectively.

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Winter, 1896.

THE BACTERIOLOGY OF PERTUSSIS.*

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Pertussis is a disease which has long been suspected or known to be communicable from individual to individual, and it is not surprising to find that various authors have approached the subject of its etiology in divers ways. The sputum seems to have been the principal subject of study, and bacteria and protozoa in the sputum have been selected, each in turn, as etiological factors. I need only mention the names of Deichler, Kurloff, on the one hand, Letzerich, Burger, Affanassjew, Ritter, Cohn and Neumann on the other, to recall to the mind a whole series of studies on the sputum, the one dealing with protozoan-like bodies in the sputum, the other with bacterial forms. In my own work, which has spread itself at intervals over several years, and lately culminated in the study of a series of cases of pertussis, I have directed my attention to the bacterial forms especially found in the sputum. I will not go into details here of my studies in other directions in this disease, such as bacterial studies of the blood, for they have led to no results. If we look over the literature mentioned above we may safely divide the communications on bacterial forms into two distinct sets: those which, like the work of Letzerich and Burger, were carried out without the aid of modern methods, and in which the instruments used were what we would call primitive; and those which can be judged to day, inasmuch as the methods employed were modern, such as those of Afanassjew, Szemetzchenko, Cohn and Neumann, and Ritter. Of those mentioned I will consider at length only the work of Burger and Afanassjew. Burger,* by means of a Seitz dry lens, 340 diameters, describes a bacillus or bacterium which he could easily see and which he calls biscuit form. He saw these in rows and chains and small rods twice as long as they were broad. He mentions distinctly that he found these bacteria in the flocculi of the sputum. It seems at this distance that it would be asking too much to decide just what Burger saw in the sputum of his cases, more especially as it is now known that both diplococci and bacilli of various varieties and size exist in this sputum. We miss unity in Burger's description. He did not isolate any one form, and from his description may have had several forms in his field when he studied the sputum, thinking they were all a single form.

Afanassjew's work appeared in the St. Petersburg Med. Wochen., 1887. Czaplewski and Hensel, who do me the great honor to agree with me in my conclusions, admit that

* Read before the Johns Hopkins Hospital Medical Society, February 21, 1898.

* Berlin. klin. Wochen., 1883.

they have not had access to the original work of Afanassjew. In view of this fact I will quote from Afanassjew's original article.

Afanassjew describes the sputum of pertussis as a transparent mucus in which are seen grayish white spots of the size of a pin's head. In the mucus of the sputum are seen bacteria and short, small bacilli, single or in pairs, at times in chains of no great length, arranged in the direction of the mucus of the sputum; at times in small groups. The length of these bacteria is 0.6 to 2.2 micro-millimeters, and are easily overlooked with low powers, and can only be distinctly seen with higher powers. "For this reason," says Afanassjew, "I doubt whether Burger has seen the bacterium described by me in the sputum, inasmuch as he says that he saw them distinctly with 340 diameters. I have made use only of powers magnifying 700 to 1000, with Zeiss ocular 3 and 4, and immersion $\frac{1}{12}$ with the tube drawn out." Afanassjew describes his bacteria as follows: "In gelatin, after two or three days, we find round or oval colonies, light brown with even borders, also oval colonies with a darker centre. The youngest colonies were almost colorless, but slightly granular, and did not fluidify the gelatin."

He also describes colonies of a thicker shorter bacillus, which in passing I may say may have been a contamination of his cultures. The bacillus described by Afanassjew grows at the temperature of the room, slowly, or more rapidly, at 38° C. or 37° C.

"*Agar stick culture* gives on the second day on the surface around the puncture a cloudy gray flat growth, transparent, glistening like a drop of fluid. In the following days the surface culture becomes more and more opaque and whitish gray."

"*Gelatin stick* gives a slower growth, thinner, on the surface flatter, grayish white with irregular edges; later on the edges become whiter and form a nail-head which is dry and rarely reaches to the periphery of the tube. The stick itself is not characteristic."

"*Blood serum* gives a grayish or whitish growth similar to the agar."

"*Potato gives rapid abundant yellowish, and after brownish growth.*"

"*In bouillon or hanging drop* we find the bacteria are alive, move very rapidly, inasmuch as they perform bobbing circular movements which soon cease."

"In the bouillon the bacteria grow in small threads."

I think in this article we may fairly leave out of consideration the work of Cohn and Neumann, and also of Ritter, which are chiefly concerned with the consideration of diplococci not clearly identified, and pass on to the recent work of Czaplewski and Hensel. The work of these authors was made known first through a preliminary communication in the Deutsche Med. Wochen., 1897, No. 37, and in the Centralbl. für Bacteriol., Dec. 22, 1897. They had worked upon over 44 cases of pertussis (an epidemic), in 18 of which they isolated what they call a polbacterium or bacillus, reminding one very much as to size of the influenza bacillus, if not smaller. The bacterium is, according to their view, not motile in itself. There was a slight motility in fresh bouillon cultures, which they were inclined to interpret as a Brown's molecular movement, but no independent movement of their own over the whole field of view. Gram stain did not decolorize fresh cultures, though it did the sputum.

The bacterium grew on Loeffler serum, agar, gelatin (non-fluidifying) bouillon, but *not as yet* on potato.

Loeffler serum gave an uncharacteristic grayish white growth; agar a delicate gray growth of transparent confluent colonies. On agar involution forms are described.

On gelatin it does not fluidify the medium, stick is not characteristic, and is made up of delicate whitish yellow granules like streptococci.

In bouillon we have cloudiness after a day and a sediment in the bottom, which on shaking resolves itself into thready slimy masses.

There is no mention in the work of Czaplewski and Hensel of the isolation of their bacillus in pure culture by means of plates and colony inoculation.

My own bacterial work on the sputum of pertussis was first read before the British Medical Association, in the latter part of August, 1897, and published subsequently in the British Medical Journal and the Centralblatt für Bakteriologie, 1897, Band XXII, Nos. 8–9.

In this communication I described a series of cases examined during the winter and spring of the same year. There were sixteen cases, and since then I may say I have been examining other cases with identical results.

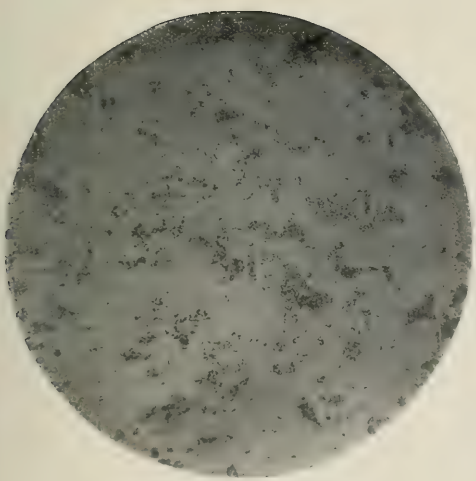
The sputum was collected during a paroxysm of coughing in sterilized Petri dishes and allowed to stand a short while. The sputum separates in these cases into a glairy colorless mucus, in which are distinctly seen small grayish white particles like the scales of dandruff. These particles were fished out with a platinum needle, and *without* being subjected to further manipulation, such as washing, were sown in the media employed. In uncomplicated cases the above pellets of sputum are easily recognized, but if bronchitis or pneumonia complicates the case the sputum is more purulent and thick and does not separate as described. I also made use of hydrocele fluid, obliquely solidified at 65° C. to 70° C., in a transparent solid medium in test tubes, as my medium for cultivating this bacterium. I found and still think this medium especially fitted for the cultivation and isolation of the bacterium or bacillus described by me. I think this is due to the fact that hydrocele fluid is a poor medium for most bacterial species and favorable to the one interesting us. I made use of all the other media, but found that it was necessary to use the hydrocele fluid first to get the crude culture *en masse*, and from this to inoculate other media and make plates. I will not detail individual cases, as this has been done elsewhere, but will describe the bacillus isolated by me.

The Sputum. If a small grayish white pellet of the sputum of the convulsive stage described above is spread between two cover-glasses stained with Loeffler blue or fuchsin and examined, we see as a constant element a small exceedingly minute bacterium, either singly arranged in the direction of the striæ of the sputum or in small colonies; it may be seen in the epithelial cells or on the epithelial cells, or free, or in the meshes of the sputum. This bacterium or bacillus is so thin and

Bacillus Pertussis in the Sputum.

Fuchsin stain × 580.

Zeiss apparatus immersion $\frac{1}{12}$.



Pertussis Bacillus. Pure Culture.

Loeffler serum × 580 diameters.

Zeiss apparatus $\frac{1}{12}$ immersion.

small as to be quite easily overlooked even with a $\frac{1}{12}$ immersion, and in zoogloea it looks like a collection of cocci. Close study of the zoogloea reveals the fact of bacillary form. In cases not complicated by bronchitis or pneumonia these minute bacteria or bacilli are the only forms to be seen. As soon, however, as bronchitis or pneumonia sets in, other bacterial forms occur in the sputum and can be seen, and this will partly explain the difficulty of former workers in isolating this bacillus. If a small grayish pellet of the sputum be spread on obliquely solidified hydrocele fluid, or hydrocele fluid $\frac{2}{3}$ and glucose bouillon $\frac{1}{3}$, we obtain after a lapse of 24 to 48 hours in the incubator at 37° C. to 38° C. a mixed bacterial growth of a whitish or transparent gray color. A small part of this is suspended in bouillon according to Loeffler, and then a few platinum loops of the mixture spread on another hydrocele tube. In this way isolated colonies may be obtained, or agar plates may be made in the usual way from the whole growth. In this manner we find that the bacillus grows in pure culture on hydrocele fluid as a delicate grayish white or pearly growth. If sugar bouillon is added to the hydrocele fluid the growth is thicker, not so delicately transparent and more of a creamy color.

On agar we have at first a delicate grayish white growth, which in time becomes thicker and whiter and more opaque. If the agar is white and made with beef extract, the growth is very delicate, grayish and not so white. Colonies in agar are whitish or grayish white by reflected light, of a straw color or deeper olive tint by transmitted light. They are irregularly round or oval.

In gelatin there develops at the room temperature and quite slowly a fine granular stick, whitish, much like that of streptococci. It has a nail-head and does not fluidify the gelatin. Colonies in gelatin have a round or an irregularly round form, whitish yellow by reflected and straw colored or olive colored by transmitted light. They are finely granular. The colonies do not become very large.

In pepton bouillon we have a finely granular appearance after 24 hours and a cloudiness; after a time we have a sediment in the bottom of the test tube which is made up of small adherent masses. After a week or more the surface of the bouillon becomes covered with a thin sediment membrane which is made up of bacilli.

On Loeffler's diphtheria serum we obtain a whitish growth, reminding one much of the diphtheria growth.

On potato I have not as yet succeeded in obtaining a growth.

On human blood serum which is solidified on the surface of agar, we have a grayish white and abundant growth after forty-eight hours.

It should be here pointed out again that on agar the growth is delicate, grayish, transparent, and sometimes stops growing after a time, never being vigorous if the agar is clear and made of beef extract instead of beef juice. If agar is browner and made with beef juice the growth after a time is seen to be white, almost of an opaque pearly color; after a time, this difference in growth of agar tubes I could well convince myself of when recently working with pure culture obtained by plate colonies. This latter peculiarity will explain why Czaplewski and Hensel talk of a delicate growth on white agar when mentioning my agar appearances. Cultures and threads which have been allowed to stand in closed tubes for six months are found to be dead and cannot be reinoculated on other media.

The bacterium or bacillus which I have isolated in pure culture and which has the above cultural characteristics, grows anaerobic as well as aerobic.

If stained with Loeffler blue it appears as an exceedingly minute, delicate, thin, short bacillus form, much thinner than the diphtheria bacillus and not more than $\frac{1}{3}$ to $\frac{1}{2}$ its length. It measures 0.8 to 1.7 micro-millimeters in length, and 0.3 to 0.4 micro-millimeters in breadth. When stained with Loeffler blue it has a finely punctate appearance like the diphtheria bacillus, but here the resemblance stops, for it is a much more minute bacillus. In pure culture it is not decolorized by Gram stain. Old cultures on hydrocele and agar show club-shaped forms, the bacillus has a deeply tinged extremity like a club—in other words, involution forms exactly similar to the bacillus diphtheriæ. Of course the involution forms are exceedingly delicate and show much smaller than the bacillus diphtheriæ.

The name of "pol-bacterium" has been proposed for this bacterium by Czaplewski and Hensel in their article in the Centralblatt für Bakteriologie. The pol staining of this bacterium cannot be compared to such distinct pol-stain as that of a chicken-cholera bacillus (Kitt), rabbit septicæmia (bacterium bipolar), where the extremities of the bacterium are deeply stained and rounded, and there is a distinct square space in between the poles unstained. The staining of our bacterium is exactly identical with that of the influenza bacillus when stained in pure culture with method blue of Loeffler. The bacterium or bacillus of pertussis stains deeply at the extremities and there is an irregular space or two irregular spaces in the long axis of the bacillus unstained or lightly tinged when stained with methyl blue of Loeffler. Some of the extremities are rather swollen, most of the extremities or poles are round, others are lancet shaped. I have never been able to convince myself by any known methods that this bacillus has spores or flagella.

Motility. In my first communication I said this bacillus was motile. By this I simply meant that in the hanging drop it was seen to have a rapid bobbing circular motion in a very circumscribed area of its own. In some fresh bouillon cultures this very limited motion was active for a while and then ceased at the room temperature. I think that some would be inclined to deny that this was a movement inherent in itself inasmuch as the bacilli never traversed the microscopic field. I am quite willing to admit that this movement might be classed with cocci movements (Brown's molecular movements).

Animal Experiments. In my first paper I showed how fruitless animal experiments with this bacillus were. It is pathogenic to mice in large amounts of a $\frac{1}{2}$ to 2 cc., but in no instance was I able to reproduce symptoms of a disease similar to whooping cough in the lower animals. I think as I did then that accidental inoculation of the human subject could alone enlighten us. It would be going too far to make any such experimental inoculations.

From the above it will be seen that from the sputum of pertussis cases in the convulsive stage, Czaplewski and Hensel and I, independently of each other, have isolated pure for the first time a bacterium which is constant and found in no other sputum. This bacterium is especially characterized by a minuteness comparable only to the influenza bacillus (Pfeiffer) or that of septicæmia of mice (Koch). In staining the dotted (not granular) appearance spoken of by me and compared to that of the bacillus of diphtheria, can best be brought out by the Loeffler alkaline blue stain. Fuchsin stains more coarsely and more uniform. The swollen end forms, or as I call them the involution forms, can also be brought out by Loeffler blue stain. I wish to point out here also that both in my first paper and in this I worked with pure cultures only (obtained by means of plate colonies). In this perhaps we find a reason why authors who have preceded the communications of myself and Czaplewski and Hensel differ so widely in what they saw. They failed to obtain the bacterium in pure culture. It may be remarked in passing that in my second cases as well as in some of my first cases there could be found among other bacterial forms a bacillus closely resembling the bacterium isolated in this work. This latter is somewhat thicker, grows in longer chains and fluidifies gelatin. I am inclined to think that observers have hitherto been much baffled by this bacillus, which I think with Czaplewski and Hensel is simply accidental. Such must have been the case of Cohn and Neumann.

I have tried to isolate my bacillus or bacterium in the early stages of pertussis before the convulsive paroxysm has appeared, and have not succeeded thus far in separating it from the saliva.

What significance can we attribute to the bacterium which is the theme of this paper? I doubt whether this can be solved except by direct experiment on the human subject. I may not be going too far to predict that the bacterium will aid us in understanding the mode of contagion in pertussis. It may be the first definite step in showing that in the sputum of the pertussis sufferer lies the danger of the communication of the affection to others.

Discussion.

Dr. Osler.—I would ask Dr. Koplik if he has followed a case through from beginning to end and whether there is any difference in the abundance of bacilli during the early and late stages. Some have held that the disease was more infectious in its early stage.

Dr. Koplik.—I would say that I have tried to make a diagnosis of pertussis before the convulsive stage appeared. I could not find the bacillus in the mouth. The bacilli seem to be most abundant in the convulsive stage, but I did not follow up the study to see whether they persisted in the stage of convalescence.

Dr. Welch.—I notice that Dr. Koplik spoke of the staining in his first paper as granular, and Czaplewski supposes that he means polar staining. In Czaplewski's photograph the polar staining is none too definite, and he uses almost altogether carbolic-gentian-violet, which gives an irregular staining with many bacteria. I would ask if this is a polar staining like that of chicken cholera, or an irregular staining as of the diphtheria bacillus.

Dr. Koplik.—I would classify it as more like the irregular staining in diphtheria. I think that the bacteria are more like the diphtheria organism than a real polar bacteria.

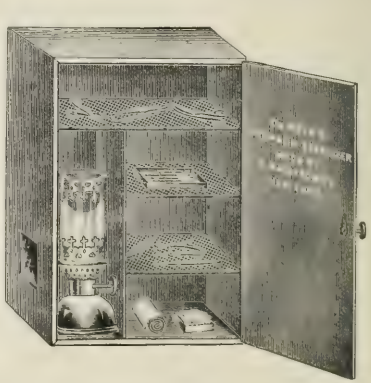
Dr. Sternberg.—It seems to me that the photograph does not show an extremely minute organism such as the influenza bacillus for example.

SUPPLEMENTARY REPORT ON THE STERILIZATION OF INSTRUMENTS BY FORMALDEHYDE.

By H. O. Reik, M. D.

The December number of this Bulletin contained an account of the work performed by Dr. Watson and myself with formaldehyde gas, and we stated then that Meyrowitz of New York was making for us an apparatus especially adapted for the use of this method of sterilization. The accompanying cut represents the sterilizer referred to and which I am now using in my daily work. It is of a size suitable for the ophthalmologist, otologist, laryngologist, or other surgeon who uses comparatively small instruments. Should the general surgeon or the obstetrician desire to adopt the method, a larger sized sterilizer can be readily made and special appliances may be inserted for holding the particular instruments used by him; as for instance there is figured in the illustration a small tray for carrying such delicate instruments as the cataract knife, etc., so as to prevent their cutting edges from coming into contact with anything.

The sterilizer which I have adopted for myself is 7x12x12 inches, giving an air space of a little more than 1000 cubic inches. The shelves are made of heavy, wide-meshed wire gauze, the upper one extending entirely across the chamber, while the lower two are only eight inches long, extending from the right side to an upright standard four inches from the left wall, thus leaving a space four inches wide by eight inches



high which is reserved for the Schering lamp used in vaporizing the pastilles.

In the report of our work we called attention to two features in the sterilization of instruments by this method which we thought required further study. The first related to the question of the deposit of paraform on the instruments and the possibility of such a deposit retarding the healing of wounds. The second was the possible effect of the gas upon the cutting edge of the instruments.

I think we are able now to give positive answers to both problems. Since receiving my new apparatus I have repeated all the bacteriological experiments quoted before and with the same results published. I have further exposed instruments to five and six successive sterilizations by the gas, without any washing or cleansing whatever, and at the end of the experiments I was not able by the naked eye to discover any deposit whatever, nor was there any taste of the gas when the instrument was applied to the tongue. A cataract knife so exposed was used in making a corneal section on the rabbit. Healing of the wound took place as usual when a sterile knife is used. Blunt instruments so exposed and then applied to my own conjunctiva produced no irritation.

As to the question regarding the edges of the knives, I tested very carefully their sharpness by means of the kid drum, both before and after sterilization, and I am not able to discover that the gas affects this in any way. To see whether or not the gas would affect instruments made of other material than steel, I repeatedly exposed the following instruments to the action of the gas: knives with aluminum handles, knives with ivory handles, a hard rubber syringe, soft rubber catheters, a Politzer air bag, and a nickel-plated syringe. None of these objects were in any way affected by the gas.

My conclusions are then that we have in this method a rapid, cheap, easy and sure method of sterilizing instruments without in any way injuring them.

CORRESPONDENCE.

DOES WILHITE'S STORY OF THE NEGRO BOY INCIDENT IN THE DISCOVERY OF ANÆSTHESIA "LACK PROBABILITY"?

Letter from Dr. Wilhite.

To the Editor:—

My attention has been called to the article published in the August and September issue of this Bulletin from the pen of Dr. Hugh H. Young, Assistant Resident Surgeon Johns Hopkins Hospital, entitled "Long the Discoverer of Anæsthesia."

The writer has in a very interesting manner restated a part of the much discussed history of anæsthesia. I shall then not tax the reader's patience by another recital. Having been an interested spectator as well as a listener at the semi-centennial in Boston, October 16, 1896, of the *alleged* first discovery of anæsthesia—at which meeting quite a number of distinguished men of the medical profession, representing different parts of the United States and elsewhere, demonstrated to *their* entire satisfaction and others that Morton was entitled to the glory *alone* of this discovery—I would have been content to let the matter rest, so far as I am interested, but for the article of Dr. Young, wherein some reflections are cast upon the memory of my deceased father, Dr. P. A. Wilhite, whose statements in New York, 1876, gave rise to the article of Dr. J. Marion Sims, published May, 1877, in the Virginia Medical Monthly. From my youth I have been conversant with the facts as related by my father; and as he was the life-long friend of Dr. C. W. Long, as well as an enthusiastic supporter of Long's claims to the discovery of anæsthesia, I have been puzzled to understand why *twenty years* after Dr. Sims' article has appeared, and after Sims, Long and Wilhite have passed beyond the realm of controversy, labored efforts should now be put forth to throw doubt upon Wilhite's statements that first awakened interest in Long's claim, when the only errors of which Dr. Long himself complained to Wilhite were the mistake made in the date when he and others entered Long's office, and of being present at the first or second operation by Dr. Long, and of saying that the first inhalation of ether in Jefferson was before the same persons. Dr. Young is charitable enough to admit that Long never mentioned this incident as being one of the mistakes in Wilhite's statement. I feel that injustice to the memory of Dr. Wilhite has been done, and that I ought not to permit some of the statements made by Dr. Young on this subject go unnoticed.

In a private letter from Dr. Young I am led to believe that it was not intentional on his part to do injustice in the matter to Dr. Wilhite, and that "his information came largely from papers of Dr. L. B. Grandy, of Atlanta." Since his information comes from Dr. Grandy, whose article was published in the Virginia Medical Monthly, 1893, and since he has courteously invited me to criticise his article and present documentary proof concerning Dr. Wilhite's claims, I will not be regarded a naked trespasser in this fertile field of controversy. Now, let me state at the outset, Dr. Wilhite never claimed to be the discoverer of anæsthesia, *only so far as being the first one to produce the full anæsthetic effect of sulphuric ether accidentally*, and it was only at the earnest solicitations of friends that he placed himself before the medical profession in 1883 to receive such honor as might be due him; neither did he in any way seek to detract one iota from the honor he believed justly due his old preceptor and friend, Dr. Long. What he claimed then was that on one occasion while a boy at a country frolic in Georgia, he with others caught a negro boy, and while the others held the boy, he (Wilhite) administered to him sulph. ether, rendering him unconscious, etc., so much so that a doctor was sent for to revive the negro boy, and that when studying medicine under Dr. Long he related to him the circumstance. It would seem from recent attacks that Dr. Wilhite's *offending* consisted mainly in making a statement from "*recollection*" to Dr. Sims in New York that he was a student under Dr. Long and witnessed the first operations, and further, when a boy about seventeen years old he accidentally etherized a negro boy at a frolic in 1839, when the

year, as we shall see, was 1841. In order to make it appear that the story "lacks probability" the date of a letter is shuffled from January 27, 1877, to June 27, 1877, which Dr. Young states is a reply to a letter from Dr. Long, of May 20, 1877, and his daughter is quoted as giving the information that her father "repeatedly told her that he had never heard of it before it appeared in Sims' article." (I shall now take the liberty to refer to his (Dr. Y.) source of information by reference to Dr. Grandy's article, etc.) Dr. Grandy in his article, speaking of Mrs. Taylor's statements, says: "She tells me that the above story *was related* (italics mine) to Dr. Long by Dr. Wilhite *himself* in the presence of several of the family, when Wilhite was on a visit to her father's house in the *spring* (italics mine) of 1877. After hearing it, Dr. Long replied, "Doctor, this is the first time I ever heard of it." Now I submit that Dr. Wilhite's visit to Long, in Athens, was after the publication of Sims' article. Dr. Young says: "The ether controversy was never re-opened and Long's work was unknown to the world until 1877, when J. Marion Sims, hearing of him *through accident* (italics mine), investigated his claims, was fully convinced of their merit, and vigorously demanded their recognition by the medical profession. His paper appeared in the Virginia Medical Monthly, May, 1877." Then he says again: "This article which obtained for Long the first recognition of any consequence was the outcome of a conversation which Sims had with *a Dr. P. A. Wilhite, of Anderson, S. C.* (italics mine). He summarizes the statements of Wilhite to Sims, and adds: "*Dr. Sims at once communicated with Dr. Long and soon convinced himself of the truth of his claim, but unfortunately failed to investigate Wilhite's satetments, but embodied them in full in his article, giving Wilhite the credit of first intentionally producing profound anæsthesia with ether*" (italics mine). How does Dr. Young know that Dr. Sims never investigated the negro boy story? Does he not state: "Sims sailed for Europe soon after the publication of his article, and Long died in a few months, and Wilhite's statements went unchallenged for many years"? Let us see what Grandy said in 1893. "Sims' article appeared in May, 1877, and Long at once noticed the errors and the absence of promised corrections. He requested Sims to correct the mistakes, but the latter replied that the 'misplacement of a few names and dates would not alter the main facts in the case.' He sailed for Europe in a few days and the matter was dropped." Now as a matter of information and to know when Sims did sail for Europe, I have in my possession a letter from his son which reads as follows:

New York, September 28, 1897.
30 West 58th Street.

My Dear Doctor:—On account of my absence from the city your letter of the 21st instant was not received until to-day. In May, 1877, my father was to have sailed for Europe on the Celtic. . . . . He and I went to San Francisco in June of that year. He returned here and sailed for Europe some time in July, about the latter part. . . . Believe me, yours sincerely,

(Signed) H. Marion Sims.

Why would Sims have needed to investigate Wilhite's statements further than to write to Long for the facts? Did not Long send them? See the letter hereinafter quoted. Dr. Young further states: "The negro boy story lacks probability, as Wilhite did not enter Long's office until 1844, two years after the first operation, as the following letter from Long to Wilhite shows." Now I admit that the letter shows this: Wilhite did not enter Long's office until 1844 and therefore he was not a student in his office in 1842 when the first operations were performed. I challenge Dr. Young to point to one word or sentence in that letter *quoted* to show that the negro boy story "lacks probability." In order that the reader may see the point I make, I quote the letter as published by Dr. Young:

Athens, Ga., May 20, 1877.

Dr. P. A. Wilhite.

Dear Sir:—I received Dr. Sims' article on anæsthesia yesterday and find several mistakes. Dr. Sims states that yourself, Dr. Groves and Drs. J. D. and H. R. J. Long were students of mine and witnessed the operation performed on Venable, 1842. Your recollection failed you at this time, as it was several years, at least two, before either entered my office. You will see that you were mistaken in giving Dr. Sims this information. You also make a mistake in saying that the first inhalation in Jefferson of ether for its exhilarating effects was before the same persons. . . . I wrote to Dr. Sims informing him of the errors and asking him if he considered the mistakes of sufficient importance to be noticed, etc.

(Signed) C. W. Long.

Dr. Young has the candor to say, "In the letter to Wilhite, Long makes no comment upon the negro boy incident." Then why should he say it "lacks probability" from *that* letter? He, I submit, does injustice by quoting a letter of Dr. Wilhite in that connection to Dr. Long, making it appear that the letter bore date June 27, 1877, and states that it was a reply to Dr. Long's letter of May 20, 1877. I will quote this letter later on in its proper connection, and I am satisfied that he will see its inapplicability to his assertion. Now his proposition is that the negro boy incident "lacks probability." That is the question at issue and he has assumed the affirmative, and the burden of proof rests upon him. I am not called upon to prove a negative. The only thing he has relied upon is the letter quoted and the statements of Dr. Long's daughter, "but his daughter informs me that he repeatedly told her that he never heard of it before it appeared in Sims' article." Before impartial judges I submit he has not made out his case and established his proposition. The letter does not do it, for even admitting for the sake of argument that Long never heard of it until he saw it in Sims' article, or never heard of it *himself* as told to him in the spring of 1877, does not establish its improbability. I might rest the matter here but for the imputation cast upon Dr. P. A. Wilhite's veracity by the proposition, and this I must be permitted to defend. It needs none in South Carolina where he was known, but your Bulletin is not local. It goes among gentlemen who did not know him. It is true that he was a country physician; but in this dawn of the twentieth century the old Pharisaical question, "Can anything good come out of Nazareth?" should be discarded and the Nazarene's command, "Render unto Cæsar the things that are Cæsar's," should take its place.

"Honor and fame from no condition rise; act well your part, there all the honor lies," might have been justly said of Dr. P. A. Wilhite in his limited sphere of action. He spent his life in

the interest of suffering humanity, and when the summons of death came, June 25, 1892, "he wrapped the drapery of his couch about him like one who lies down to peaceful dreams." Neither envy of men nor their sneers will disturb his repose. He eschewed politics and practiced medicine in Anderson, S. C., for nearly forty years upon his merits. The *People's Advocate*, a newspaper published in the city of Anderson, June 27, 1892, said: "In the death of Dr. P. A. Wilhite, Anderson loses one of her best citizens, liberal and progressive in his nature and upright in character. . . . He was one of our most noted physicians, was esteemed by all classes, and the whole city is in sorrow over his death." . . . The *Anderson Intelligencer* said: "Dr. P. A. Wilhite, one of the oldest and most skillful and most highly respected physicians in this portion of South Carolina, departed this life at his residence this morning. . . . In 1878 Dr. Wilhite was appointed a member of the State Board of Health, then created by act of the Legislature of this State, and remained an active and influential member of the Board until his death." . . . . I might add further extracts from the press, etc.; suffice it to say that neither of these notices was written by relatives, but such is a part of testimony and tribute paid his memory publicly by those with whom he lived and for whom he lived for upwards of forty years. He was born in the State of Georgia about two miles of Danielsville, June 6, 1822 ("Dr. Long in Danielsville"), Dr. Long being about seven years his senior. Dr. Grandy says, "Up to the time of Dr. Long's death the relations between himself (Dr. L.) and Dr. Wilhite appeared to have been very friendly." His daughter had stated that Dr. Wilhite was a visitor to Dr. L. in the spring of 1877. The writer well remembers this visit, as he was an inmate of Dr. Long's house for a long time as a boarder, was then a student in Athens and was frequently in Dr. Long's private place of business, as well as a visitor in the family circle, and he knows of his own personal knowledge that the relations of the two men were friendly and cordial. This was before and after Sims' article appeared, and therefore I insist the letter quoted by Dr. Young from Wilhite to Long as of June 27, 1877, is incorrect, for it was not far from about that time when Wilhite visited Long. During this visit I was with my father and Long a great deal of my time and heard them discussing the facts, and to the best of my recollection there was no disagreement as regards the negro boy incident. The letter quoted by Dr. Young from Long to Wilhite shows that Long had then (May 20th) received and read the article, had written to Wilhite about the inaccuracies of dates and persons present, and had never once mentioned the negro boy incident, as Dr. Y. says. The reader will observe the . . . . (omission) in the letter quoted. Just what was left out I do not know. Until Dr. Grandy's article appeared the statement of Wilhite has not been questioned so far as I know by Long's friends. That Wilhite enjoyed the personal friendship and esteem of both Long and J. Marion Sims is abundantly shown by the visits paid them and their private letters still in our family.

That Wilhite was mistaken as to the true date of etherizing the negro boy, and as to the time he entered Long's office, there is no doubt. He made the statement from *memory* after a great number of years in a casual conversation without any *memoranda* before him. Now let me quote some of the correspondence that bears on this subject:

267 Madison Ave., New York,
January 12, 1877.

My dear Dr. Wilhite:—I wrote to Dr. Crawford W. Long, of Athens, three weeks ago, asking him to give me some notes of himself and special data about his discovery of ether as an anæsthetic. He does not reply to my letters. Will you have the kindness to write to him and say that I am to prepare a sketch of his life for Johnson's Cyclopedia and would like to have all the facts as soon as possible. Please help me in this matter, and with kind regards to all, believe me, dear Dr. Wilhite,

Most truly yours,
(Signed) J. Marion Sims.

Admitting the genuineness of the letters published by Dr. Grandy, Dr. Wilhite wrote upon receipt of this letter as follows:

Anderson, S. C., January 16, 1877.

Dr. C. W. Long.

Dear Doctor:—I have just received a letter from Dr. J. Marion Sims of New York, stating that you will not write to him, or at least that he wrote to you about three weeks ago and received no reply. If you don't do so soon it will be too late. He has been preparing an article for publication, and wants to place you right before the world. You have been apprised, I suppose, of the nature of the article. Why you have been connected with, and will be the leading spirit in the article, *happened* (italics mine) *in this way: While I was in New York last summer at one of Dr. Sims' private operations, several prominent physicians being present, I happened to remark that I witnessed the first or second operation ever performed under an anæsthetic. Every one said I was mistaken, and particularly Dr. Sims . . . . After that I met Sims at his office and gave him such particulars as I could recollect of your first operation* and also urged your claims to the priority. He at once wrote you on the subject and has since become very much interested in the matter. Now, Doctor, *it is but justice to you* (italics mine), as it is due the world, that you give Dr. Sims such information as he asks for at once, as he is going to all this trouble only to place the proper credit of this great discovery on the man who justly deserves it. I honestly hope you will comply with the Doctor's request as soon as possible . . . . As I have been the means of giving this investigation of this subject its present shape, I am exceedingly anxious that you should give all the information you can, that you may, and justly too, receive the credit of this great discovery. If you will act it will certainly be so. Dr. Sims also wants a short history of your life, which don't fail to give. Hoping to hear from you, I remain,

Yours, etc.,
P. A. Wilhite.

I have italicized some of the letter to call attention to the fact that Wilhite was urging Dr. Long to give the facts. The reader will notice that in publishing this letter Dr. G. did not publish it all, as shown by the . . . . in two places. Dr. G. says to that long letter Dr. Long replied. Here is a copy of his reply never before published and is in my possession:

Athens, Ga., January 22, 1877.

Dr. P. A. Wilhite.

Dear Sir:—Your welcome letter of the 16th instant was received a few days ago and I have been too busy to answer it earlier. I regret that my situation was such that I could not write to Dr. Sims earlier. I made a full explanation in a note mailed him before yours was received. *This morning in sending off some certificates* obtained some years since I find a number lost, yours among

the number. Now, Doctor, I wish to obtain yours again as early as possible to send to Dr. Sims.

I see from your letter that you stated to Dr. Sims and other physicians that you witnessed an operation by me under an anæsthetic before any published account of the use of ether to produce this effect.

My recollection is that you entered my office late in 1844, and that early in January, 1845, you were present and witnessed me perform an amputation of a finger of a negro boy belonging to Ralph Bailey, Sr., the boy etherized at the time. I am not positive this was the operation, but as I have the certificates of Mr. Bailey and his son and sons-in-law, who were present at this operation, I think this must have been the operation you alluded to. I have mentioned these facts to refresh your memory if you have forgotten names and dates. The correct date of the operation was 8th of January, 1845. If this was the operation alluded to you can from these circumstances give correct report of the operation.

You may recollect some other operation; if so, state the facts in regard to it . . . .

Permit me to thank you for the interest you take in establishing my claim. If it is established you will have been the mover in it. (Italics in this letter mine.)

Yours respectfully,
(Signed) C. W. Long.

Admitting the letter as published by Dr. Grandy, Wilhite replied. I will put this letter in a parallel column with the letter Dr. Young quotes as being written June 27, 1877, in reply to Dr. Long's letter of May 20, 1877.

(Young)

Anderson, S. C., June 27, 1877.
Dr. C. W. Long.

Dear Doctor:—Yours of the 22nd instant is at hand, and I have also just received a letter from Dr. J. M. Sims which I will answer to-day . . . .

In my statement I did make a mistake in regard to my being present at the first or second operation, which mistake I will correct. But if you still prefer I will send a certificate . . . . Let me know and I will give you any information or assistance in this great matter.

Yours truly, etc.,
(Signed) P. A. Wilhite.

(Grandy)

Anderson, S. C., Jan. 27, 1877.
Dr. C. W. Long.

Dear Doctor:—Yours of the 22nd is at hand, and I have also just received a letter from Dr. Sims which I will answer to-day. In regard to the certificates you spoke about it will not be necessary, I think, as Dr. Sims has my statement written out in full. He was particular to get all the points and facts I could recollect.

In my statement I did *make a mistake about my being present at the first or second operation, which mistake I will correct* (italics mine, L. B. G.).

If you still think proper I will send a certificate. Let me know and I will give you any assistance in this great matter.

Yours truly,
P. A. Wilhite.

I think when Dr. Y. takes the letter of Sims to Wilhite, dated January 12, 1877, Wilhite's letter to Long, dated January 16, 1877, Long's letter in reply to Wilhite's, dated January 22, 1877, and Wilhite's letter to Long, January 27, 1877, in reply to the 22nd letter, he will perceive at a glance that Wilhite could not have written a letter June 27, 1877, in reply to the letter May 20, 1877. The internal evidence of the letter and the connection show this.

Sims' article had been published before May 20th, and why should Wilhite a month afterwards (June 27, 1877) be writing in reply "yours of the 22d instant"? Did Long write to Wilhite, June 22, 1877? We have no such letter in the correspondence. Then it would have been a remarkable coincidence for Long to have written January 22nd and also June 22nd, and for Wilhite to have answered January 27th that he had just received a letter from Sims which he would answer that day, and also June 27th in the same words.

After all this correspondence I must be pardoned for again asking the question, How does Dr. Young know that Sims never investigated the Wilhite statements? Upon what hypothesis does he rest his proposition that the story of the negro boy "lacks probability"? The proof is not shown in the published letters. Whether Wilhite told Long about the negro boy incident or not, was it a fact? Dr. Sims accepted it as a fact on Wilhite's own statement. It was sufficient with him, and it would have been sufficient with his old friend and preceptor Long. Has not Long requested him to give any additional operation and extended his thanks for his interest, etc.? But these men are all dead and gone. Wilhite (seemingly) being an obscure country physician, it is proposed to brush away in a flippant manner his statements from the record. I submit to all unprejudiced minds that it is immaterial, as Sims said to Long about certain dates, whether Wilhite was a student in Long's office in 1842 or 1844, so far as the facts of Dr. Long's work is concerned; whether Wilhite was seventeen years old or nineteen years old; whether it was 1839 or 1841 when he accidentally etherized the negro boy. The sole question is, did he do it the last year mentioned?

Dr. Young says that unfortunately Sims did not investigate Wilhite's statement. Then what did Dr. Sims write to Dr. Long for the facts for? Why did he write to Wilhite to urge Long to send all the data or facts? Why did Long ask Wilhite to mention any other additional operation? Suppose Sims had carefully investigated Wilhite's statements independently of his personal confidence he had in his veracity, what would have been the result of the investigation? Fortunately for the memory of Dr. P. A. Wilhite, the South Carolina Medical Association appointed three of its honored body, Dr. J. R. Bratton, Yorkville, S. C. (died 1897), Dr. B. W. Taylor, Columbia, S. C., and Dr. C. R. Tabor, Fort Motte, S. C., a committee to investigate the matter. Upon the advice of friends, there still being living witnesses to that incident in no way interested in the matter, Wilhite procured their affidavits, which, with his own statement under oath, he produced before the committee (Trans. S. C. Med. Ass., April, 1883). The original affidavits of his witnesses are now in my possession, and they were not written by Wilhite to fit his case. Fac-simile or photograph copies can be procured if Dr. Y. doubts my statement. Upon this testimony the committee made its report to the S. C. Medical Association, 1883, and published in its proceedings. This is a copy of the affidavits:

I hereby certify that in the year 1841 (exact date I do not remember) I did administer to a negro boy, about twelve years of age, sulphuric ether until he was completely anæsthetized, in which condition he remained for more than an hour. This occurred at the residence of Mr. J. N. Wier, in Clark County, Georgia. It was customary in those days for the young ladies and gentlemen to

congregate and have what were called ether frolics. It was on one of these occasions that I administered the ether to the negro boy, who was held by Mr. Robert Wier. I administered the ether on a towel until the boy became fully anæsthetized. When this happened we all became very much alarmed at his condition, he being perfectly insensible, with a slow and stertorous breathing. Nothing that we did aroused him—slap him, pinch him, roll him over, etc.; so we came to the conclusion that we had killed him. Dr. Sidney Reese, who lived five miles away, was despatched for immediately. The doctor came in about an hour and a half, during which time the boy displayed very little evidence of waking up. After the proper means were applied he was aroused from his state of insensibility.

Personally appeared Dr. P. A. Wilhite before me and makes oath that the statements herein made are correct according to the best of his recollection.

Sworn to and subscribed before me, at my office, Anderson County, S. C., this the 29th day of May, 1883.

John W. Daniels, P. A. Wilhite.
Clerk of Court Common Pleas,
Anderson County, South Carolina.

This testimony of Dr. P. A. Wilhite is fully corroborated by the affidavit of Samuel B. Wier, which is as follows:

State of Georgia, }
Jackson County. }

I hereby certify that in the year eighteen hundred and forty-one I was present and participated in a social collection of young gentlemen and ladies at John Wier's, at what was called an ether frolic, and on that occasion I saw a negro boy put to sleep with sulphuric ether, administered by P. A. Wilhite, one of the young men present, now Dr. P. A. Wilhite, of Anderson, S. C. The boy was held by Robert Wier, while Wilhite gave the ether, until the boy became unconscious. The boy remained in that condition for some time, and not waking up, as they thought he should, and breathing very heavily and being perfectly limber, the party became alarmed, believing that Wilhite had killed the boy. A physician was sent for, who arrived in about two hours. Up to that time the boy had shown but little evidence of waking up.

Dated December 11th, 1882.

(Signed) Samuel B. Wier.

I hereby certify that I was present when the above certificate was signed by Samuel B. Wier. I have known him for twenty-five years and know him to be a gentleman of honor and truthfulness.

(Signed) Green R. Duke,
Dept. U. S. Marshal.

State of Georgia, }
Jackson County. }

I, J. L. Williamson, Clerk Superior Court of said county, do hereby certify that S. B. Wier is a citizen of said county and that I know him to be a gentleman of honor and truthfulness.

Dated December 11th, 1882.

(Signed) J. L. Williamson,
Clerk S. C.

State of Georgia, }
Clark County. }

I, the undersigned, hereby certify that I was present in the year 1841, the exact time not recollected. A collection of young people met at my house for the purpose of having a little fun and an ether frolic, and on that occasion a negro boy was put to sleep with sulphuric ether, administered by P. A. Wilhite, one of the young men present, now Dr. P. A. Wilhite, of Anderson, S. C. The boy was held by one of the young men, and the ether was administered until the boy became perfectly unconscious. Remaining in that condition for some time, and showing no signs of waking up, and breathing very heavily, we became alarmed, believing that Wilhite had killed the boy. A doctor was sent for, he (Dr. Reese) arrived in about two hours, and up to that time the boy had shown but little evidence of coming to consciousness.

Dated December 12, 1882. (Signed) Mrs. L. C. Wier.

I hereby certify that I was present when the within certificate was signed by Mrs. L. C. Wier. I have known her for fifteen years and she is a lady of high standing and unquestionable veracity.

December 12, 1882. (Signed) Green R. Duke,
Deputy U. S. Marshal.

(The committee of the S. C. Medical Association omitted by oversight this last certificate and omitted giving the full name of Mrs. Wier.)

In conclusion let me say I have tried to avoid saying anything that might appear personally offensive to any of the profession or any one connected therewith. I have claimed the liberty to insert in this statement certain points made by Dr. G., showing the errors of the article of Dr. Young, for each claimed to have access to private papers of Dr. Long.

Dr. Wilhite *never* by word, deed or act, privately or publicly, sought to claim any honor in this matter for the boyish frolic, etherizing the negro boy in 1841, except what was justly due him; neither do I; and as he, if living, would not seek to pluck one leaf from the laurel of Dr. Long, neither will I seek to rob him or any one else who may have a better claim to the crown. I submit that if human testimony of disinterested witnesses has still any weight or force with gentlemen in the forum of discussion, then no one ought to rise up and make the assertion that Wilhite's statements "lack probability." It was not a figment of his imagination, but a veritable fact. Dr. Long lived over a year after the statement of the negro boy incident as published in Sims' article, and continued in the harness up to his death. If he discredited the statement, he lived in Georgia but a few miles from the place where the incident was stated to have occurred. If it had been a fake, how easy would it have been for him to have gotten the testimony to establish its incredibility had the story been untrue.

With this I must leave the matter where Dr. Sims left it, having faith that an unprejudiced profession as well as the public will in the end render a righteous verdict and see as I do that for his labor of love for Long there is in return now ingratitude.

J. O. Wilhite, M. D.

125 North Main Street, Anderson, S. C., November 1, 1897.

Letter from Dr. Young.

To the Editor:

In the paper of Marion Sims, Wilhite is quoted as saying that previous to the discovery of anæsthesia by Long he was a student in Long's office; that when Long was discussing the possibility of producing anæsthesia with ether, he "encouraged him" by relating how he had unintentionally etherized a negro boy; and when Long, thus persuaded, did administer ether to Venable and operate on him, he, Wilhite, assisted in the operation; thus modestly taking to himself a large part of the credit of the "great discovery."

The papers in my possession show conclusively that Wilhite did not enter Long's office until two years after Long's discovery; that he was not present at the first operation; that he

was a boy younger by seven years than Long, and therefore probably not Long's confidant and adviser.

The only remaining statement was the story of etherizing the negro boy, which Wilhite claimed to have done in 1839.

Numerous witnesses testified that the custom of inhaling ether in that part of Georgia began in the winter of 1841 and 1842 and was originated by Long, who had learned of the exhilarating properties of ether at the Medical College in Philadelphia, at least two years later than Wilhite, then a young schoolboy, claimed to have used it.

To say therefore that "the negro boy story lacked probability" seemed to be putting it mildly.

My conviction was further strengthened by finding that L. B. Grandy, first in an article in the Virginia Medical Monthly, October, 1892, and again in the New York Medical Journal, July 20, 1895, had vigorously attacked Wilhite's statements, declaring that they were "fiction, pure and simple—*falsus in uno falsus in omnibus*," and no one, not even his son, had contradicted Dr. Grandy. Was I not justified therefore in assuming that it was an acknowledged fact that the negro boy story lacked probability? I think so.

Permit me to add that the unimportant inaccuracy of date in my paper, which he attributes to most sinister motives, was due merely to the indistinctness of the manuscript. After debating for a long time I decided that the word was intended for "Jun." and not "Jan.," a mistake, as it now appears, but of no practical import.

Dr. Wilhite's paper is valuable because he brings witnesses to prove that his father really did unintentionally, but nevertheless actually, etherize a boy to complete narcosis, a very interesting point in the history of anæsthesia. But that he had absolutely nothing to do with the discovery of anæsthesia by Long in 1842 must still be considered certain.

Hugh H. Young.

NOTES ON NEW BOOKS.

The American Year-Book of Medicine and Surgery. Edited by George M. Gould, M. D. (*Philadelphia: W. B. Saunders*, 1898.)

The excellence of the editorial work done by Dr. Gould is so often exhibited and so well recognized that but few words of praise are needed from us for this work.

Although there has been some change of collaborators since the last Year-Book appeared, there has been no falling off in the work done, and all the assistants should be congratulated for their help in producing so useful a book and one which requires so much care and labor to make it of value.

As time advances the editing of this Year-Book will become more and more difficult, for there is a large increase yearly in medical articles and journals. This makes a proper selection harder and harder, and as the personal equation must enter into such selections, they become in a certain degree less and less valuable. No one knows beforehand what apparently insignificant point in some article may prove of significance before the next year is passed, and so articles may be omitted from consideration which a year later will prove to have been really important contributions. To remedy this, we believe lists of articles which have not been touched upon on all important branches should be appended at the end of each chapter. This scheme may not be feasible, but if some such scheme is not devised, the value of the Year-Book, which is, after all, only that of a good reference book, will diminish yearly. Had we "Centrallblätter" in this country there would be less need of a Year-Book, and these "Centrallblätter" have their distinct advantage in being to a greater or lesser extent limited to special branches of medicine, surgery, etc., so that the practitioner is not obliged to purchase a large Year-Book, only a portion of which interests him, but with his "Centrallblatt" is able from week to week to pursue any special subject in which he may be interested. Why would it not be possible to publish the several sections of the Year-Book separately? We believe they would have a large sale, whereas the price of the Year-Book must keep it out of reach of many practitioners who would be glad to own this work of reference. While the "Centrallblätter" keep us really up to date in the different branches, the Year-Book is always about six months behind; another factor which lessens its value to the busy and progressive student. He must get the last six months' information elsewhere.

We value the Year-Book and think the remarks of the collaborators of special importance in pointing out both good and bad work, or, better, in showing up errors of judgment. Such remarks should be of real service to younger practitioners who desire to write.

The profession at large should be sincerely grateful to Dr. Gould for the Year-Book, which is issued solely for the benefit of practitioners who are too busy to look up papers in which they may be interested, or too far distant from a good fountain of medical information to know what articles on any medical subject have lately appeared.

Essentials of Bacteriology. By M. V. Ball. (*W. B. Saunders, Philadelphia, Pa.*, 1897.)

Nothing in technical literature affords more depressing reading than a "compend," and the more widely removed the student from a practical acquaintance with the raw material out of which the subject itself is constructed, so much the more ineffective will be the efforts of any writer to provide him even temporarily with a short cut to knowledge Certain compends may perhaps be defended. In studying anatomy, for instance, the student has probably dissected, though perhaps more or less hurriedly, the whole or at least the greater part of the human body and has familiarized himself with the details, so that he has obtained a mental picture of the various organs and their relations. It is possible, then, that under these circumstances a compend may remind him of many half-forgotten facts, and he may retain this information until the emergency, represented by an examination, is over. But with the scanty opportunities afforded by most of our medical schools in this country for obtaining any adequate practical acquaintance with bacteriological methods, the need or advantage of a compend is hardly apparent. To any one who has had an opportunity of studying bacteriology in the only way in which it can be learned, namely, by practical work in the laboratory, the scope of the book is altogether too narrow to be of much service. To the student who has had no such opportunities it can have but little meaning, and even a word-for-word knowledge of its contents would hardly enable him to pass a properly conducted examination upon bacteriology.

The author acknowledges his indebtedness to several text-books dealing with the subject both in English and in foreign languages, but among his list we miss the names of some of the most trustworthy authorities. The definitions are terse, but not always free from obscurity or even error.

As a short text-book for the beginner, or as an aid in the case of the more advanced student to the revival of forgotten knowledge, any compend upon bacteriology must be found wanting.

In view, therefore, of the insuperable difficulties with which he has had to contend, the author must not be criticized too severely for shortcomings which are necessarily involved in the nature of the subject with which he has had to deal.

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BULLETIN

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THE JOHNS HOPKINS HOSPITAL.

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CONTENTS.

TYPHOIDAL CHOLECYSTITIS AND CHOLELITHIASIS.

REPORT OF A CASE WITHOUT PREVIOUS HISTORY OF TYPHOID FEVER, AND DISCUSSION OF A POSSIBLE AGGLUTINATIVE REACTION IN THE BILE AND ITS RELATION TO STONE FORMATION.

By Harvey W. Cushing, M. D., *Resident Surgeon in the Johns Hopkins Hospital.*

Suppurative cholecystitis, since the time of Louis, has been recognized as one of the complications of typhoid fever. That it is definitely caused in most cases by infection with the bacillus typhosus was not demonstrated until long after Eberth and Gaffky's discovery of that organism and the recognition of it as the ætiological factor in many of the other suppurative sequelæ of enteric fever.

Since the original report by Gilbert and Girode* (1890) of a case of cholecystitis caused by the invasion of the bacillus typhosus, as demonstrated by cultures, a series of most important observations, concerning the relation of typhoid fever and gall-bladder affections, has been made by investigators in various places. The quite constant occurrence of the bacilli in the gall-bladder in cases of experimental inoculation typhoid in rabbits was first noticed by Blachstein† (1891) in Professor Welch's laboratory, and attention was called to the persistence of the organisms in this situation in these animals subsequently by Professor Welch* himself. In one case the observation was made on the 128th day after the inoculation, the bacilli having disappeared from every other organ of the body. This demonstration in 1891 led to the routine examination bacteriologically of the bile in fatal cases of typhoid at this hospital, and Dr. Flexner found in 50 per cent. of the cases a pure culture of typhoid. Clinically these organisms may be present without producing any apparent symptoms. A variety of changes, however, may be set up at any time following their invasion, from simple catarrh with stone formation, to ulceration, perforation or general peritonitis; a sequence such as is more commonly seen in appendicular disease, the two having many features in common.

Acute suppurative cholecystitis, as recently emphasized by many writers (Mason,† Osler‡ and others), is a not uncommon

*Gilbert and Girode, Contribution à l'étude bacteriologique des voies biliaires. Comptes rendus de la Société de Biologie, 1890.

†A. G. Blachstein, Intravenous inoculation of rabbits with the bacillus coli communis and the bacillus typhi abdominalis. Johns Hopkins Hosp. Bulletin, 1891, Vol. II, p. 96.

*Wm. H. Welch, Additional note concerning the intravenous inoculation of the bacillus typhi abdominalis. Johns Hopkins Bulletin, 1891, Vol. II, p. 121.

†A. L. Mason, Gall-bladder infection in typhoid fever. Trans. of Assoc. of Am. Phys., 1897, Vol. XII, p. 23.

‡Wm. Osler, Hepatic complications of typhoid fever. Trans. of Assoc. of Am. Phys., 1897, Vol. XII, p. 378.

complication of a late stage of typhoid fever of the usual clinical type. In some of these cases there has been an associated cholelithiasis, but from a study of the reports obtainable it would seem that only a small percentage of cases with this complication during the fever were associated with gall-stones; a percentage no greater than could be accounted for by preformed stones.*

There seems, however, to be a distinct group of cases in which acute cholecystitis has appeared, not during the fever, but some months after it, and in all of these has there been an associated cholelithiasis. Bernheim† (1889) first called attention to the frequency of gall-stone attacks following typhoid, and Dufourt‡ (1893) found a history of typhoid, preceding gall-stone attacks by a few months, in 19 cases. A review of the cases of cholecystitis admitted in this Hospital to Prof. Halsted's service and subsequently operated on and gall-stones found, shows that 10 out of 31 gave a previous history of typhoid, the interval varying from a few months to twenty years.§ In none, however, but the present case was Eberth's bacillus demonstrated.

Further, in 1890, Professor Welch‖ demonstrated the presence of micro-organisms in the centre of gall-stones and suggested that they might have been the starting point for the deposition of the biliary salts. It has been mentioned, however, that calculi are usually not associated with early cases of acute typhoidal cholecystitis despite the great abundance of organisms in the viscus. In the one case, which we have observed in this early stage at operation, the organisms have been free and very motile; in the later cases, however, a distinct clumping of the bacilli in the bile has been noted. Attention was called to these clumps of bacilli by Blachstein, though no importance was attached to them. Richardson* found this condition in a single case and regarded it as a gigantic serum-reaction in the gall-bladder. Nichols, working in Professor Welch's laboratory on experimental typhoid in rabbits, has noted the very early appearance of the bacillus in the gall-bladder after intravenous inoculation, and the subsequent distinct clumping of the organism in those animals which have later come to autopsy.

These observations naturally lead to the hypothesis that a reaction akin to an agglutinative reaction of the organisms, as Richardson has suggested, may take place in the course of time in the bile, the clumps being the starting point for the deposition of the bilirubin calcium salts and the origin of stone, the symptoms of which occur subsequent to convalescence.

The occurrence of this post-typhoidal cholecystitis, therefore, may be readily explained by the above series of observations, summarized as follows: (1) the bacilli during the course of typhoidal infection quite constantly invade the gall-bladder; (2) the organisms retain their vitality in this habitat for a long period; (3) in the course of time the bacilli are almost invariably found to be clumped in the bile, suggesting the occurrence of an intravesical agglutinative reaction; (4) these clumps presumably represent nuclei for the deposit of biliary salts, as micro-organisms may with regularity be demonstrated in the centres of recently formed stones; (5) gall-stones being present in association with the latent, long-lived, infective agents, an inflammatory reaction in the viscus of varying intensity may be provoked at any subsequent period.

The writer has been able to collect but 4 cases of post-typhoidal cholecystitis associated with stones, in which the bacillus typhosus has been cultivated from the bile at operation. To these, two additional cases are given (cf. Table I).

This sequence apparently may not be limited solely to infection with Eberth's bacillus. In Blachstein's report a similar clumping was observed in the bile of rabbits after inoculation with the bacillus coli communis. Dr. Flexner found the bacillus coli communis present in the bile in a small percentage of fatal cases of typhoid in the human, and in a few of the hospital cases of post-typhoidal operation for gall-stones a pure culture of colon has been isolated from the gall-bladder. Gilbert and Fournier,† as a result of their experimental researches, have divided biliary lithiasis into two great pathological groups: lithiasis due to colon, by far the most common, and lithiasis due to typhoid. Mignot

* Prof. Osler (loc. cit. p. 396) suggests that preformed stones may be an ætiological factor in the production of cholecystitis during the fever, as they would render the ducts more receptive of infection. Naunyn (A Treatise on Cholelithiasis, 1896) and Hunter (A Discussion on Cholelithiasis, etc., Montreal Medical Journal, December, 1897) believe in the possibility of a rapid formation of stone following infection. Gilbert et Fournier (Du rôle des Microbes dans la genèse des Calcules biliaires: Compt. rendus heb. de la Soc. de Biologie, 1896, p. 145) have called attention to the fact that there may be different groups of calculi of various ages, old stones which have sterile centres and recent new formed stones from the nuclei of which positive cultural results may invariably be obtained. The presence of old stones therefore at times may possibly court the infection which leads to the formation of a new group of calculi and associated cholecystitis. Statistics, however, seem to indicate, that of the acute cases, both those operated on during the course of the fever, and those dead of the fever in which acute gall-bladder infection has been found at autopsy, only a small percentage are associated with the presence of calculi. Courvoisier (Casuistisch-statistische Beiträge zur Pathologie und Chirurgie der Gallenwege, Leipzig, 1890) gives in 10 fatal cases of typhoid cholecystitis only two with gall-stones. Hagenmüller (Cholecystitis in Typhoid Fever, Thèse de Paris, 1876) in a comprehensive study reports 18 cases with death in 16 from fatal peritonitis, of which number there were only two with gall-stones.

† Bernheim, Art. Ictère du Dict. Dechambre, 1889.

‡ Dufourt, Infection biliaire et lithiase, sc. Revue de Méd. 1893, p. 274.

§ This long interval would, however, not necessarily rule out an association with the primary infective agent, for in v. Dungern's case (Ueber Cholecystitis Typhosa, Münch. Med. Woch., June 29, '97) fourteen years elapsed between the original attack and the perforative cholecystitis when the bacillus typhosus was isolated.

‖ Also Naunyn ("Treatise on Cholelithiasis," New Syd. Soc., 1896, p. 51). Also Hanot (quoted by Dauriac, Gaz. Heb. de Méd. et de Chirurg., July 25, 1897). Cf. also Gilbert et Dominici (La lithiase biliaire est-elle de nature microbienne? Soc. de Biologie, 1894, p. 485).

*A case of cholecystitis due to the typhoid bacillus. Boston Medical and Surgical Journal, Dec. 16, 1897.

† Gilbert et Fournier. Lithiase biliaire expérimentale. Compt. rend. Soc. de Biol., Nov. 5, '97, p. 936.

and these writers have reproduced, experimentally, in guinea-pigs and rabbits conditions representing cholelithiasis of these two types. The writer recently operated on one of the cases of this colon group two years after a preceding typhoid. The gall-bladder contained a multitude of small faceted stones in the centres of which faintly staining bacilli could be demonstrated on cover-slip preparations, though cultures from the centres of the stones were negative. The bile contained a few isolated organisms and many small clumps of bacilli. They possessed the cultural properties of the bacillus coli communis. The patient's blood serum gave an active Widal reaction to typhoid in dilution of 1 to 30. It also gave a slow but distinct clumping reaction with the bacillus which was isolated (cf. Table II).

TABLE I.—*Collected cases of post-typhoidal Cholecystitis associated with Gall Stones which have been operated upon and the bacillus typhosus isolated.*

	Author.	Sex.	Age.	History.	Operation.	Contents of Gall Bladder.
I.	Gilbert and Girode, Comptes Rendus de la Soc. de Biologie, 1893, p. 95.	F.	45	Gall-bladder symptoms during fever. Subsequent gall-stone attacks.	Operator, Ferrier. Cholecystectomy 5 mos. after fever.	Bac. typhosus, pure. Gall stone. Purulent fluid.
II.	Duprè (Chantimesse's Case), Les infections biliaires. Paris Thèse, 1891.	F.	45	No attack with fever. Subsequent gall-stone colic.	Cholecystenterostomy 8 mos. after fever.	Bac. typhosus, pure. Gall stone.
III.	v. Dungern, Münch. Med. Woch., June 29, '97.	F.	46	No attack with fever. Subsequent cardialgia. Periostitis of lower jaw in 13 yrs. with bac. typh. Acute gall-bladder attack in 14th year. Widal reaction positive.	Operator, Kraske. Cholecystostomy with evacuation of abscess 14 yrs. after fever.	Bac. typhosus, pure. No stone found, but "probably present." Abscess.
IV.	M. W. Richardson, Bost. Med. and Surg. Jour., Dec. 16, '97.	F.	50	Recent uncertain history of typhoid. Serum reaction positive.	Operator, M. W. Richardson. Cholecystostomy.	Bac. typhosus, pure. Brownish fluid with bacilli in clumps. Gall stone in cystic duct.
V.	Surg. No. 3835, Jan'y 28, '95.	F.	37	Uncomplicated typhoid 3½ mos. ago. Gall-stone colic with jaundice three weeks ago. Recent peritonitis.	Operator, Prof. Halsted. Cholecystostomy.	Empyæma of ruptured gall-bladder which contained numerous small stones. Bacillus typhosus.
VI.	Writer's Case, Surg. No. 6339, Mar. 16, '97.	F.	26	No history of typhoid. Serum reaction positive.	Operator, Prof. Halsted. Cholecystostomy.	Bac. typhosus, pure. Brownish fluid, bacilli in clumps, gall stones.

Several other post-typhoid cases have been reported without bacteriological notes. These are omitted.

TABLE II.—*Similar post-typhoidal cases from the Johns Hopkins Hospital surgical records in which the bacillus coli communis has been isolated.*

		Date.	Sex.	Age.	History.	Operation.	Contents of Gall Bladder.
I.	Surg. No. 3805.	1895	M.	30	Gall-bladder symptoms during fever. Frequent attacks of colic since.	Prof. Halsted. Cholecystostomy 14 mos. after fever.	Mucoid fluid. Thirty calculi. Bac. coli com. pure.
II.	Surg. No. 4438½.	1895	F.	57	Preceding typhoid, subsequent attack of acute cholecystitis 7 mos. ago.	Bloodgood. Cholecystostomy.	Muco-purulent material. Impacted stones. Bac. coli communis.
III.	Surg. No. 4956.	1895	F.	29	Attack during convalescence.	Bloodgood. Cholecystostomy 7 mos. after fever.	Purulent fluid. Bac. coli communis. Subsequent discharge of a stone.
IV.	Surg. No. 4411.	1895	F.	34	No symptoms during fever. First attack 18 mos. later. Three subsequent ones.	Bloodgood. Cholecystostomy 2 yrs. after fever.	Bile-stained fluid. Seven stones. Bac. coli communis.
V.	Surg. No. 7619.	1898	F.	24	"Typhoid-pneumonia" (?) First attack 6 mos. later. Subsequent frequent attacks of gall-stones. Serum reaction positive to typhoid.	Cushing. Cholecystostomy 2 yrs. after fever.	Bile-stained fluid. Countless small faceted stones. Clumps of rod-shaped bacilli. Bac. coli communis pure.

Cases, in which bacteriological notes were incomplete, have been omitted.

Most extraordinary, however, is it to find in cholecystitis associated with stones, the presence of Eberth's bacillus when there has been no history of previous typhoid fever, and when the gall-bladder infection seems to be primary, as in the case to be reported.

The widespread occurrence of the bacillus typhosus has but lately been fully recognized, and owing to the definiteness of the serum reaction many cases are clinically recognized as typhoidal infection which have few of the classical symptoms and which at autopsy may be found free from intestinal lesions. Guarnieri* (1892) first described an infection of the biliary passages, liver and spleen with the bacillus typhosus in a case without intestinal lesions. The patient, however, had the clinical symptoms of typhoidal infection. Chiari's† grouping of the cases of typhoid without intestinal lesions gives no division which would include a case the sole apparent lesion of which is in one organ and which clinically never presented any indications of typhoid.

The history of the case is as follows:‡

Mrs. C., æt. 26; entered Professor Halsted's service at the Johns Hopkins Hospital, March 5, 1897, complaining of pain in the right hypochondrium.

The *family history* was negative.

The *personal history* was also without particular note. She had had the usual infantile diseases, and with the exception of an attack of pneumonia ten years before entrance she had led a vigorous and active life. She had been subject since childhood to attacks of indigestion and prolonged constipation. She is evidently a careless eater and has had for the past three years occasional attacks of vomiting, usually in the morning after eating too heartily the night before. Her diet has been execrable: coffee, 6 or 8 cups a day; she is especially fond of pastry, acid things, pickles, salads and the like. Her menstrual history is normal. She has been married five years; has had one still-born and one living child now aged 2 years. There has been absolutely no history of any preceding febrile attack. (Patient and friends were closely questioned about this several times. She lived in the country with no near neighbors; she knew of no one in the vicinity who had had typhoid or any continuous fever.)

Present Illness. Five days before entrance, after an enormous dinner of beefsteak and gravy, the patient was seized at 11 p. m. with pain in the right hypochondriac region. This continued until the next morning, when after eating breakfast she vomited both her breakfast and the dinner of the preceding day. The quantity she thinks was large—at least 2 quarts. Soon after her pain became very severe and required morphine for its relief, and since then she has suffered from more or less constant pain under the right costal margin. It is not paroxysmal and does not radiate. It is described rather as a soreness than as an actual pain. There has been no vomiting since the first attack; no jaundice has ever been observed. The physician who brought the patient to the hospital states that during the attack she has had some pyrexia, which on the third day reached 102°.

Physical Examination. A large, dark-complexioned woman, well developed and nourished; without jaundice. Pulse regular, 90, of good quality. Temperature 101°. Examination of chest negative. The abdomen was full, slightly tympanitic. There is a distinct rigidity of the right rectus muscle and considerable tenderness in the right hypochondrium. An indistinct tumefaction below the costal margin could be felt on deep palpation. There was tympany over this area. No increase in hepatic dullness; spleen not palpable.

Subsequent History. On the second day after admission the temperature fell to 99°. Her bowels had been freely moved and she was fairly comfortable. Abdominal tympany had disappeared and the spasm in the right upper quadrant of the abdomen was much less. On the third day the temperature was normal; there was no rigidity, no tenderness. A hard, movable mass was palpable in the right hypochondrium; tender only on the deepest pressure. The urine contained no albumen, no bile pigment. The patient was up and felt so well that she was anxious to go home. From this time she was free from subjective symptoms. A smooth roundish mass of about the size and feeling like a movable kidney, readily obtained bimanually and on deep inspiration easily grasped in the hand, persisted in the right hypochondrium. It was absolutely without tenderness.

On the 16th day Professor Halsted operated. A brief report of the operation is as follows:

Cholecystostomy. Greatly enlarged gall-bladder with recent adhesions and containing gall-stones. Evacuation of contents. Permanent drainage.

A vertical incision was made, 15 cm. long, over the site of the tumor and through the right rectus muscle. The peritoneal cavity was opened, disclosing a distended gall-bladder held by recent adhesions to the liver and omentum. Cultures were taken from these adhesions before separating them. Gall-stones were palpable through the bladder walls and in the cystic duct.

The fundus of the gall-bladder was incised and a small amount of brownish mucoid material, unlike bile, was evacuated with fifteen dark green, smooth faceted gall-stones varying in size from a pea to a large chestnut. Cultures were taken from the interior on making the first incision into the gall-bladder. One of the largest stones was impacted in the cystic duct, from which it was dislocated with considerable difficulty. The deeper ducts were free from stones. A purse string catgut suture was taken about the opening in the fundus, into which a drainage tube surrounded by gauze was inserted. The margin of the opening was then anchored to the neighboring peritoneal edges by fine silk mattress sutures. The rest of the abdominal wound was closed in the usual fashion. Her convalescence was uninterrupted. There was a constant profuse discharge of bile. The drainage was

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*Guarnieri, Contributio alla patogenisi delle infezione biliari. Revista generale italiana di clinica medica, 1897. Ref. Baumgarten's Jahresbericht, 1897, p. 234.

†Chiari und Krause, Zur Kenntnis des atypischen Typhus abdominalis resp. der reinen "Typhösen Sephthämie." Zeit. für Heilkunde, Bd. XVIII, S. 471, Oct. 1897.

‡Preliminary mention of this case has been made by Dr. Osler, loc. cit., p. 396.

omitted on the tenth day and the wound had closed on the twenty-sixth.

Bacteriological Report. Cultures and cover-slips from adhesions about the gall-bladder were negative. Cover-slips from the contents of the gall-bladder show a few rod-shaped organisms with rounded ends.

Report on cultures taken from contents of gall-bladder at operation, March 16, '97:

March 17. (A) Cultures taken on agar slants show in 18 hours, twenty or thirty opalescent, separate, whitish colonies. In the water of condensation an abundance of actively motile bacilli. Some very long forms.

March 18. (B) Bouillon inoculation from water of condensation of A gave in two days an abundant cloudy precipitate. No indol reaction obtainable. (C) Gelatine roll from B shows in 24 hours many brownish granular non-liquefying round colonies with a ground glass appearance on surface growth.

March 19. Cultures were taken from a single colony of C and controlled by others from an isolated colony of original agar slant A, as follows: (D) Inoculation on agar shows in 18 hours an abundant opalescent growth of actively motile bacilli morphologically like typhoid. They decolorize by Gram's method. (E) Sugar agar. No gas production. (F) Potato. An invisible membranous growth. (G) Litmus milk. Slightly acidulated. No coagulation.

March 30. A comparative series of cultures were made from a single colony of the original agar slant A, and as a control an undoubted typhoid bacillus, obtained by Dr. Carter in the pathological laboratory at a recent typhoid autopsy, was used. A variety of media were inoculated from both of these sources with precisely similar results.

April 3, '97. *Serum Reactions.* The patient's blood serum produces a distinct and rapid agglutinative reaction of the original organism and of the control, both obtained from agar slants four days old.

The blood serum from a case of typhoid fever in the medical wards produces a similar reaction with both organisms. Blood serum obtained from a healthy adult produces no clumping or loss of motility in either case.

Conclusion. A bacillus with the morphological and cultural properties of the typhoid bacillus.

The Widal test is positive both with the serum from the patient and that from a clinically typical typhoid.

THE PRESENCE OF THE BACILLUS TYPHOSUS IN THE GALL BLADDER SEVEN YEARS AFTER TYPHOID FEVER.

By G. Brown Miller, M. D., *Assistant Resident Gynecologist.*

The case which I report gave the following history:

Mrs. L. P., white, aged 37 years, was admitted to the public gynecological ward of the Johns Hopkins Hospital, Feb. 1, 1898, complaining of pain in the right hypochondriac region.

Family History. Negative.

Past History. She had croup and whooping cough as a child, but was otherwise healthy until the present illness.

Her menses appeared at the 16th year and were profuse, painful and regular.

She has been married 14 years; four children; no miscarriages; labors easy; micturition normal; bowels extremely constipated.

Present Illness. In the spring of 1891 she had the first attack of the pain from which she now suffers. This attack began as a severe cramp-like pain beneath the right costal margin. She had some fever but no chills, marked nausea and vomiting (the vomitus consisting of "pure gall"). This attack lasted 12 hours, and the administration of morphia was necessary in order to give relief from pain. She noticed during this attack an oblong swelling beneath the right costal margin. This tumor, which was tender and sore, gradually diminished in size and within two weeks entirely disappeared. She was much constipated during the attack and her urine was very dark, but cleared up rapidly after it. Another and similar attack followed within a week after recovery from the first.

About one month after this second attack she had an attack of what was called "bilious fever," but which some of her neighbors thought was "typhoid fever." She had high fever, severe occipital headaches, night sweats and chilly sensations, was extremely nervous and had constipated bowels. She had no pain, no epistaxis; and no rose spots were remembered. The fever lasted about four weeks, when there was a remission of 4 to 5 weeks, followed by another rise of temperature, which lasted about one month.

Following this fever she has had up to the date of admission to the hospital attacks of pain similar in character to the first two every three or four weeks. These have varied somewhat as to the severity of the pain, but have been of the same general character. She has now constant pain and tenderness over the gall bladder. She has never been markedly jaundiced.

Examination of patient. A healthy-looking woman; heart and lungs apparently not diseased; pulse, 90; temperature, 99° F; abdomen symmetrical. Edge of liver just palpable beneath the costal margin. No tumor nor irregularity was felt, but much tenderness was complained of during deep palpation over the situation of the gall bladder. The right kidney was distinctly felt. Liver dullness one finger-breadth beneath costal margin.

Vaginal examination. Negative.

A diagnosis of "gall stones in the gall bladder and probably in the cystic duct" was made by Dr. Ramsay, resident gynecologist, and an operation was advised.

Operation. She was operated upon, March 19, 1898, by Dr. Kelly, who made the following notes:

"Disease. Cholelithiasis, stones in the cystic duct.

Complications. Extensive adhesions of the colon walling off the gall bladder.

Incision in the linea semilunaris, exposing the liver; gall bladder dissected out from adherent colon, exposing a small thick bladder; stones felt low down. Gall bladder incised vertically; walls very thick; one artery cut at upper angle of incision; a small amount of bile and milky fluid escaped; spherical stone 15 cm. in diameter removed with difficulty from the lower part of gall bladder; below this another stone felt through an opening about 8 mm. in diameter, a thick fibrous septum separating the two stones, which was dilated with the finger, and the second stone was removed with scoop. Below or rather above the gall bladder a hard mass about 3 cm. long and 12 mm. broad was felt running up under liver where it could not be reached except with finger."

The gall bladder was closed, a small gauze drain was inserted just beneath it into the abdominal cavity, and the abdominal incision was partially closed.

Following the operation the patient made a good recovery and was discharged from the hospital, March 24, 1898, apparently well. There was some suppuration along the tract of the drain.

At the time of her discharge she had had no attacks of pain since operation. The wound had entirely healed. Staphylococcus pyogenes aureus was grown from the suppurating drain tract.

Bacteriological Examination of the Contents of the Gall Bladder.

Unfortunately cover-glasses of the bile were either not made or were lost after the operation. A smear upon an agar slant showed after 48 hours a growth of the micro-organism, which proved to be the bacillus typhosus. This gave upon agar a white, semi-transparent growth; cover-glasses stained with gentian violet showing a micro-organism 2 to 4 times as long as thick, slightly curved with rounded ends and staining rather faintly.

The micro-organism from an 18-hour agar growth was actively motile. Upon potato after a few days a faint, moist appearance only could be seen. Cover-glasses showed the same bacillus as upon agar, and some much larger forms were also seen. Irregularities of staining were noticeable. Litmus milk was very slightly acidified but not coagulated. No fermentation took place with glucose-agar. Gelatin was not liquefied, but showed on the surface a thin growth with irregular well marked edges. Widal's reaction was marked, as shown by the following notes made by Dr. Norman B. Gwyn, assistant resident physician:

"An agar smear from patient L. P. agglutinated *typically* by serum of a typhoid patient. Serum of patient L. P. agglutinates a known typhoid organism rapidly at 1–100 dilution. Reaction is immediate and positive, more like that of an acute attack than of an attack of several years ago."

Summary.

The patient had two attacks of pain caused by gall stones in the spring of 1891. These were followed within a month by an attack of what was presumably typhoid fever. The gall bladder became infected by the bacillus typhosus, which caused a chronic inflammation, which continued until the time of operation seven years after the typhoid fever. There was no history of an attack of typhoid fever subsequent to the attack in 1891.

THE TRANSPLANTATION OF THE RECTUS MUSCLE IN CERTAIN CASES OF INGUINAL HERNIA IN WHICH THE CONJOINED TENDON IS OBLITERATED.

(A PRELIMINARY REPORT.)

By Jos. C. Bloodgood, M. D., *Associate in Surgery and late Resident Surgeon, The Johns Hopkins Hospital.*

The term "obliterated" is used because the extreme condition is more likely to be an acquired one rather than congenital. Undoubtedly the conjoined tendon may be congenitally very narrow or very attenuated. However, the important point to be recognized at the operation is that the conjoined tendon is either obliterated, very narrow, or very attenuated, and that the lower angle of the inguinal canal (Hesselbach's triangle) has lost its strongest support (the conjoined tendon), and that something (the transplanted rectus muscle) must be substituted for this defect at the operation for hernia.

The following article will also appear in the Surgical Report No. 3 of the Johns Hopkins Hospital, Fasciculus 3–4, Vol. VII, with the report on the operation for hernia.

A Description of what is meant by the Obliteration of the Conjoined Tendon in Cases of Inguinal Hernia.

On making a careful study of inguinal hernia the writer has been impressed with the fact that they may be divided into two groups; the larger group (*A*) includes those cases in which the conjoined tendon is wide and firm, and the second, a much smaller group (*B*), includes those cases in which the conjoined tendon is practically completely obliterated.

Group A. In those cases of inguinal hernia in which the tendon is present it is easily discoverable before and demonstrable during the operation. If one inserts the index finger into the external ring, by invaginating the scrotum, the finger meets, after passing the pillars of the ring, a firm wall of tissue, the conjoined tendon, and it is to the outer side of the outer border of this tendon that the finger feels the impulse of the inguinal hernia. At the operation, if one examines the posterior wall of the inguinal canal, this tendon, if present, will be found to extend from the outer border of the rectus muscle to within about 1 cm. of the deep epigastric vessels. In some cases it may be wider, in other cases narrower. This tendon is clearly shown in Quain's Anatomy, 10th edition, Appendix, Fig. 23, p. 52. In Quain's Anatomy it is described as follows (p. 55): "At the part of the abdominal wall through

which the direct inguinal hernia finds its way there is recognized on its posterior aspect a triangular interval, the sides of which are formed by the epigastric artery and the margin of the rectus muscle, and the base by Poupart's ligament. It is commonly called the triangle of Hesselbach. The triangle measures about two inches (5 cm.) from above down, and an inch and a half (3.5 cm.) transversely at its base. In this area the abdominal wall consists of, besides the integuments, 1. the aponeurosis of the external oblique muscle, which is perforated toward the lower and inner corner of the space by the external abdominal ring; 2. the inner portion of the cremaster muscle covering the spermatic cord at the lower and outer part of the space, and above this, the lower fibres of the internal oblique and transversalis muscles passing to their insertion *by the conjoined tendon, which, as a rule, extends over the inner two-thirds of the lower part of the triangle;* 3. transversalis fascia; 4. subperitoneal tissue, and 5. peritoneum.

The conjoined tendon varies greatly in its development. In many cases it is very slight and scarcely to be distinguished, while in others its deeper portion, derived from the transversalis muscle, covers the whole breadth of the triangle, reaching outwards along the deep femoral arch as far as the internal abdominal ring."

The observations by the writer on the variations in the width of the conjoined tendon and its complete obliteration in some cases were made without the knowledge of the statement just quoted in Quain's Anatomy, and he was very glad to find a confirmation of his observations. The writer is not familiar with any other surgeon or anatomist who has dwelt upon the importance of the *obliteration* of the conjoined tendon as the chief cause of recurrence in these cases of hernia.

In cases of hernia in which the conjoined tendon is wide and firm the rupture takes place between the outer border of the tendon and internal oblique muscle. It may be either of the direct or indirect variety. It then extends down along the inguinal canal and protrudes from the external ring.

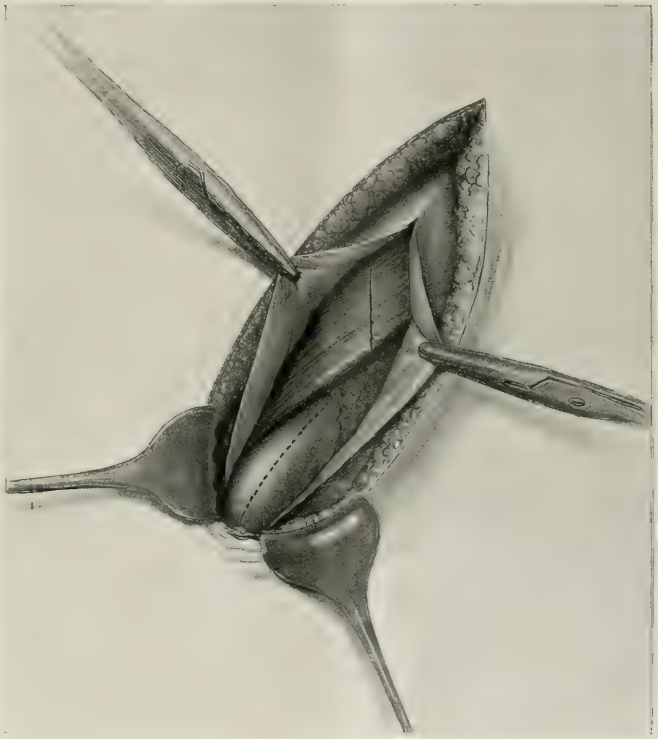

Fig. 1.

In these cases the problem is a simple one; it is only necessary to suture the tissues down to or just beyond the outer border of the tendon. There is no tendency to recur in the lower angle of the wound just above the pubes and to the outer side of the outer border of the rectus, because at this position the protrusion of the peritoneum is prevented by the conjoined tendon. If one does not transplant the cord a hernia may take place along the cord, protruding between the outer border of the conjoined tendon and sutured tissues. If one transplants the cord (as in Halsted's or Bassini's operation) the probability of a recurrence at this position (the lower angle), at least as far as our cases are concerned, is practically nil.

The probability of a recurrence if the cord is transplanted (as in the Halsted or Bassini operation) is very much less than in the older operations in which the cord was not transplanted. Theoretically (in my opinion) the position of the cord in Halsted's operation is better than the position of the cord in Bassini's operation, as the cord is made to protrude through the thickest part of the abdominal wall (aponeurosis of the external oblique and divided internal oblique muscle); practically the results after Halsted's operation in which the wounds have healed per primam are better than in any list of cases yet published, although only very slightly better than after Bassini's operation (143 cases—3 very small recurrences at the position of the cord).

Group B. In cases in which the conjoined tendon is obliterated, if one inserts the index finger (invaginating the scrotum), after passing through the external ring, the finger does not meet any obstruction, but can be introduced without difficulty into the abdominal cavity for some distance; in this position, to the medial side the finger feels the sheath of the rectus muscle; by curving the finger downwards and backwards the posterior surface of the symphysis pubis can be easily palpated. The opening into the abdominal cavity extends from the outer border of the rectus and from the arch of the pubes, upwards and outwards to the internal oblique muscle. Before operation the number of fingers which can be intro-

duced is limited by the size of the external abdominal ring. In some cases it is but one finger, in others two or more fingers. At the operation, however, after the division of the aponeurosis of the external oblique from the position of the external ring upwards, one can usually introduce the entire hand into the abdominal cavity; in these cases the conjoined tendon is either thin and relaxed or completely obliterated, and the posterior wall of the inguinal canal from the outer border of the rectus upwards and outwards to the internal oblique muscle, and downwards and outwards to Poupart's and Gimbernat's ligament, is formed only by the thin and easily stretched transversalis fascia and areolar tissue.

The following figures, taken from the "Second Report on Hernia" which the writer is about to publish, demonstrate the importance of the obliteration of the conjoined tendon as a factor (perhaps the chief factor) in the recurrence of the hernia. As stated before, the larger group includes those cases of hernia in which the conjoined tendon is wide and firm. In this group (*A*) there have been 211 cases with 7 recurrences. In 6 cases (about 3 per cent.) the recurrence has taken place at the position of the transplanted cord, to the outer border of the conjoined tendon; all of these recurrences occurred within one year, and each one is a very small affair. In one case (½ per cent.) the recurrence took place 5 years after operation, in the lower angle of the wound. After a severe illness associated with a constant cough, in this case the conjoined tendon gave way.

In the smaller group (*B*) in which the conjoined tendon was obliterated there are 10 cases, with 5 recurrences (50 per cent.); each recurrence took place in the lower angle of the wound within a few months or a year, and the recurrent hernia is larger in each case than those in group *A*. In two cases the rupture descended into the scrotum.

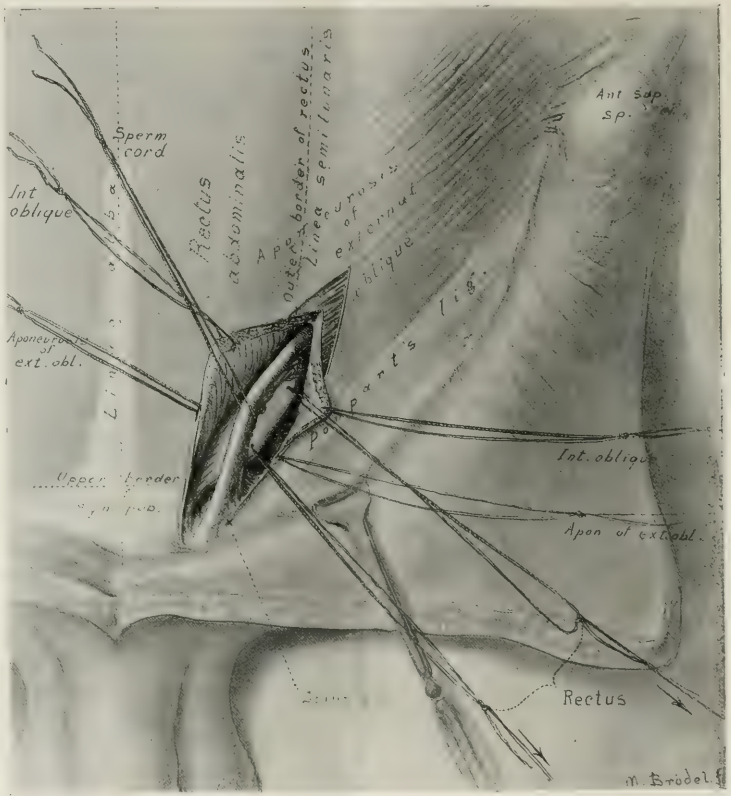

FIG. 2.

Suppuration in both groups *A* and *B* has also been associated with the recurrence of the hernia.

In the larger group (*A*) the following figures show the relation of suppuration to recurrence, but also support the conclusion in regard to the conjoined tendon.

WOUNDS WHICH HEALED PER PRIMAM.

(1) Halsted's typical operation, 143 cases, 3 recurrences. Each recurrent hernia small and situated at the position of the transplanted cord.

(2) Cases in which the cord has been excised, 43 cases, 1 recurrence. In this case the recurrence has taken place through a split in the aponeurosis of the external oblique, to the outer side of the conjoined tendon.

WOUNDS WHICH SUPPURATED.

(1) Halsted's typical operation, 20 cases, 3 recurrences. In two cases the recurrent hernia is situated at the position of the transplanted cord, in one at the lower angle of the wound, described before.

(2) Cases in which the cord has been excised, 5 cases, no recurrences.

In the 10 cases included in the smaller group (*B*) there have been 3 recurrences among 7 cases in which the wound healed per primam, and 2 recurrences in the 3 cases in which the wound suppurated; in these 2 cases the recurrent hernia descended into the scrotum, and they represent the only complete recurrences in the entire series of 221 cases.

Impressed by the large proportion of recurrences in the *few cases* (3 recurrences in 7 cases) in which the conjoined tendon was obliterated, and with a hope of solving the additional problem presented by the obliteration of this tendon, the writer has devised, and in 8 cases performed a plastic operation on the rectus muscle, bringing this muscle down and suturing it with the other available tissues to Poupart's ligament and to

the aponeurosis of the external oblique from the arch of the pubes up to the position of the transplanted cord. The procedure is a very simple one, and the inclusion of the transplanted rectus in this portion of the wound must add strength. In the past we have learned the proper introduction and utilization of muscular tissue in laparotomy wounds. Every surgeon is familiar with the numerous herniæ after laparotomies in which the incision has been made in the linea alba, in which cases only the fascia was sutured. In 4 of our own operations for umbilical hernia in which only fascia had been sutured there have been 3 recurrences; in those cases in which the rectus muscle had been exposed and sutured there have been no recurrences. After a careful observation of all the laparotomies performed by us in this hospital for a period of over eight years we find that there has been but one hernia in a laparotomy wound, which has healed per primam throughout, and in which muscle as well as fascia has been approximated. So impressed have we been with the importance of including muscle in the suture after laparotomy wounds that it is our rule in medium laparotomy to cut through the inner border of the rectus muscle rather than through the linea alba, and through the outer border of the rectus rather than through the semilunaris; and Prof. Halsted in his original conception of his operation for inguinal hernia divided the internal oblique muscle with this object in view. He states in his original communication, "I make and close the wound in operations for hernia on the same principle as in any other laparotomy wound." The writer therefore claims no originality whatever in the use of the muscle to strengthen the hernial wound, but simply the original idea of transplanting the rectus to strengthen the wound in certain cases of hernia.

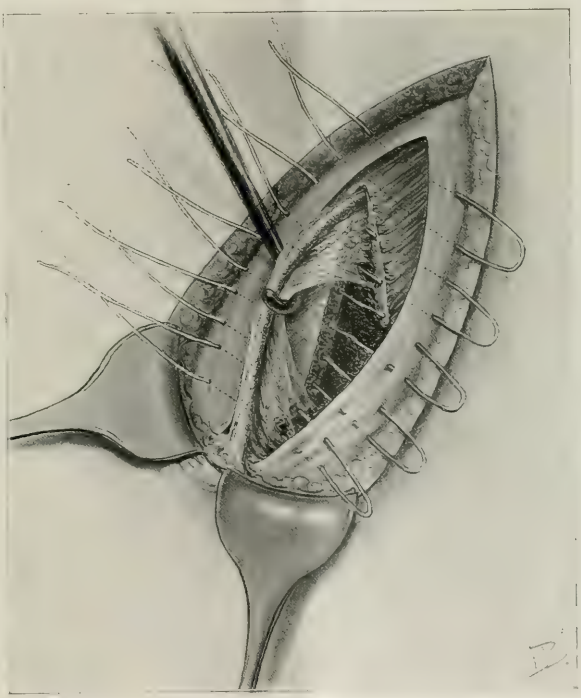

Fig. 3.

The procedure is a very simple one; the method of operation with this exception is the same as that followed in the typical Halsted operation. Before inserting the deep sutures the sheath of the rectus muscle is exposed; this is easily done by retracting upwards and inwards the aponeurosis of the external oblique and internal oblique muscles. The sheath of the rectus is divided in the direction of the muscle bundles from its insertion in the symphysis pubis upwards for a distance of 5 cm. After the division of the sheath the outer border of the belly of the muscle bulges out; it is caught with two or three sutures of heavy black silk which are used as retractors to draw the muscle outwards and downwards. The operation at this stage is shown in Fig. 2. The deep sutures of silver wire are then inserted in exactly the same manner as described in Halsted's operation, with the addition that the four sutures below the transplanted cord include the *sheath* of the rectus and the *muscle* (Fig. 4); when these sutures are tied the rectus muscle is approximated to Poupart's ligament and the aponeurosis of the external oblique, from a position just below the transplanted cord down to the symphysis pubis, in addition to the divided and transplanted internal oblique muscle. Fig. 4 and Fig. 5 clearly demonstrate that the transplanted rectus strengthens the lower portion of the wound, which has been weakened by the obliteration of the conjoined tendon, better than any other available tissue could do.

The writer had this idea in mind for over a year, but not until April, 1897, did a case present itself in which the conjoined tendon was obliterated and in which he considered it necessary to transplant the rectus.

These drawings were made by Mr. Max Brödel from careful dissection on the cadaver and from operations.

Explanation of the Plates.

Fig. 1. Halsted's operation, second stage. The aponeurosis of the external oblique has been divided, exposing the inguinal canal and the internal oblique muscle. The dotted lines on the muscle represent the direction and extent of its division.

Fig. 2. The sac has been excised and the peritoneal cavity closed. The internal oblique muscle has been divided and the rectus exposed and transplanted; at this stage the wound is ready for the insertion of the deep sutures.

Fig. 3. Halsted's operation, deep sutures inserted. This drawing demonstrates that there has been no attempt to completely close the external ring, and even if this should be done, there is no available muscle to approximate, unless the rectus is transplanted. If the conjoined tendon is wide and firm it is not necessary to completely close the external ring. Recurrence is prevented in the lower angle (Hesselbach's triangle) by this tendon.

Fig. 4. The transplanted rectus muscle included by the

deep sutures. In this drawing the cord has been excised in order to represent the operation more clearly. This drawing clearly demonstrates that the rectus muscle fills the lower angle of the wound, the part included by the lower two sutures. It also shows that the rectus strengthens the entire wound up to the position of the transplanted cord.

Fig. 5. Diagram of the position of the transplanted rectus muscle demonstrates the slight change in the direction of its fibres.

Note.—April, 1898. During the last few months Prof. Halsted in one case and Dr. Cushing in three cases have transplanted the rectus muscle.

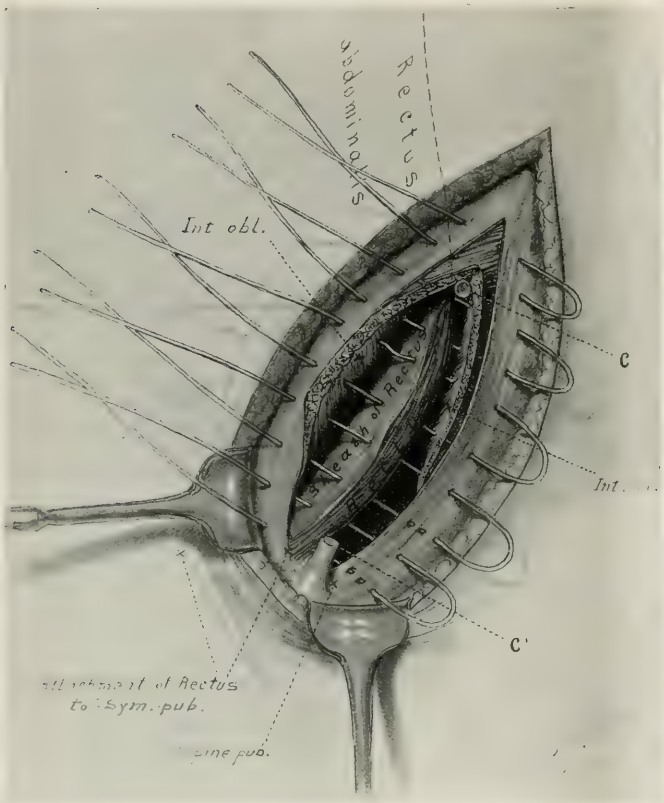

Fig. 4.

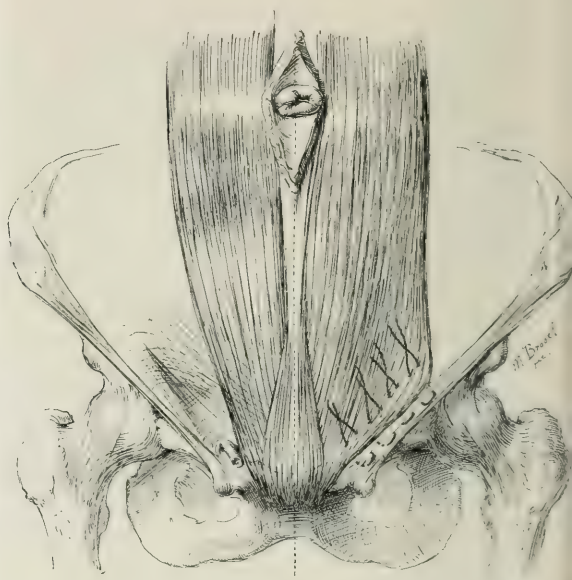

Fig. 5.

Diagram of the position of the transplanted rectus muscle, demonstrating t slight change in the direction of its fibres.

HYDRAULIC PRESSURE IN GENITO-URINARY PRACTICE, ESPECIALLY IN CONTRACTURE OF THE BLADDER.

By Hugh H. Young, M. D., *Instructor in Genito-Urinary Surgery, Johns Hopkins University.*

Since the opening of the Johns Hopkins Hospital in 1889 it has been the custom to treat cystitis by intravesical irrigations of various solutions. The irrigations have been performed without the use of a catheter, hydraulic pressure alone being used to force the irrigating fluid back into the bladder, which when full is emptied by the simple act of micturition.

This method was a direct sequence to Dr. Halsted's method of treating gonorrhœa by copious irrigations of antiseptic solutions which he promulgated in New York in 1883. While irrigating the urethra he found that some of the fluid would be forced back into the bladder if the irrigating bag were held sufficiently high.

The acorn nozzle (Fig. 1) which he had devised for urethral irrigation was used, but held crowded into the meatus until the fluid was forced into the bladder by hydraulic pressure.

According to this method many cases of cystitis have been treated at the Johns Hopkins Hospital with remarkably satisfactory results.

While treating a number of these cases I found Dr. Halsted's acorn urethral nozzle unsatisfactory for intravesical irrigations, because it is so blunt that it cannot be wedged into the meatus tight enough to prevent the escape of fluid around it. To obviate this I had a nozzle* made with conical point of much more gradual slope, which can be tightly wedged into the meatus without hurting the patient. This has proved very satisfactory (Fig. 2). By the use of this nozzle we have never found a case in which the bladder could not be irrigated without a catheter.

I have lately found that somewhat similar nozzles have been devised by Janet and Valentine.

Fig. 1.—Halsted's Acorn Urethral Nozzl

Fig. 2.—Nozzle for Intravesical Irrigations.

Case I. During the summer of 1896 a patient was admitted to the hospital suffering with chronic pyonephrosis and cystitis. He was very weak and emaciated, and his urine, which was loaded with pus and mucus, was voided every half-hour in small amounts. An examination of his bladder showed that it was greatly contracted, holding only 40 cc. (about an ounce). The mucous membrane was rough, corrugated, very tender and bled easily.

After bladder irrigations were begun it occurred to me that benefit might be obtained by dilating his bladder by hydraulic pressure, thus lessening the disagreeable frequency of urination.

At first only 40 cc. could be forced into the bladder, but its capacity soon began to increase, and at the end of ten days his bladder held 150 cc. (5 oz.), and urination was not nearly so frequent. His cystitis was also improved.

*Made by Whitall, Tatum & Co., Phila.

Unfortunately I was prevented from continuing the treatment longer, and though the results were very promising the outcome was still uncertain. The next case, however, surpassed my most sanguine expectations. I will report it at length.

Case II.—*Severe chronic cystitis, 30 years' duration. Contracture of bladder, constant dribbling urine for three years. Capacity of bladder 30 cc. Dilatation to 290 cc. by hydraulic pressure. Return of continence of urine.*

I. H., æt. 65. American. Occupation, huckster. Admitted Dec. 17, 1896, on account of continual dribbling of urine.

Family History. Negative.

Previous History. He denies syphilis and gonorrhœa.

Present Trouble. Thirty years ago he injured his perineum in a fall, following which he says he had extravasation of urine, required frequent catheterization and was very sick for several months. At the end of seven months perineal section was performed in New York (probably for stricture of urethra following traumatism). After that he passed sounds on himself about twice weekly for twenty years. Cystitis, which was continuously present, became greatly aggravated six years ago, frequency of micturition increased greatly, and for the past three years there has been a constant dribbling of urine.

Status Præsens. The urine dribbles continually, patient wearing cloths between thighs to absorb it. The odor is very offensive even ten feet away. Patient suffers severe pain in bladder and urethra and is perfectly miserable. He is unable to work and is shunned by his friends.

Examination. He is a thin, emaciated old man, with clothing wet from urine with a very foul ammoniacal odor, which appears to dribble continually.

A searcher passes into bladder readily, but reveals several irregularities in the urethra.

Bladder very small, not admitting the rotation of searcher. When fully distended with fluid it holds only 30 cc. (℥i), any further distension causing pain. Prostate not enlarged. No stone or intravesical growth made out. Mucous membrane of bladder rough. Searcher caused no hemorrhage. Kidneys not palpable.

Analysis of Urine. Heavy gray sediment amounting to one-third of specimen. Reaction intensely alkaline. Much stringy mucus. Albumen in large amount. No sugar. Microscopically mucus and pus cells, triple phosphates. One week after admission daily forced dilatation of bladder begun, using a solution of bichloride of mercury, 1 to 150,000.

The tabulation on page 102 shows the improvement made.

Remarks.—In this case cystitis had been present for 30 years. Continued inflammation had probably destroyed the mucous membrane, caused the muscle to be replaced by fibrous tissue, through the cicatricial contraction of which the capacity of the bladder was steadily reduced until it finally held hardly one ounce and had entirely lost its power of expelling urine. As a result the urine had dribbled constantly for three years before he entered the hospital.

Under forced dilatation the capacity of bladder rapidly increased from 30 to 290 cc. (℥i to ℥x), but the contractile power did not fully return, probably owing to the fibrous replacement of the bladder muscle. There was a constant residual of 60 to 100 cc. and as a result micturition was frequent.

Whether the tonicity would have returned in time we are unable to say, as we have never seen the patient since. Improvement, however, was very great.

Date.	Day of Treatment.	Capacity of Bladder. Largest amount held on forced distension.	Interval. Longest time between two urinations.		Remarks.—Case II.
		Cu. Cm.	Hr.	Min.	
Dec. 17		30		Dribbling	Severe chronic cystitis 30 years. Urine ammoniacal, loaded with mucus. Clothes saturated with urine.
" 26					Dilatation begun. Irrigation of bichloride followed by boric twice daily.
" 27	1	40		"	
" 30	4	90		"	Urine clearer, reaction less alkaline.
Jan. 6.....	11	200		"	Reaction acid. Great improvement in general health.
" 11.....	16	240		30	Has ceased to dribble, but bladder is unable to expel all of urine, 60 cc. residual, seems to have very little contractile power.
" 16.....	21	245	1		At times voids 160 cc. naturally. Urine acid, pus slight.
" 23.....	28	255	1	30	
" 24.....					He feels very badly. Some pyrexia. Refuses dilatation treatment.
Feb. 20		215			Treatment resumed. Urine has become alkaline again and is voided at frequent intervals. Great increase in pus.
" 27	7	290			
March 6		280	3		Bladder seems to have no muscular power. After catheterization he is able to retain urine for 3 or 4 hours, but then he only voids a small amount, and after that voids every half-hour or so, leaving a residual of about 100. Patient is devoid of will and energy, does not try to do better. Is greatly improved in general health. Dribbling has ceased and cystitis much improved. Discharged.

Case III.—*Chronic cystitis* 10 *years. Contracture of bladder, holding only* 40 *cc. Micturition every* 30 *minutes. Under forced dilatation capacity increased to* 160 *cc., and interval to* 4 *hours.*

Surg. No. 6573. J. T. Age 41. American. Farmer. Admitted May 26, '97.

Complaint. Frequent and painful micturition.

Family History. Negative.

Past History. Denies gonorrhœa and syphilis.

Present Trouble. Ten years ago began to have frequent and painful micturition. No cause assigned for attack. Denies ever having gonorrhœa. Had no instruments passed into urethra. Had been in good health previously.

Urination continuing frequent and painful, with occasional tinges of blood, patient consulted a physician at the end of a month, who passed an instrument to detect a calculus, but none was found.

Following examination he had chills and fever, lasting two or three days, accompanied by marked aggravation of bladder trouble.

At the end of two years patient suffered severe pain in bladder, and his urine contained a great deal of blood, and dribbles continually.

To relieve distress of patient a perineal section was done in Philadelphia. This operation was followed by marked improvement of symptoms. Perineal fistula continued for two years, and patient suffered very little till ten months ago when he again began to pass blood. Urination soon became very frequent and painful, and since then his bladder symptoms have steadily grown worse.

Status Præsens. Patient now voids urine every fifteen minutes, though at times half an hour may intervene. He suffers a constant pain located in lower abdomen, worse at end of urination, and then extending into penis. Urine often contains blood, free and clotted, and most at end of micturition. Stream frequently stops suddenly, accompanied by pain running to end of penis. Has never passed gravel.

In anterior part of anus is a fissure which he has had for several years.

Analysis of Urine. June 5th. Smoky, blood-stained deposit of mucus. Alkaline in reaction. Microscopically pus cells, red blood corpuscles and squamous epithelium.

On June 3rd treatment was begun. Bladder distended four times daily with Thompson's fluid.

In six days its capacity was doubled (60 cc.), and in two weeks trebled. Accompanying this, the interval between urinations increased from fifty minutes to one hour and thirty-five minutes. A great change had taken place in his general condition; the con-

Date.	Day of Treatment.	Bladder Capacity. Largest amount held on forced distension.	Urine. Largest amount voided at one time.	Interval. Longest time between two urinations.		Remarks.—Case III.
		Cu. Cm.	Cu. Cm.	Hr.	Min.	
June 3.....	1	40	30		30	Constant severe pain in bladder, causing him to stoop. Urine loaded with pus, mucus and blood. Reaction alkaline.
" 8.....	5	60	40	1	15	
" 11.....	8	85	70	1	40	General health improved. Pain now absent. Can now walk erect. Urine much clearer.
" 18.....	15	105	80	2	.....	Has gained 8½ pounds in weight.
" 28.....	25	130	110	2	30	Patient discharged; to continue treatment at home. Patient lost ground for a time, but soon improved rapidly.
July 14		100	80	2		
" 23		135	100	3		
" 29		160	130	4		He writes that he feels like a new man, passes no blood or mucus, is free from pain and has no trouble conducting treatment at home.
Sept. 23.....						Irrigations have been discontinued, contrary to orders, for more than a month. He writes that he still holds his urine three or four hours at a time; has no pain and is very well.

stant pain in bladder, intensified by urination, which was present on entrance, had practically disappeared, the urine had become acid, and the amount of pus diminished markedly. He had gained 8½ lbs. in weight.

At the end of three weeks his bladder held 130 cc., he voided naturally 110 cc., and the interval between acts of micturition was two hours and thirty minutes.

The tabulation on the previous page shows graphically the improvement. (See also chart of cases appended).

Remarks.—In this case the bladder was exquisitely tender and would stand very little dilatation, the increase in capacity was therefore slower. I have not heard from him for a month, but I believe the capacity will be fully restored.

Case IV.—*Chronic cystitis 5 years. Contracture of bladder, capacity 60 cc. Micturition every 45 minutes. Pott's disease. Intestinal tuberculosis. Under forced dilatation size of bladder increased to 195 cc. and interval to 3 hours 30 minutes. Marked amelioration of cystitis.*

Surg. No. 6580. G. L., single. Age 28. American. Laborer. Admitted May 30th, '97.

Complaint. Frequent and painful micturition.

Family History. Measles, pneumonia (?). Denies lues and gonorrhœa. Pott's disease 16 years ago, following injury, has never given rise to abscess, gives no pain now, seems to have undergone resolution.

Present Illness. Indefinite history of cystitis for five years or more. Denies gonorrhœa, but acknowledges having had sounds passed two years previously. Cystitis characterized by burning pain running down to end of penis, intermittent appearance of blood in urine, free and clotted, increased frequency of micturition, now every thirty to forty minutes. During past year has passed sounds on himself every week, no antiseptic precautions.

Patient has suffered from intermittent attacks of severe abdominal pain, every week or so, for a long time, associated with a continued diarrhœa, mucus and occasional streaks of blood.

Examination. Well nourished man, with a marked stoop from kyphosis in middle dorsal region.

Chest and abdomen negative. Cystic swelling attached to each epididymis.

Rectal Examination. Prostate enlarged, irregular, with slight nodular roughnesses. Very tender on pressure.

Bladder. Instrument introduced easily. No urethral stricture. Introduction causes considerable pain in region of prostate. Bladder contracted. On forced distension holds only 60 cc. (℥ ij). No stone present. No intravesical growth made out. With finger in rectum and instrument in bladder, prostate feels nodular and extremely tender.

Instrument causes slight hemorrhage.

Tuberculin injected, small but definite reaction following. It is probable that tuberculosis of intestine and prostate is present, along with latent vertebral tuberculosis.

Urinary Analysis, March 30th. Smoky, shreds of mucus, small blood clot, heavy white precipitate. Acid, sp. gr. 1020. Albumen, trace. No sugar. Microscopically red blood corpuscles, leucocytes and epithelial cells in abundance. No casts.

There was manifestly little hope of curing his bladder trouble, but the relief afforded by forced dilatation for only three weeks was wonderful, as shown in diagram.

Date.	Day of Treatment.	Bladder Capacity. Largest amount held on forced distension.	Urine. Largest amount voided at one time.	Interval. Longest time between two urinations.		Remarks.—Case IV.
		Cu. Cm.	Cu. Cm.	Hr.	Min.	
May 30			60		45	Admitted. Suffers with severe pain in bladder. Urine acid, with pus and blood.
June 5.....	1	80	60	1	10	Systematic dilatation begun.
" 8.....	3	110				
" 10.....	5	130	90	2	5	Almost free from pain. Feels greatly improved.
" 18.....	13	160	120	2	35	
" 23.....	18	180	160	2	55	
" 27.....	22	195	180	3	30	During the latter part of three weeks continued diarrhœa, with pain in anus and prostate. Urine free from blood; much less pus. Cystitis considerably improved.

Case V.—*Severe chronic cystitis for 14 years. Gradually contracting bladder, holding 20 cc. (℥ v) on entrance. Micturition every 15 minutes. Urine alkaline, with much mucus and pus. Under hydraulic pressure bladder dilated to 370 cc. (℥ xii), and interval between acts of urination increased to 4–5 hours.*

Mr. G. B. Age 40. Canadian. Drummer. Admitted May 4, '97.

Complaint. Frequency of micturition, every ten or fifteen minutes, with pain, blood and mucus.

Family History. Negative.

Past History. Usual diseases of childhood.

First and only attack of gonorrhœa fourteen years ago. Double epididymitis and posterior urethritis. Discharge lasted several months. Four months later began to have a sense of fullness in bladder, pain on micturition in end of penis, increased frequency, etc.

Vesical disturbance has continued since that time, with only temporary remissions.

Cystitis soon became very severe, urine foul, much blood and mucus. Pain in bladder often very severe. Has been treated by numerous physicians and hospitals, with internal remedies and local irrigations through catheter, with only temporary relief.

Following indiscretion in drinking, etc., every few months patient has had acute exacerbations of disease, accompanied by chills, high fever, vomiting, pain and frequent micturition.

The interval between acts of urination has steadily become shorter, and for the past two years patient has voided urine every ten or fifteen minutes. In order to attend to business he has found it necessary to wear a rubber urinal, which has produced a severe balanitis.

Status Præsens. Increased frequency of micturition, every 10–15 minutes night and day.

Pain. Site in perineum, continual, scalding or burning.

Urine. Always slightly blood-stained, ammoniacal odor, considerable mucus.

Capacity of bladder, rarely passes over ℥ ss.

General health fair, but rendered unhappy and miserable by bladder trouble. Unable to attend to business.

Physical Examination. A fairly well nourished man. Facies worried. Chest and abdomen negative. Kidneys not palpable. Right testicle atrophied, an irregular nodule in epididymis.

Rectal Examination. No enlargement of prostate. Vesiculæ seminales palpable. No abnormality. No bas fond. No stone

palpable bimanually, tenderness marked in region of neck of bladder. Cicatrix in perineum from old perineal section.

Bladder. Urine chart shows that about 20 cc. (ʒ v) is largest amount passed, with an interval of 15 minutes between acts of urination. When bladder is filled with fluid by hydraulic pressure without catheter, 22 cc. is the largest amount which bladder can hold without severe pain.

Urinalysis. Light yellow, cloudy, large clot of mucus. Strongly alkaline. Microscopically pus cells in great numbers, triple phosphates, numerous red blood corpuscles.

Treatment, May 6th. Systematic dilatation of bladder by hydraulic pressure begun; with nozzle held tight in meatus, an elevation of four feet easily forces irrigating fluid into bladder.

Patient instructed to allow fluid to distend bladder as much as can be borne without great pain, then to withdraw nozzle and force the fluid out by urination. This is repeated until 1000 cc. is used. This is to be done every four hours by patient, with assistance of orderly. Thompson's fluid used for irrigation.

The chart shows the progress of dilatation.

April 23, 1898. Patient returns for examination. He has irrigated bladder with moderate regularity once or twice daily up to present time. Solution of boracic acid used. No attempt to dilate bladder. He says he has been in fine health, and but for the presence of pus in urine would feel perfectly well. He urinates every four to six hours; control of bladder, good. Last night did not void for six hours.

Examination. General health good. 200 cc. of urine voided at one time. Urine alkaline, cloudy with pus. Many cocci and bacilli like proteus present.

On forcible distension bladder holds 325 cc. Slight recontraction of urethral stricture at site of previous operation.

Patient voids urine with ease.

It is now one year since the dilatation treatment was begun, and there is no tendency to a recurrence of contracture.

Remarks.—The improvement in this case was remarkable and is graphically shown on the chart which accompanies.

Date.	Day of Treatment.	Capacity of Bladder. Largest amount held on forced dilatation.	Urine. Largest amount voided at one time.	Interval. Average time between two urinations.		Remarks.—Case V.
		Cu. cm.	Cu. Cm.	Hr.	Min.	
May 3.....		22	20		15	Severe pain in bladder and penis. Urine filled with blood, mucus and pus and strongly ammoniacal. Wears a rubber urinal. Has voided urine every fifteen minutes for two years.
" 6.....	1	22	20			Dilatation begun—every four hours. Thompson's fluid.
" 15.....	9	94	40		25	Injected with tuberculin. No reaction.
" 21.....	15	115	70		45	Improvement has been rapid. Pain has entirely gone. Appetite is ravenous. One irrigation of silver nitrate given daily (1 to 400). Urine greatly improved.
" 29.....	24	130	105	1	10	
June 10.....	36	170	120	2	10	*Urine acid.* Very little sediment. No blood.
" 20.....	46	190	155	3		Urine acid.
" 29.....	55	250	190	4	25	Feels like a new man. Can now walk about town four hours without desiring to urinate; is entirely free from pain. Urine is almost clear, acid in reaction. Discharged to continue dilation at home.
July 15.....		225	150	3	35	Home treatment. Lost some ground while traveling.
" 21.....		275	190	3	30	Conducts his own treatment, using one nitrate of silver irrigation and three Thompson fluid irrigations daily.
" 29.....		340	260	5	30	
Aug. 9.....		370	260	6		He is now practically well.
Sept. 30.....		365	280	4	30	Still some pus in urine, but patient feels perfectly well.

Case VI.—*Chronic cystitis 7 months. Contracture of bladder moderate. Capacity of bladder 140 cc. Micturition every hour. Bladder dilated in one month from 140 to 500, with interval of 4 hours 50 minutes. Great general improvement.*

G. C., white, æt. 32. Engineer.

Complaint. Frequent and painful micturition.

History. Gonorrhœa 10 months ago. Three months later beginning cystitis. Frequent hæmaturia. Increasing frequency of micturition. Has lost fifteen pounds in six months. He now voids twenty times in twenty-four hours, burning pain at end of urination.

Urine. Pale, heavy gray sediment, slightly acid, 1012. Albumen in large amount. No sugar. Microscopically pus cells, mucus clot at bottom. Urination every hour, on the average, largest amount passed is 100 cc., generally less. Examination with searcher, no stone, bladder wall rough, corrugated, prostate not enlarged, not tender. No residual urine. Bladder distended until quite painful, holds 140 cc. Forced irrigations of Thompson's fluid begun, to be taken four times daily by patient.

Table on page 105 shows progress of case. Also chart.

General Remarks.

Is there a ureteral reflux? When this method was first adopted the question arose whether some of the irrigating fluid might not be forced up the ureter, when the bladder became forcibly distended. If such were the case pus and dangerous micro-organisms would be carried along, and ascending inflammation and pyonephrosis would certainly result.

The valve-like arrangement of the orifice of the ureter produced by its oblique course for 1½ inches in the bladder wall would seem to be a special provision of nature to prevent the backward flow of fluids from the bladder into the ureters.

In order to determine whether fluid, under considerable hydraulic pressure, would be forced into the ureters I experimented on a cadaver. After the intestines were removed the ureters were dissected out and cut across within a few inches of the bladder. A very strong solution of methylene blue was prepared and forced into the bladder through the urethra from an elevation of fourteen feet.

The bladder rapidly distended, but no fluid ran out of the cut ureters, although the distension was kept up until 1700 cc. (nearly two quarts) were forced in, and the walls became so thin that the blue solution shone through, and the threaten-

ing aspect of the huge bladder caused most of the bystanders to leave the room.

When the bladder was incised the mucous membrane was found deeply stained blue, but the stain did not extend $\frac{1}{32}$ of an inch into the ureteral orifices.

In another cadaver, with large sacculated bladder and double hydro-ureters, I found it impossible to force fluid from bladder into ureters.

To further test the matter I made the following observation upon a dog, April 4th:

A small male dog received 1 gr. morphia hypodermically. Very deep colored solution of gentian violet prepared. By hydraulic pressure of 11 feet (above dog) the fluid was forced into the bladder without a catheter until the greatly distended bladder could be seen through abdomen.

Abdomen then cleaned, dog etherized, laparotomy performed. Bladder greatly dilated, and dark purple in color from fluid within, intestines pushed aside, ureter located. It contained perfectly clear urine and not a particle of the violet stain. Kidney exposed, no stain present. Although ureter was watched for some time, no vermicular movement was noticed until fluid was evacuated from bladder, when it was distinctly to be seen. Bladder had remained distended for fully 10 minutes. On another dog under ether we exposed the ureter after laparotomy, and watched it carefully while various amounts of fluid were forced into bladder. There was never any passing of the fluid into the ureter. No reverse peristalsis was made out.

These observations seem to show conclusively that fluid cannot be forced up the ureters from the bladder in the dog

Date.	Day of Treatment.	Capacity of Bladder. Largest amount held on forced dilatation.	Urine. Largest amount voided at one time.	Interval. Average time between two urinations.		Remarks.—Case VI.
		Cu. Cm.	Cu. Cm.	Hr.	Min.	
Sept. 4.....			100	1		Burning pain in bladder. Urine faintly acid, very cloudy, heavy sediment of pus and mucus.
" 6.....	1	140	100	1	5	Forced dilatation begun. Thompson's fluid four times daily.
" 11.....	5	230	160	1	30	Much relieved.
" 15.....	9	280	200	2		
" 21.....	15	340	260	3		Free from pain.
" 25.....	19	390	320	3		Urine acid. Pus less, but still considerable.
" 28.....	22	400	380	3	30	
Oct. 3.....	27	500	440	4	50	
" 4.....	28	500	460	4	50	Patient discharged. Is free from any bladder symptoms. Holds urine often for 6 hours during night. Has gained 10 lbs. in weight. Feels like a new man. Urine acid, almost clear, very little pus.

In this case forced dilatation had been used daily in dispensary for a week or so before entrance, and I wish to thank Dr. Gaither for the interest he has shown in the method. Partial dilatation had been accomplished. Cystitis was of 7 months' duration, so there was probably less fibrous tissue present, and dilatation was therefore more rapid than in other cases. Improvement, however, was rapid and marked; relief afforded great; result, cystitis practically cured.

January 10. Capacity 500 cc., interval 5 hours. Feels perfectly well. Does not urinate at all at night. Can hold urine for 10 hours if necessary. Left hospital November 15th. Took irrigations 4 a day up to December 1st. During December twice daily. Since December 28th once daily. Thompson's fluid.

and in man, and they have been borne out by clinical evidence, for in none of the cases has there been any evidence of ascending infection, although the bladders contained many virulent organisms, some streptococci.*

* While this article was in the hands of the printer our attention was called to the work of Lewin and Goldschmidt in regard to reflux from the bladder into the ureter, and their findings are of such importance that I will add them here.

These authors (Virch. Arch. vol. 134, 1893, p. 33), after anæsthetizing rabbits, performed laparotomy and injected fluid into the bladder under pressure. The ureters were then exposed and cut to see if the fluid had entered them. In nearly all cases they found that a small amount of fluid slowly injected would enter the ureter of the rabbit.

Their conclusions are as follows:

"The backward movement of the contents of the bladder into the ureter and pelvis can be produced as well by injection as by artificial retention.

"This result always took place in bladders which were still capable of contraction and *not strongly distended*. The result consisted essentially in an over-distension of the ureters, or, on the other hand, an excitation to increased activity expressed in peristaltic or anti-peristaltic waves.

"*When the bladder is over-distended it is impossible to open the ureteral mouths with the injected fluid.*"

Courtade and Guyon repeated these experiments on rabbits and also on dogs. Their work is discussed at length by Guyon in his *Leçons cliniques sur les maladies des voies urinaires*. In rabbits the reflux into the ureters occurred in 20 out of 32 times, but in dogs only 5 out of 25 times—or strictly 5 out of 38 trials. Guyon says in substance: "In the rabbit as in the dog, entrance into the ureters is only forced when the walls of the bladder are put in a state of resistance from the beginning of the injection. In both animals, every time that the bladder remained flaccid and was passively distended the ureter was not invaded, no matter how much fluid nor how much pressure was used.

"It is established that early tension of the bladder-wall produced by injection of a small quantity of liquid is the condition when the reflux can be observed. No other condition can accomplish it.

"In the five positive experiments the reflux showed itself after the first injection, but never after the second. *Once put on its guard, the vesical muscle does not allow itself to be surprised again.*

Hydraulic Urethral Dilatation.—I have had an opportunity to observe the effect of hydraulic pressure on a urethral stricture in two cases. I may say that it is very easy to force fluid into the bladder through strictures of very small calibre.

In one case—a man convalescing from an operation for cranial abscess—the stricture of fifteen years' duration would not admit the passage of the finest bougie. Urination was extremely difficult, so much so that patient was obliged to squat on the floor and to strain so severely that a hemorrhoidal mass as large as the fist would be forced out.

His bladder was easily irrigated with an elevation of about ten feet, and after this had been done several times daily for two weeks he could void his urine while lying on his back in bed without an extrusion of the piles. The stream of urine became considerably larger.

Another case of moderately tight stricture showed decided evidence of dilatation after a week's treatment. I do not mean to advise this in preference to urethrotomy, but in cases of stricture complicated by severe cystitis, where operation is often followed by absorption of septic materials, chill, fever, and occasionally fatal pyæmia, preparatory lavage of the bladder in this manner is certainly indicated.

When a patient is discharged after dilatation of a stricture the daily use of this method would probably tend to prevent the recurrence of a stricture, and be of benefit to any bladder infection which might coexist.

After perineal section, where it is desirable, on account of cystitis, to continue bladder irrigations, I have found it very easy to force the fluid into the bladder by simply closing the perineal wound with the fingers, or if the opening is small, by the pressure of a sponge covered with rubber protective.

In cases of enlarged prostate, fluid may be easily forced into the bladder without a catheter, but the same trouble is encountered in evacuating it as with the urine. After suprapubic operation, however, it is a very valuable procedure and the most thorough method of cleaning the bladder and combating infection. By closing the suprapubic sinus with a plug or the finger the bladder may be dilated, thus curing or averting one of the most undesirable effects of suprapubic drainage, viz. contracture of the bladder.

Vesical Calculus. In several cases of stone in which the bladder was small we have employed forced dilatation with very gratifying results. In a case now in the wards, who on admission had a severe acid cystitis with a staphylococcus pyogenes albus infection and a bladder which when fully distended held only about 140 cc., we were able in a week to increase the capacity to 400 cc. This was followed by a marked improvement in the cystitis and greatly decreased frequency of micturition. The bladder was then easily reached by suprapubic operation, and the bladder infection so much bettered that it was thought advisable to suture the bladder after removal of the calculus. We consider such preliminary treatment very valuable where infection or contracture is present.

Atony of the Bladder. The possibility of benefiting an atonic bladder by alternate distension and evacuation, a form of massage, so to speak, for the weakened muscle, is shown in the following case (VII).

An old man, paralytic, constantly requiring catheterization from paralysis of bladder, after a time began to regain use of

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When the contractions of the bladder are *total and active*, rather than favoring the entrance of the vesical contents into the ureter, it opposes it.

"The mechanism depends on the fact that there is a band of muscle-fibres surrounding the ureter and wall of the bladder which act as a sphincter, and if these are cut without disturbing the relations of the ureteral mouth at all, the reflux can then occur as regularly in the dog as in the rabbit.

"*However, we can scarcely fear the reflux in man, provided the intra-parietal part of the ureter has not been changed anatomically.*" But then, in the face of that statement, on the same page Guyon says:

"This possibility of reflux is a new objection to the employment of irrigations in cystitis, and is also an indication not to allow painful bladders to strive against their contents.

"With a pathologically accentuated sensibility the bladder is put in tension by very small quantities of liquid.

"The abstention from lavage, the retained catheter, and perineal and suprapubic drainage receive new justification, and physiology again asserts the preponderating rôle of the tension of the bladder."

Guyon says the reflux is brought about by a sudden early passive contraction of the bladder, occurring when very little fluid has entered the bladder; and again, if the contraction brought about by the injection of the fluid is active and total, *i. e.* involves the whole bladder, the reflux cannot occur.

The only conclusion therefore is that this precocious contraction must be a partial one in which the muscular fibres which surround the ureters in the bladder-wall have not taken part. The *ureters are probably asleep with their mouths open*, according to Guyon, and "once awakened the bladder cannot be again surprised."

When we consider that Guyon only succeeded in obtaining the reflux 5 times in 38 cases, and that then it was often only on one side; that the narcosis might have been responsible for the "drowsy condition" of the bladder-muscle and ureteral sphincters; that it occurred every time in the thin bladders of rabbits, only 5 times in 38 in the thicker bladders of dogs, and that the human bladder is considerably thicker than that of dogs; that in the numerous cases of cystitis which have been treated by irrigations we have never seen any symptoms of renal pain or infection, we are led to believe that the aforesaid experiments are inconclusive, and that the ureteral reflux does not occur in man, or even in dogs, except under peculiar and exceptional circumstances. We even wonder how Guyon and Courtade could distinguish a "passive" partial contraction of the bladder which did not involve the ureteral sphincters from an "active total contraction." The operation of dividing the sphincter of the ureter, situated as it is behind the bladder, without weakening the bladder-muscle or injuring the mucous membrane of the ureter, is probably the most delicate operation ever performed.

We can justify our practice of forced dilatation by the assertion of Lewin and Goldschmidt that when the bladder of the rabbit, even, is over-distended, it is impossible for fluids to get into the ureters. According to all these investigators, then, a small amount of fluid injected slowly may bring about ureteral reflux with fatal kidney infection, while a large amount rapidly forced in cannot enter the ureter. Accepting these assumptions, then our method of flushing bladders with copious irrigations is much less dangerous than Guyon's favorite instillations of small amounts.

When we consider, then, the great uncertainty of the existence of a ureteral reflux in man, and the very satisfactory results we have had with forced dilatation in cases of contracture of the bladder, we are constrained to think that their use is not contraindicated.

limbs, but the power of expelling urine did not return, probably from atrophy and lessened tonicity of the bladder muscle.

Systematic forcible distension of bladder with fluid was begun and given twice daily. At first it seemed that the catheter would be required to withdraw fluid, but its use was deferred, and after a few minutes, to our satisfaction, the fluid was expelled. After a few weeks of treatment the tonicity of the bladder was practically restored and the patient required no further catheterization. The following case also shows the marked benefit obtained.

Case VIII.—*Syphilis of cord, paraplegia, paralysis of bladder, catheterization, cystitis. Cure of paraplegia under iodides, but contracture of bladder with incontinence persisting. Capacity of bladder* 65 *cc. Urination every* 20 *minutes. Under forced dilatation capacity increased to* 500 *cc. and interval to* 4 *hours. Almost complete restoration of muscular power of bladder.*

R. O., age 46. Cigarmaker. Admitted Sept. 17, 1897.

Complaint. Frequent micturition, every fifteen minutes.

Past History. Gonorrhœa twice, but no bladder trouble with it. Syphilis 15 years ago. Positive history of secondaries and tertiaries. Took K. I. very irregularly for three years, after which cutaneous lesions disappeared. In 1891 pains and sores returned, and again he took treatment irregularly.

In 1895 had a stroke of paralysis. Girdle sensation around body at level of navel, left leg completely paralyzed, right only partially. Retention of urine, incontinence of fæces. After being catheterized for 2 months began to have incontinence of urine. Urine became very foul. Patient took heavy doses of K. I. and in two months power of limbs began to improve, and in 4 months he could walk fairly well. Bladder trouble did not improve, but urine continued to be voided involuntarily in small amounts, and patient has worn a rubber urinal to catch urine.

Status Præsens. Voids urine every 10–15 minutes. No pain or dysuria. Wears urinal by day. Catheterizes himself three times at night, as by so doing he does not void so frequently. After catheterization can hold urine for half an hour.

Rectum. Has fairly good control of bowel, except when fæces are very liquid.

Examination. Knee jerks increased activity, muscular power of left leg weaker than right. Prepuce, glans and skin of penis excoriated from use of urinal. Meatus small. Searcher passed easily into bladder. No stricture. No prostatic enlargement. Record shows that 40 cc. is largest amount of urine voided, and generally 20 cc. Bladder small, capacity 40 cc., walls rough, manipulation of searcher causes hemorrhage. Urine withdrawn acid and very purulent.

When forcibly distended until painful bladder holds 65 cc.; on second trial 70 cc. forced in. Distension causes hemorrhage. Two days later 120 cc. could be forced in with considerable pressure. The bladder in this case is more easily dilatable than others. Bladder is forcibly distended with fluid four times daily without catheter by hydraulic pressure. K. I., which patient has been taking regularly before entrance, is continued.

Note.—Following this treatment the improvement of bladder was marked, capacity and interval rapidly increased, and with it the patient regained more and more control over micturition.

The following table shows the rapidity of improvement:

Date.	Day of Treatment.	Capacity of Bladder. Largest amount held on forced distension.	Urine. Largest amount voided at one time.	Interval. Average time between urinations.		Remarks.—Case VIII.
				H.	Min.	
Sept. 18.....		Cu. Cm. 70	Cu Cm. 40		22	Paralysis 2 years ago. Retention of urine. Catheterization. Cystitis. Incontinence of urine. Gradually increasing contracture of bladder. Urine now voided involuntarily every twenty minutes. Forcible irrigations begun, four times daily. Thompson's fluid.
" 19.....	2	120	40		35	
" 20.....		200	100		55	Much improved.
" 22.....	5	270	100	1	45	Power of voluntary control returning.
" 24.....	7	320	100	2	00	
" 27.....	9	340	140	2	00	Voids urine more frequently at night than during the day.
" 30.....	12	435	175	2	45	Condition markedly improved. Can now hold urine often for three hours and void at pleasure. Has given up use of urinal. No more dribbling. Has not fully regained expulsive power of bladder. Has 120 cc. residual, but muscular tonus is improving daily. Patient became insubordinate and was discharged.

Feb. 3, 1898. Patient returns to genito-urinary dispensary asking to be treated. Has not been under treatment since he left hospital (several months ago). Bladder has retained its size, patient voids urine at will, no dribbling, but still has a moderate residual. Still uses catheter from habit. Urine acid, pus moderate in amount. Prostate not enlarged.

Feb. 26. Condition as in last note. Irrigation bag prescribed to irrigate bladder without catheter three times a day with boric acid solution. Instructed to discontinue catheter habit.

Feb. 28. Has discontinued catheter and finds that he can hold his urine 4 hours during day. Bladder holds about 500 cc.

Mar. 29. Patient has irrigated bladder with boric solution twice daily. Bladder holds 580 cc. During day urine is voided every 3½ hours in amounts varying from 70 to 130 cc. After voiding a residual of 100 cc. is present. Expulsive power of bladder still defective. Still walks with a limp, rectal control not perfect, still taking iodides.

Remarks.—The results obtained in this unpromising case are very satisfactory and show the improvement of muscular tonus and continence obtainable by the exercise of the muscle. The gain in capacity of bladder was also marked.

Technique of Irrigating the Bladder without Catheter. Articles Necessary.—An ordinary fountain syringe with tube about eight feet long, a conical nozzle which will fit tightly into the meatus but not injure the urethral mucous membrane, and a pole or other apparatus by which the irrigating bag may be elevated or lowered as desired. (A nail in the wall will answer the purpose.)

The patient should lie on his back on a bed or couch which is covered by an oilcloth, with a basin between his legs. The operator stands on the right side, takes the penis between thumb and finger of his left hand, the sterile nozzle in his right. The foreskin is retracted, and with the bag elevated three or four feet, the fluid is allowed to play upon glans penis and meatus. The urethra is alternately distended with fluid and emptied to clean the anterior urethra, and the nozzle is then crowded tightly into the meatus, the bag raised to an elevation of about seven feet, the penis being held just back of the corona so as not to compress the urethra, as shown in Fig. 4. Valentine's complicated nozzle and stop-cock are unnecessary.

The urethra will soon become ballooned out and for a time the fluid will be seen to stop flowing through the nozzle, but very soon the sphincters will give way and a "purling" sensation be conveyed to the hand by the fluid flowing into the bladder. After the sphincters are overcome very little pressure is required to force fluid into the bladder, and it is best to lower to a height of four and a half or five feet, as too much pressure may produce spasm of the bladder and prevent dilatation.

As the fluid flows gently into bladder the patient will soon experience a sense of fulness and then of gradually increasing pain.

In cases of contracture where systematic dilatation is to be adopted, the distension must be continued until pain is very considerable and the patient tells you he cannot "stand any more." The tube is then squeezed to cut off the flow, the nozzle withdrawn, and the fluid, which is ejected with considerable force, caught in a half-litre glass or other receptacle.

The operation is repeated until the quart of fluid has been used.

The procedure is so simple that patients soon learn to conduct their own treatment. They always become intensely interested in the progress of the dilatation and vie with each other as to the amount of fluid and urine held.*

Solutions Used.—Very bland fluids are the most satisfactory in most cases. Best of all is Thompson's fluid, which is composed of borax, glycerine, sodium chloride and water. It is the most soothing preparation for any inflamed mucous membrane that we know of. Boric acid in 2 per cent. solution is excellent.

A very good plan is to use occasionally a stronger antiseptic fluid, such as silver nitrate gr. ½ to ℥i, or bichloride of mercury 1 to 150,000 solution, up to 1 to 50,000.

When four or five irrigations are given daily it is well to use one of these once daily, followed by a weaker solution.

Silver nitrate is especially effective where an ulcerative condition of the mucous membrane exists.

Very little internal treatment is of value. Boric acid or salol in gr. v–x doses may be given if the urine is alkaline, and citrate of potassium when hyperacidity causes much burning.

The reaction of the urine in cystitis depends almost entirely on the character of bacterium present, and it is irrational to attempt to change its reaction by internal drugs.

As shown in these cases, the urine becomes acid as the bladder inflammation begins to subside.

Contracture of the Bladder. How produced.—As in inflammation elsewhere, there is at first a proliferation and infiltration of round cells, which as time goes on become more and more spindle-shaped and finally form fibrous tissue. Ulcerative areas in the mucous membrane also lead to the production of scar tissue, with its inherent tendency to contract. The inflamed mucous membrane, irritated by the presence of urine, expels it frequently; the bladder is therefore never fully distended and offers no resistance to the contraction of the scar tissue, and contracture results. In this process the blood supply of mucosa is greatly interfered with, and the mucous membrane is thrown into folds and pockets which retain the purulent exudate, thus adding to the inflammation.

The effect of forced dilatation with fluids is probably as follows:

Irritating secretions are washed away.

The individual bundles of fibrous tissue are separated or loosened, allowing increased vascularity.

Folds and pockets of mucous membrane are smoothed out. Ulcers are stretched and cracked, allowing new blood-vessels to grow out, in precisely the same way that leg ulcers are cured by scarification. The bladder muscle is exercised and the tone is improved. The mucous membrane cleaned, stretched, and with increased vascularity, is given a chance to throw off the inflammation.

In a normal empty bladder the epithelium is several layers thick, but when fully distended is said to be only one layer thick. Dilatation of an inflamed bladder therefore gives the antiseptic fluids a better chance to reach the disease.

Conclusions.

Cases II, V, VI, and VIII may be taken as examples of what can be accomplished toward dilating a contracted bladder and restoring the normal frequency and power of urination. The improvement in case V is really wonderful.

A review of these cases shows:

That it is possible to restore the capacity of a bladder contracted by chronic inflammation of the worst character, by systematic distension by hydraulic pressure.

That such dilatation has a most beneficial effect on the vesical inflammation and muscular tonicity.

That the number of urinations daily may thus be greatly diminished.

That no ill effects are produced by considerable hydraulic pressure, and there is no danger of infecting the kidney.

One of the most striking features of the treatment is the rapidity with which patients improve. Pain present for years may disappear in a few days, pus and mucus diminish markedly, and strongly ammoniacal urine become acid in a short time.

* Up to a few months ago there was scarcely anything on the possibility of irrigating the bladder without catheter in American literature, but since the popularization of the so-called Janet method of treating gonorrhœa, it has been very widely employed. Janet deserves credit for the energetic way in which he has lauded the virtues of copious irrigations of dilute antiseptics, but the only originality is in the substitution of permanganate for bichloride in Dr. Halsted's method.

EQUIPMENT FOR IRRIGATIONS AT THE GENITO-URINARY DISPENSARY OF THE JOHNS HOPKINS HOSPITAL.

1. Bottles containing stock solutions of Bichloride of Mercury, Silver Nitrate, Boric Acid and Thompson's Fluid.
2. Copper reservoir of sterile water kept at proper temperature by a Bunsen burner.
3. Printed formulæ for making up various irrigations.
4. Irrigators suspended from pulleys, 13 feet above the floor, the right hand for anterior urethral and the left hand for intravesical irrigations.
5. Halsted's table for Genito-Urinary work.

METHOD OF HOLDING PENIS AND NOZZLE FOR BLADDER IRRIGATIONS.

The tube passes between thumb and forefinger so the flow can be regulated at will. The nozzle is held firmly with the other fingers.

And yet a late text-book on genito-urinary diseases says as follows:

"The theory that the capacity of an inflamed bladder can be increased by dilatation is contrary to physiology and anatomy. To attempt by forced injections to relieve frequent micturition cannot be too strongly condemned."

Discussion.

Dr. Cullen.—I have been much gratified with Dr. Young's method, and it is certainly destined to be of great service not only in the male but also in the treatment of cystitis in women. Last summer we had quite a number of cases showing varying degrees of vesical inflammation, and I had the opportunity of testing the efficacy of the treatment as outlined by Dr. Young. In all, with the exception of one case, much improvement followed, and subsequent examination proved that this patient was suffering from tuberculosis of the bladder, as demonstrated by sections of the bladder wall. One marked case is especially worthy of mention.

A patient (Gynecological No. 5351) was admitted to the Johns Hopkins Hospital on June 25th, 1897, complaining of frequent and painful micturition. Eight years ago she gave indefinite signs of renal colic, and the urine contained blood for two months, since which time the urine has been blood-tinged on an average every three months for 3 or 4 days, and during the greater part of the eight years micturition has been frequent and painful.

On admission the patient micturates very frequently, at times every few minutes, and has to rise eight or more times during the night, often so frequently that she no sooner gets to sleep than the desire to micturate wakes her up. The pain is most severe after the bladder is empty, and she feels as if the viscus contains a stone.

Examination under ether, June 26th. The urethra easily admits a No. 11 cystoscope. The base and the anterior surface of the bladder are red, injected and covered by whitish yellow patches which on removal are found to be composed of mucus and calcareous particles. On examining more closely these areas are found to be covered with ulcerations, and the calcareous particles occupy the centres of the excavations. The lateral bladder walls are normal, and bimanual palpation fails to reveal any calculus.

The patient was treated by irrigations with HCl, to dissolve the calcareous particles, and the hydrochloric acid was removed by washing out with boracic acid solution, and after the bladder was emptied, by the application of 10 per cent. ichthyol.

June 29th. Patient being in knee-chest position, the bladder was irrigated with 1-1000 HCl, followed by boracic acid solution and then 10 per cent. ichthyol, to ensure the widespread application of which Clark's vesical balloon was introduced. The distension caused by the rubber balloon gave great pain.

June 30th. Topical application of ichthyol to the bladder after irrigation with HCl and boracic acid solution was made.

July 2nd. Irrigation with HCl and boracic acid was repeated. The treatment is very painful, but the patient says that she already feels improvement. Frequent irrigations were employed, and on July 10th the following note was made: "All the calcareous particles have disappeared, and the mucosa, while still red and injected, has materially improved. The solution of HCl was now discontinued, and the bladder was washed out three times a week with the boracic solution, and then 10 per cent. ichthyol applied with or without the balloon."

July 16th. The posterior and anterior surfaces of the bladder are much improved, but on examination of the base just within the inner orifice of the urethra several white calcareous patches are seen. With the patient in the knee-chest posture the HCl had evidently not come in contact with those areas. After several irrigations with the patient in the dorsal position these disappeared.

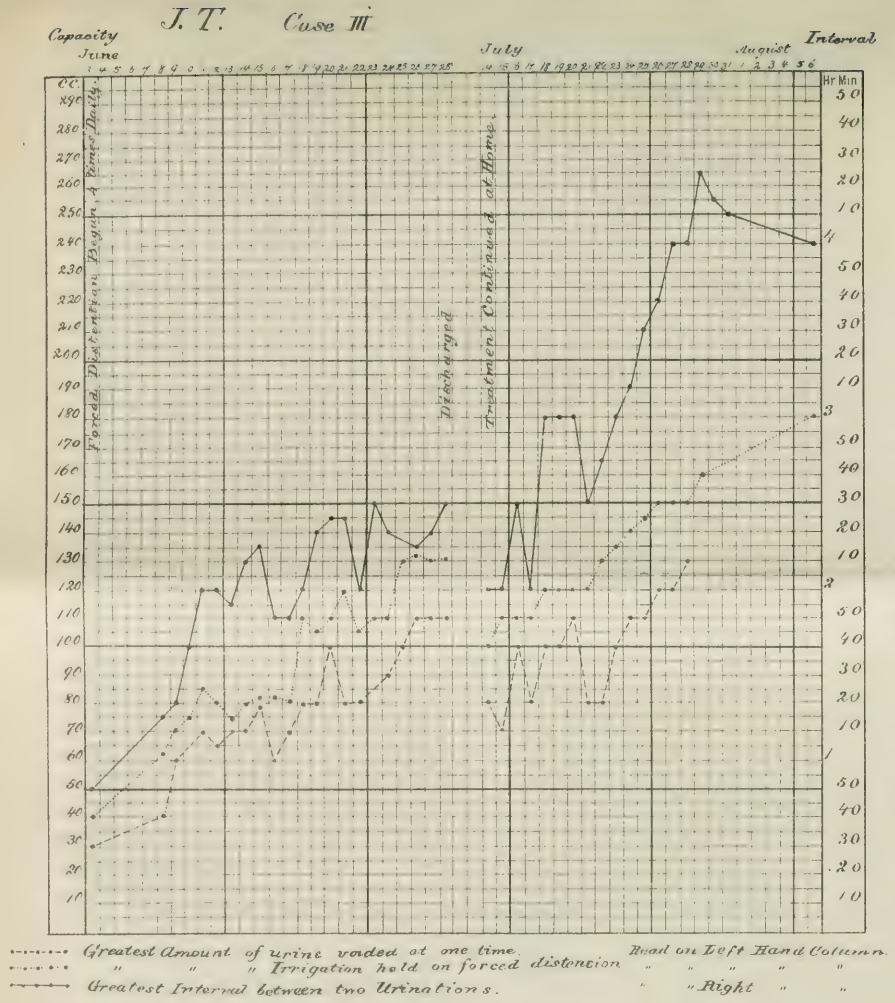
July 31st. The bladder has not been treated for eight days and a marked improvement is seen. The areas of ulceration at the trigonum are still covered by pus, which can, however, be easily removed by the applicator.

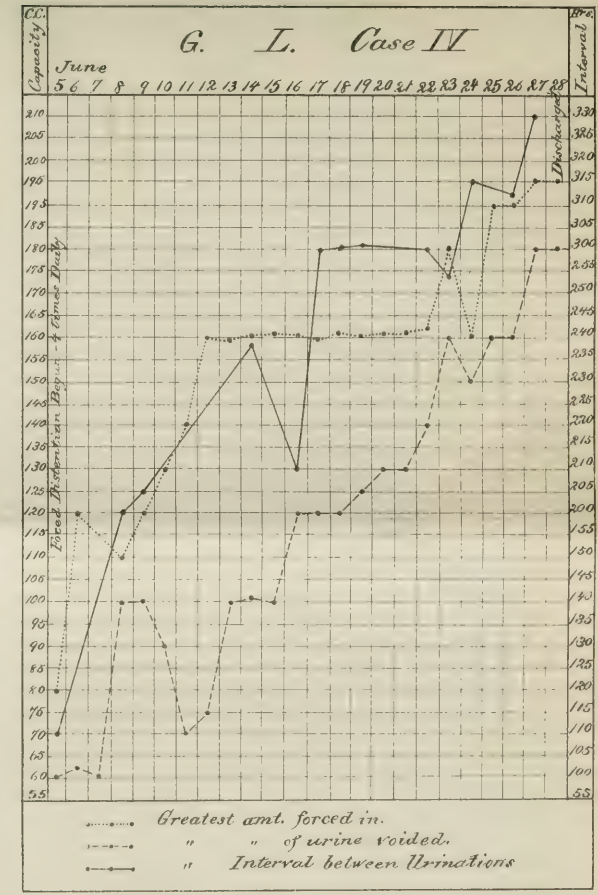
As the bladder mucosa did not assume its normal appearance as rapidly as we had hoped, dilatation of the bladder was commenced, with forced irrigations of boracic acid. The following amounts were injected each day:

August	4th,	160 cc.	August	13th,	250 cc.
"	5th,	170	"	14th,	260
"	6th,	180	"	15th,	270
"	7th,	190	"	18th,	180
"	8th,	200	"	20th,	200
"	9th,	210	"	21st,	210
"	10th,	220	"	22nd,	200
"	11th,	230	"	23rd,	250
"	12th,	240			

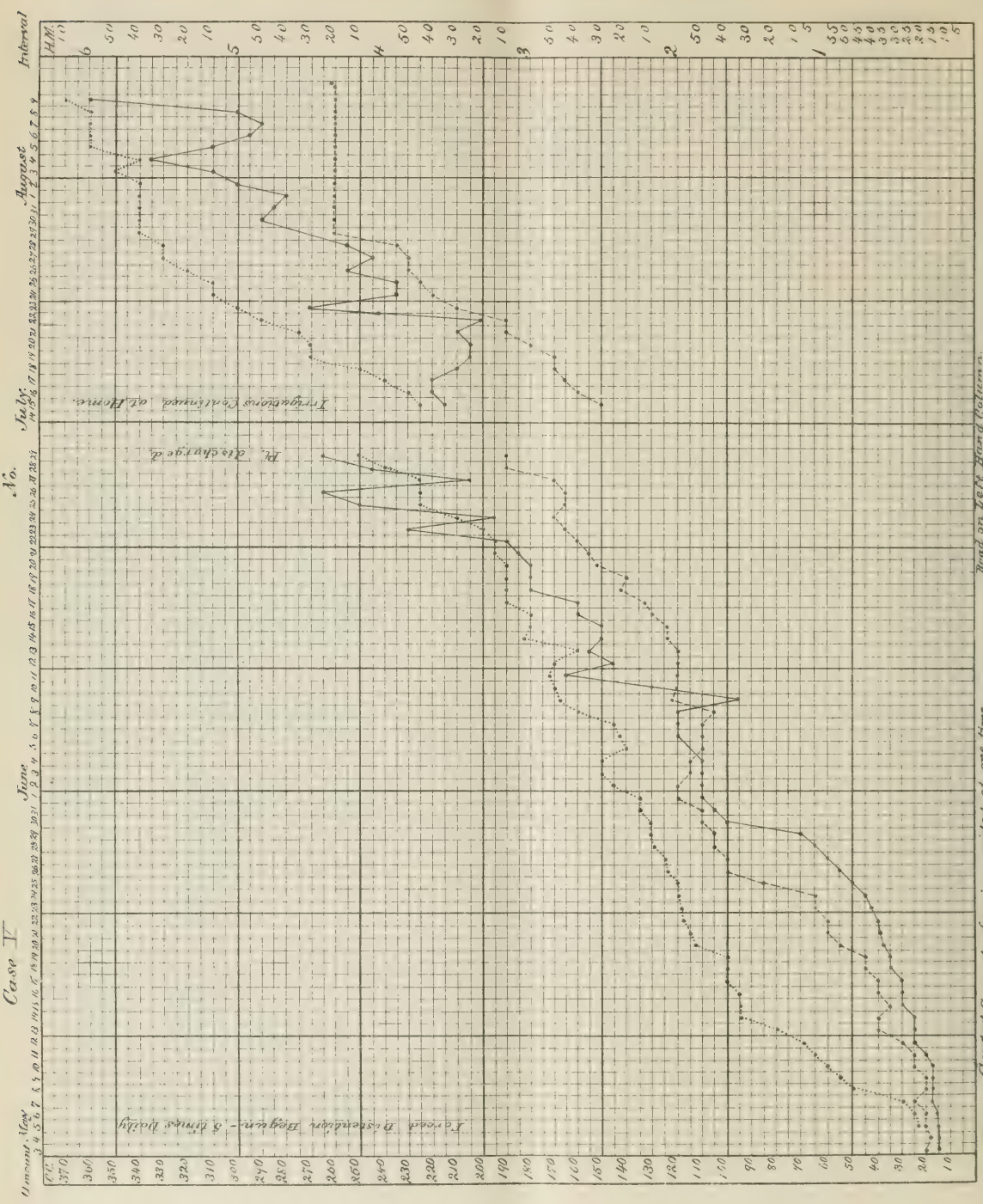
It will be seen that the dilatation was progressive up to the 15th, and then after a cessation of three days the bladder did not contain as much, but that in a very short time the maximum amount was again nearly reached. In this patient the amelioration of the symptoms was most marked. Micturition became less and less frequent, and the urine could be held from two to four hours. The pain likewise ceased, and she rose once or twice only at night.

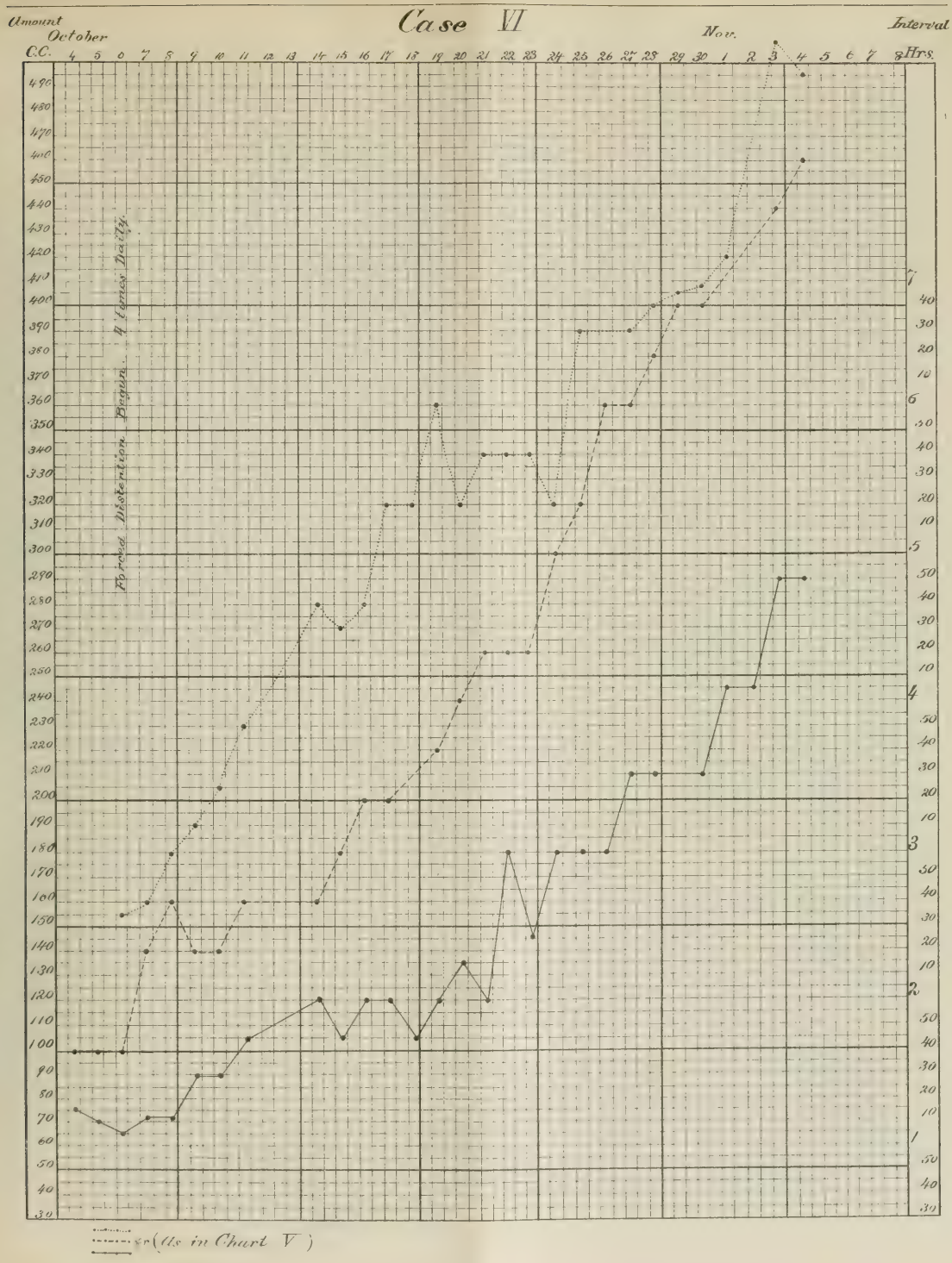
On leaving the hospital on September 8th the patient felt comparatively well and had practically no trouble with the urine. I received a letter from her three months afterward and learned that she was doing her home-work and was feeling well. (See charts of cases appended).





NOTE.—The accompanying charts show graphically the progress of some of these cases; *e. g.* in case V, on May 8, the greatest amount of urine voided at a time was 20 cc. (read on left), and the longest interval between two urinations was 15 minutes (read on right). On May 5 bladder was forcibly distended but held only 23 cc. The capacity, however, steadily increased under forced irrigations, being 50 cc. on May 8; 100 cc. on May 15, and 370 cc. August 9. The amount of urine voided, and the interval increased correspondingly from day to day: May 13, 40 cc. with 25 minutes interval; May 27, 100 cc., 1 hr. interval, and finally during August 260 cc. with interval between 5 and 6 hrs.


Case X
No.
Interval
Ounces
Temperature
Pulse
Respiration
Irrigations Continued at Home.
Discharged
Read on Left Hand Column.
Greatest Amount of urine voided at one time.
" " " Irrigation held on forced distention
Greatest Interval between two Urinations.
" " " Right " "


Case VI
Amount
October
C.C.
Nov.
Interval
Hrs.
Forced Distention Begun. 4 Times Daily.
(As in Chart V)

A CASE OF CARCINOMA METASTASES IN BONE FROM A PRIMARY TUMOR OF THE PROSTATE.

By Sydney M. Cone, M. D., *Assistant in Surgical Pathology, The Johns Hopkins University.*

Von Recklinghausen[1] writes of osteoplastic changes in bone accompanying metastases from primary carcinoma of the prostate. He compares the changes with fibrous ostitis and osteomalacia of bone, and makes many valuable additions to our knowledge of the gross and microscopic structure of bone in disease. He records five cases of his own and refers to one case of carcinoma of the prostate with subsequent metastases in the vertebræ—that of Sir Henry Thompson.[2] This case is reported in full in the Transactions of the Pathological Society of London, in 1854, Vol. V, p. 204, with a pathological report by J. Hutchinson. Saase[3] has recently reported a similar case and gives a comprehensive view of the work of Von Recklinghausen in this report.

The case I am going to report does not differ in any essentials from those previously reported, but is interesting as confirming several very important points in the pathology of bone, and discrediting the existence of primary carcinoma of the osseous system.

The patient, W. B. M., aged 75, white, was admitted to Dr. Halsted's wards in the Johns Hopkins Hospital, in September, 1895, suffering with cystitis, and was discharged October 10th, improved. He returned December 26, 1896, complaining of a painful swelling over his right tibia; he also had symptoms of cystitis with incontinence of urine. Notes made at this time by Dr. Young refer to the great enlargement of the prostate and probable existence of a tumor. Careful examination excluded the existence of tumor of any other organs. On January 5, 1897, Dr. Halsted amputated the leg and the patient made an uninterrupted recovery, returning to his home in February.

The gross appearance of the tumor of the tibia suggested to the operator carcinoma. Sections were made at once after boiling and immediate decalcification in concentrated hydrochloric acid. The appearance of these sections suggested endothelioma. Even the later results of microscopic examination showed the pictures illustrating Marckwald's[4] article on "Multiple intravascular endotheliomas in the whole bony skeleton."

Not being sure of a primary carcinoma existing in the prostate, and disbelieving the existence of primary carcinoma in bone, Marckwald's explanation seemed to be a good one. He refers, however, to the ease with which his endothelioma might be mistaken for carcinoma. Von Recklinghausen likewise mentions how readily one might mistake one of his cases for endothelioma.

When seen at his home in July the patient was very much emaciated, having lost about 30 pounds in weight. He complained of pain in his back, chest and right hip. His urinary symptoms had improved under treatment. The patient died September 12, 1897.

Autopsy. A man of large frame, very much emaciated. The stump of the right leg is covered by a pad of dense scar tissue, otherwise the leg is normal. There are no external marks to indicate tumor formation, except a few dark moles over his back and abdomen (these existed for years, according to the history). On firm palpation a nodule is felt at the right iliac crest within the pelvis. Another spindle-shaped mass can be felt over the second rib on the right side.

Examination of the abdominal viscera reveals no abnormalities except in the pelvis, where the prostate is found very much enlarged and adherent posteriorly to surrounding structures; elsewhere it is sharply circumscribed. The prostate measures 6x5x5 cm. The lateral lobes are symmetrically enlarged and measure 3 cm. in diameter. The middle lobe measures 3x1.5 cm. and seems continuous with surrounding structures.

Section of the lateral lobes shows a firm surface variable in appearance. There are bulging, gray, translucent areas and yellow, soft, expressible dots between the firmer, opaque stroma which makes up the greater mass of the gland. The middle lobe presents quite a different picture. It varies in different parts. The greater portion is soft, with a varying cut surface—yellow, soft, pus-like material being enclosed by a thin, opaque, fibrous stroma. The greater portion of this soft pulpy tissue is posterior, away from the urethra, and infiltrates the surrounding structures. The tissues about the middle lobe cannot be differentiated from one another, and no distinct pelvic lymphatic glands are to be seen, all being matted in a firm fibrous mass. The glands along the vertebræ are firm but do not show metastases. The prostatic and hemorrhoidal veins are plugged with phleboliths. The seminal vesicles are enclosed in a dense fibrous tissue.

The bones which show greatest evidence of disease are the second, third and fourth lumbar vertebræ, the second rib and the ilium. The vertebræ bulge laterally and anteriorly and can be easily penetrated by a knife blade. The rib presents a symmetrical spindle-shaped enlargement, bulging for the most part into the pleural cavity. It is covered by periosteum and pleura. The pleuræ are adherent at this point. The bone is rough beneath the periosteum and can be easily penetrated. It measures at its greatest diameter 4 cm.

Section through the rib shows a stalactitic growth of bone into the pleural cavity, the plates appearing smooth and asbestos-like. The remaining bone is granular and presents no symmetry in its arrangement. Between the plates of bone is seen a soft white material in dots and fixed in a smooth, shining lining wall. There are cysts between the plates of bone just beneath the periosteum and in the granular bone. The lining wall of these cysts shows a thin, shining, smooth surface 1 to 2 mm. in thickness. About these cysts the bone in the granular areas is denser than elsewhere. The appearance of the granular bone varies in color from a reddish to a dark brown and it contains lighter white dots. The bone is very friable. The stalactitic growths seem to be directly continuous with the granular central bone and push the periosteum ahead. There is no evidence of periosteal new-bone formation in the ribs.

The node on the ilium projects 1.5 cm. and has a diameter of 2 cm. It is covered by thickened periosteum. There is a central white, softer, fibrous mass surrounded by granular bone like that in the rib. The rim of the nodule is made up of plates of bone, asbestos-like in appearance; these seem to grow from the periosteum. In this bone is seen the white tissue described in the rib.

The vertebræ show none of the flat plates of bone, but present the same granular new growth of bone seen in the rib and the ilium. There is no spongy bone with branching cancelli in any of the new growths of bone described.

An enlarged gland alongside the trachea is for the most part firm and darkly pigmented. It contains a well-circumscribed area, white in color (this proved to be carcinoma). There is a cystic dilatation at one end of the gland filled with a dark reddish fluid (this is microscopically a cyst lined by epithelial cells such as were found in the bone and prostate). One of the abdominal lymph glands attached to the vertebra is firm, whitish-gray in color and homogeneous on section.

Description of the Tumor in the Tibia.—Six cm. from the internal malleolus and on the anterior aspect of the tibia, lying under the

periosteum, is a bulging tumor measuring 4 cm. in diameter. The shaft of the bone beneath the bulging mass is eroded, and the tumor seems continuous with a mass filling the medullary cavity. This medullary mass is an irregular mixture of bony spicules, hemorrhagic soft tissue, dark brown, soft, friable tissue with a sprinkling of gray, pin-head-sized areas throughout. This tissue fades into a more homogeneous, gelatinous, gray substance with intervening cancelli of bone, as it approaches the periosteum. The cortex is destroyed and the new growth spreads itself beneath the thickened periosteum, between it and the dense cortical bone, above and below the place where it has found its way out. This bone is irregularly eroded where the tumor growth appears. Perpendicular to the shaft and situated between the light soft masses are bone lamellæ, formed from the periosteum and intimately associated with it. Sections of this tissue fixed in boiling water and decalcified at once in concentrated muriatic acid, show epithelial cells forming a mosaic between the cancelli of new bone which are directly continuous with bands of connective tissue of the periosteum.

The microscopical examination of the prostate gland shows a great hyperplasia of the muscular elements in the lateral lobes and a proliferation of the glandular element. Some of the gland tubules are filled with loose masses of epithelial cells and alveoli of cells. Others are lined by one and two layers of cuboidal cells with a deeply stained round nucleus at the base. There is a clear refractive space or several refractile globules next the lumen. In the middle lobe all of the spaces are filled with cells in various stages of degeneration. Very few normal tubules are to be seen. Some few spaces are paved as if by a mosaic. There are few real tubules—it resembles more a meshwork of fibrous structure in which the tissue has condensed about large polygonal fenestræ, most of which are full of cells, loose and in tubular arrangement. These spaces are uniform in size, being about the size of an air vesicle of the lung; they are bounded by a condensation of the fibrous and muscular tissue of the prostate. Some of the spaces communicate with one another and give the appearance of a breaking-down of tissue by masses of cells which seem to invade the tissues at these parts.

In describing the microscopic appearance of the tumor as it appears in the prostate, bones and bronchial lymph gland, there are so many points in common that one description will suffice. Two appearances are presented by the tumor—first, a tubular adenomatous growth, cystic in places; second, a conglomerate mass of cells which have lost their arrangement in tubules. This latter gives the impression of round cell infiltration or lymphoid nodules—the cells having lost their cylindrical or cuboidal shape and the nuclei staining quite deeply and appearing homogeneous. At the outskirts of these masses there may be seen the type of cell lining the alveoli and cysts. The tubular form of the tumor is best demonstrated in the bones and the bronchial lymph gland, but can also be seen in the blood-vessels of the prostatic plexus and in the primary tumor. There is very little stroma between the tubules; the lumina are seldom seen patulous, for the cells project into them, cylindrical in shape, meeting one another in the middle line. The nuclei are situated at the base of the cells and are perfectly round, deeply staining and homogeneous in character. It is this situation of the nuclei which aids one in distinguishing the lumen from the delicate stroma which may be wanting. The character of the cells is that of the cell lining the prostate gland tubules, only they vary in shape as already stated. Another characteristic is the vacuolization and division of the clear zone situated toward the lumen into small clear spherical globules. These are sometimes so uniform in size as to give the appearance of "shadows" of red blood corpuscles filling dilated alveoli. It may be stated here that some of the alveoli are seen filled with red blood cells, causing a close resemblance to endothelioma.

As to the individual sections it may be stated that the bladder wall shows evidence of chronic inflammation, its walls being infiltrated with round cells and showing connective tissue increase; there is no carcinoma in its walls. In the tissue posterior to the prostate is a tumor filling the blood-vessels and invading the structures surrounding them. The lymph glands show connective tissue growth, but no tumor in them. One of the largest vessels filled with the cells shows a peripheral mass of cells in tubular arrangement lining the vessel wall; toward the central lumen and surrounding a blood clot are numerous cells, massed in such numbers as to give the appearance of round cell infiltration. In none of these sections are polymorphonuclears present. A gland attached to the vertebra shows a marked proliferation of its endothelium and formation of fibrous tissue along the lymph spaces; there is no evidence of metastases here. The gland next the bifurcation of the trachea shows a branching network of tubules, lined by cuboidal and cylindrical cells, through a blood clot. Blood pigment is situated in the dense connective tissue about the gland. A cyst has formed at one end of the gland and is lined by cylindrical epithelium one layer deep; it resembles the cysts in the bones.

For histological study the new-formed bone about the cysts in the rib is most interesting. The lining is of cylindrical cells on a thin fibrous tissue in which are scattered little areas of cells arranged in alveoli. The alveoli are more or less dilated in various stages of cyst formation. This same appearance is presented among the cancelli of new bone branching about the outer wall of the cyst. In fact, wherever there are new bone cancelli one sees tumor formation. The cells in these tubules come in contact with the bone—in places grooving the same. Commonly there is a fibrous tissue intervening between tubules and bone cancelli, and osteoclasts fill the grooves in the bone. The spaces between the cancelli, when not containing epithelial masses, are filled with a vascular connective tissue. The nodule in the ilium, besides showing the appearances of a tumor in the bone just described, presents a cartilaginous nodule in the midst of denser new bone formation. Even the dense bone contains tumor cells. In the cysts of this section is seen a homogeneous substance deeply stained with eosin and resembling colloid. The usual contents of the dilated tubules are granular with desquamated cells.

The section of the vertebra presents dense new bone, poorly staining granular bone and free trabeculæ in the midst of tubules of epithelial cells. Microscopic examination of the bone removed at the first operation shows a new growth of bone from the periosteum; in the medulla there is evidence of necrosis of the old trabeculæ of the tibia, fragments lying free in the midst of the tumor and refusing to stain. Tubules of epithelial cells lie between the periosteal new-formed trabeculæ.

Some of the observations of Von Recklinghausen which we were able to note in our case are of great interest. He mentions the order in which carcinoma metastases occur in bones as: vertebræ, femora and pelvis, ribs and sternum, humerus, flat bones of the skull, fibula, tibia, radius and ulna. Many interesting observations are made in the different cases described by him which make it seem valuable to mention his individual cases.

Case 1. The first case was in a man aged 75, who entered the hospital because of a large hard tumor of the right forehead; it projected 15 mm. from the bone, and was not adherent to the skin.

The operation consisted in shelling out the tumor, which was easily done, even though it extended to the dura mater. The tissue of the tumor was reddish-white, and was typically alveolar, being made up of hollow tubules and cysts lined by cubical or low cylindrical epithelium.

"A marked vascular connective tissue with alveoli of the

size and form found in the thyroid gland led to the diagnosis carcinoma and to suggest the primary lesion in the thyroid, like in a case described by Cohnheim." The ribs and bones of the skull at their points of thickening were no more easily injured than other bones, yet on the interior of them were found white prominences which proved to be carcinoma. At the trigone of the bladder was seen a flat elevation, made up of separate white pea-sized elevations covered by mucous membrane. The prostate was three times its normal size and surrounded by a bean-shaped connective tissue mass filled with carcinoma nodules.

New bone cancelli of finished or unfinished bone were found not only in the osteophytes outside the bone but also within the medullary spaces of the diploë and spongiosa. Some of these were old decalcified bone, others were new formed. (His methods for determining these points are contained in the same article.) The microscope shows the spicules in the frontal bone tumor to be a new formation and not old decalcified bone. There was great spindle-cell hyperplasia in the spaces of the new bone. Sharply bound cell-nests were held in real alveoli of the poorly fibrous and feebly cellular marrow tissue.

"The new bone formed plates about scattered carcinoma areas, not only as an evidence of reactive irritation at its border, like chains of outposts (guards) formed by the old tissue in the manner of an inflammatory proliferation against an invading enemy, but also as an integral part of the bone tumor even though it was a carcinoma."

In spite of the great ossification and absence of degeneration it was a case of multiple bone carcinoma arising from the prostate as the primary seat of the tumor. The reason for this was that all the tumors contained the type of epithelial cell found in the prostate, and especially because the lymph gland metastases followed the route which the "materia peccans" took from the prostate. It was carried by the blood to the bones alone. There would have been no examination of the other bones had it not been for the peculiarity of the tumor in the frontal bone.

Case 2. A man aged 77 years.

There were small nodules at the neck of the bladder. The prostate was hard. The lymph glands in the lumbar region were hard and contained a milky sap. Those about the jugular vein acted likewise. A cheesy gland was found at the base of the tongue. A string of lymph glands was on the left side of the prostate. A milky juice (carcinomatous) was expressed from the left lobe of the prostate, otherwise there was no degeneration or discoloration. Microscopically it resembled the first case. It was generalized in bone, but not in the soft parts. "On palpating the smooth surface of the tumors in bone one got the sensation of rubbing a file covered by a cloth." Most of the tumors were covered by periosteum. A strong needle pierced the tumor but could not penetrate the surrounding bone. The impression was made that the tumor sprung from the medulla and became secondarily subperiosteal. The axial portions of the spongy bones were the parts mostly involved. The external tumors preferred the rough places on the bones, *i. e.* "where largest vessels came to the surface." One could have thought of osteoma were it not for the microscopic examination. In all spaces, even in the densest bone, were strings and alveoli of cells in mosaic arrangement as in Case 1.

In connection with this case the following points were noted: There were not two distinct diseases growing side by side, but the carcinoma caused the secondary hyperplastic ostitis by the active congestion awakened by its presence. Bone formation was evidenced by these facts:

1. Nuclei of spongy bone with the beginning tumor formation were present; 2. sclerosis and eburnation of the axial spongiosa existed; 3. the ribs and vertebræ showed thickening within the affected areas; 4. the cancelli took up new arrangements, forming stars and appearing as radii in the callus; 5. the osteophytic growths like those seen in spina ventosa.

Case 3. A man, aged 72. Primary carcinoma in the prostate, secondary to the glands along the vertebral column, lungs and bones.

There were white areas in both lobes of the prostate and infiltration of the walls of the seminal vesicles. The areas in the bones appeared white and yellowish-white, and owing to the ill-defined boundaries gave the impression of an "infiltrating growth." Osteosclerosis and osteoporosis went hand in hand. Besides the femora, humeri, iliac bones and vertebræ, the spine of the scapula was also involved. The microscopic appearances were the same as in the other cases. In the lymph glands it was not easy to show alveolar and tubular arrangement of the cells on account of the poor connective tissue framework; one might have diagnosed sarcoma from these sections. "The lung metastases were due to retrograde transport from the bronchial glands."

Case 4. A man, aged 76. Carcinoma of the prostate with metastases to the pelvis, vertebræ, ribs and femora, and doubtful carcinoma of the abdominal lymph glands. The prostate tumor measured 55x30 mm. and resembled a venous angioma.

Case 5. A man, aged 74. Carcinoma of the prostate with regionary metastases to the ureter, bladder and glands; miliary carcinoma of the serous membranes; osteoplastic carcinosis. There was considerable infiltration of the tissues of the pelvis. The prostate was atrophic, measuring 35x20 mm., was hard and white and smooth on section. The glands in the axilla were involved.

Case 6. A skeleton preserved in the museum and described by Lobstein. The conclusion is drawn that it was a case of carcinomatous ostitis probably arising from a primary tumor in the prostate. The conclusion was made from the appearance and location of the osteophytes and endosteal bone formation, together with certain points made by Lobstein from the fresh specimen.

Some of the points peculiar to bone carcinomas obtained from the above cases were summarized under four heads:

1. These were infiltrating in character and because of this resembled inflammatory changes. Because of the diffuse growth the term carcinomatous ostitis was justified.

2. The new bone formation was prominent, the destructive character of the tumor was in the background.

3. The exostoses were seen at the exit of the vessels, while in osteomalacia the ligaments and muscle attachments were preferred.

4. The beginning of the carcinoma was within the bone and broke through from the medulla.

Comparing the changes in this series of cases with those in metastases following carcinoma of the breast, the author mentioned that the contour of the metastases in the latter is usually sharp, but when they become infiltrating, osteoplastic changes occur. Prostatic carcinoma will probably be found to be the cause of general bone carcinosis as often in man as is the mammary carcinoma its origin in women.

It is hard to make out carcinoma in the prostate with the naked eye; the tissue does not degenerate much.

Sir Henry Thompson's case was a man aged 60. The prostate gland was involved in a growth about the size of an orange; some of the adjacent glands were also infiltrated. There were "encephaloid" growths along the lower dorsal vertebræ.

Hutchinson's report on the case is quite full. He refers to the soft creamy material infiltrating the prostatic tissue. A lymph gland on the posterior surface of the bladder presented on section the same creamy material which showed microscopically the same appearance as that from the prostate. In the spinal canal attached to the lamina of a lumbar vertebra was a mass the size of a filbert enclosed in a dense fibrous envelope. This tumor presented the same appearance as the lymph gland except that "it was less succulent." The involvement of the bones seems to differ from the cases described by Von Recklinghausen in not being infiltrating in character. Saase before giving his case discusses the origin of carcinoma in bone; he quotes Von Recklinghausen's work at some length.

The case reported was a man aged 61 years. The diagnosis was not made during his life. The prostate was twice its normal size; pressure expressed a grayish white sap from its cut surface. One of the lymph glands of the pelvis showed metastases; these were located in the hilus, none were in the cortex. The vertebræ cut with ease; the femora were sclerosed in part and were spongy and friable in the lower half. The microscope showed between cancelli of bone cylindrical cells pressed together. No stroma was visible, it being substituted by cancelli and plates of new bone. He differs with Von Recklinghausen, who thinks the origin of the bone tumors to be only from the marrow. The route of the metastases suggested a vascular origin of the tumor, *i. e.* that it was an endothelioma or that the primary tumor was sarcoma.

Von Recklinghausen points out the fact that the tumors of the prostate very readily get into the blood-vessels and spread in this way. Cohnheim[3] made similar observations on tumors of the thyroid (Virch. Arch., No. 68), and two years later (1878) Winiwarter made the statement, "the breaking of carcinomas directly into the veins is more common in thyroid carcinomas than any others. Very often a general infection occurs without intermediate lymph gland involvement. It reminds one more of a general development of sarcoma." Middledorpf,[10] in writing of the bone metastases from thyroid carcinomas, refers to Von Eiselsberg's work and corroborates Cohnheim's view that the tumor grows directly into the veins of the thyroid.

Those who believe in endothelioma in bone have no difficulty in explaining the fact that the bones are involved without a necessary involvement of the lymph glands. Some go so far as to oppose the diagnosis of carcinoma in cases set down as such long ago by such men as Von Recklinghausen. Runge's[5] case, reported in Virch. Arch., No. 66, is a notable example of this fact. It involved the atlas and axis of the spinal column and was diagnosed by Von Recklinghausen as carcinoma. Driessen[6] (Ziegler's Beiträge, Vol. XII, 1893) calls this an endothelioma. He gives a fair exposé of both sides of the subject and reports a number of adenomatous-looking growths of the bones which are endothelial in origin.

The case reported by Marckwald[4] as multiple endothelioma in many of the bones shows numerous points of resemblance to the carcinomas described. The nodules are soft, brown, spherical and seem to originate in the medullary canal and pierce the bone, pushing the periosteum ahead. New bone cancelli are formed in the outgrowths. There is also a dense new bone formation in the medulla and periosteum. There are regular rows of cells, rich in protoplasm and with a large round nucleus. There is little stroma and the whole suggests carcinoma. Red blood corpuscles fill spaces between the epithelium, and these spaces widen greatly in places. Some of the cells are cylindrical and show a broad protoplasmic border next to the lumen. There is no degeneration to be seen. The greatest involvement is in the vertebræ, sternum, ribs and pelvic bones; the skull is also involved. Marchand[11] reports a case of cylindroma of the antrum of Highmore. In this case the lymph glands too were involved. The tumor resembled "the so-called bone carcinomas."

Against the endothelioma idea may be stated the fact that frequently small non-suspected primary foci of carcinoma have been found where least suspected. See for instance Cohnheim's case of goitre giving metastases, and Von Recklinghausen's remarks on the small size of the tumors of the prostate which can give metastases. Geissler[7] cites a case of carcinoma of the scapula excised for a primary bone sarcoma, whereas the autopsy revealed a carcinoma of the bladder, the primary growth.

If one were to depend on the shape of the cell and character of its nucleus in differentiating an endothelial growth from one of epithelial origin it is easily conceivable that he could readily err. Hansemann[8] states that the endothelium in ordinary proliferation looks like epithelium. It becomes cubical and cylindrical and may not have intercellular substance. He can well understand the difficulty Volkmann might have in convincing those not disposed to believe his views about endothelioma, yet he agrees with him. One need only see the diagrams of the capillaries of the uterus of the bat pictured in Böhm and Davidoff's histology to see how confusing this distinction between endothelium and epithelium may become. Orth in his Pathologisch-Anatomische Diagnostik states that by increase in size a hyaline swelling of the endothelium of the greatly multiplied vessels may there appear gland-like canals. These appear in sections as if cut in various positions, causing it to resemble gland very closely.

The literature on the subject of endothelioma is too extensive to bring into the bounds of this paper. The work on the tumors of the parotid promises the best field for clearing up this subject.

This case and those referred to lead us to make the following conclusions:

1. Tumors like carcinoma in bone, without an evident primary focus, must lead one to suspect prostate or thyroid.
2. Endothelioma and carcinoma are not readily distinguished from one another.
3. Statical and traumatic influences are potent in locating the metastases.
4. The new bone formation and location of the metastases are significant of carcinoma of the prostate.
5. The metastases occur by the veins.
6. The organs are rarely the seat of metastases.
7. The pelvic lymph glands may not be involved.
8. Very small nodules of carcinoma may give rise to extensive metastases.
9. There is an extensive new bone formation (osteoplastic carcinosis).

It is due to the kindness of Dr. Branham that we were enabled to get an autopsy and thus prove the origin of the disease. I wish to thank Dr. Livingood for performing the autopsy at the patient's home.

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Description of the Diagrams.

I. Periosteal new bone with thickened periosteum and tumor.
a, thickened periosteum.
b, carcinoma in the periosteum.
c, new formed bone cancelli of periosteal origin.
d, carcinoma between new formed bone cancelli.
e, degenerated carcinomatous area.
f, a blood-vessel.
II. From the medullary cavity of bone.
a, red blood corpuscles filling a dilated alveolus.
b, new formed bone.
c, tumor showing cuboidal and cylindrical cells and cystic dilatation of alveoli.
d, degenerated centre of a carcinomatous area.
e, fibrous tissue between the bone cancelli.

GLOSSITIS IN TYPHOID FEVER, WITH REPORT OF A CASE.

By Thomas McCrae, M. B., *Assistant Resident Physician, The Johns Hopkins Hospital.*

The cases of the occurrence of this complication in typhoid fever reported in the literature appear to be very few, the condition itself being a comparatively rare one. In over 700 cases of typhoid fever treated in the Johns Hopkins Hospital this is the first time that this condition has been found. In the case to be reported it is of especial interest, in that it occurred during convalescence from the original attack and ushered in a relapse.

There are numerous references by the older writers to the association of glossitis with the eruptive fevers. Thus, Kerr, writing on glossitis in a Cyclopedia of Practical Medicine published in London in 1833, speaks of "tumefied states of the tongue which occur in typhoid and various fevers attended with an atonic condition of the system." There are numerous references to glossitis coming on during the course of or in convalescence from acute febrile diseases. Clark in his work on the tongue says, "Indeed, slight attacks of intercurrent glossitis are not infrequent in the course of eruptive fevers." But neither he nor Butlin in his "Diseases of the Tongue" refers to any instance in which it occurred with typhoid fever. No reference to the association of the two was to be found in any of the text-books of medicine. Hoffmann in his book on the pathological conditions in typhoid fever does not speak of it. Sorel[1] in his statistics of 871 cases does not report its occurrence, nor Freundlich in a statistical report of cases in Freiburg. Renou[2] and Gallety-Bosviel,[3] in special articles on the tongue and mouth in typhoid fever, do not mention glossitis. The reports of Berg,[4] Jenner[5] and Studer,[6] embracing the reports of the examinations of 1984 cases, do not speak of it. Holscher,[7] in the statistics of 2000 cases, speaks of "purulent infiltration" of the tongue in three cases, while Dopfer[8] in 927 cases found the same condition in two cases.

Nichols[9] has reported a case of "septic infection in typhoid fever" in which two days before death swelling of the right half of the tongue was noted. The case came to autopsy and the tongue was found red, swollen and glazed in its right half. On section it showed hæmorrhages and small abscesses. Cultures yielded streptococci, staphylococci and the colon bacillus. This may perhaps be the same condition as Holscher and Dopfer have spoken of as "purulent infiltration" of the tongue.

The case reported is from Dr. Osler's clinic in the Johns Hopkins Hospital:

W. U., aged 27, white, dredger. Admitted on November 27, 1897, with a mild attack of typhoid fever. The previous history was unimportant. The attack was quite characteris-

tic—fever, rose spots, enlarged spleen and the Widal reaction all being present. The temperature fell to normal on the 16th day and he made an uninterrupted recovery. He was discharged on December 31, 1897, on the 37th day of his disease, and after 22 days of normal temperature. He seemed perfectly well on discharge.

On January 3, 1898, the fourth day after leaving the hospital, he was re-admitted, complaining of pain in the throat with soreness and swelling of the tongue. He gave a history of having felt well until January 2nd, when he had a chill, soon followed by pain in the head and throat. Swelling of the tongue and behind the jaw accompanied by pain on swallowing also came on. There was no history of the taking of mercury or the application of any irritant. His condition rapidly grew worse until his admission.

On admission—temperature 104.2°, pulse 100, face flushed, the neck full and swollen at the angles of the jaws. The mouth presented a striking picture. The tongue was much swollen, protruding between the teeth and preventing the closing of the mouth. There was a profuse constant flow of saliva. The tongue was red, inflamed, symmetrically enlarged, markedly tender and somewhat indurated as far back as could be felt. No spot of softening could be found. The throat could not be seen. Swallowing was difficult. Cultures were taken from the left half of the tongue by Dr. Gwyn. Bleeding followed the punctures. On the following day the swelling was less and the left half was rather smaller than the right, due probably to the bleeding following the punctures. Two days later there was less swelling, less pain and the mouth could be closed. Three days later the tongue was practically normal.

The temperature, which on admission was 104.2°, fell to normal on the day after admission and then rose gradually each day until it reached 104° on January 7th. With this he had a typical relapse, with continued fever, rose spots and enlarged spleen. This lasted for about two weeks and was mild throughout. The temperature fell to normal on the 16th day of the relapse and he was discharged well on January 26th. The cultures from the tongue were negative.

In this case after 24 days of normal temperature the glossitis seemed to be the first symptom of the relapse. The relapse itself was mild save for the severe onset, and as soon as the swelling subsided the patient had no further trouble in swallowing or distress of any kind. The diminution of the swelling in the left half of the tongue after the blood removed in taking the cultures supports the value of the treatment advised in severe cases, namely, free incisions into the substance of the tongue.

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PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of February 21, 1898.

The meeting was called to order by the President, Dr. Barker.

The Bacteriology of Yellow Fever.—Dr. Geo. M. Sternberg, of Washington.

[Dr. Sternberg gave an interesting review of his bacteriological studies in yellow fever and illustrated his remarks by many excellent lantern slides. As the address was unwritten we regret that it cannot be reproduced.—Editor.]

Discussion.

Dr. Welch.—Dr. Sternberg has presented to us in a most interesting way the history and present status of the bacteriology of yellow fever. Incidentally he spoke of his observation that organs taken fresh from the body and at once wrapped in cloths soaked with sublimate solution frequently show within forty-eight hours development of bacteria in their interior. This is in accordance with our experience. Several years ago Dr. C. O. Miller in my laboratory removed with antiseptic precautions from recently killed animals the liver, spleen, kidneys and other organs and threw them entire into solutions of sublimate as strong as 1 to 500. Often bacteria developed in the interior of these organs, especially often in the liver.

Dr. Sternberg's bacteriological studies of yellow fever are generally recognized as most trustworthy. He successfully disproved the claims of the numerous alleged discoverers of the specific organism of this disease. Dr. Sternberg's attitude of caution as to the acceptance of Sanarelli's bacillus icteroides as the causative agent of yellow fever seems to me entirely warranted in the present state of the evidence. It may be demonstrated that this bacillus is the cause of the disease, but the matter is still open to debate. Weak points in the evidence thus far are the small number of cases of yellow fever examined by Sanarelli and the failure to demonstrate his bacillus in nearly half of his cases. His explanation of this failure does not seem to me entirely satisfactory. The results of inoculation of animals by this bacillus are regarded by Sanarelli as a main support of his conclusions, but suggestive and striking as these results are they do not suffice to warrant the statement that yellow fever has been produced experimentally by

inoculation of Sanarelli's bacillus. The remarkable necroses of the liver, of which Dr. Sternberg has shown photographs, may be caused by inoculation with many kinds of bacteria as well as by various toxins.

Probably the strongest argument at present in support of Sanarelli's bacillus as the cause of yellow fever is its agglutination by the blood of yellow fever patients, but here also further observations are needed.

Dr. Booker.—The interesting review Dr. Sternberg has given us of his work on yellow fever is a pleasant reminder to me of the time we worked together, in the pathological laboratory of this institution, upon our respective investigations on yellow fever and the summer diarrhœas of infants. Some of the illustrations Dr. Sternberg has exhibited to-night are familiar objects in my work, and it is interesting to note the points of resemblance of some of the toxic lesions and the bacteria found in the two diseases. His picture of the kidney might well be used to represent the condition of this organ in fatal cases of summer diarrhœa. Degeneration of tubular epithelium occurred in nearly all of my cases, and hyaline tube casts were found in the tubules in many cases. The form of degeneration he has represented for the liver in yellow fever I have not seen, but other kinds of degeneration of the liver are often found in fatal cases of summer diarrhœa. We frequently made comparison of the bacteria isolated from our cases, and among other bacteria which showed resemblance was a strongly pathogenic bacillus isolated by Dr. Sternberg from yellow fever patients in Decatur, and, at first, thought to be of considerable importance, which proved to be identical with bacillus *a* of my series. It is a liquefying bacillus, and causes diarrhœa convulsions, and death when injected subcutaneously in rabbits. When the identity of the two organisms was established Dr. Sternberg abandoned its study, and soon afterwards became interested in bacillus *x*, which he has just described to us, and which did not resemble any of the bacteria found in my cases.

Although Dr. Sternberg removed from the laboratory before the study of this organism was completed, I remember that he was greatly impressed with its importance, and considered it, even then, to be highly promising.

The rosette colony which he described as a rare growth for the colon bacillus isolated from his yellow fever cases was frequently seen in the cultures of the colon bacillus isolated from the feces of infants affected with summer diarrhœa, especially when the cultures were made in old gelatine.

NOTES ON NEW BOOKS.

Diseases of the Stomach. By John C. Hemmeter, M. B., M. D., Ph. D. (*P. Blakiston, Sons & Co., Philadelphia*, 1897.)

This large volume of 788 pages is prefaced by an introductory chapter in which Prof. Da Costa is quoted as having said that "books attract books, and, as a rule, any new work in any particular class has a striking familiar resemblance to those already published." The author, in justification of the publication of this work, remarks that "if this new contribution to the pathology and treatment of organic diseases of the stomach does not conform to Da Costa's generalization, it is not because of any premeditated plan to make it different from other works on the same subject, but because a number of entirely new methods of diagnosis have entered into it, and because an attempt has been made to do justice to the work of American clinicians in this department." Attention is drawn to the extensive contributions made to our knowledge of the normal and diseased stomach and its functions by the clinicians, surgeons, pathologists, anatomists and physiologists of America.

The work of the publishers has been well executed, the paper and printing being excellent, while the figures and plates, which are quite numerous, have been well reproduced.

The subject-matter is divided into three parts, all of which are more or less closely related. In each division the various subjects are dealt with in detail.

Part I, which is subdivided into nineteen chapters, deals with the "Anatomy and Physiology of the Digestive Organs.—Methods and Technics of Diagnosis." In the chapter on the "Histology of the Stomach" extensive quotations are made from the valuable contributions of Mall and of Bensley on this subject, and two beautiful colored plates devised by Mall on the block system for showing the vascular and lymphatic supply of the various coats of the stomach are reproduced.

The originality of the author is more amply illustrated in this than in any other part of the work. Among others, reference may be made to his method of intubating the duodenum to obtain the intestinal contents; to his device for determining the capacity of the stomach by the use of a dilatable intragastric rubber bag having the general form of the stomach, the capacity being indicated by the amount of air required to distend the bag sufficiently to just fill the stomach; and finally to his method of testing the activity and character of gastric peristalsis (also by the use of an intragastric dilatable rubber bag), in which the peristaltic waves are recorded on a kymograph. Whereas these methods may, with further use, yield valuable information, they cannot be expected to come into general use and must necessarily be largely confined to ward and laboratory use.

The chapters on the chemistry of the gastric juice are concise and to the point. Whereas German text-books on diseases of the stomach usually give a greater variety of methods, here only those that have been found of most practical value are described.

In this section we find some inconsistencies in spelling, which cannot altogether be attributed to typographical errors. Thus, on page 66 and in one or two other places we find "von Mehring" instead of "von Mering," which is the usual spelling where this author's name is quoted. Another inconsistency is the manner of spelling the plural of apparatus; in some places "apparati" and in others "apparatuses" are found.

Part II, comprising nine chapters, is devoted to the "Therapy and Materia Medica of Stomach Diseases." The principles of the dietetic treatment of gastric diseases are dealt with at considerable length. A valuable chapter is devoted to the diet kitchen, and to the preparation of various articles of diet, which cannot help but be of great value to the practitioner in the dietetic treatment of gastric diseases. The therapeutic uses of electricity, mineral waters and various medicinal substances are discussed. Chapters are devoted to the various surgical operations used for the relief of the organic diseases of the stomach, and to the urine and blood in gastric affections.

Part III, subdivided into thirteen chapters, comprises a little more than one-half of the volume. It includes a very thorough consideration of the etiology, symptomatology, pathology and treatment of the various diseases to which the stomach is subject. The different forms of gastritis are described at considerable length.

The chapters on gastric ulcer, malignant growths, gastroptosis and dilatations, and gastric neuroses are deserving of special mention. In considering the diagnosis of carcinoma ventriculi considerable stress is laid on the diagnostic value of the presence of the Oppler-Boas bacillus in the stomach contents.

In some chapters the work is less systematic than is desirable. On page 530 the author proceeds to give a resumé of the diagnostic factors in carcinoma ventriculi. He divides the tumors under three headings as regards their position, viz. (1) Carcinoma of the cardia; (2) Carcinoma of the body of stomach, *i. e.* the curvatures and the fundus and walls; (3) Of the pylorus. The first two divisions are discussed at length, but one looks in vain for a separate discussion of the last division, the most important, and finds to his disappointment that it has been included under division 2.

Altogether the volume is a very creditable American production. We think that it might, with advantage, have been curtailed at certain points, and certain unnecessary repetitions might have been avoided.

The author shows that he has kept abreast with the current medical literature. The bibliography on all the subjects is very extensive, thus increasing the value of the volume as a book of reference.

Constipation in Adults and Children. By H. ILLOWAY, M. D. (*The Macmillan Company, New York*, 1897.)

This work is divided into two parts; the first consisting of 400 pages dealing with the causes and treatment of constipation in adults; the second with the same conditions in infants. Under the heading treatment, most attention is given to massage and Swedish movements, illustrated by numerous cheap cuts. The work has many pictures, but most of them are poorly reproduced and do not add essentially to its value. Much space is taken up with long histories of cases of constipation, quoted from other authors, which had better have been omitted or at least abbreviated.

The tendency throughout the work is to magnify the importance of constipation, which, after all is said, is not a disease but a symptom.

The author evidently has a "bee in his bonnet" and does not weigh fairly the difference between cause and effect. He seems to us to be continually putting the cart before the horse and thus injuring his plea. The book should be condensed to be really valuable. It is a mistake and a work of supererogation to devote so much attention to a symptom. One might with equal fairness write a book on headache or stomach-ache.

We do not intend to discuss the author's views, but differ essentially with him on many points. We cannot agree in thinking that appendicitis is frequently a result of constipation, or that torpidity of the liver results from it; after both conditions exist a vicious circle may be set up, but we believe constipation in both these instances rather the result than the cause. As to its effects on the nature and consistency of the chyme there is only doubt, nothing is actually known on this point. The author does not believe that auto-intoxication is the result of constipation, except when the latter is associated with a certain degree of diarrhœa. The question of auto-intoxication is a most obscure one as yet, but we think many of the symptoms so often associated with chronic constipation are the results of this condition and the patient may be said to suffer from auto-intoxication.

The book will prove helpful to many if they are willing to wade through it, although there is nothing new in it; but constipation is frequently a difficult condition to manage satisfactorily, and the detail of treatment herein described will be appreciated by those who have been troubled by these trying cases.

The Bulletin of the Ohio Hospital for Epileptics. (*Published by the Hospital, Gallipolis, Ohio, January*, 1898.)

The first number of this bulletin contains a report of more than ordinary interest and suggestiveness by Ohlmacher, the director of the pathological laboratory. Although divided into two parts it is practically but one paper; the first half giving the clinical histories and pathological findings of six cases of epilepsy which came to autopsy, and the second half being "Upon the resemblance of the foregoing cases of epilepsy to certain diseases associated with thymic hyperplasia."

These six cases all occurred in adults, and all but one suffered from grand mal; "in Case VI," as the author says, "the unsatisfactory evidences of the existence of epilepsy seem to be verified by the results of the autopsy." In three cases the thymus was found persistent and enlarged, in two others remnants of this gland were found, and in one only that body known as "fatty thymus," which shows no traces microscopically of a true thymus gland. In but one instance did death apparently occur suddenly. To quote again: "While the presence of a persistent or enlarged thymus gland in three of these cases must naturally be regarded as an important matter, it should be distinctly noted that the presence of the thymus gland makes but a portion of a series of anatomical findings relating to a peculiar hyperplastic condition of the lymphatic structures in the body." In four of the cases other glands such as tonsils, bronchial and mesenteric were found enlarged, in another there was carcinoma, and in that case where only the "fatty thymus" was found no enlargement of lymph glands could be demonstrated.

The importance of this paper rests on the very careful microscopical work done by the pathologist, and the attention he has drawn to the concurrent existence of epilepsy and persistent thymus. In his introduction to the second paper he says: "A study of the literature bearing upon the persistence and enlargement of the thymus gland in human adults, which was suggested by the discovery of a persistent or enlarged thymus in three out of five cases of genuine epilepsy, results in centering attention upon at least two morbid states, one of which has long been suspected to have a clinical affinity with epilepsy. In these two conditions a third disease may be added on account of the possibility of its morbid anatomical analogy with what we have found in our cases. These three conditions are: 1. Thymic asthma; 2. Sudden death in adults with persistent thymus; and 3. Exophthalmic goitre."

Whatever deductions we may feel inclined to draw from the result of this study of Ohlmacher's, we are grateful for the appearance of such a thorough piece of work and one which is a most valuable contribution to the literature on these conditions. We are still in profound darkness as to the purport of the thymus gland in the human system, or of the whole system of lymph glands, and also as to the causes of epilepsy and exophthalmic goitre. We know that the thymus usually is quite atrophied at the end of the second year of life, but that it does frequently persist and remain active, and that many cases of sudden death have occurred in adults where the only pathological (?) findings were an enlarged, active thymus, with hyperplasia of other lymph glands. The action of its secretion is not yet understood, but it is not hard to believe it possible that in adults its hyper-secretion, or hypo-secretion, or perhaps some modified secretion, may give rise to epilepsy. If such a syndrome of toxic symptoms is caused by modifications of the thyroid gland secretion as we see in exophthalmic goitre, why is it not easy to conceive of epilepsy and even sudden death occurring from changes in the secretion of the thymus? It is more difficult to explain the co-existent lymphatic hyperplasia, but enlargement of the lymph glands is frequently found as a result of toxic influences, and the constant secretion of the thymus gland in adults might readily lead to hyperplasia of the smaller lymph glands. However, it is not worth while to enter into vague speculation as to these conditions. We desire merely to draw attention to this most admirable contribution to our knowledge of the thymus, which has appeared at a most opportune time, when much more attention than formerly is devoted to the study of all the glands, and especially to the large ductless ones of the human system. There are pathologists at other epileptic and insane asylums who have abundant opportunity to investigate these points, and we hope it will not be long before we have further illumina-

tion on these obscure diseases. There are three first-rate illustrations in this article.

The hospital board of governors is to be much congratulated on having obtained the services of such an excellent pathologist as Ohlmacher, and the future bulletins of this institution will be awaited with much interest. The remaining papers in this bulletin are of lesser import, but as a first number from a but little known institution we have only words of praise for it and believe that it deserves most hearty recognition from all interested in the science of medicine.

A Text-Book of the Diseases of Women. By HENRY J. GARRIGUES, A. M., M. D., Professor of Gynecology and Obstetrics in the New York School of Clinical Medicine. Containing three hundred and thirty-five engravings and colored plates. 728 pp. Second edition. (*Philadelphia: W. B. Saunders*, 1897.)

This neatly bound and well-printed book contains a large amount of information upon diseases of women. The writer has treated the subject in a systematic manner, and his style is clear and for the most part concise. The illustrations are, as a rule, old ones, and most of the photographs among the new ones are indistinct and show little. The book was written to meet the demands of the medical student and the general practitioner of medicine. One feature of the book which will be of particular value to the medical student is the large number of methods for the surgical treatment of the different gynecological diseases. To meet the demands of the general practitioners of medicine, general treatment is dwelt upon at some length. The chapter upon Anatomy is full, while the paragraphs upon Pathology leave much to be desired. Taken as a whole the work is one of the most complete which we have seen printed in English and will, no doubt, have a large number of readers. G. B. M.

Elements of Latin. For Students of Medicine and Pharmacy. By GEORGE D. CROTHERS, A. M., M. D., Teacher of Latin and Greek in the St. Joseph (Mo.) High School, and HIRAM H. BICE, A. M., Instructor in Latin and Greek in the Boys' High School of New York City. xii-242 pp. (*The F. A. Davis Co., Publishers, Philadelphia, New York City, and Chicago, Ill.*)

This is an excellent little book for those who wish to know enough of Latin to write or to read prescriptions and to understand anatomical terms. The method employed is simple and sensible, the vocabularies are carefully selected and the arrangement of the book is good. The "Notes" seem rather far-fetched and are of doubtful utility. They are cumbered with extracts from the U. S. Dispensatory which seem to have little connection with the study of Latin and are of little utility to the student of medicine.

BOOKS RECEIVED.

The American Year-Book of Medicine and Surgery. Collected and arranged with critical editorial comments. By S. W. Abbott, M. D., *et al.* Under the general editorial charge of George M. Gould, M. D. 1898. 4to. 1077 pages. W. B. Saunders, Philadelphia.

Orthopedic Surgery. By James E. Moore, M. D. 1898. 8vo. 354 pages. W. B. Saunders, Philadelphia.

Therapy of the Clinics of the Royal and Imperial Hospital of Vienna, Austria. Translated and revised with notes from the last two compilations of Earnest Landesmann, M. D. By John H. Metzerott, M. D. 1897. 12mo. 765 pages. Fergus Printing Co., Chicago.

The Diseases of Infancy and Childhood. By L. Emmett Holt, A. M., M. D. 1898. 8vo. 1117 pages. D. Appleton & Co., New York.

Prize Essays on Leprosy. Thompson. Cantlie. 1897. 8vo. 413 pages. The New Sydenham Society.

A Guide to the Clinical Examination of the Blood for Diagnostic Purposes. By Richard C. Cabot, M. D. 1897. 8vo. 405 pages. William Wood & Co., New York.

The Medical Annual and Practitioner's Index. 1898. Sixteenth year. 12mo. 847 pages. John Wright & Co., Stone Bridge, Bristol.

Transactions of the College of Physicians of Philadelphia. Third series. Vol. 19. 1897. 8vo. 256 pages. Printed for the College, Phila.

Diseases of the Stomach. In three parts. By John C. Hemmeter, M. B., M. D., Ph. D. 1897. 8vo. 788 pages. P. Blakiston, Son & Co., Phila.

Atlas of Methods of Clinical Investigation, with an Epitome of Clinical Diagnosis and of Special Pathology and Treatment of Internal Diseases. By Dr. Christfried Jakob. Authorized translation from the German. Edited by A. A. Eshner, M. D. 1898. 12mo. 259 pages. W. B. Saunders, Phila.

The Surgical Complications and Sequels of Typhoid Fever. By William W. Keen, M. D., LL. D. Based upon tables of 1700 cases. Compiled by the author and by Thompson S. Westcott, M. D. With a chapter on the Ocular Complications of Typhoid Fever. By G. E. de Schweinitz, A. M., M. D. And as an appendix the Toner Lecture, No. V. 1898. 8vo. 386 pages. W. B. Saunders, Phila.

A Compendium of Insanity. By John B. Chapin. 1898. 12mo. 234 pages. W. B. Saunders, Phila.

Doctor and Patient: Hints to Both. By Dr. Robert Gersuny. Translated by A. S. Levetus. With a preface by D. J. Leech, M. D., F. R. C. P., etc. 1898. 12mo. 79 pages. John Wright & Co., Bristol.

Annual and Analytical Cyclopædia of Practical Medicine. By Charles E. de M. Sajous, M. D., and one hundred associate editors, assisted by corresponding editors, collaborators and correspondents. Vol. I. 1898. 4to. 601 pages. The F. A. Davis Co., Publishers. Philadelphia, New York, Chicago.

A Modern Pathological and Therapeutical Study of Rheumatism, Gout, Rheumatoid Arthritis and Allied Affections. By Edmund L. Gros, M. D., of the Faculty of Paris. (Translated from the French.) 1897. 16mo. 47 pages.

The Anatomy and Functions of the Muscles of the Hand and of the Extensor Tendons of the Thumb. By J. Francis Walsh, M. D. Essay awarded the "Boylston" prize for 1897, Department of Anatomy and Physiology, by the Boylston Medical Committee. Boston, Mass. 1897. 8vo. 51 pages. Charles H. Walsh, Philadelphia.

An American Text-Book of Genito-Urinary Diseases, Syphilis and Diseases of the Skin. Edited by L. Bolton Bangs, M. D., and W. A. Hardaway, A. M., M. D. 1898. 4to. 1229 pages. W. B. Saunders, Philadelphia.

Medical and Surgical Reports of the Boston City Hospital. Ninth Series. Edited by C. F. Folsom, M. D., W. T. Councilman, M. D., and Herbert L. Burrell, M. D. 1898. 8vo. 276 pages. Published by the Trustees, Boston.

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Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

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BULLETIN

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CONTENTS.

A MICROSCOPICAL STUDY OF THE SPINAL CORD IN TWO CASES OF POTT'S DISEASE.*

BY WILLIAM G. SPILLER, M. D., *Professor of Diseases of the Nervous System in the Philadelphia Polyclinic; Associate in the William Pepper Laboratory of Clinical Medicine, University of Pennsylvania.*

[*From the William Pepper Laboratory of Clinical Medicine.*]

We have learned much about spinal caries since Percival Pott† wrote his work on this disease so many years ago, but we have not exhausted the subject, and it is still one of much interest.

The two cases which I have the honor to present for your consideration represent two forms of the affection, an early and a late; one in which the cord has not been compressed by displaced vertebræ, and one—and rather a rare variety—in which the cord has been almost severed as the result of such displacement in connection with an extradural tuberculous abscess.

The cause of the compression is only mentioned in thirty-nine of the fifty-two cases of paralysis from spondylitis which Schmaus collected from the literature;‡ in thirty-three of these a caseous pachymeningitis was noted; in six the compression was caused by dislocation of the vertebræ, and in five of these six the odontoid process of the axis was dislocated. Therefore only in one of thirty-nine cases the compression was due to kyphotic displacement. Kraske* adds to this number and shows that only in one case out of fifty-two was the compression of the cord due to deviation of the vertebræ alone (omitting the five cases above mentioned). He tells us that only in about two per cent. of the cases the paralysis from spondylitis is caused by kyphosis alone; in all the rest it is due to compression from a peripachymeningitic exudate.

The case B. H. is, therefore, one of considerable interest, for the compression was chiefly due to displaced vertebræ, though there was also a peripachymeningitis.

The first case—for which I am indebted to Dr. Willard and Dr. Lloyd—was in a boy of about twelve years of age. Dr. Lloyd, who frequently saw the patient during his lifetime, told me that the boy had complained of great pain in the region of a cervico-thoracic kyphosis. He was not paralyzed. Before death dyspnœa became intense, and Dr. Lloyd believed

* Read by invitation before the Johns Hopkins Hospital, January 17th, 1898.

† Pott, Remarks on that kind of palsy of the lower limbs which is frequently found to accompany a curvature of the spine, etc. The Chirurgical Works of Percival Pott, F. R. S., Vol. III.

‡ Die Compression-Myelitis bei Caries der Wirbelsäule. Wiesbaden, 1890. J. F. Bergmann. Quoted by Kraske.

* Kraske, Archiv für klin. Chirurgie, Vol. XLI.

that death was due to paralysis of the respiratory muscles. This was possibly the result of intense round cell infiltration of the cord in the mid-cervical region where the phrenic nerve has its origin.

The report of the necropsy is as follows: The body was that of a much emaciated boy. Kyphosis was present without scoliosis, and the prominence was at the fifth, sixth, seventh cervical and first thoracic vertebræ, and was greatest at the junction of the seventh cervical with the first thoracic. Much pus was found within the cervical portion of the vertebral canal, external to the dura. The dura was adherent by its anterior surface to the bodies of the seventh cervical and first thoracic vertebræ, and a cheesy, fibrous mass was observed on its ventral and external surface. The bodies of the lower cervical and first thoracic vertebræ were carious and yielded to slight pressure from a blunt instrument. No tuberculous lesions were found elsewhere.

The spinal cord was not compressed and secondary degeneration was not noted. The chief interest of this case lies in the fact that it shows the earlier stages of Pott's disease—whereas the following case shows the late—and presents a very intense round cell infiltration of the meninges and cord, without specific signs of a tuberculous process interior to the dura. Such signs are, however, very abundant in the mass external to the dura. The dura has acted to some degree as a barrier, but it also shows some round cell infiltration. Along the periphery of the lateral columns in the upper thoracic region spaces are found from which the nerve fibres have disappeared, and in some sections a few swollen axis cylinders are seen. There is very distinct perivascular infiltration of round cells within the cord; this is well marked at the mid-cervical region and involves the vessels of all parts of the transverse area, and is noticed also within the anterior horns. The perivascular infiltration is especially noticeable at this level, about the vessels of the anterior fissure and posterior septum. In the posterior columns of the mid-cervical region necrotic areas are seen, which stain faintly with Weigert's hæmatoxylin solution and show a diminution in the number of nerve fibres. When the carmine and Delafield's hæmatoxylin are used, moderate round cell infiltration, some proliferation of neuroglia, and some slight swelling of the axis cylinders are noticed in these areas. This necrosis is probably dependent on the vascular condition. No other necrotic areas have been noticed within the cord. The motor cells of the mid-cervical region do not appear greatly altered, but unfortunately the method of Nissl could not be used. In the first and second cervical segments the infiltration is much less in intensity, but it is very distinct in the lumbar region, where the vessels are also much dilated.

The anterior roots in the upper thoracic region are greatly degenerated, but the posterior have partially escaped. The motor cells in this portion of the cord are distinctly altered. The Marchi stain does not reveal degenerated fibres.

In the mass external to the dura many giant cells, large collections of round and epithelioid cells, and caseous areas are found.

The second case, for which I am indebted to Dr. Willard, is as follows: The child, B. H., came of a tuberculous family and suffered from bronchitis every winter. The evidences of Pott's disease first appeared when the patient was three years of age. She complained of pain in the back, and kyphosis was soon afterward noticed. About four months after the first evidences of the disease were detected the child was found to be liable to fall without sufficient cause. A year later the tendons of both heels were operated on, a fact which shows that the disease progressed rapidly. At eight years of age prominence of the first, second and third thoracic vertebræ, atrophy of the legs with paralysis, contracture of the hamstring tendons, and large sores over the hip-joints were noticed. The child died when eight years old; the process, therefore, lasted five years. It is stated that she had had no power of motion in the legs and no control of the bladder, although rectal disturbance had not been noted.

When the vertebral column was examined at the necropsy the body of the seventh cervical vertebra was found almost at a right angle with that of the first thoracic. The latter was carious and yielded to slight pressure from a blunt instrument. Permission was not obtained to remove any of the bony part of the spinal column, and more careful examination of the vertebræ could not be made. The cord was very small in the region corresponding to the prominence made by the first thoracic with the seventh cervical vertebra, and had evidently very little space for growth. The unusual degree of compression was possibly the result of the development of the Pott's disease at the early age of three years. Segments an inch above or below the seat of compression were much larger. The compressed portion was soft and was removed with difficulty. A cheesy fibrous mass was found adherent to the external and right side of the dura, extending downward about an inch, and upward about half an inch from the compressed region, and together with the displaced vertebræ had caused the signs of compression. The dura was not adherent to the cord, and no evidence of internal meningitis was present.

Dr. Sailer examined the thoracic and abdominal viscera and found areas of pneumonic infiltration in the stage of red hepatization in the middle lobe of the right lung and in the lower part of the upper lobe of the left.

After the spinal cord had been hardened it was examined microscopically. In the region of greatest compression, at the cervico-thoracic junction of the vertebræ, the cord contains very few medullated fibres, and even those present are most irregularly arranged. It is impossible to make any distinction between gray and white matter. The vessels within the cord are sclerosed. Numerous nuclei, both round and elongated, are found in all parts of the sections, and some of these probably represent a round cell infiltration. No nerve cells are observed. The pia is much thickened and contains altered blood pigment. Both anterior and posterior roots external to the cord are in a fairly good state of preservation. The vessels within the cord stand out prominently from the surrounding tissue as faintly stained pink patches when the carmine is used, and as pale yellow ones with Weigert's hæmatoxylin. The central canal is closed at this portion of the cord.

Sections two to three root segments above the area of greatest compression show the central canal quite widely open. There is little round cell infiltration. The columns of Goll,

with the exception of a few fibres along their periphery, are greatly degenerated. These few normal fibres have probably escaped destruction at the area of compression. A few scattered normal fibres are found also in other parts of these columns. Normal fibres from the posterior commissure are distinctly seen passing into the degenerated columns of Goll. Burdach's columns also are not free from degeneration. The direct cerebellar tracts and columns of Gowers are much degenerated, but just below the motor decussation many medullated fibres may be seen within the former; it would seem, therefore, that these tracts are partly formed by nerve fibres whose cells are situated above the lower cervical region, or that—and this is more probable—fibres of the crossed pyramidal tracts are more intimately mingled with those of the direct cerebellar tracts at this level. Very distinct ascending degeneration of the lateral columns in the area of the crossed pyramidal tracts is noted, and this extends through several root segments and gradually disappears above the mid-cervical region. The direct pyramidal tracts show an ascending degeneration of less intensity.

Below the compressed area the horns of the cord gradually assume their normal form, and medullated fibres first appear nearest the gray matter and gradually increase in extent toward the periphery. The crossed pyramidal, Gowers', and the direct cerebellar tracts are greatly degenerated, and the direct pyramidal is also involved. Very few medullated fibres are found in the area of the lateral motor tracts below and near the region of compression, and though the number of these increases as lower levels of the cord are examined, they are never as abundant as one might expect. There are, therefore, associative fibres within the crossed pyramidal tracts, but their number is limited.

In the lateral columns the degeneration extends considerably in advance of that marked out as the area of the lateral motor columns by secondary degeneration from cerebral lesions. Degeneration of the peripheral part of the anterior columns near the anterior fissure may be traced well into the mid-lumbar region.

The central canal is enlarged both above and below the cervico-thoracic junction, and in the lumbar region is surrounded by so much gliar tissue that it almost resembles the condition frequently seen in syringomyelia. Very distinct degeneration is seen in the posterior columns below the area of compression, not limited to Schultze's comma zones, and involving most of the transverse area of the posterior columns, except at their periphery, where the long neurones from the lumbo-sacral cord are found. This degeneration may be traced fully three and a half to four centimetres below the compressed portion of the cord.

The cells of the anterior horns in the lumbar cord appear to be normal both in shape and number, but Clarke's columns are entirely deprived of cells throughout their extent in the thoracic region, and in the upper part of the lumbar cord, where they contain normally very many cells, they present the usual form but are without cells. The fibres within these columns from the posterior roots are normal in number. Careful search may possibly reveal here and there an atrophied cell in these columns.

This is evidently a case in which compression has played the chief rôle, but there is some round cell infiltration about the vessels of the pia and certain of those of the cord as far as the lower thoracic region.

The Marchi stain reveals degenerated fibres scattered all over the transverse area of the cord below the compression, but these are most numerous in the anterior columns.

The ascending degeneration in the pyramidal tracts, both crossed and direct, observed in the case B. H., is worthy of mention. In the crossed pyramidal tract this is more distinct than in the direct, and extends through several cervical segments. This retrograde degeneration has formed the subject of study in a number of cases, and in 1896, in the American Journal of the Medical Sciences, Dercum and Spiller gave the literature on the subject so far as they were able to obtain it. It has been explained by some writers, and especially by Sottas, as an upward degeneration in motor fibres which, of course, conduct impulses downward; by others it has been thought to be an involvement of associative fibres—of fibres which arise within the spinal cinerea, pass out into the lateral column and terminate within the cinerea at higher levels. In favor of the first view is the fact that it is found usually in processes of long duration, for I am unaware that it has been described as occurring in any acute process, which we should expect would be the case if it is merely a cellulifugal degeneration. Then again, when the remaining part of the lateral column and the crossed pyramidal tract are degenerated the process often does not extend so far upward in the former as in the latter. Thus Hoche* mentions degeneration of fibres in the lateral column, not belonging to any known system, extending through three segments above the focal lesion, and of the crossed pyramidal tract extending through seven segments. It is not easy to explain this on the assumption that longer associative fibres are found in the crossed pyramidal tract than in the remaining part of the lateral column. "The law of the excentric position of the long tracts in the spinal cord" (Flatau, Zeitschrift f. klin. Med., Vol. XXXIII, Nos. 1 and 2), which simply means that the long fibres take a peripheral and posterior location, might possibly be used as an argument. Egger† explains the retrograde degeneration of the crossed pyramidal tracts, observed in his case, by the theory that it represented short fibres, and that sclerosis occurred when these fibres were degenerated, and that this in turn caused degeneration of the long pyramidal fibres. I have several times observed this retrograde degeneration of the motor tracts and am convinced that it is more common than is usually supposed. In my case B. H. the normal fibres in the crossed pyramidal tract below and near the focal lesion are not numerous. Below the transverse lesion these ascending associative fibres, having their origin in the spinal cinerea, should not be affected, and they should be in normal number, if retrograde degeneration is to be discarded. If we grant that retrograde degeneration may occur in associative fibres, we should be at a loss to explain why the pyramidal fibres are not subject to the same laws, and we must

* Hoche, Archiv für Psychiatrie, Vol. XXVIII, 1896.
† Egger, Archiv für Psychiatrie, Vol. XXVII.

grant the possibility of this form of degeneration in order to explain the degeneration of the direct cerebellar tracts below the transverse lesion in this case.

In the direct pyramidal tracts the degeneration possibly is confined to Marie's* sulco-marginal zones, but does not extend very far upward. I know of no way in which the question as to whether it involves associative fibres here, or fibres of the direct motor tracts, may be settled. These areas may degenerate upward for a long distance. Hoche (*l. c.*), for instance, has traced this degeneration from a lesion in the mid-thoracic region into the motor decussation, and Dercum and Spiller (*l. c.*) traced it from the upper thoracic region to the same point.

The degeneration of Gowers' tract below the lesion, which is observed in the case B. H., has been found also in other cases, and it seems to be generally held that this tract contains fibres which conduct impulses in both directions. Hoche (*l. c.*) in a case with a lesion of the mid-thoracic region found this bundle degenerated below the lesion as far as the lower lumbar cord. This is where many neuropathologists believe the bundle arises,—at a lower level than the direct cerebellar tract. Daxenberger† and others speak of descending degeneration of Gowers' tract.

The fact that fibres of the antero-lateral column not belonging to any known system degenerate only a few segments either above or below a transverse lesion of the cord has been observed in many cases. This may be well seen in the case B. H. The restoration of fibres in the antero-lateral column begins always nearest the cinerea, for these in this portion are short associative fibres, and the Grenzschicht of Flechsig is never degenerated through any great extent of the spinal cord. This is in conformity with "the law of the excentric position of the long tracts in the spinal cord." (Flatau, *l. c.*)

As a rule the comma zones of the posterior columns can only be traced a short distance by Weigert's stain, two, three or four segments, but when the Marchi method has been employed they have been followed much further. In the case B. H. they are not sharply separated from the degenerated fibres in the rest of the posterior columns, though the area occupied by them is possibly slightly paler by Weigert's stain. This generalized degeneration of the posterior columns seems to me well worthy of note, for it can be followed four centimetres below the focal lesion, through several segments, in portions of the cord in which the gray matter is apparently normal. It seems to be more extensive than that we are accustomed to speak of as the traumatic zone, for according to Schiefferdecker the traumatic degeneration extends above or below a focal lesion only about ½ to 1 cm. (quoted by Worotynski, Neurologisches Centralblatt, No. 23, 1897). I am inclined to regard this descending degeneration in the posterior columns as retrograde, if we have the right to use such a term for a process which is more one of atrophy than degeneration. It may be that the development of the compression at the early age of three years explains this condition, for we have been taught that the pyramidal fibres are not fully developed until the fourth year of extra-uterine life. We know that the fibres of the posterior columns receive their medullary sheaths quite early, but it is possible that at the third year of extra-uterine life—if we can believe that the compression of the cord in the case B. H. was already well developed at that period—these fibres are less resistant than they are later.

Similar diffuse descending degeneration in the posterior columns below the area of compression has been noticed in a case of Pott's disease by Fürstner. In his case the compression was at the level of the ninth thoracic vertebra. He describes the lesion as follows: "There is a degeneration in the posterior columns which is not very intense, but which may be traced into the lumbar region, and occupies almost the entire width of the posterior columns, with the exception of the peripheral portion of these columns and of the well known band of fibres which has its course parallel to the posterior horns." This degeneration of the posterior columns Fürstner* regarded as wider than that we not infrequently see in Schultze's comma zones.

Cellulipetal degeneration of sensory fibres has been considered a rare occurrence, and indeed I have seen the statement (Nageotte†) that retrograde intramedullary degeneration of posterior root fibres has never been observed. It would be difficult to explain the descending degeneration of the posterior columns as an involvement of the associative fibres, for v. Lenhossék‡ tells us that positively there are only a few cells in the posterior horns which send their axis cylinders into the posterior columns.

The descending degeneration of the direct cerebellar tracts has not been frequently mentioned, and the completeness of it in the case B. H. is possibly due to the early age of the patient at the time the destruction began. Strümpell,§ Daxenberger,‖ and Bischoff¶ have spoken of it, and Bischoff thinks it is possible that the destruction of the direct cerebellar tract in his case may have had a connection with the descending cerebellar fibres described by Biedl.** In his case the cells of Clarke's column were normal. Thomas,†† in lesions experimentally produced on the cerebellum in the dog, found atrophy of these cells. In Daxenberger's (*l. c.*) case also these cells were not normal in number and size, nor were they normal in Strümpell's (*l. c.*) case. I have, therefore, searched carefully for cells in Clarke's column in the case B. H. and have been unable to find them, even in the lumbo-thoracic segments, where normally they are most abundant. A very few atrophied cells may be found by diligent search. The fibres within Clarke's columns are normal in appearance, as we should expect them to be, inasmuch as most of them come

* Marie, Leçons sur les maladies de la moelle. Paris, 1892.

† Daxenberger, Deutsche Zeitschrift für Nervenheilkunde, Vol. IV.

* Fürstner, Archiv für Psychiatrie, Vol. XXVII.

† Nageotte, Revue Neurologique, 1895.

‡ v. Lenhossék, Der feinere Bau des Nervensystems. Second edition, p. 355.

§ Strümpell, Archiv für Psychiatrie, Vol. X.

‖ Daxenberger, Deutsche Zeitschrift f. Nervenheilkunde, Vol. IV.

¶ Bischoff, Wiener klin. Wochenschrift, No. 37, 1896.

** Biedl, Neurologisches Centralbl., 1895, p. 434.

†† Thomas, Le Cervelet. G. Steinheil, Paris, 1897.

from the posterior roots. This retrograde degeneration of sensory fibres—for we have every reason to believe that the direct cerebellar tract is sensory—extending even to the origin of the fibres within the cells of Clarke's column, is of considerable importance and has rarely been described. It is probably due to the fact that the destruction began when the patient was very young, for such complete cellular atrophy is far more common in the young, as many experimental lesions have shown. It is also possible that the cells of Clarke's column were altered by the "reaction at distance" before the fibres of the direct cerebellar tracts were entirely degenerated.

In the case B. H. the area of degeneration, representing the fibres of the crossed pyramidal tract, in its downward course passes toward the periphery of the cord, and in the lumbo-thoracic region occupies the external and posterior part of the lateral column. Normal fibres are found in the crossed pyramidal tract below the area of compression, but they are not nearly as numerous as I have been led to expect from similar lesions of this tract reported in the literature, though in my case B. H. the normal fibres within this tract are more numerous at low than at high levels of the thoracic cord. It has been frequently stated that degeneration of the crossed pyramidal tract, resulting from a cerebral lesion, is less extensive than that following a spinal lesion. It may be that fibres of cerebellar origin—Van Gehuchten's* cortico-ponto-cerebello-spinal tract—are added to the cortico-spinal tract, or that a system of fibres forming the anterior part of the crossed pyramidal tract arises in the thalamus, as v. Bechterew† has concluded from the investigations of Boyce and Sakowitsch and from a study of the greater area of the lateral motor tract as represented during its myelination, compared with the area as represented by degeneration from cerebral lesions.

It is unquestionably true that the degenerated area of the crossed motor tract in the case B. H. is greater than that we find after cerebral lesions, but this is also partly due to the fact that many associative fibres are destroyed. It is probable that some associative fibres are contained within the lateral motor tract, but I cannot believe, from the case B. H., that fibres which arise below the lower cervical segments and pass downward are very numerous within this tract.

There is no atrophy of the motor cells of the anterior horns in the lumbar region, although we should expect to find it in this case, if in any, on account of the early age at which the transverse lesion occurred. I have never been able to observe this atrophy of the cell body of the peripheral neurone resulting from a lesion of the central neurone, and confess that I have always been most skeptical regarding statements concerning its existence. Recently, however, Schaffer‡ has published some noteworthy observations of tertiary degeneration. It may be mentioned that Egger (*l. c.*) says that in his case the cells were less numerous in one anterior horn in the lumbar region. I am not questioning Egger's statement, but from repeated observation we know how likely one is to be misled in an investigation of this kind, for often in normal cords the cells in the two anterior horns are not equally numerous, and we have no standard of what constitutes a normal number of cells.

Bruns* found the crossed pyramidal tracts, especially the right, wonderfully well preserved below and near a transverse lesion, though they were not entirely normal; and the explanation he suggests is that the degeneration began in the peripheral end of these tracts and had not extended to the traumatic area within the space of about four months. In my case B. H., which had lasted five years, this difference in the degree of degeneration in the distal and more proximal portions of the pyramidal tracts is not observable.

The degeneration in the antero-lateral columns in Bruns' case was believed by the author to represent the fibres of the direct pyramidal tract, descending fibres of Gowers' column, fibres of the système descendant du zone sulco-marginale (Marie) or faisceau marginal (Löwenthal), fibres of the faisceau intermédiaire du cordon latéral (Löwenthal), and the descending cerebellar tract of Marchi. The latter has never been demonstrated in man (Thomas). These areas are degenerated in the case B. H., and they have been found altered by Westphal, Schultze, Tooth, Schmauss, Daxenberger (quoted by Bruns) and others in cases observed by them.

Bechterew† has recently shown that there is still another system in the inner portion of the anterior column of the cord, and that this system arises in the anterior part of the corpora quadrigemina. He gives no name to this or to his system anterior to the crossed pyramidal tract, and we may, perhaps, speak of them as the quadrigemino-spinal and the thalamo-spinal tracts.

Dr. Young states that the patellar reflex in the case B. H. was diminished. So much has been written on the loss of the reflexes in total transverse lesions situated high in the cord that I may simply refer to the excellent papers by Bastian,‡ Bruns,§ Egger,‖ Hoche,¶ Habel** and others. Bruns' case was the first in which the reflexes were lost, and the entire spinal cord, the roots of the cauda equina, and a number of nerves and muscles of the lower extremities were examined microscopically. The changes in the nerves and muscles were not of great importance and could not be used to explain the absence of the patellar reflex and the flaccidity of the paralysis.

The posterior roots in Bruns' (*l. c.*) case in the area of total traumatic degeneration were remarkably well preserved, but the anterior were totally degenerated. He gives no satisfactory explanation for this. In the first case reported in this

* Van Gehuchten, Journal de Neurologie et d'Hypnologie, 1897.

† v. Bechterew, Neurologisches Centralblatt, No. 23, 1897.

‡ Schaffer, Monatsschrift für Psychiatrie und Neurologie, Vol. II, No. 1.

* Bruns, Archiv für Psychiatrie, Vol. XXV, 1893.

† Bechterew, Neurolog. Centralbl. No. 23, 1897.

‡ Bastian, A Dictionary of Medicine, edited by Richard Quain, M. D., F. R. S., p. 1481. Medico-Chirurgical Transactions, published by the Royal Medical and Chirurgical Society of London, Vol. 73, p. 151.

§ Bruns, Archiv für Psychiatrie, XXV.

‖ Egger, Archiv für Psychiatrie, XXVII.

¶ Hoche, Archiv für Psychiatrie, XXVIII.

** Habel, Archiv für Psychiatrie, XXIX.

paper the posterior roots were less affected. This is probably due to the fact that the anterior roots were most exposed to pressure and the invasion of the tuberculous process, and shielded to some degree the posterior roots placed behind them.

Bischoff (*l. c.*) concluded from his examination of a case of Pott's disease that the root fibres which enter below the second thoracic segment do not form all of Goll's columns, inasmuch as the ventral and lateral portions of these columns in the cervical region are formed by fibres from higher segments and probably not by those from the thoracic region.

If this view of Bischoff, viz. that the ventral and lateral parts of Goll's column are formed by fibres of the cervical roots, is correct, we are not surprised that these are the portions which the cervical fibres occupy. We know that the higher the degeneration of the posterior roots extends, the greater is the degeneration of the ventral and lateral portions of the postero-median columns in the cervical region. Reference may be made to the two cases pictured in the author's digest on the pathology of tabes,* or to many other cases, in illustration of this point. But there is considerable evidence to show that above the sixth thoracic roots the column of Goll in man is fully formed. In Pfeiffer's† case in which the first and second thoracic roots, in Nageotte's‡ case in which certain fibres of the second and third posterior thoracic roots, in Marguliés'§ case in which the right sixth posterior thoracic root, and in Dejerine and Thomas'‖ case in which the eighth cervical and first thoracic roots were affected, the columns of Goll in the cervical region were not degenerated. Bischoff employed the method of Marchi, and his results were possibly more accurate than those of the above-mentioned cases in which the hæmatoxylin of Weigert was used.

The case B. H. bears on this subject. The transverse lesion is situated in the lower cervical and upper thoracic cord, and at the mid-cervical region the columns of Goll are degenerated as far as the posterior commissure and spread out against the commissure in the well known flask-like form. The columns of Burdach also show distinct degeneration, but just below the motor decussation (first to second cervical segments) the degeneration is almost entirely confined to the columns of Goll, and only along their lateral borders is a slight degeneration of the columns of Burdach. At this level the columns of Goll do not extend to the posterior commissure. The columns of Goll, as they are represented by the degenerated area in the sections from the case B. H., do not receive cervical fibres except from the lowest cervical roots, if they receive them from these.

In a paper read at the last meeting of the American Medical Association I¶ attempted to show that there is considerable evidence for the theory that tuberculosis of the cord and its membranes may appear in the form of simple meningomyelitis, without the presence of giant cells, miliary tubercles, or even detectable bacilli, especially if Müller's fluid has been used for hardening. I was led to this conclusion after the examination of a case of meningomyelitis, apparently due neither to syphilis nor tuberculosis, as far as specific lesions were concerned, in a person who had died from generalized tuberculosis.

When the idea that spinal tuberculosis might appear as simple meningomyelitis first presented itself to my mind I was not aware of the attention which this subject had received, and was therefore somewhat surprised by the results of my examination of the literature. I found that a number of writers hold that both syphilis and tuberculosis may appear as simple meningomyelitis. Oppenheim, for instance, says: "We observe in syphilitic and tuberculous persons a form of myelitis which neither clinically nor anatomically can be considered specific, and yet it must stand in some relation to the infectious process."*

In the examination of these two cases of Pott's disease I have not noticed any lesions interior to the dura which might be called specific. It hardly seems probable that any one would hesitate to call these two cases tuberculous, unless the question of the rare manifestation of syphilis in this form might arise. The caries of the vertebræ, the external pachymeningitis, the giant cells, the necrosis of tissue within the tubercles, the epithelioid cells, render the diagnosis of a tuberculous process very probable. Within the dura, especially in the first case, the meninges are infiltrated with round cells, some of the vessels show a distinct endarteritis, round cell infiltration may be found about certain vessels within the cord, and in the first case several foci of degeneration may be noticed in the posterior columns at a considerable distance above the point of compression. A nuclear stain shows that these foci are the seat of a slight round cell infiltration. Within the dura, therefore, at least in one of these two cases of tuberculous spondylitis, only the signs of an ordinary meningomyelitis are present, even at some little distance from the seat of compression. Indeed in this first case the compression was so slight that it did not produce ascending or descending degeneration. The action of bacterial products on the cord need cause no surprise. We have had numerous experiments on this subject, and in this country Welch† and Flexner‡ have done much to enlighten us.

It is not clearly proven that the tuberculous process, external to the dura in my first case, has been the cause of the meningomyelitis, but it seems probable. If now a simple meningomyelitis may be produced by a process probably tuberculous external to the dura, what is there objectionable in the theory that it may also be produced by a tuberculous process external to the vertebræ?

Boettiger§ has attempted to show that the tuberculous and

*Spiller, International Med. Mag. 1897.

†Pfeiffer, Deutsche Zeitschrift für Nervenheilkunde, Vol. I.

‡Nageotte, Revue Neurologique, 1895.

§Marguliés, Neurologisches Centralblatt, 1896, p. 347.

‖Dejerine and Thomas, Comptes rendus de la Société de Biologie, 1896, p. 679.

¶Spiller, The Journal of the American Medical Association, April 9, 1898.

*Oppenheim, Lehrbuch der Nervenkrankheiten, p. 224.

†Welch and Flexner, The Johns Hopkins Hospital Bulletin, II, 107, 1891; III, 17, 1892.

‡Flexner, The Johns Hopkins Hospital Reports, VI, 1897.

§Boettiger, Archiv für Psychiatrie, Vol. XXVI, 1894.

the syphilitic meningomyelitis are the same in their histological appearances, and Raymond says that "the syphilitic meningomyelitis at its commencement has nothing specific but its cause; it has nothing specific so far as relates to the appearances under the microscope."* It therefore follows from this and other papers that the tuberculous meningomyelitis has nothing specific histologically at its commencement except the bacillus.

Virchow† teaches, if I understand him rightly, that in contusion and similar conditions with extravasation of blood, chemical products are formed which act as irritants with or without the presence of bacteria, and he compares these products with those formed by the micro-organisms. If this is true it may have some relation to the meningomyelitis in my first case.

I have been much interested in trying to find the nature of this round cell proliferation observed in these and other cases of meningomyelitis, and its final destiny. Raymond (*l. c.*) speaks in very positive terms, and Virchow (*l. c.*) in his paper on inflammation says that even yet the expression "small cell infiltration" is commonly used. I have been frequently struck by the expression "leucocytic infiltration," and have sought to find some authority for its use. It seems to be the opinion of some writers that unless we find multinuclear cells or cells with multilobular nuclei we have no right to speak of "leucocytic infiltration," and that we should regard the cells containing little protoplasm and large single and round nuclei as proliferations of connective tissue or its analogon, the neuroglia. But surely there are such cells as these within the blood.

Raymond (*l. c.*), in speaking more especially of syphilis, tells us that these round cells may undergo a retrograde change and disappear, or that they may form larger or smaller masses and undergo a gummatous change, or that they may form connective tissue and give rise to sclerosis.

Strümpell‡ takes a very decided stand in regard to the presence of meningomyelitis in Pott's disease. He says that all the changes in the spinal cord in spinal caries are only the necessary consequences of purely mechanical pressure. "At all events," he continues, "as we must state after numerous examinations made by us, in opposition to the prevailing view, no one has the slightest right to explain the paralysis occurring from spondylitis as the result of secondary myelitis." If preparations are made from the spinal cord, there are, according to Strümpell, no vascular changes to be found, no hyperæmia, no accumulations of cells about the vessels, and only occasionally small traumatic hæmorrhages. Frequently there are foci of degenerating nerve fibres, groups of swollen axis cylinders with partial or complete loss of their medullary sheaths, and in places spaces from which the nerve fibres have disappeared. In later stages there is proliferation of the neuroglia.

We can hardly be in doubt from this as to what Strümpell considers evidences of inflammation, for our views on this subject do not always harmonize.

Strümpell finds a supporter in Kraske (*l. c.*), who also says that the paralysis cannot be attributed to secondary inflammatory changes in the cord, and that this is equally true of the rare cases in which the cord is involved in the tuberculous inflammation, for this involvement occurs after the paralysis and toward the end of life. He acknowledges that the views regarding the relation of the paralysis to the tuberculous inflammation are still contradictory to one another.

Dinkler* reports a case in which two lesions were present in the spinal cord, one at the second and third thoracic segments, and one at the sixth, seventh and eighth thoracic segments. The lower lesion was evidently the older and showed proliferation of the glia, round cell infiltration, distension of vessels, etc. The upper lesion Dinkler regarded as the result of a dural tuberculosis, and he states that it was a typical compression lesion such as was described by Schmaus. Dinkler mentions, however, that at this upper level he noticed round cell infiltration in the pia and arachnoid. It seems to me, therefore, that both these lesions must be regarded as inflammatory. Dinkler states that tuberculosis of the lungs and vertebræ often causes mixed infection, and he thinks the lower lesion was possibly a metastatic process which had its origin in the pulmonary tuberculosis. It is difficult to see why the lower lesion should not be regarded as tuberculous, but be that as it may, it is evident that meningomyelitis may be caused either directly or indirectly by the tubercle bacillus, and even before paralysis appears, as in my first case.

Fürstner† observed intense round cell infiltration of the membranes and cord in a case of Pott's disease. He had operated on his patient, but there is no reason to think the cord was infected at the time of operation. It would not be difficult to quote other cases of Pott's disease in which meningomyelitis was observed.

In one of my cases there are large accumulations of round cells within the cord about the vessels, vascular dilatation and some swollen axis cylinders. These are distinct signs of inflammation, and indeed it seems to me after reading Virchow's recent address in Moscow that we should regard the swelling of the axis cylinders as a sign of parenchymatous inflammation. If we do so, we shall have difficulty in separating degeneration of nerve tissue from inflammation. These are Virchow's words: "I chose the name of parenchymatous inflammation for that process which, in the first place, produces swelling of the specific portions."

It is not easy, according to Bruns,‡ to determine the truly inflammatory nature of myelitis, and anatomically it is possible with certainty only in the very rare cases in which the producers of the inflammation (Entzündungserregern) have been shown to be present in the cord. By this I suppose he means the bacteria. All other histological findings which are regarded as characteristic of inflammation are found in cases of tumor and compression, cases which cannot truly be regarded as inflammatory. They are present also in thrombotic softening.

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*Raymond, Leçon sur les maladies du système nerveux, deuxième série, p. 491.

†Virchow, Virchow's Archiv, Band 149, Folge XIV, Band IX, 1897.

‡Strümpell, Lehrbuch der spec. Path. u. Ther., Vol. III.

*Dinkler, Deutsche Zeitschrift für Nervenheilkunde, Vol. XI, Nos. 3 and 4.

†Fürstner, Archiv für Psychiatrie, XXVII.

‡Bruns, Allgemeine Zeitschrift für Psychiatrie, Vol. LIII, p. 614.

In contradiction to the statements of Strümpell, Noble Smith* informs us that the nerve symptoms in spinal caries are much more frequently the result of the inflammatory process extending to the cord or nerves than they are of pressure. This, however, does not seem to be the generally accepted view. I cannot follow Smith when he says that recovery occurring after symptoms of paralysis may indicate regeneration of pyramidal fibres. While regeneration frequently occurs in the peripheral nerves, and theoretically there is no reason why it should not occur within the cord, as a matter of fact the evidence of the latter is not satisfactory, as Leyden and Goldscheider state.

I shall merely touch upon the subject of operation in Pott's disease, as it hardly comes within the scope of this paper. Paralysis so frequently exists without degeneration of fibres that we can hardly be too cautious in suggesting surgical interference, at least by any of the older methods. It is not uncommon to find that the paralysis disappears even when it has existed for some time. It seems to be in these cases merely the expression of a functional change. Oppenheim† reports a case in which the paralysis disappeared after a duration of five or six years. Recently Calot's method has received great attention, although one writer states that its principle is as old as Hippocrates. This statement, however, can hardly detract from the honor due Calot. The time has been too short to judge fully of the efficacy of the method. The chief fear seems to be that the forcible reduction may arouse a quiescent process. In the first of my two cases there is a possibility that it might have increased the meningomyelitis, and in the second case it could have done little or no good, but in this case Calot would not have advised it.

Occasionally we hear of cases in which the method has not been successful and the patient has died of tuberculous meningitis after a few months. We cannot forget the hopes that were at one time raised by the suggestions of operation on the spinal vertebræ in Pott's disease, but the papers of Kraske (*l. c.*), Fürstner‡ and Dinkler§ are not encouraging, and Willard,‖ at a meeting of the New York Neurological Society, voiced the general opinion of those present when he spoke of the disappointment which has followed surgical interference in these cases by the older methods.

Discussion.

Dr. Barker.—There are many points in Dr. Spiller's report in common with a case which has recently been studied in the anatomical laboratory by J. Rosenheim. The latter has cut sections from many segments of the spinal cord of a case of Pott's disease, and although the results of the study have not yet been published, they are soon to appear. The pressure-lesion in Mr. Rosenheim's case was situated between the 8th cervical and the 4th thoracic nerves, some three segments of the spinal cord being extensively involved. Above the lesion there was marked degeneration of Gowers' tract and of the direct cerebellar tract as well as of the dorsal funiculi. Below the lesions there were the typical degenerations in the pyramidal tracts.

Dr. Spiller has been able to trace a degeneration in the comma tract for a distance of 4 cm. below the lesion; in Mr. Rosenheim's case it was possible to follow it through some three segments. We know now from the studies of Hoche, Mann and others that this tract is really a long tract extending throughout the whole thoracic region of the spinal cord. I did not understand from Dr. Spiller's paper whether or not he had found degenerations in the oval field of Flechsig in the lower portion of the cord. Mr. Rosenheim has been able to demonstrate degeneration in this area in his case, and there can be but little doubt from his findings and those in similar cases by Hoche that in some way or another certain fibres from the upper part of the cord are continuous with the oval field of Flechsig. It seems probable from Hoche's studies and from the researches of Bruce and Muir that there are two distinct descending endogenous tracts in the dorsal funiculi, one more ventrally placed corresponding to the "comma" tract and the "cornu-commissural fibres" of Marie; the other more dorsally placed and corresponding to somewhat scattered fibres in the upper portions of the cord, in the lower portions to more compact bundles, the septo-marginal tract of Bruce and Muir, the oval field of Flechsig, and further down the *triangle médian* of Gombault and Philippe. In order to bring these endogenous fibres of the dorsal funiculi into accord with corresponding fibres in the ventral and lateral funiculi I would suggest that we speak of the two tracts together under the name of the *fasciculus dorsalis proprius*, distinguishing a *pars ventralis* from a *pars dorsalis*.

I am glad that Dr. Spiller has referred to the views of von Bechterew and others regarding descending fibres in the region of the pyramidal tracts, which probably have their origin in centres below the pallium. There is much evidence in favor of the view that very numerous nerve fibres come down from the region of the inter-brain and the mid-brain to the medulla and to the spinal cord, fibres which throw the lower motor neurones under the influence of higher centres. Without such fibres it would be difficult to explain many of the facts of comparative anatomy and of ontogeny. The studies of Dr. Mellus show the importance of the substantia nigra as a way-station between the pallium and lower centres.

The changes referred to in the nucleus dorsalis of Clarke are of especial interest, and Dr. Spiller has brought further confirmation of the view now universally held that the fibres of the direct cerebellar tract represent the medullated axones of the cells in the nucleus dorsalis. Thus far no one, unless it be Laura, has actually demonstrated the connection of Clarke's nucleus with the fibres of the fasciculus cerebello spinalis. The embryological studies of Flechsig, however, and the results of experimental degeneration as investigated by Mott, taken together with evidence which has been afforded by the study of changes in the nucleus secondary to lesions of the tract (as in cerebrospinal meningitis), make it almost certain that the axones of the tract and the cells of the nucleus both represent constituent portions of the same set of neurones.

* Smith, Spinal Caries, second edition.

† Oppenheim, Berliner klin. Wochenschrift, No. 47, 1896.

‡ Fürstner, Archiv für Psychiatrie, XXVII.

§ Dinkler, Deutsche Zeitschrift für Nervenheilkunde, Vol. XI, Nos. 3 and 4.

‖ Willard, Journal of Nervous and Mental Disease, April, 1897.

FIG. 1.

Section just below the pyramidal decussation. The columns of Goll are entirely degenerated, with the exception of a few fibres along their periphery, and do not extend to the posterior commissure. The columns of Burdach are slightly degenerated adjoining the columns of Goll. Normal fibres are found in the area of the direct cerebellar tracts (*nn*).

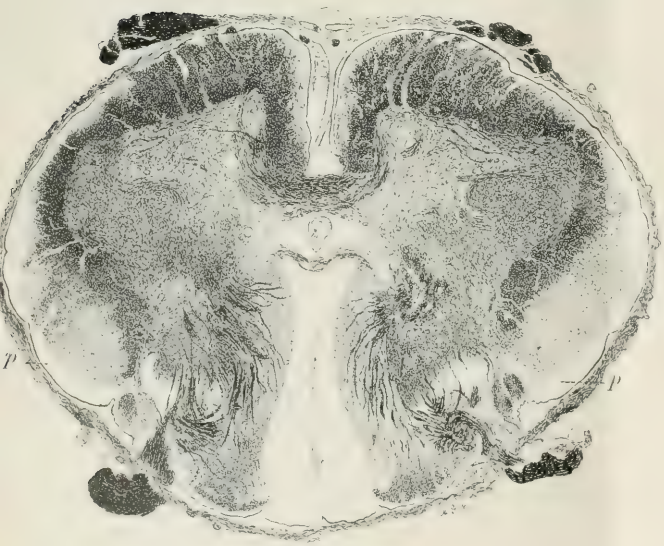

FIG. 2.

Section from the mid-cervical region. The direct cerebellar tracts (*pp*) and columns of Gowers are greatly degenerated. The crossed and direct pyramidal tracts are also much degenerated. The columns of Goll extend to the posterior commissure. The columns of Burdach are not entirely free from degeneration.

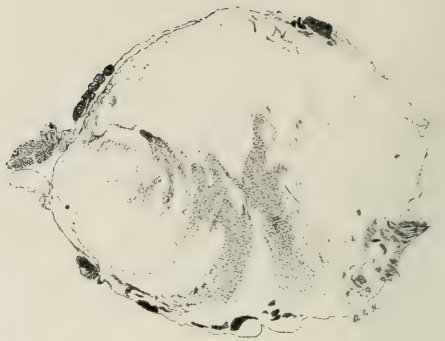

FIG. 3.

Section from the region of greatest compression, at the cervico-thoracic junction of the spinal column. The normal arrangement of the white and gray matter is entirely altered, and only a few normal fibres are present within the cord.

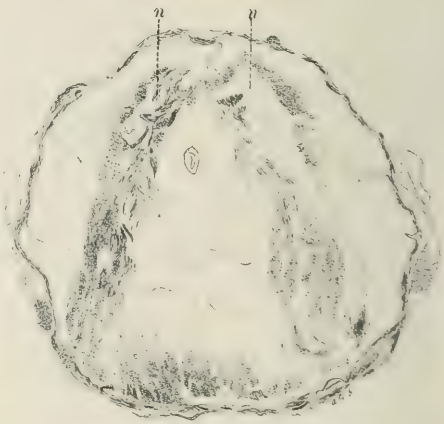

FIG. 4.

Section from the lower part of the compressed area. The anterior horns *nn* are indistinctly marked out by normal fibres in the adjoining columns. The greater portion of the section is entirely degenerated.

FIG. 5.

Section 3½ cm. below Fig. 3. The antero-lateral columns, including the direct cerebellar and Gowers' tracts (*qq*) and the periphery of the anterior columns, are greatly degenerated. The ventral portion of the posterior columns is also distinctly degenerated.

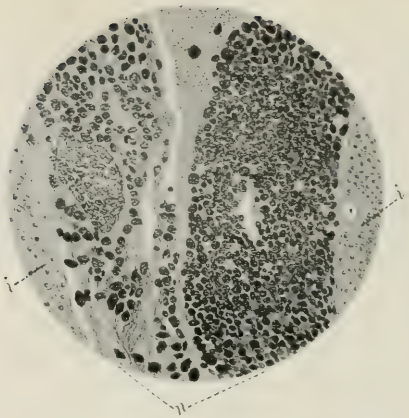

FIG. 7.

Section from the mid-cervical region in Case I, showing intense cellular infiltration in the posterior septum (*n*) near the posterior commissure. *ii* Right and left columns of Goll.

FIG. 6.

Section from the mid-lumbar region. The direct (*rr*) and crossed pyramidal tracts are degenerated.

Figures 1 to 6 inclusive are from Case II.

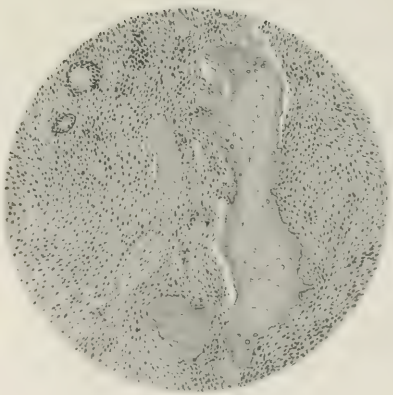

FIG. 8.

Osteoid masses contained within the tuberculous exudate in the thoracic region (Case I). The majority of them are present in the outer zone of the exudate near the bony canal and only slightly removed from the intervertebral discs which show irregularities and are becoming clarified.

Dr. Flexner.—Dr. Spiller's paper is an embarrassment of riches. There are two or three points only which the limited time will permit me to refer to. The first concerns the relation of degeneration in the nerve-roots and peripheral spinal nerves to changes in the motor cells of the anterior horns. I was surprised at the slight changes observed in the cells notwithstanding the extensive degenerations of the nerves. It is, of course, unnecessary to remind Dr. Spiller, or this audience, of the experimental and other work of Von Gudden, Friedlander, Grigoriew and Nissl, which has shown that the nerve cells suffer severely following injury to and removal of the peripheral nerves.

Dr. Spiller's remarks on this topic have raised the question of what characters stamp an inflammation as specific, that is, in this instance, as tuberculous. We have come to recognize in the micro-organisms of the specific diseases a capacity to produce definite histological structures which can be at once recognized as due to that cause—so, for example, the miliary tubercle—and at the same time, to give rise to other changes of a simple and non-specific inflammatory type. The thickening of the framework in the lung in tuberculosis is one example of such an action, and many other fibroid and degenerative processes in the body have the same origin. An intermediate sort of lesion is found in the diffuse tuberculous tissue in which even giant cells may be wanting and blood-vessels present, and whose specific characters are given through the presence of tubercle bacilli and the degenerations which it tends to undergo. The crucial test, of course, is the finding of the tubercle bacillus, and in many chronic conditions this is a laborious undertaking.

It is interesting to have Dr. Spiller bring up again the Virchow conception of parenchymatous inflammation. Since the days of Cohnheim, pathologists have demanded something more than a mere degenerative lesion before stamping the process "inflammation," and they have attempted, although it must be confessed not always with success, to mark off more sharply simple degenerative from actual inflammatory changes.

Dr. Spiller.—It is well known, as Dr. Flexner states, that the cells of the anterior horns of the spinal cord are affected by degenerative changes in the anterior roots. It is much to be regretted that the spinal cord in my first case was hardened in Müller's fluid and that the application of the Nissl stain was impossible. In the thoracic region the motor cells were distinctly altered. Could the Nissl stain have been employed, the cells of the mid-cervical region might also have been found degenerated. I have not intended to deny the existence of cellular lesions in the latter portion of the cord visible by Nissl's method, but I place very little value on studies of cells stained by carmine alone, unless the changes are of an intense degree.

I have been unable to stain the tubercle bacillus in this tissue hardened in Müller's fluid, but Dr. Abbott and Dr. Flexner tell me that they know the bacillus has been found under similar conditions. As Dr. Flexner puts it, "it is a labor of love."

It is impossible to assert that the myelitis in my first case has been caused by the tubercle bacillus, though I have found no other cause. It is, however, a very important fact that myelitis of considerable intensity, with polynuclear and mononuclear cellular infiltration, may occur in Pott's disease, and it is possible that some of the symptoms of this disease may at times be due to the myelitis and not entirely to the compression.

I should like to emphasize the statement that the degeneration of the posterior columns in my second case was not confined to Schultze's comma zones, but was much more extensive. This diffuse form of descending degeneration in the posterior columns of the cord has rarely been reported, and is entirely different from the degeneration frequently observed in Schultze's comma zones, inasmuch as it is not systemic.

Note on the osteoid tissue found in the tubercular exudate in the thoracic region of the cord.—Dr. Flexner.

There is contained amid the typical tuberculous exudate, outside the dura, scattered masses of osteoid tissue. These are of irregular form and shape. They consist of a ground substance which is homogeneous or faintly granular or fibrillated, and contain irregular nuclei resembling, in part, bone corpuscles. For the most part the masses are non-calcified. But now and then calcification can be seen to be going on, and in such cases the masses take a blue hæmatoxylin stain. The majority of the flakes are in the outer zone of the exudate nearest the bony canal; and the cartilage of the intervertebral discs (?) shows slight irregularity, and in places is undergoing calcification. It is therefore not improbable that serial sections might have shown the osteoid masses to have originated from the intervertebral cartilages.

A CASE OF OSTEITIS DEFORMANS.*

By Wm. T. Watson, M. D., *of Baltimore.*

In 1876 Sir James Paget reported to the Medical and Chirurgical Society of London, five cases of a previously undescribed disease to which he gave the name "Osteitis Deformans." He described one case in great detail and gave reports of both microscopical and chemical examinations of the bone. Although a good many cases have since been reported, about sixty in all, nothing very material has been added to the description of the disease as first given by Paget. He gave as the chief characteristics of the disease the following:

It begins in middle age, or later; is very slow in progress; may continue for many years without influence on the general health, and may give no other troubles than those which are due to the changes of shape, size and direction of the diseased bone. Even

* Read before the Johns Hopkins Hospital Medical Society, February 7, 1898.

when the skull is hugely thickened and all its bones exceedingly altered in structure the mind remains unaffected.

The disease affects most frequently the long bones of the lower extremities and the skull, and is usually symmetrical. The bones enlarge and soften, and those bearing weight yield and become unnaturally curved and misshapen. The spine, whether by yielding to the weight of the overgrown skull, or by change in its own structures, may sink and seem to shorten, with greatly increased dorsal and lumbar curves; the pelvis may become wide; the necks of the femora may become nearly horizontal, but the limbs, however misshapen, remain strong and fit to support the trunk.

In its earlier periods, and sometimes through all its course, the disease is attended with pains in the affected bones, pains widely various in severity and variously described as rheumatic, gouty or neuralgic, not especially nocturnal or periodical. It is not attended with fever. No characteristic conditions of urine or feces have been found in it. It is not associated with syphilis or any other known constitutional disease, unless it be cancer.

The bones examined after death show the consequences of an inflammation affecting, in the skull the whole thickness, in the long bones chiefly the compact structure of their walls, and not only the walls of their shafts, but, in a very characteristic manner, those of their articular surfaces.

In 1890, fourteen years later, after Paget had seen 23 cases of the disease, he made the following statement:

1. The preponderance of males among the patients affected with this disease is confirmed.

2. The most frequent ages at which the disease was first observed were between 40 and 50.

3. The frequency of cancer or sarcoma occurring in those affected with osteitis is confirmed. Of eight cases traced to the end, five died with cancer or sarcoma. This fact, confirmed as I believe it is by the observations of others, is decisive as to an intimate relation between osteitis and the formation of malignant tumors. I do not venture to guess what that relation is.

4. It may be only by chance coincidence, but it seems worth mentioning that in 23 cases, 4, after long continuance of the osteitis, became blind—1 with choroiditis, 3 with retinal hæmorrhages.

5. I have tried in vain to trace any inherited tendencies to the disease. Many have had gouty ancestors, but I do not think more than any other equal number of persons in the same rank in life.

6. The most frequent seats of the osteitis are the tibiæ, femora, clavicles, spine, and vault of the skull. The posterior and regularly median curvature of the spine is always well marked, the pelvis often broad. I have never seen any evidence of the disease in the bones of the face, hands or feet. In this respect the contrast with the acromegaly of Marie has seemed complete.

The morbid anatomy, as given by Paget, is as follows:

Periosteum not visibly changed. The outer surface of the walls of the bones irregularly and finely nodular, as with external deposits or outgrowths of bone, deeply grooved with channels for the periosteal blood-vessels, finely but visibly perforated in every part for the transmission of the enlarged small blood-vessels. Everything seemed to indicate a greatly increased quantity of blood in the vessels of the bone.

The medullary structures appeared to the naked eye as little changed as the periosteum. . . . The medullary spaces were not encroached upon.

The compact substance of the bones was in every part increased in thickness. . . . In the greater part of the walls of the shafts of the bones the whole construction of the bone was altered into a hard, porous or finely reticulate substance like very fine coral. In some places there were small, ill-defined patches of pale, dense and hard bone, looking as solid as a brick.

In the compact covering of the articular ends of the long bones . . . the increase of thickness was due to encroachment on the cancellous texture, as if by filling its spaces with compact porous new-formed bone.

The microscopical appearance as given by Mr. Butlin is as follows:

The number of Haversian systems and canals in any given section would seem to be much diminished. The space between the Haversian canals was occupied by ordinary bone substance, containing numerous lacunæ and canaliculi. The Haversian canals were enormously widened, many of them were confluent, and thus the appearance of a number of communicating medullary spaces was obtained; an appearance that was rendered still more striking by the presence in the canals of a large quantity of ill-developed tissue in addition to the blood-vessels.

The contents of the Haversian canals were seen to consist generally of a homogeneous or granular basis, containing cells of round or oval form, about the size and having much the appearance of leucocytes. Larger nucleated cells were also present, and fibres or fibro-cells sometimes in considerable quantity. Myeloid cells were occasionally observed, but they were not plentiful. Fat also existed in many of the larger spaces, especially in the skull. The vessels were unusually small compared with the channels in which they ran; indeed, they did not seem to be larger than those of normal bones.

The walls of some of the canals were lined by a single layer of osteoblasts—a condition precisely similar to that observed in a normal ossification of the bone in membrane.

The presence of new bone was most evident in the periosteum of the tibia, external to the ordinary compact layer of the shaft. This external layer was of course but thin, and was much softer and less developed than the cortex of the bone from which it sprung. It evidently was not nearly sufficient to account for the great increase in the diameter of the tibia. There was no similar recent formation of bone on the outskirts of the medullary canal.

The number of lamellæ surrounding the Haversian canals was no larger than in normal bone, whilst the arrangement of the intervening space was most complex and totally different from that of healthy bone. Lacunæ and canaliculi throughout the sections did not strikingly differ from those of ordinary bone.

As to the nature of the disease, Paget, Butlin, Clutton, Eve, Silcock and others believe it to be a chronic inflammation of bone, but Goodhart, Lunn and others do not deem that its inflammatory nature has been proven.

Lunn, who reported 4 cases in 1885, while admitting that chronic inflammation might have some share in the process, thought that it would not altogether account for the changes found after death. His conclusions were that osteitis deformans consists of—

1. A constitutional disease, producing atrophy and absorption of a large part of the osseous system.

2. Consequent weakening of the bones so that they yield when exposed to strain.

3. Compensatory strengthening by the growth of what may be looked upon as a variety of callous.

4. The occasional formation of definite tumors.

5. A fatal cachexia.

Commenting upon these views, Silcock, in 1885, said:

It is difficult to imagine how a process can primarily be one of atrophy and absorption when the first recognizable sign of the disease is the thickening and enlargement of the bone. Nor can the superadded bone in this case be regarded in the light of "compensatory strengthening" of the curves, or of a buttress-like forma-

Fig. 1.

Skiagraph of left knee joint. Tibia greatly enlarged. Fibula apparently normal.

Fig. 2.

R. at 36 years of age.
Height 5 ft. $11\frac{3}{4}$ inches.

Fig. 3.

R. at 62 years of age.
Height 5 ft. $2\frac{1}{2}$ inches.

FIG. 4.

Side view, showing bowing of back and lower extremities.

FIG. 5.

Head view, showing enlargement of cranium, the face bones remaining normal.

FIG. 6.

Skiagraph of left tibia, showing marked anterior curvature, and great thickening. Dark and light areas probably correspond to areas of condensation and rarefaction.

tion, since the mass of it is deposited on the convexity of the curve and not in the concavity. Again, the external thickening of the bones of the cranium is wholly inexplicable on the theory enunciated. As held by Paget and Butlin, the essential features of the osseous lesions of the disease are indistinguishable from, if not highly characteristic of, inflammation.

Concerning the etiology of osteitis deformans absolutely nothing is known.

It is more frequently seen in England than elsewhere, and is more common in London than in other parts of England. This fact led Johnathan Hutchinson to conclude that the malady was probably connected with gout, but this view has not been accepted by others.

Diagnosis: The diseases with which it might possibly be confounded are rickets and osteomalacia. In rickets the bones are too short and not too long, too small, not too large; and their curvatures are not like those of osteitis.

In osteomalacia the walls of the bones become exceedingly thin, and when they yield it is not with regular curving, but with angular bending or breaking.

The course of the disease is very chronic. When death ensues it is from some coincident disease which has been aggravated by the condition of the bones only in so far as they may have diminished the range of breathing and the general muscular activity.

Six cases of this disease have been reported in America, the first by McPhedran in Toronto in 1885, the second by Gibney in New York in 1890, the third by Mackensie in Toronto in 1891, the fourth and fifth cases by Taylor in New York, 1892, and the sixth by Herwisch in Philadelphia in 1896.

The present case is then the seventh to be reported in America and is more typical than any of the others.

I had hoped to be able to bring the case before you to-night, but have been disappointed. I have, however, some photographs which will in some measure make up for his absence.

R., aged 62. Family history unusually good. His father was a French Canadian, born near Montreal, who "never had a day's sickness," and died of congestion of the brain at the age of 79. His father's brother, at the age of 100, was killed while walking on a railroad track. His mother was born in New Jersey and died on her 90th birthday of old age. He has two brothers living at the ages of 72 and 75. No relative ever died of cancer.

Personal history. He was never in bed a day from any illness. A slight attack of measles in childhood and a carbuncle ten years ago were his only ailments. He has always led a very active life. He conducted a successful business from 1860 until 1886, and did not then retire on account of physical or mental disability. Every year since he was a boy he has indulged in fishing, duck shooting, sailing and outdoor sports. Up to the age of 42 he was strong and active, "as straight as an arrow," and five feet eleven and three quarter inches in height.

The present malady began about 25 years ago, when the skin over the anterior portion of the upper half of the left leg became inflamed, the inflammation gradually spreading to the ankle. Later on an inflammation appeared on the corresponding portion of the right leg. This lasted four or five months and then subsided, leaving behind some large pigmented areas.

About twenty years ago he began to have pains in the bones and calves of his legs. The calf muscle would be drawn into bunches. These pains have persisted more or less ever since, usually worse at night. At the onset of these pains he noticed for the first time that his legs were bending and his height was diminishing. This bending of the legs has steadily advanced and is still progressing.

About fifteen years ago the increased size of his head began to attract attention. This increase, the patient is confident, began 35 years ago, when at the age of 27 he had to increase the size of his hat from a No. 7 to a 7¼. At intervals of four to five years he has had to take a hat a size larger, until now he wears a No. 8. This indicates a total change in circumference of $3\frac{1}{16}$ inches. There has been no evident increase in the size of the head for three or four years past. He has never had pain or discomfort of any kind in his head.

Ten years ago his back commenced to bow and the shape of his chest to change, becoming flatter in front. These changes are still progressing. His height was formerly five feet eleven and three quarter inches. In July, 1897, it was five feet three inches. At the present time it is five feet two and one-half inches. Total loss in height nine and one quarter inches. This loss of height, due to bowing of the back and lower extremities, is rapidly progressing.

The general health of the patient has continued very good. While his gait is awkward it is steady, and his only complaint is of the pains in his legs and thighs, which are not so annoying as formerly. His intellect is unimpaired.

In the fall of 1896 he went on a hunting trip. When attempting to take aim he found to his surprise that he could not see with his right eye.

Present condition. In July, 1897, I took R. to Dr. Osler, who made the diagnosis and dictated the following note:

"Head fairly symmetrical, looks large; the most marked prominences are just over the temporal muscle at the squamo-parietal junction. Above this there is a distinct groove like flattening, and then a marked prominence on either side of the parietal suture. The posterior parts of the parietal bone and the occipital bone are uniform and symmetrical.

No apparent enlarging of the bones of the face; no enlarging of the jaws or of the zygoma; in fact the face looks small in proportion to the size of the head. Teeth are bad; nearly all gone. No enlargement of maxillary process.

Body: No enlargement of cervical vertebræ. A most remarkable bowing of the dorsal spine. The lordosis is of the most extreme grade. There is no special prominence of any of the vertebræ. The ribs do not appear to be enlarged. The chest, from the front, is singularly box-shaped, a perfectly quadrilateral thorax. There is a little scoliosis, the curve being towards the left.

No enlargement of the clavicle or shoulder-blades. No enlargement of the bones of the arm or of the hand. No clubbing of the fingers. Dupuytren's contraction in both hands.

The pelvis is not enlarged, crests of the ilia feel normal.

Legs are remarkably bowed. With the heels together, from

the inner side of one knee-pan to the other is 23 cm. From the crest of one tibia to the other is 26 cm. The thigh bones do not seem enlarged. The tibiæ present the most remarkable deformity. They are both extremely curved anteriorly, enormously enlarged; a condition of diffuse hyperostosis. The left leg is larger than the right. Measurement of the most prominent part of the calf: left, 37 cm.; right, 35.5 cm. The bones are smooth and uniform, except on the anterior margin, where both are a little rough. The fibulæ feel a little enlarged at the upper end, but do not seem to be involved to the same extent. On the anterior surface of both legs and over the outer maleoli there are old pigmented changes in the skin, which is rough and hard. Both inner condyles of the femur look enlarged. Measurements over the knee joint: right, 39.5 cm.; left, 38 cm. Height five feet three inches."

Dr. Reik has recently examined his eyes and reports as follows:

Mr. R. has a high grade of myopia, with large posterior staphyloma and extensive choroidial changes in each eye. In the right eye there is in addition a central lens opacity and consequently vision is practically nil. Vision in the left eye is $\frac{6}{30}$ with a —12 Ds.; with a —8 Ds. he can read Jaeger No. 1.

Discussion.

Dr. Cone.—It is interesting in the bibliography of this case to bring in the work of Von Recklinghausen. He mentions cases of osteitis deformans in which there was a development of fibroma and of sarcoma, and mentions also that cysts frequently form in these cases, and he describes them very fully. The walls are fibrous, contain a spongy network of bone, and outside of this is fatty marrow. He mentions that the seat of these changes is the spots where the bone is under most statical pressure. As to the inflammatory origin of the disease, there is one case cited by Gruber in which, following erysipelas, there was this hyperostosis and a condition resembling elephantiasis.

Dr. Watson.—In reply to Dr. Osler I would say that in Paget's experience the cranial bones were frequently affected. In four of the six American cases there was enlargement of the head. In Mackensie's case, aside from some spinal curvature, a very much enlarged cranium was the sole lesion. In Herwisch's case, in addition to an enlarged cranium there was some thickening and curving of the femora and left tibia and some thickening of the crests of the ilia. In the case of Dr. Gibney the head was increased in size and the legs very much bowed.

In one of Dr. Taylor's cases there was a very large head, considerable bowing of the spine, some enlargement of the pelvis and enlargement and bowing of the right femur. In his second case there was no head enlargement, the sole lesions consisting of enlargement and bowing of the right femur and some lateral spinal curvature. In McPhedran's case the only bones involved were the right tibia and femur.

The case reported to-night corresponds more closely to Paget's description than any of the American cases, although one of Dr. Taylor's cases is almost as typical.

The statement made by Paget that there is a preponderance of males among the patients affected with this disease seems to be contradicted by later statistics, for of 43 cases analyzed by Thieberge in 1890, 21 were men and 22 were women.

THE RISE OF THE THEORY OF ELECTROLYTIC DISSOCIATION, AND A FEW OF ITS APPLICATIONS IN CHEMISTRY, PHYSICS, AND BIOLOGY.*

By Harry C. Jones, Ph. D., *Instructor in Physical Chemistry, Johns Hopkins University.*

It is doubtless unusual for this Society to be confronted with a subject which is apparently so widely removed from medicine as that of physical chemistry. But since certain comparatively recent developments have made it probable that the latter is destined to exert some influence upon the former, I have been kindly asked by your President to discuss that side of physical chemistry which has already been brought in touch with certain biological problems. I shall therefore give a very brief account of the origin and development of the theory of electrolytic dissociation, which is one of the keystones to the whole science of physical chemistry.

The botanist, Pfeffer, carried out a quantitative investigation of the osmotic pressure which solutions of both non-electrolytes and electrolytes exert against the pure solvent. His work is so well known that a mere reference to it is nearly sufficient. The artificial membranes which he devised, by depositing some finely divided precipitate, such as copper ferrocyanide, in the walls of fine-grained porcelain, were semipermeable, *i. e.* they allowed the solvent to pass through them, but prevented the dissolved substance from doing so. With such membranes he was enabled, for the first time, to make a careful quantitative study of the amount of osmotic pressure which different substances exert.

The results of Pfeffer were examined by Van't Hoff, who pointed out that they led to the following interesting and important generalizations:

I. The osmotic pressure of solutions of non-electrolytes is proportional to the concentration.

II. The temperature coefficient of osmotic pressure is very nearly $\frac{1}{273}$ of the osmotic pressure, for every degree Centigrade.

III. The osmotic pressure of a solution is *exactly equal to the gas pressure* which the dissolved substance would exert, if it were present as a gas, in a space equal to that occupied by the solution. A molecule exerts the same osmotic pressure as it would exert gas pressure under the same conditions of temperature.

* Read before the Johns Hopkins Hospital Medical Society, March 7, 1898.

These three laws of osmotic pressure will be recognized, at once, to be strictly analogous to the three laws of gases—that of Boyle, that of Gay-Lussac, and that of Avogadro.

Van't Hoff further pointed out that the electrolytes—strong acids, and bases, and the salts—present exceptions, and exercise a greater osmotic pressure, for equivalent concentration, than the non-electrolytes.

The explanation of this difference was offered by Arrhenius. He studied the depression of the freezing-point of water produced by both electrolytes and non-electrolytes, and found that the former was always greater than the latter. He took into account, also, the property of solutions of electrolytes to conduct the current, and pointed out a quantitative relation between the conductivity of such solutions and the depression of the freezing-point of the solvent produced by the dissolved electrolyte. He showed, thus, that solutions of those substances which give abnormally large osmotic pressure, give abnormally great depression of the freezing-point of the solvent, and conduct the current.

It had already been shown by Raoult, that the depression of the freezing-point of a solvent by any dissolved substance, depended upon the relation between the number of parts of the dissolved substance and of the solvent. It seemed, then, that in the case of electrolytes there were more parts of the electrolyte present than could be accounted for on the assumption that the substance was present in the solution in the simplest molecular condition. To account for such facts as these, Arrhenius proposed the theory which has become so well known as the theory of electrolytic dissociation. When an electrolyte is dissolved in a solvent like water, the molecules break down, not into atoms, but into ions, which are atoms, or groups of atoms, charged with electricity. The amount of such dissociation is dependent upon the concentration of the solution. The more dilute the solution, the greater the dissociation of the molecules into ions, and at about one one-thousandth normal, the dissociation of all the strong acids, and bases, and most of the salts, is complete. This means that there are no molecules of the electrolyte present, but only the ions into which the molecules have dissociated.

This suggestion, it must be said, is not entirely new with Arrhenius, it is closely related to certain views held by Grotthuss, Williamson and Clausius. But the broad application of the theory to these newly discovered facts, together with quantitative methods for measuring the amount of the dissociation in a given case, we owe to Arrhenius.

Given the theory, the all-important question remains, is it true? The time at my disposal will not permit me to discuss many of the lines of evidence which bear upon the theory of electrolytic dissociation. It is so far-reaching in its significance, so fundamental in its bearing, that any physical or chemical property of solutions can reasonably be summoned to furnish evidence as to its validity. I will refer very briefly to a few points which bear directly upon the theory in hand. If dilute aqueous solutions of electrolytes contain only ions, and no molecules, then it is clear that all the properties of such solutions must be the properties of ions, and not of molecules, since there are no molecules present. But since a molecule always dissociates into at least two ions—a cation, which is charged positively, and an anion, which is charged negatively—the properties of completely dissociated solutions must be a function of two constants, the one depending upon the cation and the other upon the anion. If we study the physical properties of such solutions, such as their specific gravity, power to refract light, power to rotate the plane of polarization of light, color, etc., we find that they are the sum of a constant for the cation and a constant for the anion.

If we turn to the property of completely dissociated solutions to conduct the current, we find here again the same additive condition. The conductivity of these solutions is the sum of two constants, which is the well known law of Kohlrausch, usually expressed as the law of the independent migration velocities of the ions.

A quantitative test of the theory may be made by a study of the osmotic pressure of solutions of electrolytes. It will be remembered that the generalizations of Van't Hoff were reached through a study of Pfeffer's measurements of the absolute osmotic pressure exerted by non-electrolytes. Pfeffer found also that electrolytes exert a greater osmotic pressure than non-electrolytes. De Vries, using the plasmolytic, or living cell method, which gives only relative osmotic pressures, found, also, that electrolytes exert a greater osmotic pressure than non-electrolytes. This excess in the osmotic pressure of non-electrolytes is, in terms of the theory, due to a dissociation of the molecules into ions. De Vries showed that solutions of undissociated substances, containing the same number of molecules in a given volume, exerted the same osmotic pressure. Such solutions were terms *isohydric*. The same applies to solutions of electrolytes, with this difference, that at moderate dilutions we have to deal with the sum of the molecules and the ions present. De Vries was able by his method to determine the concentrations of solutions of electrolytes which are isohydric with one another. When these concentrations were represented in molecular quantities their reciprocal values were termed *isotonic coefficients*.

The dissociation of electrolytes can be calculated from the measurements of the osmotic pressure of solutions made by De Vries, and also from the measurements of the conductivity of the same solutions, and these two sets of values should agree with one another, if the theory of electrolytic dissociation is true. Below are given the amounts of the dissociation of a few substances, calculated for a given dilution, from osmotic pressure and from conductivity:

Substance.	Dissociation from Osmotic Pressure.	Dissociation from Conductivity.
KNO_3	69%	80%
$NaNO_3$	69	73
KCl	69	84
NaCl	71	82
$(COOK)_2$	61	66
K_2SO_4	60	67

Considering the large error involved in the osmotic pressure method, the agreement is probably within the error of experiment.

It was early found that the power of electrolytes to lower the vapor-tension, or to lower the freezing-point of the solvent in which they are dissolved, is greater than that of non-electrolytes. Either of these properties of solutions of electrolytes can be used to measure their dissociation. Since the method of measuring the freezing-points of solvents and solutions has been worked out far more accurately than the method of determining their boiling-points, the former is to be preferred as a method for measuring dissociation. I will give some results of the dissociation of electrolytes as calculated from my own measurements of the freezing-point depression of solvents, produced by them, and compare these with the dissociation of the same dilutions of the same electrolytes as calculated from Kohlrausch's conductivity work.

Substance.	Concentration. Gram-molecular normal.	Dissociation from Conductivity.	Dissociation from Freezing-point Lowering.
NaCl	0.001	98.0%	98.4%
"	0.01	93.5	90.7
"	0.1	84.1	83.5
KCl	0.001	98.0	101.0
"	0.01	94.2	90.7
"	0.1	86.0	83.4
H_2SO_4	0.003	89.8	86.0
"	0.005	85.4	83.8
"	0.05	62.3	60.7
HCl	0.002	100.0	98.4
"	0.01	98.9	95.8
"	0.1	93.9	88.6
HNO_3	0.002	100.0	98.4
"	0.01	98.5	96.8
"	0.1	93.5	87.8
KOH	0.002	100.0	98.4
"	0.01	99.2	93.7
"	0.1	92.8	83.1

These are but a few results taken from a large number, involving all classes of electrolytes—acids, bases, and salts. The agreement is so striking that comment is superfluous.

Another line of evidence is to be sought in the study of mixtures of salt solutions. In terms of our theory, a dilute solution of potassium chloride contains only potassium ions and chlorine ions, and, similarly, a dilute solution of sodium bromide contains only sodium ions and bromine ions. These facts would be expressed thus:

$$KCl = \dot{K} + \bar{Cl}$$

$$NaBr = \dot{Na} + \bar{Br}$$

A mixture of these solutions would contain, then, potassium, sodium, chlorine, and bromine ions; and all the properties of this mixture would be a function of the properties of these four ions, there being no molecules present. If, on the other hand, we started with potassium bromide and sodium chloride, and mix their dilute solutions, we would have exactly the same ions present, and the properties of the second mixture should be, for the same concentration, exactly the same as the first, and such is the case.

But if we should mix solutions of substances which are undissociated, such as methyl chloride and ethyl bromide, we ought to obtain a mixture with properties which are different from a mixture of methyl bromide and ethyl chloride, because we have here to deal only with molecules, which would be different in the two cases. And here again the facts agree perfectly with the theory. A mixture of methyl chloride and ethyl bromide has properties which are different from a mixture of methyl bromide and ethyl chloride.

Would that time permitted to take up an adequate number of the many lines of evidence which point to the theory of electrolytic dissociation in solution in water, and, to a less extent in many other solvents, but it does not.

I believe that when all the evidence at hand is taken into account, it points so conclusively to the general truth of the theory of electrolytic dissociation that we can accept it with the same degree of confidence as we do the law of Avogadro or many of the so-called laws of nature. And it may be said that the theory is now generally accepted by those who have impartially examined the evidence which is available.

If the theory be true, the question which next arises is, what is its scientific value? Has it been helpful in correlating facts which have hitherto appeared to be unconnected? If so, its value is apparent. Or does it suggest, or point out new lines of experimental investigation? If it does, its value is unquestioned. If it should assist in both of these directions, so much the greater is its worth. I can take up only a few examples. Take the well known reaction of the neutralization of acids and bases. In terms of the theory of electrolytic dissociation, a dilute aqueous solution of a strongly dissociated electrolyte contains no molecules, only ions. A solution of a base contains the hydroxyl anion, and a cation whose nature depends upon the base used. A solution of an acid contains the hydrogen cation, and an anion whose nature depends upon the acid chosen. Similarly, a solution of a salt is but a solution of anions and cations. To take as a concrete example, hydrochloric acid and sodium hydroxide, the reaction would be represented thus:

$$\bar{Cl} + \dot{H} + \bar{OH} + \dot{Na} = \bar{Cl} + \dot{Na} + H_2O,$$

or in general:

$$\bar{A} + \dot{H} + \bar{OH} + \dot{C} = \bar{A} + \dot{C} + H_2O.$$

The anion of the acid and the cation of the base remain unchanged in the process of neutralization, which consists only in the formation of water. If this is true, then the process of neutralization of a given acid by a given base, is the same as the neutralization of any other acid by any other base.

This can be tested directly by experiment. The heat liberated in the neutralization of an equivalent of a completely dissociated acid by an equivalent of a completely dissociated base, being always the heat of formation of the same amount of water from the ions $\dot{H}$ and $\bar{OH}$, must be a constant, independent of the nature of the acid or of the nature of the base. The following results show that this is true:

	HCl. HBr. HI.	HNO_3.	CH_3COOH.	HCOOH.
NaOH	13.7 Cal.	13.7 Cal.	13.3 Cal.	13.4 Cal.
KOH	13.7	13.8	13.3	13.4
$\frac{1}{2}Ca(OH)_2$	14.0	13.9	13.4	13.5
$\frac{1}{2}Ba(OH)_2$	13.8	13.9	13.4	13.5
$\frac{1}{2}Sr(OH)_2$	14.1	13.9	13.3	13.5

The agreement between the heats of neutralization is striking, in consideration of the necessary errors involved in thermo-chemical measurements.

The theory of electrolytic dissociation thus brings together all the processes of neutralization of acids by bases, and refers them to a common cause, the union of the hydrogen and hydroxyl ions to form water.

It may be stated that it has been shown by no less than a half-dozen separate pieces of work, that hydrogen and hydroxyl ions cannot exist in the presence of one another, in any appreciable quantity, uncombined; or, in a word, water is undissociated.

Another example may be taken from chemistry.

If the properties of solutions of electrolytes are properties of the ions, then what relation exists between the chemical activity of solutions and their dissociation? The dissociation of substances must be determined, and also their power to effect chemical reaction, and the results of these two measurements must then be compared. A few of the many results available will suffice to bring out the relation. In column I are given the dissociations of acids referred to hydrochloric acid as 100; in II, the velocities with which they effect the catalysis of methyl acetate; in III, the velocities with which they invert cane sugar.

	I.	II.	III.
HCl	100	100	100
H_2SO_4	65.1	73.9	73.2
HCOOH	1.68	1.31	1.53
CH_3COOH	0.42	0.34	0.40
$CH_2ClCOOH$	4.90	4.30	4.84
$CHCl_2COOH$	25.3	23.0	27.1
CCl_3COOH	62.3	68.2	75.4
$(COOH)_2$	19.7	17.6	18.6
$CH_2(COOH)_2$	3.1	2.87	3.08
$C_2H_4(COOH)_2$	0.58	0.50	0.55

The agreement is as satisfactory as the conditions would allow us to expect.

The strength of acids is thus directly proportional to their dissociation.

We then naturally look for a common cause of that property which we describe as *acid*, in compounds such as those given in the last table, and this is easily found. All of these compounds dissociate into a hydrogen cation ($\dot{H}$) and an anion, whose nature depends upon the compound in question, varying with every acid. Wherever we have hydrogen ions we have the acid property, and the strength of any acid depends only upon the number of hydrogen ions present.

The same applies to hydroxyl bases, where their strength depends upon the number of hydroxyl anions ($\dot{O}H$) present.

The direct quantitative relation between chemical activity and dissociation has now been so frequently established that we often use dissociation to measure chemical activity, and also chemical activity to measure the amount of dissociation.

And this raises the question as to whether chemical activity is due solely to ions. Are molecules incapable of reacting with one another? It would be going too far, in the light of our present knowledge, to maintain this. There are substances known which apparently do not conduct at all (are completely undissociated), and yet react chemically. There are cases known of dry solids, which we suppose contain only molecules, reacting with one another. We have well characterized chemical compounds formed by the union of two parts of apparently the same general electrical character: thus phosphorus and chlorine, chlorine and bromine, chlorine and iodine, etc. Yet chemical reactions in which acids and bases are involved are now known to be reactions involving only ions, molecules as such not coming into play. And indeed the number of reactions which are known to be purely ionic, is very great, including the majority of the cases with which we have to deal in chemistry.

The application of the theory of electrolytic dissociation is by no means limited to chemical phenomena. It touches with equal success, certain sides of physics. With its aid we are now able to calculate the electromotive force of many forms of primary cells, knowing the concentration of the solutions of electrolytes used around the electrodes. We have also, for the first time, been able to locate the seat of potential in such cells, which has been an unsettled question every since the discovery of the battery by Galvani and Volta, at the close of the last century.

The theory of electrolytic dissociation was not applied to biological problems as early as to chemical and physical. This is probably due to the greater complexity of those phenomena in which life is involved. But a beginning has already been made in this direction. Kahlenberg and True have shown that the toxic action of a number of acids on a certain plant, is due to the hydrogen ions of the acids, and similarly the toxic action of a number of bases can be ascribed to the hydroxyl ion of the base.

Loeb has found that the power of a frog's muscle to absorb water in the presence of acids, is dependent upon the number of hydrogen ions present,—upon the dissociation of the acid.

The pharmacologists have actively employed the theory of electrolytic dissociation in the solution of a number of problems. In this connection the work of Dreser is especially to be mentioned, and the theory has also been extended to problems in disinfection, by Paul and Krönig.

The applications of the theory of electrolytic dissociation above considered, are but a very few, taken from a large number where its significance has been already recognized. While it has suggested much new experimental work in several branches of chemistry, and in the study of the electromotive force of elements, yet, it seems to me, that perhaps its greatest service thus far to science has been in correlating facts, pointing out relations hitherto unobserved, and thus leading us from unclassified to at least partly classified knowledge. This has resulted, in a number of cases, in wide-reaching generalizations. We are thus led one step nearer to the solution of the question, not simply how do substances behave in the presence of one another, but why do the phenomena observed take place?

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LOCALIZED SCLEROSES OF THE AORTA OF PROBABLE SYPHILITIC ORIGIN. CLINICAL REPORT AND NECROPSY IN TWO CASES.

By Clement A. Penrose, M. D., *House Medical Officer, The Johns Hopkins Hospital.*

At the request of Dr. Osler I presented (February 7, 1898) to the Medical Society the clinical report and necropsy in a case of circumscribed or nodular arterio-sclerosis of probable syphilitic origin and located quite definitely in two portions of the aorta. Since then we have been fortunate enough to obtain the notes in a second case, that died recently in the hospital, and showed also a well localized sclerosis of the aorta of a circumscribed or nodular type, less advanced and with an even more positive etiology of syphilis.

Case I. J. K., age 36, married, white, an American, a barber by trade, was admitted Tuesday, Jan. 4, 1898, to ward F of the Johns Hopkins Hospital.

Family History. As a child had measles, mumps, whooping cough, and pneumonia. At 19 thought he had syphilis; remembered a primary sore, but could give no definite history of secondary symptoms or treatment. One year later an attack of gonorrhœa. Malarial fever at 24, and at 29 acute rheumatism, with a second attack one year ago. When a young man was a sailor, worked hard, and was not infrequently drunk.

Present Illness. Was well and strong until Nov. 1897, when symptoms of non-compensation of the heart, shortness of breath, palpitation, œdema, etc., set in acutely, and increased in severity up to the time of admission.

Physical Examination. A well-nourished, strongly built man, with symptoms of marked aortic and mitral insufficiency and the corresponding physical signs. Of *especial interest* is a roughened first heart sound in the second right interspace, pronounced dyspnœa relative to other symptoms, absence of any hardening of the radials, for the most part a normal or subnormal temperature, with comparatively slow rate of pulse and respiration (average 90 and 25 per minute), and lastly, a poor reaction to treatment.

The patient improved somewhat, left the hospital 12 days after admission to arrange some private matters, was away one week and returned in about the same condition as on first entry. He gradually sank, and died Jan. 24, 1898, with Cheyne-Stokes respiration for one hour, and slight convulsive movements for a few minutes before death.

Autopsy. The following conditions were found: a slight insufficiency of the aortic valves as indicated by the water test; an absence of vegetations on any of the valves, which were normal, except for a slight thickening and shortening of one of the aortic segments, and considerable hypertrophy with some dilatation of the heart confined chiefly to the left ventricle. The heart muscle on section showed exquisite fatty degeneration, with here and there fibrous areas.

Of special interest was a circumscribed or nodular form of sclerosis, localized in two portions of the aorta, one patch of which involved the ascending and transvere sections of the arch and gave rise to an aneurismal dilatation about the size of one's fist (12 cm. long by 17 wide) extending posteriorly and to the right, containing no blood clots. The walls of the aorta in this region presented a rough, uneven surface; no atheromatous or calcareous degeneration was visible.

The descending portion of the arch and thoracic aorta were practically free from sclerosis until a point was reached a short distance above where it pierces the diaphragm. Here a second patch of sclerosis was found extending down about 8 cm. to the cœliac axis, showing diffuse thickening with nodular elevations especially well marked about the openings of the intercostal arteries.

Microscopical examination showed considerable round cell infiltration and degeneration of the media, interrupting here and there the course of its muscle fibres, with marked irregular thickening of the intima. In places there was some round cell infiltration of the adventitia also. Dr. Flexner in one section found a rather suspicious nodule of epithelioid cells in the media, suggesting a gummatous formation.

Case II. J. R., age 35, single, colored, a laborer, admitted Feb. 2, 1898, to Ward M.

Family History. Negative.

Personal History. None of the diseases of childhood. At 25 had rheumatism, and has had one or two attacks since. Gonorrhœa at 27. He denied syphilis, but showed on corona of penis a well defined, elevated scar about 1.5 cm. in diameter, which seemed fairly recent. He drank moderately. Was not a hard worker.

Present illness began four months ago with shortness of breath, palpitation and œdema, which have been growing steadily worse.

Physical Examination. Strong, well-nourished man, presenting symptoms of aortic and mitral insufficiency with corresponding signs. Dr. Osler, in a note made Feb. 26th, called attention to the wiry character of the systolic murmur in the mitral area, the development of a Flint murmur just outside the nipple, and to the moderate grade of sclerosis of the arteries.

The patient slowly sank, and died quietly, March 3, 1898. His average pulse rate was 104, his respiratory 24, and his temperature 99.5° F.

Autopsy. The heart was much enlarged, both ventricles hypertrophied and dilated. The aortic valve was insufficient to the water test and showed on examination a diffuse thickening with shrinking of the anterior and posterior coronary segments, the intercoronary segment being fairly normal.

The aorta just above the lesion in the valve was the seat of an irregular patch of atheroma, 3 by 4 cm. in diameter, which extended into the sinus of Valsalva of both the anterior and posterior segments and from there out on the valve. The aorta appeared slightly dilated at the portion of the arch where the sclerosis was situated. The anterior and posterior coronary arteries showed yellow patches of atheroma along their course, but no evidences of calcification or occlusion. The aorta

generally was free from atheroma excepting a few yellow patches scattered here and there over the intima.

Microscopical examination of the patch of sclerosis showed marked round cell infiltration of the media, which in places appeared to be quite broken up, the muscle fibres being separated by an œdematous cellular tissue. The adventitia was also considerably infiltrated with small round cells, but the vasa-vasorum showed, however, little change. Nowhere were any definite gummatous nodules found, although a number of sections were examined.

In addition specimens of the chancre scar were examined which showed marked thickening of the epithelium, with an elevation above the surrounding coronal tissue and much subepithelial granulation tissue formation, but no especial vascular changes.

On consulting some of the authorities as to the significance of these localized arterio-scleroses one is impressed with their unsatisfactory classification from a clinical point of view.

Accepting Dr. Councilman's division of arterio-scleroses into the nodular or circumscribed, the diffuse and senile forms, we scarcely know where to place those cases in which both nodular and diffuse scleroses coexist, or cases in which the lesions are definitely localized, at least macroscopically. In addition many writers seem to confuse the term nodular or circumscribed with localized, the former applying more properly to the small nodular elevations or compensatory thickenings in the vessel wall than to the sclerosis as a whole.

It was necessary therefore to look up the subject of localized sclerosis under each one of its etiological factors in the various works at hand, and chiefly under the heading of syphilis, thinking it to be the most probable agent in the two cases under consideration. Forms of localized inflammations and degenerations in arteries arising from local influences such as injuries, burns, skin diseases, tuberculosis and leprosy, fade so gradually into those general arterial conditions arising from general influences such as gout, rheumatism, hard-work and alcohol, that, midway, we find a group of cases very hard to classify.

Syphilis demonstrates remarkably in its different stages this transition from *the local changes* in the arteries in the region of a primary chancre and in various secondary phenomena, up to the later *general arterio-scleroses* of the tertiary period; while intermediate are cases similar to the two reported, where the conditions causing the sclerosis seem general but which present a more or less localized manifestation.

Thoma says we must discriminate between the effects of the luetic virus and disturbances in nutrition caused by lues, when considering arterio-scleroses.

George Thibierge says: "The sclerosis of syphilis is less diffuse than that due to other causes, is more localized, shows often a marked proliferating endarteritis and periarteritis, and is occasionally associated with the formation of gummata containing epithelioid cells and giant cells."

Ziegler says: "Nodular scleroses have a greater tendency to be localized," and later he shows that syphilitic sclerosis tends to be nodular.

Neumann says: "Syphilitic arteritis tends to be nodular."

Chiari described a typical endarteritis obliterans in a child 5 months old, dead from congenital syphilis, and suggests this as an etiological factor in obscure cases of arterio-sclerosis.

Oettinger cites cases of localized arterio-scleroses following acute infective diseases, but occurring in cases under 20 years of age, and quotes Parrot, Andral and Crisp.

Many of the authors, Nasse, Cornil, Huchard and others, show that in tuberculosis we have well localized arterio-scleroses in arteries of the lung and brain.

Heubner says: "Luetic sclerosis begins as a subendothelial growth and later invades the adventitia."

Baumgarten and Lancereaux say: "It starts first in the lymph vessels of the adventitia and later attacks the intima."

Arthur Ernest Sansom says the great pain in certain cases of syphilitic arterio-sclerosis is due to the especial involvement of the adventitia, which has a more abundant nerve supply. He quotes Huchard, who said 35 out of 150 cases of angina pectoris gave a luetic history. He shows that the most pronounced cases of aneurism of the aorta among young persons or among those in the prime of life, were due to syphilis, and that prostitutes for this reason are affected with aneurism of the aorta much more frequently than other classes of women. He quotes Karl Malmsten of Stockholm, who said 80 per cent. of his cases of aneurism were luetic, and Aitken, who said 50 per cent. of soldiers thus afflicted gave a syphilitic history, 5 per cent. a gouty and 5 per cent. a rheumatic.

Welch says that the nodular forms of arterio-sclerosis or endarteritis deformans are limited to the aorta and larger arteries.

Osler thinks that the points of origin of the large branches of the aorta are more prone to undergo sclerotic changes and hence form aneurisms.

Huchard in a very satisfactory manner, in his elaborate article on arterio-sclerosis, sums up his conclusions regarding the effects of syphilis on the arterial system as follows:

Local scleroses are only a beginning of a general condition, as is shown by the microscope, and he quotes Duplaix, who says "General sclerosis is always found by those who look for it." The chief characteristics of syphilitic sclerosis are:

(1) It is nodular and not diffuse.

(2) It has a tendency to invade portions only of a vessel-wall.

(3) Its onset is usually chronic, but it may be acute.

(4) The points of attack in order of frequency are:

1. Cerebral arteries.
2. Aorta—especially ascending portion of arch.
3. Arteries of heart.
4. Arteries of pericardium.

(5) It has a tendency to obliterate vessels.

(6) It has a tendency to form aneurisms.

(7) In analogy with tuberculosis it has a tendency to obliterate arteries, to form aneurisms, and to become localized.

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FURTHER REMARKS ON ADENO-MYOMA OF THE ROUND LIGAMENT.

By Thomas S. Cullen, M. B. (Tor.), *Associate in Gynecology, Johns Hopkins University.*

In the May-June number of the Bulletin, 1896, I reported a case of adeno-myoma of the round ligament, the first on record. Since that time three cases bearing on the same subject have occurred, and our own case has revealed some very instructive etiological factors.

Pfannenstiel* reports the case of an unmarried woman, 39 years of age, who had long been suffering from dysmenorrhœa, and who came under observation on account of a tumor in the right inguinal region which had made its appearance about six months previously. On examining the patient a nodule was also found in the vagina; this Pfannenstiel supposed was the primary tumor, and inferred that the nodule in the inguinal region was a metastasis. The uterus and its right appendages, together with the nodules in the inguinal region and vagina, were removed. The vaginal nodule on section presented the picture of a myoma, but scattered throughout it were yellowish-brown dots of pigment, and it contained fine depressions and cysts. On histological examination the tissue was found penetrated in all directions by glands, and in their cavities were pigment granules, and in one place a pseudo-glomerulus was found. The nodule from the inguinal region was scarcely the size of a walnut. It was situated a short distance within the external ring and presented the same picture as the vaginal nodule. In short, Pfannenstiel says there was a simultaneous appearance of adeno-myoma at two different points in the genital tract. He identifies his case with the same group as the one reported by us.

v. Herff† examined two vaginal myomata removed by Fehling during a hysterectomy for prolapsus uteri. One of these contained numerous delicate glands, some of which were branched and slightly dilated, others formed small cysts. These glands lay as little islands in the musculature. The gland epithelium was either cuboidal or low cylindrical. At no point could a comb like arrangement of the glands or the pseudo-glomeruli of v. Recklinghausen be demonstrated.

Blumer's* case, 47 years of age, had first noticed the growth 23 years before coming under observation. At that time it formed two distinct nodules, each about 6 mm. in diameter, in the right groin. These gradually coalesced and the combined tumor grew slowly until six months ago, since which time it rapidly increased in size, being at the operation as large as a hen's egg. The growth had never been painful, even at the menstrual period. Dr. Van der Veer, who removed the tumor, believed that it originated in the inguinal canal.

The tumor was firm in consistence, greyish-white in color, and contained pin-point hemorrhages; in most points it resembled an ordinary uterine myoma. Histological examination showed that the tumor was composed mainly of non-striped muscle fibres, and in one section gland elements were found. These appeared round or oval, but occasionally as dichotomously branched spaces. The gland epithelium was cylindrical and contained oval, darkly staining nuclei; in some places cilia could be seen. The glands were in direct contact with the muscle, there being no stroma intervening, and Blumer was unable to find any structures resembling pseudo-glomeruli or to make out any sign of pigmentation.

Our patient (Gyn. No. 5286) was readmitted to the gynecological ward, May 25, 1897. Shortly after the previous operation she noticed a swelling in the opposite or left inguinal region immediately above the pubes. This has gradually increased in size and is quite painful. The menstrual period has not been regular, occurring at intervals of from three to five weeks. The last menstruation commenced May 18th and ceased May 23d. On May 26th I removed the nodule with little difficulty and found that it was directly continuous with the left round ligament.

Pathological report. Gyn. Path. No. 1741. The specimen consists of an irregular mass approximately 3 cm. in its various diameters. It comprises a firm central portion 1.5 cm. in diameter, which is surrounded on all sides by adipose

* Ueber die Adenomyome des Genitalstranges. Verhandlungen der Deutschen Gesellschaft für Gyn., 1897.

† Ueber Cystomyome und Adenomyome der Scheide. Verhandlungen der Deutschen Gesellsch. f. Gyn., 1897.

* A Case of Adeno-myoma of the Round Ligament. American Journal of Obstetrics, 1898, XXXVII, p. 37.

tissue. Traversing the central portion are numerous delicate fibres, and at several points are brown or yellow homogeneous areas. Several pin-point cavities are demonstrable. At one point is a semicircular slit 2 mm. long, and in the immediate vicinity an irregular cavity averaging 3 mm. in diameter. The walls of this cavity are rather uneven and are slightly granular.

Histological examination. The adipose tissue in the outlying portions is comparatively normal, but as one approaches the firm nodule the blood-vessels increase in number and size, young capillaries are found wandering in between the fat cells, and there is considerable connective tissue increase, the fat cells becoming gradually separated from one another. At the margin of the firm nodule the tissue is composed almost exclusively of connective tissue. Here and there this connective tissue encircles round or oval clumps of cells having oval, fairly deeply staining nuclei, and scattered between these are a few small round cells and occasionally polymorphonuclear leucocytes. Such areas are very striking on account of their richness in nuclei, in contrast to the surrounding tissue which is poor in cell elements. The cellular areas resemble closely the stroma of the uterine mucosa. On passing toward the centre of the nodule similar areas are found containing one or more glands lying in their centre or at the periphery. These glands, according to the angle at which they are cut, are round, elongate or slightly branching. Their epithelium is cylindrical, apparently ciliated, and their nuclei are oval and situated some distance from the base of the cell. In short these glands cannot be distinguished from uterine glands. The majority of the gland cavities are completely filled with blood and desquamated epithelial cells. The stroma of the central portion of the nodule is composed almost entirely of non-striped muscle fibres, and here the glands are more abundant and present a more complicated picture. The glands are branching, form narrow channels and little bays, and in places can be traced in their continuity for at least 4 mm. On one side of the gland there is usually considerable stroma separating the epithelium from the underlying muscle. At such points the epithelium is cylindrical, but on the opposite side where the cells rest directly on the muscle it is frequently flattened. There are a few areas corresponding to von Recklinghausen's pseudo-glomeruli; some of these contain glands, others do not.

Origin. Even from such a small number of cases we are able to gather valuable information as to the distribution of these tumors. In v. Herff's case the nodule was limited to the vagina, Blumer's to one inguinal region, while Pfannenstiel's contained two nodules, one in the inguinal region and a second in the vagina, and in our case nodules were found in both inguinal regions. This apparently varied distribution seems nevertheless to follow definite channels, viz. the round ligament on one or both sides, and it will be little wonder if in later publications reports of adeno-myomata near the uterine end of the round ligament will be recorded.

Pfannenstiel and v. Herff mention nothing as to any definite relation between menstruation and the nodule, but Blumer states that menstruation in no way affected the nodule in his case. When publishing our case I drew attention to the excessive pain in the nodule at the menstrual period, suggesting some definite sympathetic relation between the uterus and the nodule in the round ligament.

Two sources of origin for these tumors have been suggested, viz., from a displacement of a portion of the Wolffian body or from a part of Müller's duct. v. Recklinghausen has very kindly examined sections from the nodule removed from the right round ligament in our case and thinks that it is undoubtedly of Wolffian origin. v. Recklinghausen,* after seeing Pfannenstiel's and v. Herff's specimens, says that these also are of Wolffian origin. When publishing our case I made the following remark: "While admitting the probability of the glands in our case being due to remains of the Wolffian body, we cannot, from their striking resemblance to those of the uterine mucosa, and from the fact that their stroma resembles that of the mucosa, refrain from suggesting the possibility that they may be due to an abnormal embryonic deposit of a portion of Müller's duct." In this connection the relation of the last menstrual period to the presence of blood in the glands is interesting. Menstruation commenced May 18th, ceasing May the 23rd, or just three days before operation, and on making sections the glands were found filled with well preserved blood. In adeno-myomata of the uterus and also of the round ligament, blood or blood pigment is met with in the gland cavities in the gland epithelium or in the underlying stroma. If these glands be derived from a portion of Müller's duct we would naturally expect them to fulfil, at least in part, the functions of the normal uterine mucosa, viz., furnish their quota of blood at the menstrual period. Under the existing conditions, however, this blood cannot escape and will be gradually taken up by desquamated cells lying in the gland cavity, by the epithelium or by the stroma cells. In our case the blood was not perfectly fresh, but the corpuscle outlines were still intact. This is what might be expected, assuming that the hemorrhage had occurred at the menstrual period. I am still more inclined to favor the Müllerian origin than heretofore.

Prognosis. Our case was of eight years' duration, and on histological examination gave no signs of malignancy, showing that the growth was benign in character. Blumer's case is even more convincing, as it had been followed for 23 years, the growth in that time not becoming larger than a hen's egg, and on microscopic examination also showing its harmless character.

* Personal communication.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of February 21, 1898 (*continued*).

Regeneration of the Dorsal Root of the Second Cervical Nerve within the Spinal Cord.

Messrs. BAER, DAWSON and MARSHALL.—The present work was undertaken in order to determine whether it is possible to obtain regeneration of the nerve fibres within the spinal cord, and these studies were confined to the regeneration of the dorsal-root fibres after their continuity had been destroyed between the spinal ganglion and the cord.

The second cervical nerve of the dog was selected for the experiments, because the spinal ganglion of this nerve lies outside the intervertebral foramen. The dorsal root can, therefore, be operated upon much more readily and with less danger of injuring the cord than would be the case if it were necessary to open into the vertebral canal. There were, also, reasons connected with the histological work which made it advisable to select the second cervical nerve.

The two roots of this nerve pass together to the ganglion 2 mm. beyond the foramen, the trunk then subdividing to supply muscular and cutaneous branches to the neck and base of skull. The occipitalis magnus, with which we are chiefly concerned, courses through the neck muscles and beneath the skin, to end in the integument behind the ear. The second cervical is connected with the sympathetic, not by a mixed ramus communicans, but by a gray ramus alone.

The present article deals only with the physiological results; the histological studies will be completed at a later day. Our method of investigation included two operations. At the first, the roots of the second cervical were tightly ligated, so as to destroy the continuity of the dorsal-root fibres and cause them to degenerate throughout their extent in the cord. The animals were kept alive long enough to allow regeneration to follow the degeneration.

At the second operation the nerve was tested for return of function of the dorsal root. Such a return would be indicated by reflex variations in respiration, blood pressure and pulse rate, which might follow stimulation of the nerve in question.

As control experiments, kymographic tracings were obtained from two normal dogs, showing the reflex changes due to stimulating the second cervical nerve.

At the first operation the occipitalis magnus was followed through the muscles and exposed as far as the cord. The roots were freed from surrounding tissue, a ligature was passed around them and tied tightly, great care being taken to avoid exerting traction upon the cord. The ligature was then cut away, leaving a constriction plainly visible at the point of ligation; the two parts of the nerve being united only by a tube of translucent connective tissue—the epineurium—while the continuity of the enclosed fibres was destroyed. In every case the wound healed per primam.

The interval between the first and second operations was about 90 days, the two longest intervals being 109 and 151 days.

At the test for regeneration a canula was inserted into the carotid artery and connected with a mercury manometer which was made to record upon a kymograph. Similarly the trachea was connected with a tambour which was arranged to give a kymographic record. A time recorder and a stimulating or short-circuiting key also recorded upon the kymograph, so that the tracings were made to give four simultaneous records, that of circulation, respiration, time, and duration of stimulation.

Scar tissue rendered dissection more difficult than previously, but the nerve was exposed as at the first operation and stimulations were applied at various points along the occipitalis magnus, upon the ganglion and upon the roots. Stimulations were of two kinds, faradic and mechanical. The current was never of greater strength than sufficient to cause slight pain when the electrodes were touched to the tongue, and for the most part a weaker current was used. Mechanical stimulation consisted in crushing the nerve with forceps or a ligature.

The results obtained upon the several dogs may be summarized as follows:

In the two normal dogs, used as controls, every stimulation of the second cervical nerve was followed by marked increase in the frequency of pulse and respiration, increased amplitude of respiration and a rise of blood pressure; these being the usual reflex effects of stimulating a sensory nerve.

In dog I, every stimulation caused increased amplitude of respiration, rise of blood pressure, and usually, but not always, a quickening of pulse and respiration.

In dog II, stimulation of the ganglion and roots caused an increase in the amplitude and rate of respiration and a rise of blood pressure. The pulse rate showed practically no reflex change.

In dog III, faradic stimulation at the ganglion and mechanical stimulation of the occipitalis magnus caused a rise of blood pressure, with an increase in the rate and amplitude of respiration. The pulse rate was affected variably and to only a slight degree.

Dog IV responded less to stimulation than any dog of the series. Respiration was unaffected throughout. The pulse rate and blood pressure showed reflex variations for the first three stimulations of the occipitalis magnus, after which there was no sensory reflex present.

Dog V gave positive but diminished changes after stimulation in respiration, blood pressure and pulse rate.

Dog VI responded very slightly, but gave both respiratory and cardio-vascular reflex changes.

In the case of dog VII very positive reflex changes were obtained. Blood pressure was greatly affected, while the respiratory reflex was tremendous.

From a study of the above experiments it appears that a more or less complete return of function occurred in every

case, although the reflex effects were very slight in dogs IV and VI. Such an apparent return of function might be produced in several ways.

1. By failure to destroy the continuity of all the dorsal-root fibres at the first operation. The following facts contradict this assumption. After obtaining the usual effects from stimulating the second cervical nerve of a normal dog, the roots were ligated in the usual manner. Subsequent stimulation produced no effect. Again, after giving the routine stimulations to dog III, with positive results, the roots were again ligated. Subsequent stimulation was without effect, and microscopical examination showed a complete break in the continuity of the fibres at the point of ligation.

2. The apparent return of function might be due to anastomosis with neighboring nerves. But the above-mentioned controls on dog III and a normal dog show that although the finer ramifications of the second cervical anastomose with neighboring nerves, it is not possible for impulses to pass from a branch of the second cervical to the cord through these connections.

Again, escape of current to the cord might be assumed to account for the apparent return of function, but that this was not the case is shown by the positive results of mechanical stimulation of the nerve. Moreover, in every case the nerve was dissected out and retracted from the surrounding tissues before the electrodes were applied, and in some cases positive results were obtained from stimulation with weak currents applied at the extreme periphery of the occipitalis magnus about 6 cm. from the ganglion. In the case of the ganglion, where retraction was impossible, many of the stimulations, especially with strong currents, were accompanied by control stimulations of the surrounding tissues, and always with negative results.

We are left, then, with but one explanation of this return of function, which is, that the reflex effects were produced by impulses passing through the dorsal root of the nerve stimulated, that is to say, through the dorsal root of the second cervical nerve.

Such a return of function could occur in only one of two ways. Either the root may be regenerated from fibres having their trophic centers within the cord, or else the regeneration may proceed from trophic centers outside the cord. From a study of the literature it is a justifiable conclusion that all the fibres of the dorsal root of the second cervical nerve in the dog spring from centers outside the cord. Therefore, any return of function of the injured dorsal root is proof of regeneration of the injured fibres both in the root and within the cord itself.

As we have seen, there was return of function in every animal experimented upon, though the degree of restoration varied in the different cases.

Owing to the limited number of our experiments we have been unable to determine how complete regeneration may be, and how it is influenced by varying conditions.

After the first few days the animals did not appear to suffer inconvenience from the first operation, nor was there any evidence of trophic disturbance over the area supplied by the injured nerve.

The completeness of functional return appeared to depend very little upon the length of the interval between the first and the second operations. The most complete return of function occurred in dogs I and VII, with an interval between the operations of 90 days and 109 days respectively. The lowest degree of regeneration was seen in dogs IV and VI, with intervals of 90 and 151 days respectively.

We could not determine how the power of regeneration is affected by the age of the animal selected for experimentation. Of the only two adult dogs operated upon, one (dog I) gave marked reflexes, the other (dog IV) gave only slight evidence of regeneration.

There is, however, one condition, namely, scar tissue around the nerve, which exerts an unfavorable influence upon regeneration. This action has been frequently discussed by other observers, and we consider that the successful regeneration of the dorsal-root fibres in these cases has been due, in great measure, to the fact that the new growth of the fibres was not interfered with by the presence of excessive scar tissue; the operation employed reducing to a minimum the cicatricial tissue at the growing point of the nerve. In only one case, dog VI, was the spinal ganglion affected by scar tissue. Here the ganglion was distorted and bound down by adhesions, and, correspondingly, the sensory reflexes were very slight in this case.

From the experiments described above we feel justified in concluding that, after severance of the fibres of the dorsal root of the spinal cord, between the ganglion and the cord, regeneration of the fibres into the cord will take place under suitable conditions, so that normal reflexes upon the respiratory, cardiac and vaso-motor centers may be obtained.

Finally, we wish to thank Dr. Howell for his many valuable suggestions and the interest which he has taken in our work.

Discussion.

Dr. Barker.—This study, if confirmed, and it seems likely that it will be confirmed, includes results of importance not only for the physiologist and anatomist but also for the clinician. It leads us to hope that regeneration within the central nervous system may occur much more extensively than has hitherto been thought possible. It is true that most investigators believe at present that destruction of cells within the central nervous system means a permanent loss, since the opinion is general that there can be no regeneration of ganglion cells once destroyed. There have been two researches, however, recently, one by Vitzou and another by Tedeschi, on regeneration of nerve cells in the cortex of monkeys after extirpation. The results of these experiments, though worthy of note and control, by no means justify the extravagant enthusiasm which has been manifested by certain lay journals. The problem in the research reported to-night, however, is somewhat different, inasmuch as the regeneration of nerve fibres alone is postulated, not the regeneration of total neurones.

In connexion with this study of Messrs. Baer, Dawson and Marshall we shall await with interest the results of the histological examination. It is necessary that the return of fibres within the dorsal root and within the cord itself shall be

histologically demonstrated, although from the physiological experiments reported there can be but little doubt that this proof will be easy to bring forward.

Mr. MARSHALL.—With Dr. Barker, we look forward with great interest to the histological findings in the cases just reported, but we are, nevertheless, of the opinion that the physiological evidence is weightier and of more positive value than the histological.

When the experiments were undertaken, I may say, it was our intention to complete both the physiological and histological sections before making public our results. But the former method yielded results which were so unequivocal that we felt justified in publishing the physiological work alone, in the belief that the histological studies could be only confirmatory.

Hydraulic Pressure in Genito-Urinary Practice.—Dr. H. H. YOUNG. [See May BULLETIN, p. 100.]

Dr. RUSSELL.—At the request of Dr. Kelly I will briefly report the following case of cystitis treated in his private hospital by Dr. Young's method. The case, although not one of contracted bladder, shows the value of this method in the treatment of cases of chronic cystitis where the ordinary irrigation and drainage have failed. Mrs. L. F. D., age 32, five years ago, after an instrumental labor, had a severe attack of acute cystitis, and since then there has been almost constant bladder trouble. She cannot hold her urine longer than two hours, day or night, and usually the interval is much less. Urination is nearly always attended by severe pain, and occasionally she loses control over the bladder. Three years ago she had Emmet's button-hole operation, which gave relief during the eight months the bladder was drained, but as soon as the fistula was closed the old trouble returned. Pus has been present in variable quantity during this time, and occasionally blood. Once there was quite a free hemorrhage from the bladder. Her husband has been washing out the bladder through a catheter, which has given temporary relief.

February 25, 1898.—An examination revealed a complete tear through the perineum and an acutely retroflexed uterus. The bladder on the posterior surface was deeply reddened, but no vessels were seen. In the left lower quadrant was a deposit of white lymph and mucus intimately adherent to the surface beneath it. The vault of the bladder was mottled with red injected areas, and absolutely no vessels could be seen. The affection was most severe at the base of the bladder, which was covered with extensive greyish deposits, the largest area being on the left side at the junction of the wall and base, covering an area about 3x3 cm. The left ureteral orifice appeared as a little point in the midst of a white area. These greyish areas had irregular margins covering shallow ulcers of the mucous membrane. The only trace of sound mucosa was about the internal orifice of the urethra.

The bladder was then thoroughly curetted by a sharp curette, and about 2 oz. of a twenty per cent. solution of silver nitrate was injected, followed immediately by a pint of normal salt solution.

Two days later Dr. Young's method was employed, the irrigation being given every two hours. After two weeks the improvement was so marked that the number of irrigations was dropped to intervals of four hours.

March 16th.—On account of some return of pain the patient was again examined under ether. The change in the local condition was astonishing; in every direction the mucous membrane had returned to normal, except at the left and base of bladder. This area has the same appearance as previously described and bleeds easily on touch. These points were again curetted and an application of silver nitrate made. The intervals between the irrigations were then reduced to six hours.

March 23rd.—A continuous steady improvement has been noted since the Young method was adopted. The patient now goes four to six hours frequently without voiding urine and sometimes sleeps all night. Several times during the past ten days the patient has been able to hold 500 cc. of solution during irrigation. The urine, which upon admission was loaded with pus and mucus and was always strongly alkaline, is now at times slightly acid and has only a small sediment.

Forty-six Intubated Cases of Diphtheria treated with Antitoxine.—W. T. WATSON, M. D.

Of the 46 cases reported, 37 recovered and 9 died, giving a mortality of 19.5 per cent.

The recovered cases were of all grades of severity, from the cases in which the constitutional symptoms were slight and the children lively and playful as soon as the laryngeal stenosis was relieved, to those in which there was such profound prostration that for days life was despaired of. In some cases the tube was coughed up in two or three days and did not have to be replaced; in others it had to remain in for two weeks, and in one instance for 22 days. In the earlier cases the tube was allowed to remain in place for a week, unless coughed up or taken out to be cleaned. In the later cases, according to the practice of O'Dwyer, the tube was removed in four days and reinserted if necessary.

In some cases the nourishment was entirely liquid; in others, particularly the later cases, the children were given anything they would take, liquid or solid, of a wholesome character.

Only in one case, where for two days the patient was unable to swallow, was nasal feeding found necessary.

The amount of antitoxine in the earlier cases was almost invariably 1000 units; in the later cases the initial dose was usually 1000 units for a child under two years and 2000 units for children of two and over. It was usually given just after intubation.

The diagnosis was confirmed by culture, by membrane in the pharynx or which came up from the larynx during or after intubation, or by the presence of diphtheria in other members of the family.

Particular attention was paid to a study of the nine fatal cases. In at least four of them death was due to neglect, the children being in a practically moribund condition when intubation was performed and antitoxine administered. In one case, an infant of 11 months, the tube became blocked with a tough piece of membrane and the baby immediately suffocated. One died of broncho-pneumonia four days after the tube had been removed and the laryngeal symptoms had disappeared.

The other three cases received antitoxine and were intubated reasonably early, but died with symptoms of lung complication.

The death-rate from laryngeal diphtheria before the advent of intubation was almost 100 per cent. After the introduction of intubation it fell to about 75 per cent. At present with the antitoxine treatment some cases do not require operation, but in the operated cases the death-rate has fallen to about 27 per cent.

This death-rate is far too high and will be much reduced in the future when physicians are more impressed with the importance of the early use of antitoxine and early operation to relieve stenosis.

Intubation should be performed upon the first advent of dyspnœa. In some cases where the dyspnœa is slight the amount of mucus which will escape from its imprisonment below the glottis, during and after intubation, is often surprising. If this mucus is allowed to accumulate for many hours it is possible that it might be the means of conveying infection to the lungs and setting up a broncho-pneumonia.

Discussion.

Dr. Flexner.—The last point made by Dr. Watson, that of the release of the bronchial mucus and its expectoration, impresses me as very important. We know now, thanks to the studies of Wright and Kanthack and Stephens, that the secondary pneumonias of diphtheria are caused in the majority of instances by the Klebs-Loeffler bacillus, and are not pyococcal in origin as was formerly believed. Dr. Anderson and myself have also been able to show that intratracheal inoculation of pure cultures of the bacillus diphtheriæ in rabbits provokes a pneumonic process. The bronchial and tracheal mucus contains the diphtheria organisms, and often in large numbers, so that its aspiration into the lung substance is to be prevented as far as possible, in the hope of averting the lobular pneumonias which so often are the immediate cause of death.

Dr. Watson.—In determining to intubate every case where the first signs of dyspnœa appear I am led to do so because no harm can result from it. It is painless, bloodless, and can do nothing but good.

I think, too, that intubation should be done by the general practitioner. He sees these cases first, and sometimes the parents have already delayed the matter too long, and in some cases by the time the physician has arranged to secure the services of a specialist, the child is dead, or at least it is too late for it to recover. I recently had a case where the child died a few minutes after intubation just from exhaustion; it had been struggling for breath for 24 hours. I have been called to three cases within the last year and a half where the children were dead before I arrived, and I know that others in this city have had similar experiences. When the general practitioner becomes qualified to intubate the death-rate of laryngeal diphtheria will be greatly lowered.

NOTES ON NEW BOOKS.

Die Anaemie. I. Abtheilung. Normale und pathologische Histologie des Blutes. Von Geh. Med.-R. Prof. Dr. P. Ehrlich und Dr. A. Lazarus. 8vo. *Wien: Alfred Holder*, 1898. [Extract from *Specielle Pathologie und Therapie*. Herausgegeben von Hofrath Prof. Dr. Herman Nothnagel. Bd. viii, 1. Theil, 1. Heft.]

The contributions of Professor Ehrlich and his pupils to the study of the blood have been of such great importance that this work has been looked forward to with considerable interest, both by physiologists and practitioners; and neither will be disappointed in their anticipation.

The present volume deals only with the general normal and pathological histology of the blood. The consideration of the pathology of the blood in special diseases will be dealt with in a second fasciculus. In an introduction the clinical methods of blood examination are considered. In discussing the methods of estimation of hæmoglobin the authors justly speak of the value of the very simple clinical test, consisting in allowing a drop of blood to flow upon a piece of white cloth or filter paper, a method which if more used would prevent many a careless diagnosis of "anæmia."

They next take up the *morphology of the blood*, recommending especially the study of dried and stained specimens. The methods of preparing and examining dried cover-glass specimens are thoroughly set forth, and several valuable formulæ are given for the preparation of different staining solutions; that for the preparation of the *triacid* stain is of particular value as a distinct improvement over the previously recommended methods.

The section upon the *normal and pathological histology of the blood* begins with the consideration of the red blood corpuscles The well known idea of Ehrlich as to the manner of origin of poikilocytosis (schistocytosis) and its conservative significance is reiterated. The question of the manner of origin and significance of the different varieties of nucleated red corpuscles is then discussed in a most interesting manner. The authors maintain that the disappearance of the nucleus takes place in the normoblasts by extrusion, in the megaloblasts by fragmentation and absorption. These latter elements they have found only in pernicious and in bothriocephalus anæmia. The megaloblastic degeneration of the bone marrow is believed to be due to chemical influences of unknown origin.

The section upon the colorless corpuscles is, as might have been expected, one of great interest and importance.

The function of the spleen with regard to blood formation is considered at length. The conclusions reached from the work of Kurlov and others—that the spleen is of little importance as a producer of colorless corpuscles—that if cells be produced in the spleen, these are non-granular elements—that its function in this respect is more similar to that of the glands than to that of the bone-marrow—that "the spleen has not the least relation to ordinary leucocytosis," seem to be abundantly justified.

The fact that the glands are the seat of origin of the lymphocytes is clearly brought forth, and great emphasis is laid on the fact that no sufficient proof has yet been advanced that these cells have any genetic relation to the ordinary polymorphonuclear leucocytes. They form, according to the authors, a totally distinct and separate class of elements. This conclusion is in sharp contradistinction to that of the school of Uskov, who have assumed that the cellular elements of the blood have a distinct genetic relation to one another, the lymphocytes representing the youngest forms, the polymorphonuclear neutrophiles the fully developed or "old" elements, an attractive but hardly justifiable view.

It is interesting to note that the authors deny positively the power of lymphocytes ever to emigrate from the blood-vessels.

The bone marrow is shown to be the point of origin of those blood cells possessing specific granulations, neutrophilic, eosinophilic and basophilic (Mastzellen). The possible origin of the eosinophiles from fixed tissue cells is doubted. Beside being the

point of origin of the majority of the leucocytes in the blood, the bone marrow is regarded as a storehouse for the polymorphonuclear neutrophiles, from which, by chemotactic influences, they may be called forth in great numbers. 'Leucocytosis is a pure function of the bone marrow." In the section on the "*Demonstration and significance of the granules*" the original view of Ehrlich that these elements represent specific metabolic products of the cell is maintained. The granules of the cellular elements of the blood are believed to be truly specific; but one variety of granule ever appears in a single cell. The common idea that eosinophilic and basophilic granules may occur in the same cell is believed by Ehrlich to be due to misinterpretation of a staining reaction which may occur in young imperfectly developed eosinophilic cells, where some of the granules may for some time show a more or less well marked basophilic tendency. This color reaction is, however, always distinct from the sharp metachromatic stain taken by the true Mastzellen granulations. There is, the authors believe, some evidence that under circumstances the substance of the granules may become dissolved and escape from the cell. In conclusion they say: "In general the granules of the wandering cells are capable of being given off into the neighborhood. This elimination is possibly one of the important functions of the polynuclear leucocyte."

Leucocytosis is divided into an *active* and a *passive* form according to whether the cells increased in the circulation are incapable of individual movement and appear in answer to chemotactic irritants, or whether they are elements without locomobility which are washed passively into the circulation by mechanical influences. The type of the active form is represented by the ordinary polymorphonuclear leucocytosis; of the passive, by conditions of lymphæmia.

The active leucocytoses are separated into:

"(*a*). Polynuclear leucocytoses:

(1) Polynuclear neutrophilic leucocytosis.

(2) Polynuclear eosinophilic leucocytosis.

(*b*). Mixed leucocytoses in which granular mononuclear elements take part: 'Myelæmia.'"

The leucocytosis of the death agony is believed to be due solely to circulatory changes; the slowing of the current is followed by an accumulation of the leucocytes along the walls of the vessels. The polynuclear neutrophilic leucocytosis is considered, as has been said before, to be purely a function of the bone marrow, dependent upon chemotactic substances calling forth the neutrophilic cells from their storehouse. The authors also believe that in most instances the substances positively chemotactic for the neutrophilic cells act in a negative manner toward the eosinophiles; hence the small number of the latter cells in ordinary leutocytoses. All active leucocytoses are not, however, of chemotactic origin. In some forms an increased activity of the bone marrow or an extensive change of fatty into red marrow may be the exciting cause.

The various conditions under which the *polynuclear eosinophilic leucocytosis* occurs are next considered. The authors are strongly of the opinion that the eosinophilic leucocytosis depends also upon chemotactic causes, other, however, than those calling forth the polynuclear leucocytosis. They do not believe in the local origin of eosinophilic cells elsewhere than in the bone marrow, nor do they agree with those who believe that the eosinophilic granules may arise from a direct transformation of the neutrophilic elements, a view which, it is but fair to say, has considerable in its favor, especially the remarkable observations of Brown in trichinosis. They believe that these chemotactic substances, while in some cases—for instance, in helminthiasis—foreign to the organism, are, for the most part, the products of some tissue destruction in the body itself. Attention is drawn to the remarkable relation between the presence of Charcot's crystals and the increase in eosinophilic cells

The section upon *leukæmia* is extremely interesting. With justice, apparently, the authors insist that, from an hæmatological standpoint, there exist but two forms of leukæmia:

"(1). Leukæmic processes associated with an hyperplasia of lymphoid tissue: 'Lymphatic leukæmia.'

"(2). Leukæmic processes associated with hyperplasia of myeloid tissue: 'Myelogenous leukæmia.'"

Lymphatic leukæmia is divided into an acute and a chronic form. The increase in the number of lymphocytes is believed to be due to a passive washing out into the blood, not to an active emigration due to chemotactic influences.

Myelogenous leukæmia is discussed at length and an admirable description of the elements is given. "The microscopical picture of myelogenous leukæmia, apart from the almost invariable extensive increase in the colorless corpuscles, is conspicuous for its extremely variable and changeable character. This results from the association of various anomalies, namely:

A. Beside the polynuclear cells and their forerunners, the mononuclear granular leucocytes circulate in the blood.

B. All three types of the granulated cells, neutrophiles, eosinophiles and mast-cells, take part in the increase in the colorless corpuscles.

C. Atypical cell-forms appear; for instance, dwarf forms of different varieties of colorless corpuscles, and, moreover, mitotic figures.

D. The blood always contains nucleated red blood corpuscles, often in considerable numbers."

Attention is called to the constancy of the *absolute* increase in the number of eosinophilic cells in leukæmia, one of Ehrlich's original observations which every competent observer has been able to confirm.

Emphasis is also laid on the constant increase in the number of mast-cells in this disease. This is a point which, so far as we are aware, has been little emphasized and yet one of considerable importance. The authors justly remark that the mast-cells may be recognized as well in specimens stained with the triacid mixture as with the characteristic stains for basophilic granules, inasmuch as they are here represented by polynuclear non-granulated elements. We believe that in many instances it is possible to actually distinguish the non-stained granules in such specimens.

The nature of myelogenous leukæmia is discussed in an interesting manner, and the conclusion is reached that the "origin of the leukæmic blood picture is to be explained by the assumption that, under the influence of the specific leukæmic poison, not only the ripe polynuclear elements but also their mononuclear eosinophilic as well as neutrophilic forerunners, wander into the blood; that, therefore, myelogenic leukæmia is in all probability to be classed among the active leucocytoses."

The diminution of the leucocytes observed experimentally preceding leucocytoses, and believed by Loewit and others to be due to an actual destructive process (*leucolysis*), is thought to depend rather upon a negative chemotaxis. Attention is, however, called to the true *leucopenia* which may exist in some grave anæmias, dependent apparently upon a lack of activity of the bone marrow.

The authors speak guardedly with regard to the nature of the blood platelets as well as of the *hæmokonion* of Mueller.

The volume is a clear and direct statement of the views of the foremost living authority upon changes in the blood; it is an extremely valuable addition to medical literature. It is to be hoped that the second part will be soon forthcoming. W. S. T.

BOOKS RECEIVED.

Operative Gynecology. By Howard A. Kelly, A. B., M. D. Vol. I. 1898. 4to. 563 pages. D. Appleton & Co., New York.

Manual of Operative Surgery. By H. J. Waring, M. S., M. B., B. Sc. (Lond.), F. R. C. S. 1898. 12mo. 661 pages. Young J. Pentland, Edinburgh, and The Macmillan Co., N. Y.

Fig. 1.

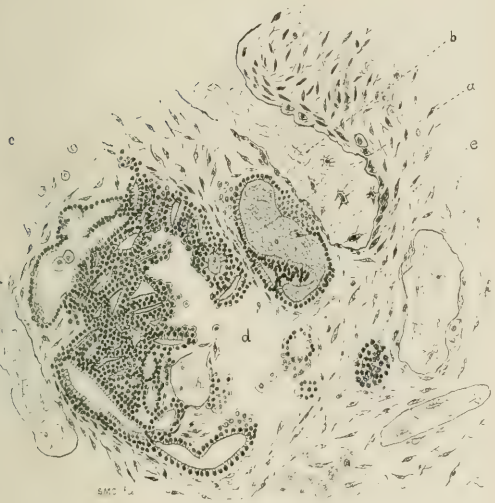

Fig. 2.

Note. This plate is intended to accompany Dr. Cone's article in the May number. To face p. 118.

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The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter.

Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have acquaintance with Latin and a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry, and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the
REGISTRAR OF THE JOHNS HOPKINS MEDICAL SCHOOL, BALTIMORE.

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BULLETIN

OF

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CONTENTS.

REMARKS AT THE PRESENTATION OF THE CANDIDATES FOR THE DEGREE OF DOCTOR OF MEDICINE AT THE COMMENCEMENT OF THE JOHNS HOPKINS UNIVERSITY, JUNE 14, 1898.

By William H. Welch, M. D., *Dean of the Medical Faculty.*

Mr. President, Gentlemen of the Board of Trustees, Ladies and Gentlemen:

As this is only the second class to receive the degree of Doctor of Medicine from this University, it will not be inappropriate, before presenting the candidates for the degree, to say a few words concerning the development and aims of the recently organized Medical Department of the University.

Through the munificent gift of Miss Mary Elizabeth Garrett, added to a smaller but generous contribution from other public-spirited women, and supplementing the available resources of the University and Hospital, the Trustees of the University were enabled to open the Medical Department for the instruction of men and women on the second of October, 1893. At two previous commencement exercises the opportunity has been afforded me to present in some detail the plan of organization and the purposes of the new Medical School, and it is not necessary to repeat what was then said.

We began five years ago with only the first year of the course organized, with a teaching staff of fifteen, and with an entering class of students numbering eighteen. A year from last October the organization of the entire four years' course was completed, and last June we graduated our first class of fifteen students. During the academic year now closing 167 students have been enrolled as candidates for the degree of Doctor of Medicine, 26 in the fourth year, 34 in the third, 44 in the second, and 63 in the first. All of these are college graduates, and before admission spent a year or more in the study of chemistry, physics and biology. In addition, 69 physicians have been in attendance upon special courses or have engaged in research, making a total attendance of 236. The teaching staff numbers 53, of whom 21 are professors, clinical professors or associate professors. The steady growth of the Medical Department with each succeeding year has, therefore, been most gratifying and has laid to rest the fears, which some at first entertained, that our high standard of admission, necessitating not only a degree in arts or science, but also a good practical training in physics, chemistry and biology, with a reading knowledge of French and German, and acquaintance with Latin, would restrict unduly the number of students.

Not less significant is the national character of this Medical School as shown by the distribution of the students among the several States. 30 are credited to Maryland, but of these a number have made this their home only since entrance into the School. Of the remainder, 32 come from New England, 22 from the Middle States, 27 from the Southern, 38 from the Middle West or Central States, 13 from the West (11 being from California), and 5 from Canada, Hawaii and India.

47 colleges are represented, the Johns Hopkins University by 31 students, Yale by 29, Harvard and the University of

Wisconsin by 9 each, Wellesley and Smith by 7 each, the Leland Stanford Jr. University and the University of California by 6 each, and Princeton, Williams, Amherst, Vassar, Cornell, the University of Chicago and other colleges by smaller numbers.

But more significant than the growth of the School in numbers or the wide area from which our students are drawn are the contributions to the advancement of medical education in this country which we may fairly claim to have made. The mere addition of a new medical school to an already overburdened list can hardly be regarded as a meritorious act. We have realized from the start that unless we had something to contribute to the promotion of medical education and knowledge, there was no reason for our existence. No one familiar with the conditions of medical education in this country could fail to see that the opportunity existed to do for medical education what this University has accomplished for university education in this country. With the inspiration of such an example and with these high ideals before us, what better place could be found for such a work than in this University and in the city of Baltimore? It would occupy too much time on this occasion to enter into details upon this subject, but concerning two or three of the more distinctive features of this medical school I shall ask permission to say a few words.

We have raised the requirement as to the training preliminary to the study of medicine to a point not only beyond that of any other medical school in this country, which in view of the former low demands in this respect might not signify much, but to one equal to, if not in advance of, that of any foreign university. This high standard of admission, instead of proving a weakness, has been one of the main sources of our strength. It has secured for us students whose average fitness for the study and practice of medicine is unquestionably greater than has been hitherto attained in our medical schools, and it has brought to us not a few of unusual capacity and promise. Students are attracted to an institution where their associations are wholly with liberally educated classmates, and the resulting tone and morale of the School are elevated, in welcome contrast to the traditional conception of the social and moral atmosphere of a medical school. It is evident that far better methods of teaching and better results can be secured with highly trained students than with those without adequate preparation.

While we designate our required period of medical study as four years, it is in reality from five to six years, for we relegate to the period of preliminary collegiate training the study of general chemistry, physics and biology, which are included in the medical curriculum of many schools, especially in Europe. The study of these sciences, which is justly considered to be an essential part of a thorough medical education, can be pursued to greater advantage in a college or university than in a medical school, and the arrangement which we have adopted adjusts itself readily to the existing conditions in our best colleges and universities.

Coming to us with this exceptional training, our students have a right to expect exceptional advantages for the study of the profession which they have chosen, and, so far as our resources permit, we have endeavored not to disappoint them in this respect. The aim of the School is primarily to train practitioners well grounded in the fundamental medical sciences and in practical medicine and surgery and their branches. We have broken completely with the old idea that reading books and listening to lectures is an adequate training for those who are to assume the responsible duties of practitioners of medicine. Anatomy, physiology, physiological chemistry, pathology, bacteriology, pharmacology and toxicology are taught during the first two years by practical work in the laboratory, and in the last two years disease is studied in the dispensary and at the bedside, not merely as it is described in books.

At the beginning we had only one laboratory building; in 1894 we were provided with a second commodious building, the Women's Fund Memorial building, intended for the various anatomical sciences; in 1896, through a generous gift to the Hospital, we were enabled to construct the Clinical Laboratory, and in the coming autumn a still larger building, now in process of erection, will be ready for the laboratories of physiology, physiological chemistry and pharmacology. We shall then be well equipped with the needed laboratories, which constitute the workshops of our students during the first two years of the course.

From these laboratories the students pass at the beginning of the third year directly to the Dispensary and the wards of the Hospital, where our arrangements to enable them to become practically familiar with the symptoms, the diagnosis and the treatment of disease constitute perhaps our most original and valuable contribution to the methods of teaching practical medicine. The generous co-operation of the Trustees of the Johns Hopkins Hospital, in accordance with the wishes of its founder, in rendering available for the instruction of students the resources of this great institution, has placed it in our power to make the years devoted to the training in the practical branches of medicine and surgery peculiarly attractive and efficient. They also provide for a large number of our graduates, as well as to others, opportunities to serve as interns in the Hospital.

The advantages of thus coming throughout the entire course into direct personal contact with the objects of study are not merely that the students thereby acquire a more useful and living knowledge of them, but that they become familiar with scientific methods and acquire something of the scientific spirit of investigation and of approaching medical problems. They should thus be enabled by their subsequent observations and experience to carry on an education, only begun at the medical school, and which should continue throughout their professional lives.

To obtain the best results of practical training of the kind mentioned it is of importance that the student should be brought into contact with those who are not merely teachers but also investigators. In the selection of heads of departments the Trustees of the University and of the Hospital have kept in view that a great medical school should not only teach medicine but also advance the medical science and art. We feel that we may take just pride in the number and value of the published contributions to medical knowledge by mem-

bers of the staff of the School and Hospital, and, indeed, it is a sign of great promise that several of our students have already conducted noteworthy investigations, leading in some instances to important discoveries.

In a school with such standards for preliminary training and with such opportunities and methods of study, it is self-evident that the standard of attainment should also be kept high, so that the bestowal of its diploma may be a real distinction to such as attain it. In this respect the Faculty have felt a serious sense of responsibility, directed solely by the desire that no one shall be promoted to the doctorate of medicine in this University who does not measure up to the high standards which have here been set.

I have endeavored to point out in a few words the lines along which this Medical School in the short period of its existence has developed and certain of its salient characteristics. We feel that we have here an unrivaled opportunity for the development of a great medical school, devoted to higher education and the advancement of medicine. The time is one of marvellous activity and progress in medicine, with new paths and new vistas constantly opening for exploration. We cannot occupy the vast field so fully as we desire. We need ampler resources to take full advantage of our opportunities. I know of no direction in which pecuniary investments for education will yield larger returns in advancement of knowledge and promotion of the welfare of mankind than in the endowment of higher medical education.

Medical departments of universities in this country have usually been such in name only and at best have been looked upon as step-children, out of harmony with true university life and ideals. A medical department which brings to the University only liberally educated men and women, provides a four years' course of study conducted with the best methods, cherishes the scientific spirit and contributes to the advancement of knowledge, is surely a worthy member of a university, however high its ideals. The medical department which has here been founded has been cordially received by this University as equal and coordinate with its philosophical department. This intimate union of Medical School and University is of mutual benefit, and in this close association we find constant encouragement and incentive to attain the best. We have been guided throughout by the unceasing care and wise direction of the President of this University, and we believe that the enlightened and generous policy of the Trustees of the University and the Hospital has brought to fulfillment the wishes of the founder of this University and of the Hospital concerning the Medical School for which he provided.

Members of the Graduating Class:

In behalf of my colleagues and for myself I congratulate you upon the satisfactory completion of a prolonged period of liberal and professional study in preparation for your chosen career.

You, with the class which preceded you, came to us when you could not see plainly the end from the beginning, trusting in assurances held out to you for the future. You have participated in the establishment of this Medical School. This circumstance imparts peculiar interest and intimacy to your relations with us.

It is during this formative period that the impress of students' ideals and conduct upon the inner life of a university is most distinctly felt and that traditions are formed which may powerfully influence the future health and vigor of the institution. That your influence upon this inner life has been for good, we feel assured. During all these four years we have been stimulated by your diligence, enthusiasm, ability and desire for knowledge, and we appreciate your hearty cooperation with our efforts. We, your teachers, have acquired more than a teacher's interest in you. Intimate acquaintance has led to genuine friendship, and we do not doubt that we shall have occasion to feel a personal pride in your future good work. You go forth with the best wishes and high expectations of all of us.

You have acquired some knowledge of the fundamental principles of medical science, some practical familiarity with the nature and treatment of disease and injury, the ability to use the instruments of your profession, and, above all, I trust, correct methods of work and a trained scientific spirit of investigation. Of the entire contents of the science and art of medicine you have, however, learned relatively only a small part, but you are now in position to increase your knowledge through your own individual efforts and through experience to acquire wisdom.

Such a training as you have received should enable you to derive satisfaction of a high order in the pursuit of your profession, a satisfaction not to be obtained from its practice merely as a trade and means of subsistence. The scientific physician of to-day finds intellectual pleasures, as never before, in the study of the science and the practice of the art of medicine, and this scientific interest is dignified and enhanced by the power, ever increasing, of doing good to others through the relief of pain and suffering. To the ranks of this noble and useful profession we now welcome you.

Mr. President:

In the name of the Medical Faculty I have the honor to present to you twenty-two candidates whom we recommend for promotion to the degree of Doctor of Medicine in this University. All, after receiving a liberal education indicated by a degree in arts or science and fulfilling all of our requirements for admission, have spent four years in the study of medicine and have satisfactorily completed the course in this University.

List of Students Receiving the Degree of Doctor of Medicine.

William Stevenson Baer. A. B., Johns Hopkins University, 1894. Baltimore.

William Jephtha Calvert. A. B., University of Kentucky, 1893; Graduate Student, Kentucky State College, 1893–94. Lexington, Ky.

Patrick Joseph Cassidy. A. B., Yale University, 1894. Norwich, Conn.

John Williams Coe, Jr. Ph. B., Yale University, 1893. Meriden, Conn.

Percy Millard Dawson. A. B., Johns Hopkins University, 1894. Montreal, Canada.

Arthur Wells Elting. A. B., Yale University, 1894. Upper Red Hook, N. Y.

William Weber Ford. A. B., Adelbert College, 1893. Norwalk, O.

Thomas Wood Hastings. A. B., Johns Hopkins University, 1894. Morristown, N. J.

Alfred Birch Herrick. A. B., Williams College, 1894. Amsterdam, N. Y.

James Hall Mason Knox, Jr. A. B., Yale University, 1892, and Ph. D., 1894. New Haven, Conn.

Millard Langfeld. A. B., Johns Hopkins University, 1893. Baltimore.

Gertrude Light. S. B., University of Wisconsin, 1894. Milwaukee, Wis.

James Daniel Madison. S. B., University of Wisconsin, 1894. Mazomanie, Wis.

Harry Taylor Marshall. A. B., Johns Hopkins University, 1894, Baltimore.

Roger Griswold Perkins. A. B., Union College, 1893, and Harvard University, 1894. Schenectady, N. Y.

Katherine Porter. A. B., Bryn Mawr College, 1894. Baltimore.

Joseph Hersey Pratt. Ph. B., Yale University, 1894. North Middleboro, Mass.

Georgiana Sands. A. B., Vassar College, 1893; Graduate Student, Barnard College (N. Y.), 1893–94. Port Chester, N. Y.

Benjamin Robinson Schenck. A. B., Williams College, 1894. Syracuse, N. Y.

Walter Ralph Steiner. A. B., Yale University, 1892, and A. M., 1895; Graduate Student, Johns Hopkins University, 1892–94. Baltimore.

Emma Elizabeth Walker. A. B., Smith College, 1887. Parkersburg, W. Va.

Andrew Henderson Whitridge. S. B., Harvard University, 1894. Baltimore.

CONCLUSIONS FROM CLINICAL AND BACTERIOLOGICAL EXPERIMENTS WITH HOLOCAIN.

By Robert L. Randolph, M. D.

I have been using holocain for some months and have recorded here fifty-four cases where I employed it in the eye clinic of the Johns Hopkins Hospital. Seventeen of these cases were foreign bodies in the cornea, and the average time employed to produce anesthesia was a little less than two minutes. In three cases iridectomy was performed, and in eight cases cataract extraction. Here I made the same number of instillations as I do when employing cocain, that is, three in fifteen minutes, and all that can be said is that I noticed no difference in the anesthesia from that produced by cocain, and the same may be said of eight tenotomies. The other cases were where the holocain was employed after the application of irritating substances as copper sulphate, nitrate of silver, and after the passing of probes, in operations for tarsal cysts and pterygia. With the exception of the tarsal cysts the anesthesia was produced in a little more than two minutes.*

Most of those who have reported on the subject of holocain have alluded to its germicidal properties. I have looked through the literature and, with the exception of some very meagre experiments made by Heinz showing that the yeast bacteria are retarded in their growth by contact with holocain, have found no record of experiments proving that a solution of holocain is germicidal.

The following experiments were made to throw some light upon this aspect of the question.

I. To determine the effect of a 1 per cent. solution of holocain upon the micrococcus epidermidis albus (Welch). For this purpose thirty wooden toothpicks were sterilized by boiling for ten minutes. They were then immersed for five minutes in a suspension of the organisms in sterilized water, afterwards taken out and dropped into a 1 per cent. solution of holocain. Here they were allowed to remain fifteen minutes. They were then taken out with long sterilized forceps and plunged each into a tube containing nutrient agar. After being in the thermostat twenty-four hours they were inspected and in every tube there was a luxuriant growth. Control tubes showed that the pieces of wood were sterile before immersion in the suspension of organisms. The growth in half of the tubes was examined and the micrococcus epidermidis albus was found in every instance. Fifteen experiments made with the staphylococcus pyogenes aureus resulted in the same manner. In another series glass rods were employed instead of pieces of wood. The rods were sterilized by holding them in the flame. They were then dropped into a suspension of the aureus in sterilized water and allowed to remain there five minutes. When taken out, instead of putting them directly into the holocain solution as was done in the first and second series, they were put into a sterile tube and allowed to dry thoroughly, and then immersed fifteen minutes in a 1 per cent. solution of holocain, after which each rod was plunged into a tube of nutrient agar. The result was the same as in the first and second series.

II. To determine whether a 1 per cent. solution of holocain has an inhibitory effect upon these same organisms.

Five grains of holocain were dissolved by boiling in 8 cc. of water, and to this were added 24 cc. of fluid agar. The resulting mixture was practically a 1 per cent. solution of holocain. Twenty tubes of "slant agar" were prepared in this way, and ten "smear cultures" made of the staphylococcus pyogenes aureus, and ten of the micrococcus epidermidis albus. These tubes were inspected every day for three days, but there was never any evidence of a growth. This experiment was repeated a number of times by others in the laboratory as a control measure, and in every instance with the same result. Neither the staphylococcus pyogenes aureus nor the micrococcus epidermidis albus would grow in a medium containing holocain in the proportion mentioned. It should be said that these organisms will grow in nutrient agar containing holocain in the proportion of $\frac{1}{2}$ of 1 per cent.

The positive results of the experiments to determine whether

* For an exhaustive account of the clinical aspect of holocain see the various reports of Henry Würdemann, M. D., Milwaukee.

holocain had an inhibitory effect upon the organisms would seem to indicate that some of the organisms on the glass rods and pieces of wood in the first, second and third series were killed. To determine this question the following experiments were made. A thick suspension of the staphylococcus pyogenes albus was made in a physiological salt solution. Five loops of this suspension were transferred to a tube containing 8 cc. of a 1 per cent. solution of holocain, and five loops were transferred to a tube containing the same quantity of salt solution; this latter measure as a control. After allowing the organisms which had been transferred to the holocain solution to remain there five minutes, two loops of the latter solution were carried into fluid agar and plate cultures made. This was repeated after ten, fifteen, twenty and thirty-five minutes, and finally after twenty-four hours. In the first plate (after five minutes) there were fifteen colonies; in the second plate (after ten minutes) there were about the same number; in the third plate (after fifteen minutes) there were five colonies; after twenty minutes three colonies; after thirty-five minutes two colonies and a big impurity, and finally after twenty-four hours the plate was sterile. This series was repeated and with practically the same result. There was a gradual diminution in the number of the colonies the longer the organisms were allowed to remain in the holocain, and after twenty-four hours it was seen that the holocain no longer contained living organisms. Plate cultures made after twenty-four hours from the salt solution showed numerous colonies.*

Conclusions: Holocain, in so far as its anesthetic properties are concerned, seemed in these fifty-four cases to have been sufficiently effective. In those cases where a test was made of the rapidity of its action, as for instance in foreign bodies in the cornea, pterygia, and after the application of irritating substances, the quickness with which anesthesia was produced was striking. Whether the anesthesia produced after two minutes is sufficiently profound to guarantee a painless iridectomy or a satisfactory cataract extraction I did not determine, but in those cases where operations of this character were performed, and where the holocain was instilled just as we do cocain, no difference was observed in the anesthesia from that produced by the latter.

The drying of the cornea and desiccation of its epithelium and the dilatation of the pupil, the absence of which phenomena has been noted by others, have been confirmed by my own observations. The absence of these two properties should recommend it for office use for the removal of foreign bodies, as it is well known that after the employment of cocain in such cases, blurred vision and slight photophobia are often present for hours.

A 1 per cent. solution of holocain has not only an inhibitory effect upon the pus organisms, but these organisms are killed when exposed to a solution of this strength for a certain length of time. No attempt was made to determine the point of time at which these organisms lose their vitality on exposure to holocain, but it may be safely said that this point is somewhere within twenty-four hours. Furthermore, exposure to a 1 per cent. solution of holocain for periods of five, ten, fifteen, twenty, twenty-five and thirty-five minutes showed in every instance a gradually diminishing number of colonies in the plates, so that it is plain, in spite of the luxuriant growth around the glass rods and pieces of wood, many of the organisms were killed.

It may be said in conclusion, then, that a solution of holocain of the strength employed in ophthalmic practice possesses distinct germicidal properties, a fact which it is evident enhances the value of this product.

* It is evident that the amount of holocain brought over in the loops was not sufficient to alter the properties of the agar to the extent of inhibiting the growth of organisms. In order to produce this effect more than ¼ of 1 per cent. holocain should be present in a given quantity of agar. Hardly more than two or three drops in all of holocain were brought over in the loops, so the reason, then, that the organisms did not grow was because they were killed before they were transferred to the plates.

OBSERVATIONS ON THE EPITHELIUM OF THE URINARY BLADDER IN MAN.

By Percy M. Dawson, M.D.

The following report deals, first, with the clinical history of a patient treated for urethritis in the genito-urinary dispensary of the Johns Hopkins Hospital; secondly, with the microscopical study of specimens of bladder epithelium obtained from this patient during the course of treatment.

CLINICAL HISTORY.

F. S., male, aet. 23, single, huckster, native of Baltimore.

The patient presented himself at the dispensary on January 6, 1898, complaining of swelling of the left testicle. He gave a history of an attack of gonorrhœa one year ago, and of a second attack which began about December 18, 1897. Of this last attack the period of incubation was nine days. There was considerable ardor urinæ, but only a slight discharge. No other local symptoms and no constitutional symptoms were present. By December 28, 1897, the discharge had become too scanty to be observed by the patient. On January 2, 1898, he noticed a swelling of the left testicle and also tenderness on pressure.

On examination (January 6, 1898), the contents of the left scrotal sac measured 3.5 x 4 x 7 cm., the swelling being chiefly in the globus minor, which was extremely tender on pressure. The skin of the scrotum was red, slightly œdematous, but not adherent. The left cord was slightly enlarged and somewhat tender. Right testicle and cord normal; inguinal glands palpable on both sides, but not enlarged.

The urethral discharge was thick, slightly yellowish and very scanty. It contained a few pus cells and a few cocci

and short thick bacilli which did not decolorize by the Gram method.

The urine was of a pale amber color and slighly acid. In the first glass of the two-glass test the urine was uniformly cloudy, but on standing a small quantity of light, white, flocculent sediment was deposited, leaving only a few mucous shreds in the supernatant fluid. This sediment was found to contain a considerable number of pus cells and a very few epithelial cells. The contents of the second glass were similar except that the sediment was very scanty and contained no pus.

The treatment adopted was the vigorous use of the Paquelin cautery over the affected epididymis, as recommended by Halsted, and for the urethritis intravesical injections of a solution of potassium permanganate, 1: 6000. An order was given for an irrigation apparatus and for permanganate tablets, and the patient was directed to force the solution into his bladder three or four times daily.

On January 10, 1898, the patient returned. The urethral discharge had ceased. The urine showed a diminution in the amount of sediment and in the number of pus cells which it contained.

On January 11, 1898, the patient began to retain the irrigation fluid in his bladder, sometimes for as long as one or two hours, thinking that this might hasten his recovery. This manœuvre was persisted in for two days (January 11, 12), in spite of the fact that the patient experienced a dull heavy pain in the region of the sacrum while holding the irrigation fluid. This pain always disappeared immediately on micturition.

On January 13, 1898, the patient came complaining of these pains in his back and of a sensation of itching on the glans penis. The affected testicle, though still considerably swollen, was much less painful. The meatus looked a little reddened, but there was no discharge. The patient had not emptied his bladder since his last injection at 8 a. m. and it was then 10.30 a. m. The urine when voided was of a peculiar smoky brownish color and contained a number of small brownish flakes which soon settled to the bottom. There was also a considerable sediment composed of such flakes. In the supernatant urine floated about twenty large membranous flakes, of extreme thinness and of a dark brownish color. Several of these flakes were as large as the little finger-nail, one measuring 8 x 12 mm. They hung quivering just beneath the surface of the liquid for some hours before finally settling to the bottom.

On microscopical examination, these bits of membrane were found to consist of a single layer of polyhedral cells, forming a perfect mosaic and entirely intact. The sediment was composed of cell detritus and a great number of epithelial cells, single or in groups, some well preserved, others more or less decomposed or necrotic. No pus was observed and no blood.

The contents of the two glasses were similar, except that the first contained a larger quantity of sediment.

The patient was directed to continue the use of the permanganate solutions, but not to retain them in the bladder.

All this was at 10.30 a. m. At 1 p. m. the patient irrigated himself, but on expelling the fluid observed nothing unusual. At 4.30 p. m. he made the same observation. At 8.30 p. m. he came to the hospital and voided there perfectly normal urine, in which neither pus cell nor epithelial cell could be demonstrated even after centrifugalization.

Subsequently the patient returned to the dispensary several times. His last visit was on January 31. He assured us that he felt perfectly well. He had been away from home since January 17 and had irrigated himself only four times during the past two weeks.

The left globus minor was slightly larger than the right (which may have been normal) and was not at all tender. There was no discharge. The urine was amber, slightly cloudy, with one or two shreds in each glass. On standing, a small amount of sediment was deposited in the first glass, which on examination was found not to contain pus cells.

MICROSCOPICAL EXAMINATION.

The specimens obtained from the patient, F. S., consist entirely of surface epithelium. They were fixed and hardened, some in sublimate, others in absolute alcohol, and were stained with saffranin or by the iron-hæmatoxylin method.

The larger cells are irregular and polygonal in form; the smaller ones are often hexagonal. Their outlines are very clear. Along the margins of many of the cells is a row of short teeth-like processes which seem to bind together the adjacent cells. They resemble the intercellular protoplasmic bridges described by some authors, but from our preparations their exact nature cannot be determined.

The granular protoplasm usually fills the entire cell, but sometimes, especially in the larger cells, there is a clear non-granular zone in the periphery. In the cells in which the finer structure can be made out, the cell body appears to be composed of countless minute vacuoles, between which the protoplasm is uniformly granular. In some cases the whole cell body appears homogeneous, but usually this vacuolated structure can be observed.

The nucleus is round or oval, sharply outlined, and situated at or near the centre of the cell. The chromatin is diffused throughout the nucleus, and also concentrated into several dark irregular masses about five to fifteen in number. With careful focusing connecting bands between these masses may sometimes be found, resembling somewhat a nuclear figure composed of several moniliform chromosomes knotted and coiled together.

In many instances vacuolated nuclei were found. There is rarely more than one vacuole in a nucleus. They are usually central, and the chromatic masses are displaced and lie upon the surface of the vacuole.

In the protoplasm of many of the cells vacuoles can be seen, some quite small, some so large that the nucleus is crowded to the periphery, the whole cell being swollen and presenting the signet-ring appearance so characteristic of fat cells. Between these extremes all sizes of vacuoles and all degrees of nuclear displacement occur.

The most striking phenomenon observed in the study of these cells is the budding of the nuclei. In some cases the buds occur as knobs upon the surface of the mother nucleus; in others they are attached to the mother nucleus by a pedicle containing a chromatic material which may be either short and broad or may appear as a fine uniting band. Or again, the bud may be free in the cell protoplasm, and in such cases it is only

their small size which suggests their origin. The larger buds contain one or more masses of chromatin; the smaller ones usually do not. The varieties of these budding forms are almost innumerable. There may be one to four buds each varying independently of the others in size and in the manner of their attachment, so that examples of all stages of this process occur in abundance.

In addition to the cells with budding nuclei there are many multinucleated cells, and the rarity with which one finds the nuclei dividing into equal daughter nuclei, and the fact that between the nucleus with a little broken-off bud and the binucleated cell every gradation exists, strongly suggests that the multinucleated cells are derived from the mononucleated by a process of budding.

There is a class of cells of which examples are frequently found. They differ from those above described in being larger, with one or two larger and paler nuclei which are sometimes irregularly fragmented. These may be cells which have become swollen and degenerated either before the budding process had begun or perhaps just after the first division of the mother nucleus.

Not only do cells with two nuclei occur, but we also find them with three, four, up to huge giant cells with fifteen nuclei. As a rule the nuclei of these giant cells stain more feebly than do those of the mononuclear cells. The protoplasm is somewhat more granular, the clear zone bordering the periphery is often very marked, and the surrounding cells often appear to bulge into them. The protoplasm is often vacuolated, and in some, one or more of the nuclei are found budding.

To give some idea of the frequency of the budding and of the multinucleated forms, a differential cell count was made. In an area which under the low power did not appear particularly promising there were in 1000 cells—

	70	cells with 1 bud,
	15	" " 2 buds,
	5	" " 3 "
	3	" " 4 "
	93	cells with budding nuclei.
Also	40	cells with 2 nuclei,
	3	" " 3 "
	43	multinucleated cells.

And in another area where the giant cells were abundant there were in two adjacent fields of the $\frac{1}{12}$ oil immersion—

	5	cells with 2 nuclei,
	3	" " 3 "
	2	" " 4 "
	1	" " 6 "

Literature.

The literature on the structure of the bladder mucosa appears to be very scanty. Our text-books on histology are almost silent on the subject, and it was only in an article by Dogiel that a detailed description has been found.

In 1890, A. S. Dogiel, professor of histology in the University of Tomsk, published in the Arch. f. Micro. Anatomie an article entitled "Zur Frage über das Epithel der Harnblase."

In his study of the epithelium Dogiel employed paraffin sections and macerated preparations of the bladders of the house mouse, white mouse, rat, hamster, cat, dog, and man.

He describes the epithelium as being composed of four layers: the first consisting of squamous cells; the second of cuboidal, columnar, and pyriform cells; a third layer similar to the second; and the fourth layer of round or fusiform cells filling up the interstices between the cells of the third layer.

The cells of the first layer resemble thick plates. They are irregular, polygonal, and sometimes divided into two parts by a central constriction.

The protoplasm of the cell usually consists of two more or less distinct parts—an upper and a lower. The upper is one-third the whole thickness of the cell, homogeneous or only slightly granular, and stains red with picro-carmine. The lower part is very granular and stains yellow with picro-carmine. The granular appearance is due to a network of rather thick fibres, between which is a clear interfibrillar substance.

On the under surface of the cell one finds rather deep depressions. They are from three to ten in number, depending upon the size of the cell. Into these depressions fit the upper ends of the cells of the second layer. From the bottom of each of these depressions several canals of various calibres arise and run towards the upper surface of the cell, passing almost completely through the granular layer. These canals have usually an oblique direction and end blindly. They are continuous with the cup-shaped depressions on the under surface of the cells. They contain protoplasmic prolongations arising from the underlying cells, which, together with protoplasmic threads hanging down from the cells of the superficial layer, intimately unite the cells of the two layers. These canals and protoplasmic threads are conspicuous in the mouse and rat, but are poorly developed in other animals.

On the superior surface of these cells one often finds one or more nodular, polypoid or sausage-shaped projections composed of a granular material. These granules may be regarded as being of a mucous character, for they bear a close morphological resemblance to mucous granules and stain intensely with hæmatoxylin. Hence the whole surface of the bladder may be regarded as a spread-out mucous gland.

In the granular part of each epithelial cell lies the large vesicular nucleus, round or oval in shape, and surrounded by a rather thick membrane with a double contour. In some cases vacuoles occur in the nuclei.

The nuclear network is composed of threads of varying thickness running from the center to the periphery. In each nucleus occur two to fifteen round, oval, or rod-shaped granules, one usually being larger than the rest. They stain much more deeply than the rest of the nucleus and sometimes appear to have a bright border.

Of these nuclei there are present in each cell one to twelve or more. The multinucleated cells are quite abundant in the small rodents, while in the cat, dog and man this is not the case. The nuclei may be in one or more groups, or scattered, or in pairs and biscuit-shaped. In size these nuclei vary greatly. There may be a number of equal nuclei, or one nucleus may have a number of smaller nuclei clustered about it, forming a sort of colony.

One often meets with nuclei which are constricted by a circular furrow, sometimes of such a depth that the two parts of the nucleus are united by only a slender band. In many cases there are two or more such furrows. The parts into which the nucleus is thus divided vary greatly in their relative sizes, and hence the variation in the size of the nuclei of the multinucleated cells.

Throughout this division the nuclear membrane remains perfectly distinct and there is no observable change in the chromatin. Hence we have to do with a process of amitotic division, or rather of budding.

As to whether or not the division of the nucleus is followed by a division of the cell body, Dogiel is unable to decide, but merely remarks that the occurrence of constricted cells favors the view that such division does occur.

The remaining layers of the mucosa concern us but little. Their cells increase by a process of mitosis and not by budding. In the rodents the cells of the second layer are brought into intimate relation with those of the first layer by means of the protoplasmic processes above mentioned.

Conclusions.

It will be observed that the description of the cells obtained from the urine of the dispensary patient agrees in part with the description given by Dogiel. There are, however, some noteworthy differences.

In these specimens no stellate arrangement of the chromatin is present, nor any pale ring surrounding the masses of chromatin, nor is there any tendency for one mass of chromatin to exceed the rest in size. There is no cupping of the under surface of the cells, nor any sausage-shaped projections from the upper surface.

Dogiel makes no mention of the "bridges" between the cells of the superficial layer, while on the other hand our specimens do not show the canals and threads which Dogiel describes as being so well developed in the small rodents but so poorly developed in the larger mammalia. In our specimens, the absence of these connecting threads and the existence of the cell bridges may explain the occurrence of the large flakes of mucosa, the connections between the individual cells of the superficial being so much stronger than the connections between this layer and the one below it.

That there is any protoplasmic network of rather thick fibers, such as Dogiel describes, these specimens afford no evidence at all. Whenever any finer structure can be made out, the cell body is seen to be composed of vacuoles with a uniformly granular protoplasm between them.

Of the occurrence of the giant cells, Dogiel says that they are common in the small rodents but rare in man. In these specimens of human bladder, however, there is quite a different state of things, as the result of the differential cell count shows.

What is the significance of this formation of giant cells? Is it a simple process of proliferation, as Dogiel thought, or is it a process, so to speak, of slow and orderly fragmentation? The specimens have furnished not the slightest evidence that this is a true cell division and not merely a nuclear division, for in no instance have cells been found having a central constriction of the protoplasm such as Dogiel has described. It is not probable that the weak solution of potassium permanganate produced any particular change in the cells. The giant cells contain large vacuoles much more often than do the mononuclear cells, their nuclei usually stain more feebly and are more often seen to be fragmenting irregularly. All these observations, namely (1) the absence of cell division, (2) the deficient nuclear staining, (3) vacuolization, (4) karyorhexis, point to the fact that we have to do with a process of degeneration.

In conclusion I wish to thank Dr. Young for the permission to report the case, and for the interest he has shown in the study of the specimens.

Fig. 1.—*a.* Nucleus with two buds.
b. Large pale nucleus with bud.
c. Nucleus with vacuole.
d. Nucleus dividing.
e. Cell with two nuclei
f. " " three " (near center of field).
g. " " four "
h. " " five "
i. " " ten "
j. " " vacuole.
k. Giant cell with vacuole displacing nuclei.
l. " " " degenerated nuclei and vacuolated protoplasm.

Fig. 2.—Shows single cells with "teeth-like margins," and more or less distinct vacuolization of the protoplasm.
a, b, c. Cells with one, two and three nuclei respectively.
d. Cell with nucleus in process of division.
e. Cell with three nuclei, of which one has a large and a small bud.

Discussion.

Dr. Barker.—We are to be congratulated upon having this case so thoroughly worked up. It is curious that the epithelium is shed in such large sheets. It looks as though the cement substance connecting the superficial layer with the parts below is more susceptible to attack by the permanganate solution than that between the individual cells of the superficial layer. I have had the opportunity of studying these specimens with Mr. Dawson and have been much interested in many of the pictures he has obtained. The number of giant cells present is surprising. It is important to determine whether or not as many as he finds are normally present, that is to say whether or not the permanganate solution has actually caused an increase in the number of these cells. There is some evidence that these giant cells of the bladder wall may play a part in pathological processes. The late Dr. Brown once showed me a section from a carcinoma of the bladder in which there were large numbers of such multinucleated epithelial giant cells.

It would be easy to continue the study by animal experiment, and I would suggest if it should turn out that water alone is incapable of causing the changes described in the bladder, that an attempt be made to determine just what constituent of the permanganate solution it is that is active, the cation, the anion, or the non-dissociated molecule. It would seem probable *a priori* that the anion is the constituent concerned.

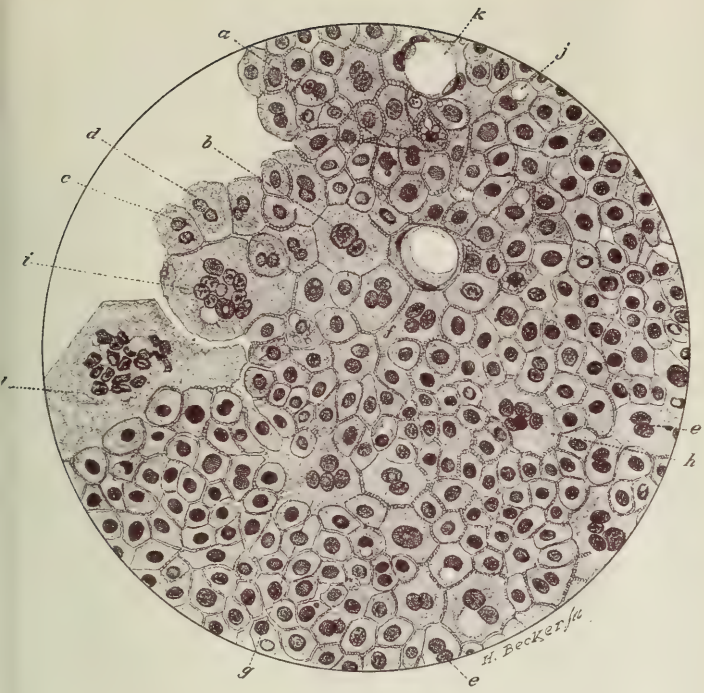

Fig. 1.

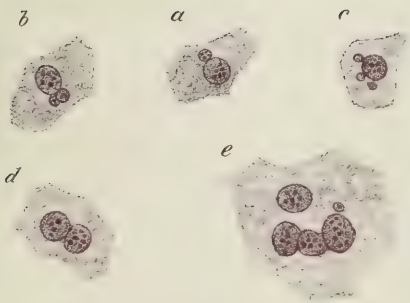

Fig. 2.

Dr. Thayer.—I saw some of the specimens and I would like to call attention to the great similarity of some of the pigment of the nuclei to that of some of the blood corpuscles in grave diseases. In the blood there can be very little doubt that it is a karyolitic process.

Dr. Osler.—It would be very interesting to have Mr. Dawson study the epithelium of the bladder in a series of post-mortem cases. I think he would probably find a very large number of these giant cells with many nuclei.

Mr. Dawson.—Dogiel used two methods, that of cutting sections and that of maceration in various fluids. He does not mention having obtained by the latter method any large flakes of mucosa, but he does describe the single cells obtained in this way.

A CASE OF SARCOMA OF THE ŒSOPHAGUS.*

By L. E. Livingood, M. D., *Associate in Pathology, Johns Hopkins University.*

Through the courtesy of Dr. Frank R. Smith I have to present this evening a specimen obtained at autopsy from a patient who died of sarcoma of the œsophagus.

On July 6, 1897, H. S., a German by birth, cabinetmaker, æt. 55, was admitted to the Johns Hopkins Hospital complaining of difficulty in swallowing and "rheumatic pains," especially in the shoulder.

From careful notes taken by Dr. McCrae I have made the following abstract:

"Family history negative. He has been an active, healthy man; denies venereal infection; takes beer moderately, a glass of whiskey regularly in the morning; his work is done indoors. He has lived in Baltimore 15 years; has had rheumatic pain at times during past two years.

"About April 1, 1897, he began to complain of pain in the throat in the neighborhood of the sternal notch. The onset was gradual, and at first the pain was not constant, the patient attributing it to having caught cold. The pain was increased by swallowing, and there developed difficulty in swallowing solids, especially bread. The pain on swallowing seemed to begin at the sternal notch and to extend to the stomach. It persisted only for a few moments. The pain in the neck, however, was constant and was sometimes severe enough to keep him awake. Sometimes on swallowing the pain would run up to both ears, not infrequently bringing tears to his eyes.

"The appetite has been fairly good. No regurgitation of food, no vomiting, no cough, no expectoration, no shortness of breath; bowels regular. He has lost 30 pounds in the last 3 months, but does not think he has lost any strength. No increase of pain on deep breathing, no interference with respiration. Patient was able to keep at his work until July 3rd, nearly 3 months after the symptoms were first noted."

"On admission. Fairly well nourished. No emaciation. Color fair. Puffiness under the eyes. Sclerotics somewhat injected. Pupils equal. Tongue coated, edges red and indented. Gums and mucous membrane of mouth of a fair color. No mass to be felt in the neck. No tracheal tugging. No marked pulsation. Thorax: large and muscular. No pulsation seen or felt. Expansion poor. Respiration largely abdominal. On percussion the note seems clear; possibly there is slight relative dullness behind on the right side in the interscapular region. Breath sounds clear. Heart sounds appear clear, second sounds strong. Pulse strong, synchronous and of equal volume in radials and femorals. Well marked dermatographia. No general glandular enlargement. Soft tube passed into stomach easily, no obstruction." It may be noted that before entering the hospital patient was seen in the dispensary and an attempt to pass a stomach tube was made. Just before entering the stomach it seemed to meet with an obstruction; patient became very much distressed; the tube was withdrawn and a little blood was seen upon the end.

On July 12th the following note was made:

"Stomach tube meets with no obstruction where patient complains of pain, but when passed 44 cm. from the lips there is some resistance to passage of tube. Pressure on tube causes pain. Small amount of bloody material was removed on the point of the tube, but on microscopic examination was found to consist of red blood cells, pus and squamous epithelial cells. No fragments of tissue found.

"The blood examination showed hæmoglobin 88 per cent., red cells 5,040,000, whites 7500. Urine practically normal (3 exms.). On one occasion a faint trace of albumin was found and one hyaline cast. No diazo reaction. No sugar. Specific gravity 1018. The temperature ranged between normal and 101° F. Patient was discharged on July 17th, improved, especially in regard to the rheumatic pains."

From this time on he was seen occasionally at his own home by Dr. Smith. His condition varied a good deal. At times he felt a little stronger and seemed to gain slightly in weight. At other times he complained of great pain and was unable to swallow anything but the smallest quantity of liquids. With the latter he often had great difficulty. For several days at a time he could hardly take any nourishment and complained of a severe cough and pain. On more than one occasion after severe coughing he brought up fragments containing mucus and what looked like necrotic tissue and blood. One specimen of this was examined under the microscope, but it was too much decomposed to give any clue as to the nature of the disease. However, the existence of a new growth (probably carcinoma) was strongly suspected. For several days after coughing up this material, patient's condition was materially improved. He could take liquids easily, and even partially solid food could be swallowed. About four days before his death he was suddenly seized with intense

* Read before the Johns Hopkins Hospital Medical Society, May 16, 1898.

pain over the lumbar region and between the shoulders. The abdomen was much distended and was tympanitic. It was not, however, very painful and the distension disappeared in the course of a day or so. After this the patient sank almost into a state of collapse, but occasionally revived and said that he felt much better. He finally died on the 26th of November, 1897, at 4 P. M.

Autopsy at 9.30 P. M., 5½ hours after death.

Body of strongly built man. Very much emaciated. Skin of sallow hue. Body still warm. Small amount of deep yellow fat. Abdominal cavity shows nothing abnormal.

Thorax.—Lungs voluminous. Left pleural cavity free from adhesions. Right pleural cavity obliterated over lower lobe posteriorly by recent adhesions which can be readily broken up. Left lung shows congestion in posterior portions. Right lung: Anterior and upper portion pale and slightly emphysematous. Upper lobes somewhat puckered and at one point bound by fibrous adhesions to ribs. A few fine adhesions between the middle, upper and lower lobes. On freeing the lower lobe the lung tissue about the root and posteriorly is torn, and a foul-smelling necrotic material escapes, the last part of which is more fluid and smells sour. The lower lobe is large, firm and congested. The serous surface from which the adhesions spring is roughened and hæmorrhagic. About the place where the lung has been torn on removal the tissue is much discolored, soft and necrotic. On cutting the lung loose from its root a cavity communicating with the œsophagus is opened up, from which more sour-smelling turbid fluid pours. The lung in this portion is soft and discolored, and in it there is a gangrenous cavity which could contain several ounces of fluid. The lobe (lower) around this gangrenous area is irregularly consolidated, the consolidation affecting the posterior inferior two-thirds of the lobe. On section the surface in this area is deep red, slightly elevated, dry or granular. The lung is completely airless. The bronchi in this portion of the lung are congested and contain a purulent discolored material. The middle lobe is normal. The upper lobe contains an encapsulated calcareous nodule.

The pericardial cavity normal. The heart is of moderate size. The wall is rather soft and pale. Surface of section is dry. Endocardium normal. Slight atheroma of aorta just above valve. The spleen weighs 250 grams. Condition described as that of acute spleen tumor. Kidneys are large, each weighs about 220 grams. They were in condition of cloudy swelling with congestion of glomerular capillaries. Liver large; condition of cloudy swelling. No evidence of tumor metastases. Other abdominal organs were normal.

Description of Tumor.—About 4 cm. below the bifurcation of the trachea the lumen of the œsophagus is obstructed by a new growth, made up of a main body with several smaller polyp-like masses extending down from it. The main mass presents a thick circular ridge arising abruptly from the mucous membrane of the œsophagus and almost completely encircling a crater-like central portion. It measures about 6 cm. from the upper to the lower edge. It does not entirely surround the lumen of the œsophagus, but leaves a strip of mucous membrane about 2 cm. wide running vertically between its lateral adjacent edges. This thickest part of the mass representing the upper portion of the ridge projects about 1.5 cm. into the lumen, and overhangs the mucous membrane. Its edge is quite regular, sharply defined from the mucous membrane, although the latter is reflected for a short distance upon it. The surface is smooth, rounded, nodular, yellow-white in color; its inner surface, representing the wall of the depressed center, becomes more and more discolored and necrotic. The crater in the center is partially filled with foul-smelling purulent material and shreds of necrotic tumor tissue. The floor is discolored, necrotic, soft and friable, and in the lowest part is continuous, through a short fistulous opening several cm. in diameter, with a gangrenous cavity in the right lung. From the lower end the new growth is seen invading the mucous membrane without much elevation, at first uncovered by epithelium, later projecting beneath the epithelium as a very slightly elevated spur.

This main mass of the new growth extends to within 4.5 cm. of the cardiac orifice of the stomach. Growing down from it for a distance of 1.5 cm. and projecting still further is an elevated irregularly formed polyp-like mass, about the size of the last two phalanges of the little finger, from which a second polyp projects into the lumen. This mass also arises abruptly and regularly from the mucous membrane which is reflected for a short distance over it. Its surface is smooth, white or slightly discolored. The smaller projecting polyp has become necrotic and is quite readily friable. The line of continuity between the two main masses is plainly evident. There is a small nodule the size of a small bean in the muscularis of the œsophagus, about 4 cm. above the main tumor mass, apparently quite distinct from it, although the wall of the œsophagus between them is thickened. This nodule is only visible on section of the wall.

These tumor masses are uniformly firm, elastic, and not friable except in those places in which necrosis has occurred. The surface and edges are smooth, with no appearance of vegetation or excrescences. The surface of section of the periphery of the tumor, when the œsophagus is cut open, shows a shining, uniform, white or slightly pink, moist appearance. It is made up of delicate circling strands of tissue. The mass is subdivided into small nodules by strands of more vascular tissue, extending upwards here and there from the muscularis. No juice can be squeezed from the cut surface. Its surface is somewhat discolored towards the central portion, which is friable, discolored and necrotic, and which penetrates deeply into the wall, and at one point entirely through it. The inner muscular layer of the œsophagus seems to be involved in the new growth, and small areas of new growth appear in the outer muscular coat.

At the upper limit of the growth the muscular wall, mucosa and submucosa, become rapidly normal, showing that the tumor is not infiltrating the wall, as a carcinoma would naturally do.

In the lower polyp the new growth seems to rest upon the inner muscular coat and to be continuous with it. The surrounding tissues are more congested than normal portions, and more congested than the tumor tissue.

The œsophagus is slightly distended above the mass. Its mucous membrane is congested and discolored, having a

green-gray appearance for several cm. above and below it. The external fibrous coat is greatly thickened. Its outer surface is roughened. Corresponding to the central part of the tumor, several pea-sized nodules, which on section are seen to be practically continuous with the tumor tissue, project from the surface. One of these, which is yellow and opaque, is readily broken into and appears to form the floor of a necrotic crypt. To the right of this point the right lung is closely adherent to the œsophagus. Its substance here is gangrenous, of a green-black color, soft and friable. The adjacent portions of the lung are deeply congested. At the point of perforation the lung substance has disintegrated, and there has been formed an irregular gangrenous cavity filled with putrid material. The main bronchi, which run to and through this portion of the lung, contain a blood-stained gangrenous material. Their walls are deeply congested, but are intact. The bronchial lymph glands are diffusely pigmented, enlarged and congested, but careful study shows that they are not infiltrated. A small lymph gland is found lying in the outer wall of œsophagus which is apparently normal.

Bacteriological Examination.—Cover-slips from lung (consolidated area) showed: (1) a number of typical capsulated forms of a lancet-shaped diplococcus; (2) long slender bacilli with pointed ends; (3) a shorter form of thin bacillus, staining irregularly. The diplococcus forms were subsequently isolated in pure culture and identified as diplococcus lanceolatus. The bacilli failed to grow under aërobic conditions. Cultures taken from the spleen and liver were negative.

Microscopic Examination.—Sections cut from a number of points in the tumor show it to be rather uniform in its structure, made up of a tissue rich in cells, often arranged in whorls, but not with distinct alveolar appearance. The deeper portions of the tumor are the most cellular, the superficial portions gradually become necrotic and the cells are separated by wider intervals, giving the appearance of œdema.

The cells are of *spindle shape*, varying in size, usually rather large, surrounded by more or less intercellular substance. The nuclei of the cells are of two distinct types, both elongated and vesicular. One type is small, more deeply staining and irregular; the other is large, pale, sometimes greatly swollen. This latter type of nucleus is usually closely intermingled with the smaller type throughout the tissue. At one place, however, these nuclei seem to lie concentrically placed about a small space and are hemmed in by a zone of cells of smaller type. These larger cells resemble the endothelium lining the tissue spaces and vessels; the smaller represent the fibroblasts of young connective tissue.

The tissue is vascular. The fully formed blood-vessels of the mucosa and submucosa have persisted and lie in deeper parts of the tissue. In the younger parts the blood-vessels consist of a single layer of endothelium, often without even the appearance of a basement membrane separating them from the tissue elements.

For the most part the tumor lies on the muscularis, having infiltrated the submucous and mucous coats, and projects as a group of polyp-like nodules into the lumen of the œsophagus. At the lower margin the transition from normal tissue of submucosa to the cellular tissue of the tumor is quite abrupt. Here the new tissue seems to spring from the muscularis or submucosa. It lies directly on the muscular layer, while strands of muscle tissue project upwards into it.

About the middle of the tumor the new tissue cells have infiltrated in masses and strands the muscularis, and extend down even into the thickened fibrous tissue layer. At a point near the perforation the layers of the œsophagus are seen to be infiltrated, but owing to the great thickening of the fibrous sheath the new growth does not completely penetrate the œsophagus at any point.

Just above the tumor the normal tissues of the œsophagus are very much indurated. There is marked proliferation of small round cells, which are arranged in groups running longitudinally in the mucosa under the epithelium and along the blood-vessels.

A line of union between the main mass and small nodule lying in submucosa above cannot be traced; the small mass seems to have had a separate origin. For a short distance at the periphery the epithelium of the mucosa covers the surface of the new growth, but it soon becomes desquamated.

The surface of the mass is almost everywhere necrotic. Approaching the surface the nuclei stain more and more feebly and the tissue about them becomes œdematous. There is swelling and fragmentation of nuclei. At the edge the nuclei fail to take the stain. Usually there is no polymorphonuclear cell infiltration on the surface.

At some points beginning necrosis is indicated by more marked changes in cells. The nuclei become greatly swollen and contain deeply staining globules of their chromatic elements; this enlargement and hyperchromatosis is a common appearance. Sometimes a cell will contain 2 to 3 large swollen vesicular nuclei, about which there will be a distinct zone of protoplasm staining deeply in eosin. In the lower part the tumor shows most extensive degeneration and is infiltrated with polymorphonuclear leucocytes. The surface is covered with bacteria.

The wall of the perforating sinus extending through the outer wall of the œsophagus *is not lined with sarcoma tissue*, but with necrotic, fully formed fibrous tissue, very vascular, congested and infiltrated with leucocytes, red blood corpuscles and bacteria. This fact indicates clearly that the tumor did not come from the outside nor did it completely penetrate the œsophagus. The penetration was due to destructive action of bacteria which found lodgment in the crypts formed by breaking off of necrotic masses.

Sections stained with polychrome methylene blue show a number of "mastzellen" scattered through the tissues, and occasionally where the tissue is especially cellular, a few "plasma cells" of Unna grouped about blood-vessels. They can have little to do with tumor formation. It appears most probable that the tumor took its origin from the submucosa, growing in form of a polyp, and that all the connective tissue elements of the part entered into its formation. The tissues were fixed in formalin, hardened in alcohol, and stained with hæmatoxylin and eosin, picric acid, fuchsin, and polychrome methylene-blue.

Although the tumor appears of rather benign type of sarcoma, the presence everywhere of karyokinetic figures in cells indicates, aside from the clinical history, that its growth was rapid. These evidences of proliferation were not more marked at the points of contact with the normal tissues than near the necrotic surface, and usually there was appearance of but little reaction on the part of tissues adjacent to either tumor tissue. From this one may assume that the direction of growth was not so much into the surrounding tissues as into the lumen of the gullet. There was no evidence of proliferation of muscle nuclei, and nothing which indicated vascular origin for the tumor except the occasional concentric arrangement of the larger endothelial-like cells.

The literature on sarcoma of the œsophagus, strictly speaking, is very meagre, although text-books on special pathology mention its occurrence. Virchow mentions it in a group with others. Sarcoma of the pharynx, on the other hand, is not uncommon. It is not improbable that this apparent rarity is due to a lack of careful histological study

of tumors arising in this part, where carcinoma is of such frequent origin as to throw one off his guard. Clinically and even on macroscopic examination these two can appear in the same guise. Under certain conditions it may be mistaken for a fibrous polyp.

In the first thousand autopsy records of the Johns Hopkins Hospital primary carcinoma of the œsophagus occurs 11 times, whereas this is the first primary sarcoma noted arising in that part.

In 1877 S. H. Chapman reported a case, which may be included here, of sarcoma of the inferior constrictor of the pharynx and inlet of the œsophagus. The patient was a woman, aged 45. No family history of new growth. No distinct evidence of trauma. Had symptoms of increasing dysphagia during one winter. Died of exhaustion.

Wall of œsophagus was thickened like an inverted cone. On right side of œsophagus, in midst of densest tissue, a cavity communicated from lumen of œsophagus with body of a tumor lying apparently outside, closely adherent to œsophagus and an enlarged gland. The structure of tumor is described as "alveolar." To the right and in front of the carotid artery was another larger gland measuring 1 x 2 inches of alveolar structure, enclosed in dense wall and containing some sero-purulent fluid. Cells of the tumor were mostly spindle cells and large oval granular cells which had formerly occupied the alveoli made by interlacing fibrous tissue strands. The new tissue involved, in some places, mucosa, submucosa and muscularis, and consisted almost entirely of spindle cells, although an earlier stage, of round cells, was observable. No involvement of pharyngeal glands; no secondary deposits anywhere. Chapman believed that the tumor began in the cellular tissue in the inlet and spread upwards and downwards in the wall of the œsophagus.

In the Transactions of the Pathological Society of London three cases are to be found. The first reported by Targett, which the author states is the very first to be reported to that venerable society, occurred in a man of 70. The patient had suffered for three months with much pain between the shoulders and with difficulty in deglutition. He had physical signs of lobular pneumonia in both lungs. The tumor mass, which was attached to the outer wall of the gullet, measured 4½ x 2½ x 1½ inches. Its upper border was just opposite to the bifurcation of the trachea and extended downwards nearly to the cardia. The œsophagus was dilated at the site of the growth, which here was moulded in the form of a tube. The tumor sprang from the submucosa. The muscular coat was free from infiltration except at one spot. The mucous membrane could be traced for a short distance over the upper and lower ends, but on the free surface it had been destroyed by ulceration and sloughing of the tumor itself. The tumor looked white, was uniformly succulent and resembled an "encephaloid cancer." Histological examination showed "small round spindle and tailed cells, some of the latter being very large and containing four nuclei." The spindle cells were arranged as bands and ran in all directions. Some parts resembled myxomatous tissue; no secondary growths.

Shaw recorded a case occurring in a woman of 38. She had suffered from dysphagia for several months, was unable to take her food and became rapidly emaciated. The growth consisted of an ulcer with well defined raised edges encircling the œsophagus. In front it extended up to within one inch of the cricoid cartilage and measured vertically three inches. For the most part the ulcer had merely destroyed the mucous membrane, but in front it involved all the coats and had perforated the trachea a short distance above the bifurcation. Some neighboring lymph glands had been enlarged by the deposit. Microscopically the œsophagus was found infiltrated by a sarcomatous growth consisting of round and oval cells. Secondary deposits were found in the lungs and kidneys. The committee chosen to examine the specimen reported that "The cells are too large for a lympho-sarcoma, nor has the stroma the typical disposition seen in that form of tumor."

Rolleston's case occurred in a man aged 54, who for seven months had suffered from difficulty in swallowing. Two months before he died there developed a painless tumor in the left hypochondrium. Cause of death, lobular pneumonia.

The œsophagus for the lower three inches was narrowed and thickened owing to the presence of a firm growth which completely encircled the lumen. The mucous membrane had ulcerated over the greater portion of the surface of the growth. The growth was adherent to the pericardium, but had not penetrated it. It was firmly united to the right lung. In the upper part of the structure there was a fistulous passage through the growth leading into a gangrenous cavity in the lower lobe of the right lung. The lower lobe was solid, gray in color and œdematous. Several of the glands on the root of the lung were swollen and infiltrated. The whole naked-eye appearance was that of an epithelioma of the œsophagus. Microscopically, the narrow part of the œsophagus was found infiltrated with a growth composed of medium-sized round cells. Towards the edges the growth was seen to begin in the submucosa and to pass underneath the mucosa and outwards into the muscular coat, which was extensively but irregularly infiltrated with nodules of new growth. No alveolar arrangement was noted, except when tumor was invading muscle tissue. There was a fluctuating tumor, very vascular, the size of a man's fist, growing from and displacing the lower ribs on the left side. In the right iliac and in the middle fossa of the skull, and on the first and sixth ribs, and in the lymph glands, vascular soft tumor masses were found, the cells of which resembled those present in the tumor of the œsophagus. Rolleston considers that the growth must have been primary in the œsophagus, judging from its position and its density.

Oppenheimer's tumor seems to have reached the œsophagus by direct invasion from the outside. From his description one is led to believe that he was dealing with an aneurism of the œsophageal artery with an organizing lamellated clot.

From a study of the few reported cases it appears that clinically there is no essential difference between these growths and carcinoma occurring in the œsophagus, and a diagnosis must depend upon those features which indicate the presence of the latter. Age and sex will not distinguish them; they are both incident to more advanced life. The ages correspond very closely to those given by Orth for carcinoma: 40 to 70

years. They occur more frequently in males. The advance, however, of the sarcomata is always rapid, and duration of illness after first appearance of symptoms does not extend over nine months. The factors of causation which are invoked for carcinoma and sarcoma generally, are hidden in these cases.

The symptoms of progressively increasing dysphagia, associated with painful deglutition, exhaustion and cachexia, are common to both.

The partial relief of dysphagia after the discharge of a necrotic mass was noted in one of these cases. Microscopic examination of such a mass might reveal the exact nature of the growth.

The occurrence of wide-spread metastases is apparently as infrequent as is carcinoma, and the localization of these metastases is not more definite.

The more frequent immediate causes of death from sarcomata, too, are exhaustion, with terminal lobular pneumonia or perforation, occurring in one case into the trachea, and in two cases into the lung followed by gangrene of the organ.

With the few cases at command and the abridged descriptions one cannot make more than a provisional statement as to the types of sarcoma most frequent in the œsophagus, their point of origin and their position.

Presumably three of the tumors are of the same type, spindle cell sarcomata, in Shaw's, Targett's and our own; although Shaw's approaches the round cell type.

All of these are without any alveolar structure and seem to have sprung from the submucosa. Rolleston's case appears to be a large round cell sarcoma without any appearance of alveolation. The origin of his tumor is not clear. Chapman's tumor is difficult to understand; it is alveolated and appears to have sprung from the tissues outside of the œsophagus and to have penetrated its walls. A natural conclusion would be that it arose in a lymph gland, although he describes the cells occupying the alveoli as large, oval and granular.

The tumors may occur at any point in the length of the œsophagus, more frequently they appear in the upper part. They may infiltrate all the coats and project into the lumen of the œsophagus. Necrosis of the superficial parts due to contact with the food masses occurs, and extensive sloughing and ulceration with perforation follow.

Rolleston's and Shaw's cases show wide-spread metastases. The liver has always escaped.

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PAPILLOMA OF THE FALLOPIAN TUBE.

By J. G. Clark, M. D.

(*From the Pathological-Anatomical Laboratory of Professor Chiari in Prag.*)

Up to the present time only six cases of simple, non-malignant papilloma of the Fallopian tube have been reported, abstracts of the histories of which, accompanied by a very excellent résumé of the salient points of the subject, have lately been made by Sänger and Barth (Die Krankheiten der Eileiter; Martin, 1895). Of these cases three have been reported by Alban Doran, two by Bland Sutton and one by Doleris.

Doran, who first called attention to the subject, inclined to the theory that these growths are not so much tumors as a simple hyperplastic process produced by chronic inflammation.

On account of the rarity of these cases the following well-marked example, which Prof. Chiari has kindly placed at my disposal for study, appears worthy of report.

History of the Case.

Museum specimen No. 4769. A cystic tumor removed by Prof. Bayer, from a woman aged 60, June 11, 1892.

The following clinical notes were obtained by Prof. Bayer from Dr. Slansky, the attending physician.

The patient had never miscarried or given birth to a full-term child, and until one year ago had been healthy. At that time she discovered a tumor in the abdomen, which, according to her statement, completely disappeared after a thermal cure, but later again appeared. During the first months of the year 1892 she was confined to bed on three occasions, first for three weeks, then for eight days, and again for three weeks, with attacks of peritonitis. After her recovery she consulted her physician with regard to the abdominal tumor.

Her general condition, as noted at that time by Dr. Slansky, was as follows: A rather weakly built, emaciated woman, of good facial color; heart and lungs normal; tongue slightly coated. The hypogastrium presents the vaulted appearance of a woman six months pregnant. The tumor which gives this appearance to the abdomen is globular, elastic, fluctuating, and in its upper part, towards the groin, is somewhat movable. The cervix is movable, the uterus is deviated to the right, and although the fundus cannot be palpated, it appears to be small and adherent to the tumor, which lies to the right. By digital examination a point in Douglas' cul-de-sac a considerable distance above the cystic tumor may be reached.

From this examination Dr. Slansky diagnosticated an ovarian cyst of the right side and advised its extirpation.

Owing to violent retching by the incompletely narcotized patient, during the preliminary cleansing of the abdomen the cyst was ruptured, and at once became soft and flat, and on physical examination free fluid could be demonstrated in the sides. Upon opening the abdomen, the contents of the cyst, a viscid, clear, honey-yellow fluid, were discharged and the top of the cyst prolapsed through the incision. With this part as a tractor, the entire tumor, which now appeared to be about the size of a child's head, was drawn out upon the abdomen and was found to be connected with the right mesometron by a small band-like pedicle about four fingers in length.

The ovary was situated below this pedicle and appeared perfectly normal. The central part of the pedicle consisted of the uterine half of the right Fallopian tube, which passed over into the tumor, where it became lost. In view of these points the diagnosis of an ovarian cyst was abandoned, and the thought of a parovarian cyst came much more prominently into mind. The pedicle was ligated in several sections and cut through transversely, after which the stump was cauterized, and separate ligatures were applied to all of the larger vessels. The contents of the cyst remaining in the abdomen after extirpation of the tumor were evacuated as completely as possible by rolling the patient over on her side The convalescence was uninterrupted and the patient was discharged well.

MACROSCOPICAL DESCRIPTION.

Cystic tumor half the size of a man's head (12 x 12 cm.), presenting at one spot an amputated surface 4 cm. square, at one point of which is a very short pedicle having the appearance of the enlarged uterine end of the Fallopian tube. Close to the point of amputation is an irregularly torn opening, through which the fluid contents of the cyst have escaped.

The exterior of the tumor is smooth, and in the superficial parts of the wall there are a few large dilated blood-vessels, wandering in irregular tortuous channels, while in the deeper parts an occasional necrotic area is noted.

The internal surface is almost completely covered with a thick papillary growth, consisting of multiple fungus-like excrescences, which, in some areas, are massed together in thick dense clumps, presenting a typical cauliflower appearance. The branches of these excrescences vary in size from delicate fimbriæ to large fusiform projections which contain small cysts. At one place, not far from the point of amputation, are circular folds, some of which reach the height of ½ cm., only covered with delicate velvet-like and small knobbed excrescences. The arrangement and general appearance of these folds at once remind one of those in the normal Fallopian tube. Bordering this area is a palm-sized surface devoid of papillary excrescences.

Upon spreading the excrescences apart, they are found in some parts of the cyst to spring from folds resembling those just described. Here and there these folds have become adherent and pressed back against the cyst wall, forming locculated spaces, some of which also contain papillary growths.

MICROSCOPICAL DESCRIPTION.

Sections through the circular folds show a greatly attenuated cyst wall measuring only 0.05 to 0.1 cm. in thickness. Layers of tissue are seen in the following order, counting from the outside towards the cyst cavity: peritoneum, circular muscle fibers, thin stratum of connective tissue, longitudinal muscle fibers followed by a denser layer of connective tissue, upon which one layer of columnar epithelium arranged in regular order rests. Except in the bay-like projections between the folds, the epithelium is non-ciliated, and even in these spaces the ciliated cells are only rarely found.

Numerous large dilated blood-vessels occupy the connective tissue layer beneath the epithelium. The folds of the Fallopian tube, as such, are no longer present, but are represented by sessile and pedunculated papillary growths.

The low sessile projections are composed of dense connective tissue, like that seen in chronic inflammation of the tube, whose cells extend at right angles from the underlying circular fibers, forming warty prominences clad with one layer of columnar epithelium which gradually shades off into the low columnar and cuboidal variety as the domes of the projections are reached. Besides the sessile excrescences there are a few long, slender processes to which are attached daughter offshoots. The main stem in all instances contains large dilated blood-vessels. The connective tissue forming the stroma of these papillæ shows a marked variation in its structure in different areas. At the bases of the papillæ the cells are closely crowded together and contain deeply-staining spindle-shaped nuclei. This appearance is maintained until the apices or domes of the growths are approached, when the cells gradually become hyaline, and in turn shade off into a pure mucoid degeneration.

Sections from the thicker portions of the cyst wall (0.5 cm. thick) show unstriated muscle fibers scattered very sparsely among the connective tissue fibers which make up the chief part of the section. The internal surface of the cyst wall is covered with innumerable, vigorous growing papillomata, whose main stems extend far out into the lumen of the cyst, forming the most complicated, coral-like systems. The offshoots have, in many instances, coalesced, forming spaces which contain small papillary growths.

In some instances the main stems have become adherent to each other, enclosing much larger gland-like spaces. The mucoid degeneration noted above is even more marked here, and in the large fusiform ends of some of the branches the entire stroma has undergone this transformation, giving the cystic appearance noted in the macroscopical description. Hemorrhage has occurred into some of these spaces containing the mucous tissue, leaving a granular debris which stains a bright yellow by Van Gieson's method.

The ends undergoing degeneration are covered by one layer of shrunken cuboidal epithelium, which rests upon a thin layer of hyaline connective tissue. Besides the cystic spaces formed by the fusion of the papillomata, others are found occupying a deeper portion of the cyst wall, lined by cuboidal epithelium and surrounded by a dense connective tissue stroma like those seen in "sacto-salphinx pseudo-follicularis." (*Martin.*)

In one of these spaces a small papilloma is seen in process of formation. The single layer of cuboidal epithelium lining the

cavity forms an uninterrupted line, except at one point, where it assumes a columnar shape and becomes heaped upon a delicate connective tissue papilla projecting from the main stroma.

Concluding Note.

In a general survey of the sections taken from various parts of the cyst wall the muscular tissue appears to be much less abundant and the connective tissue greatly increased over that seen in the normal tube. The papillomatous growths throughout have a non-malignant appearance, the epithelium being in general one-layered and at no place tends to invade the underlying tissue.

According to Sänger and Barth the differential diagnosis in these cases is rendered difficult on account of the tendency of all new growths of the Fallopian tube to assume a papillary appearance; in this case, however, its non-malignant character is so evident that its recognition is comparatively easy.

The early stages of primary carcinoma, before the epithelial cells have deeply penetrated the underlying tissue, or have formed metastatic foci in adjacent parts of the tube, may closely simulate the non-malignant papillary growths, especially where the latter possess the low wart-like form first described by Rokitansky and Hennig.

On account of the marked tendency as pointed out by Williams which papillomata of the ovary show to undergo cancerous degeneration, these growths of the tube must also be looked upon with suspicion, for even if they do not become malignant they may give rise to transplantation growths to the peritoneum, which may so seriously impair the function of this organ as to cause death.

From the foregoing history it appears that the patient suffered with repeated attacks of pelvic inflammation, and the histological examination of the tube shows a condition similar to that seen in chronic inflammation of the tube, plus the papillomatous growths, which sustains throughout the theory advanced by Alban Doran, that papillomata of the tube are but the after-results of inflammatory changes. While some of the smaller growths, especially the sessile ones seen on the remaining folds of the tube, appear as simple hyperplastic processes, as suggested by Doran, the majority are essentially new growths, in which there is a great increase in the connective tissue associated with proliferation of the epithelium.

Bland Sutton has recorded a case similar to the foregoing one, which he classifies as an adenoma, holding to Hennig's original theory that the spaces between the folds of the tube are glands, and therefore new growths which affect them are of the glandular type.

Sänger and Barth quite properly reject Sutton's classification, substituting for it the term *papilloma tubæ cysticum s. vesiculosum*. As our case presents, besides the papillomatous growths, the cystic spaces, it can properly be classified under this title.

THE HISTO-PATHOLOGY OF HERPES IRIS. WITH REPORT OF TWO CASES.

By Lucius Crocker Pardee, M. D.

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Although herpes iris as a clinical entity has been recognized since the early part of the century,* and notwithstanding the fact that considerable clinical knowledge has been added by dermatologists during the last few years, comparatively little attention has been directed to its histo-pathology. Even such an extensive writer as Unna has given but a very unsatisfactory description of its pathology, and the usual account which one finds in looking through the literature of the subject may be practically summed up as follows: Oedema, vascular dilatation and "round cell infiltration" (whatever that may mean). In the following case, in connection with which the opportunity of a very complete investigation from clinical, pathological and bacteriological standpoints was offered, many interesting features presented themselves, which seem worthy of some attention and may possibly lead to a clue as to its etiology.

On December 4, 1897, there appeared in the Dispensary of the Johns Hopkins Hospital a case presenting vesiculo-bullous lesions on the skin, concerning which the following history was obtained. The patient was a girl eight years of age, fairly well developed, slight but not thin, with dark hair and complexion. She seemed bright and intelligent, and was in fact somewhat precocious. Her antecedents did not reveal anything of interest.

Family History. Her father, mother and brother are all living and in good health.

History. Personally, beyond one attack of measles which occurred two years ago, and habitual constipation, the patient had always been in good health up to the present time. She had, however, always been, as her mother expressed it, "a nervous child." Her present trouble began two weeks before applying for treatment. At that time she was vaccinated and now has the remains of a fairly typical vesicle on her arm. Directly after the vaccination she began to complain of flushes of heat and chilly sensations, the latter being of a transitory nature. These symptoms were ascribed to the vaccination and no particular attention was paid to them.

In a few days there appeared on the extensor surface of the right forearm "a blister" which was about the size of a split pea when first noticed. This was soon followed by others of like character in the same region, and also upon the left forearm and wrist, together with isolated lesions scattered over the trunk and lower extremities. She was taken to the family physician, who pronounced the case as one of "poisoning"

* Bateman and Willan (1810).

(meaning Rhus toxicodendron), which is quite common in and about Baltimore. A patent mixture of sarsaparilla compound was ordered,* but no local treatment, other than bicarbonate of soda baths, was given.

Present Condition. The patient upon examination presented an eruption, consisting of vesicles and bullæ varying in size from one to five millimeters in diameter, mostly discrete (though some showed signs of confluence), and arising from apparently normal skin. They were tensely filled with a clear colorless fluid, and the lesions which had existed for a day or two possessed a slight erythematous halo, and their contents had become opaque. These lesions occurred principally upon the extensor surfaces of the forearms (Figs. I, II, III), the right being the more affected, though scattered vesicles were found upon other regions, as follows: one small discrete vesicle was to be seen upon the tip of the right ear, a group of similar ones just beneath the chin, and a few discrete lesions on the buttocks. Upon the dorsum of the right foot were also a number of vesicles less developed than those of the regions mentioned. The mucous membranes were free of any eruption, with the exception of a small herpetiform group upon the inner surface of the vulva. The majority of the lesions were discrete and showed but little tendency to group. One bulla upon the right forearm (probably the first to appear) was sunken at the center, its roof having become adherent to the base, and the peripheral portion, still being tense and filled with opaque fluid, presented the appearance of having been formed by the confluence of smaller lesions which had surrounded a central bulla. No marked subjective symptoms were complained of other than the malaise already mentioned, which still persisted, and a slight feeling of tenseness and itching of the cutaneous lesions, which was most troublesome at night. The itching, however, must have been very slight, as neither excoriations nor ruptured bullæ were observed.

At this stage of the eruption erythema bullosum was principally thought of on account of the distribution, but the character of the lesions seemed to point to the pemphigus group, and liquor potassii arsenitis was ordered as an aid to diagnosis. At the same time two vesicles, each of about two millimeters in diameter, situated on the forearm, were excised and dropped into 95 per cent. alcohol for microscopical examination. The patient returned three days later feeling much worse and showing a much more extensive eruption. New vesicular lesions of the character already mentioned had appeared on all the regions previously affected, and the older ones had increased somewhat in size.

The forearms, wrists and backs of the hands and feet were most markedly affected. Upon the back of the right hand was seen a bulla about one-half cm. in diameter surrounded by small (2 mm.) vesicles which had formed a complete circle, the whole patch being situated upon an erythematous base. (See photograph, Fig. I.) Some of the older lesions upon the arms also presented ring-like formations (Fig. II), and the case was now definitely diagnosed as erythema exudativum multiforme, of the bullous variety (herpes iris). Appropriate treatment was ordered and special directions given as regards the diet.

During the next few days no improvement occurred other than the drying up of some of the lesions, which had first appeared and were now desquamating, leaving reddened plaques. New vesicles and bullæ still continued to make their appearance, the duration of each individual lesion being about a week or ten days. No primary lesions other than vesicles and bullæ were noticed. At the end of the first week the patient became confined to her bed, because of the vesicular lesions, which had formed continuous patches on both feet, making walking quite painful.

The temperature at this time was almost constantly above normal (103° being the highest point noted) and slight chills were complained of. The bowels were extremely constipated and the appetite completely lost. The tongue became heavily coated and the breath very foul. During the next few weeks the emaciation became somewhat marked, although the physical examination of the various organs did not reveal anything abnormal. At the end of the second and beginning of the third week the disease was at its height, the patient suffering great discomfort and complaining somewhat of the itching, which seemed to have increased in severity, especially in the lesions on the feet. Pains in the great toe joints were now complained of, the left one being the more affected. This symptom was not constant, as the pain seemed to vary in intensity at different times and was usually worse at night. The lesions now (three weeks after their first appearance) presented all stages of development and resorption and were pretty generally distributed over the entire body.

The regions most affected at this stage were not only the forearms and backs of the hands and legs and dorsal surface of the feet, but the back, thighs, buttocks and perineum also were attacked. Upon the back a large patch 20 cm. in diameter had formed, and the lesions upon the buttocks, perineum and inner surfaces of the thighs were continuous. The neck also was completely encircled by a band of lesions, which extended partly into the hair behind and included both ears.

Smaller, dark venous red colored patches, the ragged edges of which reminded one of the edge of a desquamating syphilitic lesion, and in whose center new vesicles could be seen appearing beneath the thin newly formed epidermis, were situated upon the knees and calves, and about the ankle in the region covered by the shoe. The parts least affected, viz. the upper part of the face, the anterior surface of the thorax, the abdomen, the upper arms, anterior surface of the thighs, and the palms and soles, all showed scattered lesions with large areas of normal skin between them. Even the scalp did not escape entirely, as crusts (probably the remains of aborted vesicles) were noticed in this region, but no true vesicles.

Although comparatively few lesions existed upon the mucous membranes, yet the inner surface of the lips, including the red border, presented fairly numerous aborted vesicles and vesicular detritus; but with these exceptions and one small vesicle upon the hard palate which soon disappeared, no eruption was seen.

During the next three weeks the condition varied, sometimes

* The potassium iodid, which such mixtures usually contain, may have aggravated the eruption; this feature has been noted by many authors, though some report to the contrary.

showing considerable improvement and at others a slight relapse. No return of a temperature above 100° was observed after the time already mentioned. The pains in the joints gradually decreased, both in frequency and severity, and the older lesions began to dry up and desquamate, leaving brownish pigmentations. New vesicles still continued to appear, however, although their number and size were less, and they were mostly discrete and of a shorter duration.

About this time (six weeks after the outbreak) an enlargement of the lymph glands of the right femoral region was noticed. They formed a somewhat tender and doughy mass which measured 3 cm. broad by 6 cm. long. No other glandular enlargements were found. After being eight weeks under treatment the general health of the patient became much improved, in spite of the fact that the parents had insisted on keeping the child at home, where the attentions were of the poorest and the surroundings most squalid. The appetite also returned, and she seemed to be gaining in weight and strength.

Although all the larger patches had now disappeared, leaving pigmented areas, yet there were still quite a number of lesions to be seen, especially upon the backs of the hands and wrists.

Upon the left ankle there was now formed the only lesion other than vesicles or bullæ observed during the entire course, and it also presented the typical iris-like formation. It was composed of four concentric, slightly raised erythematous rings surrounding a darker central spot, and possessed the typical iridescent appearance which characterizes the disease. After twelve weeks had elapsed since the beginning of the attack the child was able to be up and about again; she seemed comparatively well, but came occasionally to the clinic. The hands were still troublesome, and isolated lesions occasionally appeared upon the trunk and extremities, and the attack, therefore, could not yet be said to be at an end. This condition of the skin persisted until about March 30, 1898, when a severe relapse occurred. The photograph shown in Fig. III, was then taken. During this relapse the lesions were almost entirely confined to the forearms and hands. Itching was absent, and among the lesions were many typical of herpes iris. Upon the right arm was to be seen a bulla half surrounded by three semicircular lines of vesicles. A like arrangement occurred upon the left wrist. Remains of other circular patches are also shown in the photograph.

The blood count during this relapse gave the following results regarding the leucocytes:

Polynuclear	70 per cent.
Mononuclear (small),	18 "
" (large),	5 "
Transitional	3 "
Eosinophile	8 "

The treatment was symptomatic throughout, and being along well recognized lines laid down by so many dermatologists, need not to be gone into in detail.

During the attack the blood was examined several times, both fresh and in dried and stained specimens.

Erlich's triple stain and eosin and aqueous methyl blue were chiefly used.

Beyond a slight increase of the white-blood corpuscles, observed in the specimens which were taken during the first week, nothing abnormal was noted.

A number of eosinophiles were present in all the preparations, but their relative proportion was, however, not markedly increased. No plasmodia malariæ were found, although their presence was diligently sought for.

The contents of the vesicles were examined fresh and stained *in situ* and after having been mounted, but all gave results which did not differ from the findings in the cutaneous sections which will be described later.

Numerous cultures from the vesicles were made upon slant agar, but no positive results were obtained, with the exception of one tube which showed a growth of the staphylococcus pyogenes albus, probably derived from the surface of the skin.

It may be mentioned here that while dressing the patient, her mother in pressing upon a tense bulla ruptured it suddenly, discharging its contents directly into her eye, from which no results followed.

During the second week of this relapse the patient was admitted into the Johns Hopkins Hospital. During the acute stage the treatment consisted of mild laxatives, strict attention to diet and the application of a mild ointment. Three weeks after the acute stage has passed into a chronic condition Fowler's solution, 2 mins. three times a day was given, and when it was found to be beneficial it was gradually increased to 4 mins. No further relapses occurred but the patient began to improve remarkably in health and all the lesions disappeared. The patient was discharged quite cured four and a half months after the first lesion appeared.

PATHOLOGICAL HISTOLOGY.

The portions of skin taken for examination were from the flexor surface of the forearm, and each represented a vesicle about two millimeters in diameter. They were discrete and arose from apparently normal skin. They were hardened in alcohol and stained with hæmatoxylin and eosin, Loeffleur's blue, Unna's polychrome methylene blue, aniline gentian violet, and by Weigert's method.

The epidermis (Fig. IV) as a whole was practically very little affected, except mechanically. The stratum corneum (*b*) (as one would naturally expect to find it in this region) was of a loose rather than of a compact nature. The stratum lucidum was visible only in places, and was nowhere well defined. The stratum granulosum (*c*) was well marked. It consisted of from one to two layers of cells and was practically unaltered.

The rete mucosum (*d*) showed a slight dilatation of its inter-epithelial spaces and a consequent increase in depth. This increase, however, was only to be seen at the edges of the vesicle, as over the vesicle itself it was somewhat flattened by the pressure from beneath of the vesicular contents acting against the resistance of the horny layer. The cells of the rete showed no change beyond slight so-called vacuolation, such as is to be observed in many cutaneous affections, as well as in the normal skin. No mitoses were observed above the germinal layers. Here and there, in the inter-epithelial spaces, lymphoid cells and polynuclear leucocytes were found, and near the vesicle a small amount of nuclear detritus. (Fig. IV.)

The corium (Fig. IV, *e*) in the affected area showed acute inflammatory changes, limited to its upper half. These consisted of a localized œdema, marked dilatation of the superficial network of blood-vessels, large numbers of polynuclear leucocytes and a great increase in the number of lymphoid cells. These cells were massed in and about the blood-vessels (*f*), and also scattered about in the connective tissue, making their way toward the epidermis. The papillary body, and more especially the papillæ themselves, were most markedly involved, being the seat of acute œdematous inflammation. The serum appears to have exuded so rapidly that instead of producing a marked œdema of the epidermis, the latter was raised mechanically.

On examining the earliest stage of this pathological condition, which could easily be observed at the periphery of the minute vesicle, one could see how the lesion commenced. In one papilla (Fig. V) the upper third was replaced by serous exudation, as shown by the presence of fine granules and a network of fibrin, among which a number of polynuclear leucocytes were present. These could be seen at all stages of disintegration, from the disappearance of their protoplasm to the breaking up and separation of their nuclei. (Fig. VI.)

The next stage of the process showed the entire papilla filled with coagulated serum, fibrin, and large masses of broken-down nuclei, with only comparatively few polynuclear leucocytes, and the nuclei of a few detached connective tissue cells.

The papillæ in other places were completely destroyed, or flattened out so as to be unrecognizable, their place being taken by a mass of nuclear detritus suspended in a network of fibrin and the remains of the connective tissue. (Fig. VI.)

The vesicle was formed, therefore, by the simultaneous involvement of several neighboring papillæ; the roof being represented by the compressed, but otherwise unaltered epidermis, with the twisted and distorted interpapillary processes dependent from it and extending into the vesicle proper, while the corium with its compressed and swollen papillæ formed the floor.

The contents of the vesicle consisted of a finely granular substance (coagulated serum), strands of fibrin, mononuclear and polynuclear leucocytes, occasional detached epithelial cells, much nuclear detritus and a few eosinophiles.

The lymph vessels were slightly dilated in the vicinity of the vesicle, but the hair follicles, sebaceous glands and sweat coils and ducts were unaffected.

The lower half of the corium showed a slight œdema, but was otherwise normal, as was also the subcutaneous tissue. No micro-organisms were found in sections stained for that purpose.

DIAGNOSIS.

In connection with the diagnosis of this case the chief points to be considered were, (1) its acute onset, (2) the vesicular and bullous character of the lesions, which were frequently to be seen arranged in patches consisting of a central bulla surrounded by one or more concentric rings of vesicles, as is well depicted in Fig. I, and (3) the symmetrical distribution, which was chiefly upon the forearms and hands, the lower part of the legs and dorsal surface of the feet, appearing first in these regions and persisting there after having disappeared from the other portions of the body.

The marked itching of the lesions on the feet at the height of the attack caused one to think of dermatitis herpetiformis or of pemphigus pruriginosus. According to Duhring, however, the itching in the former disease "is out of all proportion to the eruption," while in the case which has been described it was only when the patient was nearly covered with lesions that this symptom was at all troublesome, and even then it was limited to a portion of the eruption only.

Another point of difference was the purity of the lesional type as already mentioned, in contrast to dermatitis herpetiformis, which even when of the vesicular variety is extremely apt to show a mixture of primary lesions (*i. e.* wheals, vesicles, pustules, etc.) with the vesicular form predominating, while in the present case no lesions other than vesicles and bullæ were noted, with the single exception of a typical patch of iris-like erythematous rings, which tended to strengthen rather than disprove the diagnosis.

From a microscopical standpoint the pictures were about as similar as the clinical, but likewise presented decided differences. Several slides* from a typical case of dermatitis herpetiformis were carefully gone over, the points of difference from the present case being chiefly the enormous number of eosinophiles present in dermatitis herpetiformis and the entire absence of nuclear fragmentation, in contrast to the small number of eosinophiles and the large mass of nuclear fragments present in the sections from the case described.

The blood examinations not showing an increase of the eosinophiles, did not correspond to the reports of Leredde, Perrin and Fordyce, who found an increase of these cells present in the blood of patients with dermatitis herpetiformis.

The diagnosis of pemphigus pruriginosus (a typical case is now under observation at the Johns Hopkins Hospital Dispensary, from which material was obtained for comparison) may be thrown out for similar reasons, as the clinical pictures are seemingly enough different to warrant this. The fact that in pemphigus of this variety there is no tendency to special arrangement of the lesions, and no especial seats of predilection manifested by the eruption, would render such a diagnosis in this case improbable.

Case II.—In connection with the above case may be mentioned another which appeared a few weeks later. It occurred in a man twenty-six years old, a Russian by birth, and with no regular occupation at the time. His past history was negative, and no reliable data of his family were obtainable.

Three days before applying for treatment he noticed that his hands felt puffy and stiff, and upon compressing the palms he noticed a "blotchy" eruption which had escaped his attention before, being hidden by the natural redness of the skin. Soon after, spots began to appear on the backs of his hands and wrists, and a few also on the feet, which caused enough apprehension to bring him to the Dispensary for treatment.

Upon examination there was found present a slight erup-

* These specimens were from a case already published by Gilchrist (Johns Hopkins Hospital Reports, Vol. I).

tion, limited to the forearms and hands and backs of the feet, which consisted of maculo-papules, roundish in shape, varying from two to three cm. in diameter, and of a dark purplish red color.

Some of these were slightly elevated at the edges, giving them the appearance of having depressed centers. The lesions were discrete and few in number. Upon the palms the above mentioned blotches were to be seen when the skin was compressed so as to cause partial blanching, but were not perceptible otherwise.

Two of the lesions on the forearm showed a tendency to vesiculation, the vesicle appearing as an addition to the maculo-papule. No constitutional symptoms were present, nor were there subjective symptoms of any kind.

Three sections of skin were excised for examination. One represented the macular stage, the lesion selected not being raised above the level of the skin, of a pinkish red color and showing no central depression. The second was a papulo-vesicular formation, the vesicle being about two millimeters in diameter, and situated upon a raised erythematous base which extended about one millimeter beyond it.

At the same time cultures were taken from the other vesicles, which resulted in the growth of staphylococci (pyogenes albus and aureus). The patient was put upon diuretics and laxatives, and all symptoms disappeared in ten days.

The preparations from the excised lesions presented histologically an almost identical picture with those of the first mentioned case, with the following exceptions: The lymph channels of the epidermis were considerably dilated, causing a spreading apart of the epidermal cells, especially of the basal layers, and their consequent detachment upon the formation of the vesicle. This dilatation caused an apparent widening of the entire epidermis, so that over the vesicle it was broader than normal, instead of being compressed.

The destruction of the polynuclear leucocytes, so marked in the first case, was only very slightly present.

The leucocytes were massed at the tips of the papillæ, but appeared in much greater proportion to the amount of serum, the latter having escaped into the epidermis. Otherwise, the findings of the two cases as before mentioned were practically identical in character and correspond in almost every particular with sections prepared from a series of typical cases of erythema exudativum multiforme kindly lent by Dr. Gilchrist for examination and comparison.

Among the various theories of inflammation those formulated by Metchnikoff (although opposed by many eminent pathologists) seem to explain some of the phenomena observed in this case.

According to this author, any foreign substance, upon gaining entrance to the tissues, will (provided it is capable of causing an irritation) exert an attractive power (positive chemotaxis) over the leucocytes.

When the invading body is of a powerful nature as compared with the resisting power of the leucocytes, certain of the latter perish in the attempt to nullify its effects, and are either absorbed by other phagocytes and carried away, or escape as detritus in purulent formations. Whether the substance causing the irritation gains entrance to the tissues from within or without, and whether it is physical, chemical or biological, the result is the same, provided it has or produces other substances which have positive chemotactic properties.

Leloir and Gilchrist have demonstrated in numerous cases of true urticaria that excised urticarial wheals present the picture of an acute inflammation.

Gilchrist has further noticed in factitious wheals, excised from several cases of chronic urticaria (many sections of which were carefully examined) fifteen minutes after irritating the apparently normal skin, that together with the general emigration of leucocytes there occurred a limited destruction of the same, their nuclei appearing as fragments throughout the affected area, this fact suggesting the idea that possibly the mechanical irritation had set free some poison strong enough to attract the leucocytes and to destroy a certain number of them.

Leloir has demonstrated the fact that the lesions of erythema exudativum multiforme show from the beginning the successive steps of an exudative inflammation.

If the cutaneous manifestations of this disease are examined at the earliest stage (at which point many cases cease to develop and the lesions disappear), even at this period a slight migration of the white blood corpuscles may be observed; and as one investigates lesions of a more advanced condition, signs of a more profound disturbance of an inflammatory character are discovered. In herpes iris, representing as it does the most advanced type of erythema exudativum multiforme, the inflammatory process has reached nearly the highest grade shown in primary lesions, the step from the vesicle to the pustule being a slight one.

The observation in Case I of the very rapid breaking down of the polynuclear leucocytes, occurring even as soon as they made their appearance in the papillæ outside of the vessel walls, has not, as far as could be learned, been before reported in connection with this disease, and has suggested the idea that possibly the rapid death was due to a toxine set free from the capillaries of the papillæ, which represent a point of least resistance in the vascular system.

Such a toxine would act as the chemotactic agent, which, in this case, had probably proved powerful enough to cause the death and destruction of the emigrated cells.

What this toxine (if present) is, or how it obtains entrance to the blood stream, is a question which can only be discussed problematically.

The origin of such a toxine might, however, occur in the intestinal canal, and, acting on a nervous system already less resistant than normal, produce the phenomena above described.

The opinion given by some authors, that a toxine causing such a reaction could be formed by some specific micro-organism unrecognizable by present methods of investigation, which gains entrance to the cutaneous tissues through the blood stream, has neither been proved nor disproved as yet.

This hypothesis may seem to combat the term angio-neurosis, and to a certain extent it does, unless the understanding expressed by v. Duhring is accepted. This author says that the term angio-neurosis must be taken "not in an etiological sense . . . but rather as the physiological method by

which the lesions are developed." Schwimmer's definition, that "one designates as vasomotor and angio-neurotic affections all those caused by pathological changes in the innervation of the blood-vessels," is quoted by v. Duhring, who then says, "There is scarcely an hyperæmia, arterial or venous, transient or of long duration, and no inflammation acute or chronic, be what kind it may, that according to this definition one may not designate an angio-neurosis."

Some difference of opinion is to be found in the reports given by the various authors who have written an account of their observation of the histological changes to be seen in herpes iris, especially as regards the formation of the vesicle. Unna, after saying that "the histological examination of the simple erythema multiforme gives almost the same result as that of the vesicular and iris forms," and that "in the latter cases the epidermis changes are more pronounced," and "so far as concerns the changes in the cutis we have . . . altogether four different symptoms: dilatation of the vessels, cell proliferation around the vessel walls, emigration, and œdema of the cutis," goes on to say in reference to the formation of the vesicle, "Where there is actual vesicular development on the border of the eruption we find a marked widening of all the lymph spaces of the epithelium, and in certain spots dilatation into a subcorneal vesicle containing pure lymph. In many eruptions this extends with undermining of the horny layer and neighboring vesicles to a large monolocular blister, under which the prickle layer is simply compressed without undergoing in any sense degenerative changes."

Elliot (Morrow's System of Genito-Urinary and Skin Diseases) says that "vesicles and bullæ are formed by the penetration of the exudation through the intercellular spaces of the rete, and the lifting up of the stratum corneum and portions of the stratum lucidum and granulosum to constitute the outer wall."

Crocker is also of the opinion that the vesicle is formed by the serum "forcing its way between the rete cells."

In contradistinction to these views is that of Gilchrist (Duhring's Cutaneous Medicine), who holds that the vesicle is formed *beneath* the epidermis. It seems not improbable that in cases of the milder form, where the process of vesicular formation is slow and is preceded by the macular or papular forms of erythema, the view of Elliot and Crocker may be correct. With such cases the process observed in Case II might easily be made to conform, with the supposition of a more gradual infiltration of serum. In cases of a more severe type, however, the accumulation of fluid appears to be so rapid that no time is given for the dilatation of the inter-epithelial spaces, and the epithelium is lifted as a whole from the œdematous papillary body, and becomes more or less compressed by the intra-vesicular pressure acting against the resistance of the horny layer.

"Subcorneal vesicles" with the contents of "pure serum," such as Unna describes, were not observed.

The other features in the cases here reported agree in the main with those of other observers. The following exceptions, however, appear. Unna found many mitoses in the perithelia of the blood-vessels and of the epidermal cells. Neither of these locations showed marked proliferation of their respective cells in sections from any of the cases examined, and the point to which special attention has been directed, *i. e.* the fragmentation of the polynuclear leucocytes even immediately after leaving the vessels, does not appear to have been mentioned by any previous observer, and yet it is a fact on which some stress should be laid.

The findings in these two cases are well supported by those of Gilchrist (numerous sections from his six typical cases of the various stages of erythema exudativum multiforme were carefully investigated, the specimens being kindly lent by him for comparison) and it seems probable that the description here given is the correct one as regards the severe type of the exudative erythemata as shown in herpes iris.

RESUMÉ.

The cases here reported represent, in Case I, a severe type of erythema exudativum multiforme bullosum, or herpes iris, which had a protracted course and developed considerable constitutional disturbance.

Case II was of the mild form, the whole attack being limited to two weeks, and only a few of the lesions showing a tendency to vesicular formation.

The distribution and character of the lesions in both cases were typical.

The histopathology may be summarized as an acute exudative inflammation of the upper half of the corium, with dilatation of the superficial network of blood-vessels and lymphatics (the latter being slight), accompanied by a considerable emigration of polynuclear leucocytes, which in Case I became almost immediately disintegrated after leaving the capillaries of the papillæ. The latter, as the process extended, became practically filled with nuclear detritus, and by the confluence of neighboring papillæ similarly affected the vesicle was formed. This phenomenon of nuclear fragmentation does not appear to have been noted by any previous observer.

In Case II, which presented the same general microscopical features, the breaking up of the polynuclear leucocytes was much less marked.

In both cases the vesicle was formed by the lifting of the entire epidermis from the papillary body, the former becoming compressed over the vesicle in Case I, and in Case II appearing swollen and œdematous, and showing more or less dilatation of the inter-epithelial spaces and detachment of the cells of the basal layers of the epithelium. The contents of the vesicles were always the same, and consisted of coagulated serum, polynuclear and mononuclear leucocytes, occasional detached epithelial cells, strands of fibrin, and in Case I much nuclear detritus.

No infarcts of blood-vessels and no hemorrhages were noted.

The sweat apparatus, hair follicles and sebaceous glands were unaffected.

In closing I wish to express my obligations to Dr. T. Caspar Gilchrist of the Johns Hopkins Hospital for his invaluable aid and suggestions in the preparation of this paper.

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Fig. I.

Fig. II.

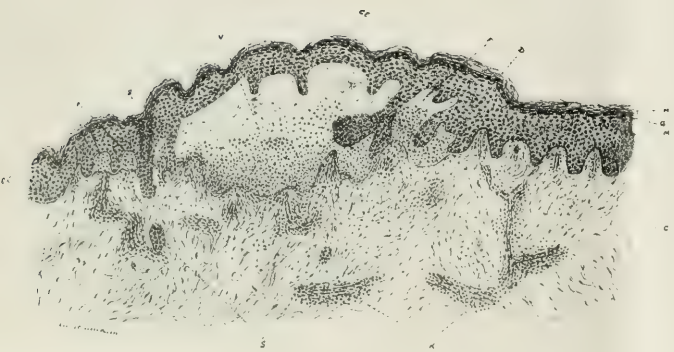

Fig. IV.

Fig. V.

Fig. III.

Fig. VI.

(Twentieth Century Practice), Unna (Histopathology of Diseases of the Skin, 1896); Bateman and Willan (1810).

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PHOTOGRAPHS OF CASE OF (I) HERPES IRIS.

FIG. I was taken 24 hours after the appearance upon the back of the right hand, of the first lesion characteristic of herpes iris. The central bulla, with a circle of vesicles surrounding it, is well shown. Various sized, tense, discrete vesicles and bullæ, as well as numerous crusts, are scattered over the forearms.

FIG. II represents the antero-external surface of the forearms.

FIG. III shows a relapse 14 weeks after the first attack. The characteristic features of herpes iris are again well developed. In several places four half circles of vesicles have made their appearance.

SECTIONS FROM CASE I.

FIG. IV represents one of the minute vesicles from the forearm. It shows an acute inflammation of the upper half of the corium (*c*). The epidermis (*e*) is practically normal, save a slight increase in depth (*d*) at the edge of the vesicle, and a narrowing over it (*c. e.*). The vesicular formation (*v*) was wholly subepidermal, and its contents were serum, fibrin, mononuclear and polynuclear leucocytes, and much nuclear detritus. (*P*) indicates two papillæ, showing the earliest stage of the process, and (*F*) one somewhat later. (*H*) Horny layer of the epidermis, (*G*) granular and (*M*) prickle layer, (*S*) sweat ducts, (*K*) dilated blood-vessels surrounded by emigrated cells.

FIG. V represents a magnified papilla, with only the two adjoining rows of epidermis (*e*). The earliest stage of the process is shown by the microscopic vesicle (*v*) which has displaced the upper third of the papilla, and contains serum, fibrin, one polynuclear leucocyte (*P*), and fragmented nuclei (*N*). (*C*) connective tissue.

FIG. VI shows a later stage than Fig. V. The entire papilla is here displaced by serum, fibrin, a few polynuclear leucocytes, and a mass of nuclear detritus. Lettering the same as Fig. V.

NOTES ON NEW BOOKS.

The Medical Annual and Practitioner's Index. 1898. Sixteenth year. (*Bristol: John Wright & Co.*)

This volume of the Medical Annual not only will compare favorably with its predecessors, but in some respects it easily exceeds them. The leading articles continue to be supplied by some of the best known writers in the English language and physicians whose interests and field of work especially fit them to present the contributions associated with their names. In a volume containing so much of interest to the busy physician who wishes to be placed *en rapport* with the latest authoritative utterances on medical topics, one can but select a few examples to consider in a brief review. A. Mitra, of Kashmir, supplies the article on bubonic plague. The results of the recent bacteriological and epidemological studies of the outbreaks in China and India are used freely. Attention is called to the contagiousness of the disease, which, it appears, had been rather underestimated. Although the treatment occupies a large part of the article, its richness is embarrassing and depressing rather than inspiring of hope. Thus far no specific remedy has been discovered, and the preventive inoculations of Haffkine and the serum treatment of Borel and Calmette are to be regarded still as *sub judice*. The operation for obliteration of the deformity in Pott's disease, introduced by Calot of Berck-sur-mer, is discussed by Messrs. Jones and Tubby. These writers give an account of the treatment of 56 cases, two of which resulted fatally—"one under circumstances very unsatisfactory," the other from epilepsy five weeks after operation. The tabulated account of these 56 cases will be read with much interest by surgeons. The curves found best suited to treat by this method are (a) those occurring in the young; (b) those in which the disease is active; and (c) those in which the angle of deformity is changing; (d) in those cases where paralysis is present, and as an alternative to laminectomy, which in their experience has often failed to relieve the pressure point. The authors, despite their relatively limited experience which does not permit them to predict unqualified success in this new departure, would yet point out that "the diseased spinal column is no longer too sacred to be touched."

Mr. Shattock has contributed a chapter on the bacteria pathogenic in the human subject, the value of which is greatly enhanced because of the excellent illustrations which accompany it. When this contribution is completed, which it is promised will be achieved in the succeeding volume, the whole will comprise an atlas of pathogenic bacteria very useful to physicians, surgeons and specialists. The drawings are true to nature, and are printed in the colors in which the stained bacteria are usually seen under the microscope. It is a pleasure to recommend this handy volume to the medical profession. S. F.

Jakob: Atlas of Methods of Clinical Investigation, with an Epitome of Clinical Diagnosis, etc. Edited by AUGUSTUS A. ESHNER, M. D. Authorized translation from the German. (*Philadelphia: W. B. Saunders*, 1898.)

A properly executed atlas on clinical diagnosis is to be commended very warmly. Undoubtedly this is the age in medical teaching and practice in which intuition, the so-called "Aerztliches Gefühl," counts for least. Instead of tradition and authority we have substituted observation and experiment and the practitioner who follows in the march of clinical methods resorts to the stethoscope and perhaps the fluoroscope, counts and studies the

blood, estimates the percentage of haemoglobin, differentiates the several kinds of leucocytes, collects the serum for the Widal test, looks carefully at the urinary sediment, neglects not the diazo-reaction, gives test-breakfasts and analyzes the stomach contents, stains the sputa for bacteria, makes bacteriological cultures from the blood, and at last perchance follows the patient into the dead-house and post-mortem chamber. The small and handy volume under consideration is designed to be an aid to these and many other operations, by supplying as far as possible life-like reproductions of the various appearances observed in health and disease in the blood, urine, stomach and intestinal contents, viscera, etc. The plates in the volume cover the normal histology of the red and white blood corpuscles, the special changes in the blood in leukæmia, pernicious anæmia, leucocytosis, malaria, relapsing fever, anthrax, etc. The blood spectra are given and blood crystals represented. The microscopic appearances of the buccal and nasal secretion in gingival deposit, thrush, diphtheria, etc., and reproductions of unstained and stained (asthma, etc.) sputa in health, cardiac disease, actinomycosis of the lung, etc., are given. Next follow plates representative of the microscopy of the contents of the stomach and intestines, the most important color reactions of the gastric juice, urinary sediments, crystalline and organized, the most important color-reactions of the urine, the commoner pyogenic micro-organisms, etc. Part II is devoted to normal projection of the viscera and percutory topography. The diseases of the lungs, heart and abdominal organs are represented in outline. The concluding part of the volume treats of the various steps embraced in the physical examination, and discusses briefly the special pathology and therapy of the more important diseases.

This very convenient volume can be recommended unhesitatingly to the practising physician no less than to the student in clinical microscopy and physical diagnosis. S. F.

The Elements of Clinical Diagnosis. By Professor G. Klemperer, First American from the seventh German edition. Translated by N. E. Brill, M. D., and S. M. Brickner, M. D., of New York. (*The Macmillan Company*, 1898.)

This work appears to be the result of an attempt to state as much regarding clinical diagnosis in as small space as possible. As a result clearness is apt to be sacrificed to brevity, and accurate description to space. There are many excellent points in the book, but one needs a previous knowledge to appreciate them. A student using it for a text-book frequently would be apt to be led into error, especially through many statements made without necessary qualification. Parts of the book are put clearly and well. Many of the illustrations would have been better left out; they leave much to be desired.

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LOUIS EUGENE LIVINGOOD, M. D.

AT A MEETING HELD AT NOON ON THE EIGHTH OF JULY, IN THE OFFICE OF THE SUPERINTENDENT OF THE JOHNS HOPKINS HOSPITAL, PRESIDED OVER BY PROF. W. H. WELCH, THE FOLLOWING RESOLUTIONS WERE ADOPTED:

Whereas, on the Fourth of July the steamship La Bourgogne sank at sea with more than 500 passengers; and

Whereas, among those lost was our beloved colleague, Louis Eugene Livingood;

Be it Resolved, That we, the Medical Faculty of the Johns Hopkins University and the staff of the Johns Hopkins Hospital, who for five years have been his associates and friends, do express to his family our deepest and most heartfelt sympathy in their cruel bereavement.

He has left a record of unusual purity of character, of singleness of purpose, of devotion to duty, of work well done, which will remain a treasured memory to all who knew him.

And, Be it Further Resolved, That a copy of these resolutions be transmitted to his family and published in the Baltimore News and in the Bulletin of the Johns Hopkins Hospital.

GEORGE W. DOBBIN,
LEWELLYS F. BARKER,
WILLIAM SYDNEY THAYER,
Committee.

PUBLICATIONS OF THE JOHNS HOPKINS HOSPITAL.

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Report in Pathology.

The Vessels and Walls of the Dog's Stomach; A Study of the Intestinal Contraction; Healing of Intestinal Sutures; Reversal of the Intestine; The Contraction of the Vena Portae and its Influence upon the Circulation. By F. P. MALL, M. D.

A Contribution to the Pathology of the Gelatinous Type of Cerebellar Sclerosis (Atrophy). By HENRY J. BERKLEY, M. D.

Reticulated Tissue and its Relation to the Connective Tissue Fibrils. By F. P. MALL, M. D.

Report in Dermatology.

Two Cases of Protozoan (Coccidioidal) Infection of the Skin and other Organs. By T. C. GILCHRIST, M. D., and EMMET RIXFORD, M. D.

A Case of Blastomycetic Dermatitis in Man; Comparisons of the Two Varieties of Protozoa, and the Blastomyces found in the preceding Cases, with the so-called Parasites found in Various Lesions of the Skin, etc.; Two Cases of Molluscum Fibrosum; The Pathology of a Case of Dermatitis Herpetiformis (Duhring). By T. C. GILCHRIST, M. D.

Report in Pathology.

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On Fever of Hepatic Origin, particularly the Intermittent Pyrexia associated with Gallstones. By WILLIAM OSLER, M. D.

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Men and women are admitted upon the same terms.

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BULLETIN

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A TRAGEDY OF THE GREAT PLAGUE OF MILAN IN 1630.

By Robert Fletcher, M. D.

In early Bible history there are records of the utter destruction of temples or even cities, the removal of every stone which marked their existence, and the sowing of the ground with salt, so that it might ever after be sterile. Of the efficacy of the latter part of the proceeding, some doubts might be entertained. In more modern times the residence of some notorious criminal has, in like manner, been destroyed and removed with the solemn declaration by the State that the ground upon which it had stood should be held as accursed, and that no building should ever be erected upon it. There are two noteworthy instances in which, in addition, a stone column with an inscription describing the crime and its punishment was erected upon the site of the dwelling of the criminal. The first in order of date is still in existence in Genoa. A certain Julius Cæsar Vacchero, known as the "richest merchant of Genoa," entered into a conspiracy in 1628 to destroy the republican government of Genoa and to deliver the State to the Duke of Savoy. He was beheaded with many of his fellow conspirators, his wife and children were banished, and by a decree of the Senate his palace was razed to the ground, every stone removed, and a pillar with an inscription devoting him to "eternal infamy" was erected on its site. A naval officer* who visited the spot a few years ago described to me the desolate appearance of this vast space of ground overgrown with brambles and weeds, with the weather-beaten stone pillar in its centre. In reply to his enquiries, no one could tell him anything of the story connected with the place, only that the ground was "accursed," and the pillar was "*colonna d'infamia.*"

The other column was erected in Milan, in 1630, and the tragedy it commemorated is the subject of the present sketch.

Traditions of the terrible pestilence known as the Black Death, which ravaged Europe in 1348, and which, according to estimates made from such sources as were accessible, swept away one-third of the inhabitants of the known world, were still rife in Milan when the great plague of 1630 broke out in that city. A writer has left a vivid description of the conditions brought about by the former visitation. He says:

*Captain Greer, now Rear Admiral Greer, U. S. N. (Retired). He copied the inscription, which corresponds exactly with that given in the account of Vacchero's conspiracy in the *Archivio storico d'Italia*, an important collection of public documents published by the Italian Government, and amounting to nearly a hundred volumes.

"Wild places were sought for shelter; some went into ships and anchored themselves afar off on the waters. But the angel that was pouring the vial had a foot on the sea as well as on the dry land. No place was so wild that the plague did not visit—none so secret that the quick-sighted pestilence did not discover—none could fly that it did not overtake.

"For a time all commerce was in coffins and shrouds, but even that ended. Shrift there was none; churches and chapels were open, but neither priests nor penitents entered—all went to the charnel-house. The sexton and the physician were cast into the same deep and wide grave; the testator, and his heirs and executors were hurled from the same cart into the same hole together. Fire became extinguished, as if its element had expired, and the seams of the sailorless ships yawned to the sun. Though doors were open and coffers unwatched, there was no theft; all offenses ceased, and no cry but the universal woe of the pestilence was heard among men."

There is nothing more cruel than fear, and no fear more debasing than that which is engendered by the presence or approach of a pestilence. We have not been without some experience of this in our own day, but when we add to this ignominious cowardice, the gross ignorance and superstition which existed at the period of which I am about to speak, we can understand, partly at least, how such a story became possible.

Manzoni, the famous Italian writer, the author of the best romance of the century in his language, "*I promessi sposi*," "The Betrothed," has told the story of this Milanese column in a small work published in 1840, *Storia della Colonna infame*. It has not been translated into English, though there is a French version of it.

The column in question was erected in 1630, and was blown down during a storm, in 1788. The inscription upon it was in Latin, which, in its construction, very closely resembles some portions of the inscription on the Genoese pillar. The literal translation of it is this:

"Here, where this plot of ground extends, formerly stood the shop of the barber Giangiacomo Mora, who had conspired with Guglielmo Piazza, Commissary of the Public Health, and with others, while a frightful plague exercised its ravages, by means of deadly ointments spread on all sides, to hurl many citizens to a cruel death. For this, the Senate, having declared them both to be enemies of their country, decreed that, placed on an elevated car, their flesh should be torn with red-hot pincers, their right hands be cut off, and their bones be broken; that they should be extended on the wheel, and at the end of six hours be put to death, and burnt. Then, and that there might remain no trace of these guilty men, their possessions should be sold at public sale, their ashes thrown into the river, and to perpetuate the memory of their deed the Senate wills that the house in which the crime was projected shall be razed to the ground, shall never be rebuilt, and that in its place a column shall be erected which shall be called Infamous. Keep afar off, then, afar off, good citizens, lest this accursed ground should pollute you with its infamy. August, 1630."

This barbarous sentence was executed in all its details, and for a hundred and fifty years, this pillar, intended to blast the memory of two really innocent persons, stood as the proof of the ignorance and credulity of their judges. In 1777, a certain Count Pietro Verri, Counsellor of State in the service of the Empress Maria Theresa, wrote a work, which, however, did not see the light until 1804, twenty-seven years later, entitled (translated) "Remarks upon torture, with special relation to the effects of the baleful ointments to which was attributed the plague which devastated Milan in the year 1630." Count Verri had carefully perused all the records of the trial of Piazza and Mora, and while pointing out the injustice done these wretched men, he decried in good set phrase the legalized use of torture. It is not surprising that he delayed the publication of his treatise. As late as 1768 the Empress Maria Theresa had authorized the publication of a codification of the laws relating to the use of torture by the courts. The judicial application of torture, or "the question," as it was termed by a delicate euphemism, comes down from the Roman code of laws. Count Verri quotes from the writings of many jurists as to the rights of the accused, and the power of the judges, in cases where it was necessary to extract the truth. The late Dr. Welling, of Washington, delivered an address on the law of torture, giving the codification of Guazzini, a famous Italian jurisconsult, which was published in 1612. There is a wonderful resemblance in the provisions of all these laws as described by Guazzini, Verri, and the later codification of Maria Theresa. Great discretion was given to the judges, but they were forbidden to apply the torture in any case more then three times. If the accused, appropriately named *l'afflitto*, the sufferer, bore these three administrations without confessing, then he was to be held guiltless as by Divine decision. In the "Ancient customs of Brittany," a very curious compilation made in 1330 and 1340, the same limitation was made, and if the accused bore it all without yielding, then he was to be, in the language of the compiler, "Safe and free, because it was evident that God exhibited miracles for him."

Another provision of the law regulating the application of torture, which was violated in the case in question, was that which forbids its use for the discovery of the *corpus delicti*, which must appear *aliunde*—from other sources—but only for the purpose of discovering the author and accomplices of the crime. Here there was certainly neither dead body nor injured person.

The preparation of the accused for the torture was ceremonious. It was a general belief of the times that an amulet or compact with the evil one which would enable him to endure the cruelest suffering, and thus evade the desired confession, might be concealed in his clothes, hair, or even in his stomach or bowels. His clothing was therefore changed, every particle of hair was shaved off, and a purgative was given him, so that he might be effectually deprived of all diabolic aid. Piazza was thus prepared every time that he was tortured.* The belief in this protective power was of ancient date. A distinguished Italian magistrate,† in a work on criminal law published in 1532, states that an accused man revealed the

* "Abraso prius dicto Gulielmo, et vestibus Curiæ induto, propinata etiam potione ea purgante." (Processo [etc.], p. 41.)

† Hippolytus de Marsiliis. Practica criminalis [etc.], fol., Venetiis, 1532, fol. 12.

secret of his ability to resist torture and refrain from cries or disclosures. He confessed that one of his relatives had prepared for him a cake of wheat flour, to which was added the mixed milk of a mother and daughter. Every day he was to swallow some crumbs of this cake, and as long as it lasted it insured his insensibility to torment. On the other hand, there were certain liquids and greases which, when rubbed into the body of an accused person, counteracted all his protective charms, and, says Marsiliis, with cynical exultation, "when that was done one could hear the joints crack and the bones sing." M. Le Blanc* says that these counter-charms were known in England in the 12th century, in Italy in the 14th century, and in China to quite recent days.†

The original account of the proceedings which led to the tragic end of Piazza and Mora is that of the Canon Ripamonti. He was born in 1577, and was historiographer of Milan. He published the first ten volumes of the Ecclesiastical History of Milan, in 1617, and by request of the Decurions wrote an account of the plague which devasted the city in 1630. This latter is a quarto book of 410 pages, written in Latin, and published at Milan in 1641. The title-page is a copper-plate engraving, curiously emblematic. There is a gigantic skeleton filling the entire page; his hands hold weapons, armor, and books of devotion; his bony feet protrude from under a carpet on which lies a man, the victim of the plague. In front of the skeleton is an altar with a crucifix, to which a woman, seated, with the usual naked boy attending her, points with a sword.

Two hundred years later, in 1841, this work was translated into Italian by Francesco Cusani, who has added many valuable notes in an appendix.

In 1839 the full official account of the trials of the "Anointers" was published in Milan.‡ It is in Italian, but all that relates to the application of the torture is discreetly veiled in the less familiar Latin, which, however, the modern editor has translated into Italian.

From these sources the facts have been obtained, now to be briefly presented.

Early in the morning of the 21st of June, 1630, during the prevalence of the plague in Milan, a woman of the lower classes saw from her window a man going down the street who was writing on a paper. He wiped his fingers on the wall of a house, probably to get rid of ink-stains, but with the readiness of ignorance and fear, she was sure that he was smearing deadly ointments to promote the spread of the pestilence. A crowd of excited women invaded the Council-chamber, and the Senate was informed of the occurrence. Orders were immediately given to trace out and arrest the guilty man.

It must seem strange to us that the rulers of a great city, even at that time, could have been so ignorant as to believe that such means could be productive of the pestilence, or that any man or men could desire to destroy their fellow-citizens, and risk their own lives besides. But extraordinary occurrences demanded extraordinary causes to account for them. The plague was attributed to hail, to the poisoning of the fountains by the Jews—to deadly ointments so placed that passers-by would touch them. It became dangerous for any one to touch walls or buildings. Ripamonti relates that three French travelers admiring the façade of a building, one of them touched the marble, and was immediately set upon by the mob and dragged half dead to the prison. An old man, 80 years of age, about to sit down on a bench in the church of San Antonio, wiped off the dust with his cloak. A woman cried out that he was anointing the benches, and even there, in the house of God, the worshippers beat and kicked the life out of the unfortunate man. Such was the spirit of the time.

The earliest notice, perhaps, of this belief in "Anointers" is to be found in the works of Guy de Chauliac, who was physician to Pope Clement VI and was living in Avignon, in 1348, when the Black Death ravaged that city. He says: "It was believed that the Jews had poisoned the world, for which reason they were slain. In other places they drove away beggars after cutting off their ears * * * and if it was found that any one had powders or ointments, he was compelled to swallow them, to show they were not poisons.*

Ambroise Paré, in his *Livre de la peste*, throws further light on the matter. In his Advice to Magistrates, during the visitation of the pestilence, he concludes the chapter thus:

"What shall I add? They must keep an eye on certain thieves, murderers, poisoners, worse than inhuman, who grease and smear the walls and doors of rich houses with matter from buboes and carbuncles, and other excretions of the plague-stricken, so as to infect the houses and thus be enabled to break into them, pillage and strip them, and even strangle the poor sick people in their beds; which was done at Lyons in the year 1565. God! what punishment such fellows deserve; but this I leave to the discretion of the Magistrates who have charge of such duties."†

The scrivener, with the ink-horn at his belt, was discovered, and proved to be a certain Guglielmo Piazza, a commissioner of health, a petty officer employed to report cases of the disease. He stoutly denied all knowledge of the crime charged to him, and maintained his resolution through two applications of torture, although the second one was the "question extraordinary," in which atrocious complications were added to the ordinary proceeding. But in his cell, broken down with the effects of the torments he had twice experienced, and dreading their renewal, which he knew would come, the unhappy man yielded to the insidious suggestions of those around him. He confessed his guilt, and declared that he obtained the death-dealing ointment from the barber Giangiacomo Mora. The latter was immediately arrested, but was likewise vehement in his declarations of innocence, avowing that he had never seen or known Piazza. The latter was made of sterner stuff than the barber, who yielded at the first application of

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* Le Blanc, (Edmond). De l'ancient croyance à des moyens secrets de défier la torture. Paris, 1892, p. 14.

† Bodin states that magic words conferring immunity under torture were sometimes written on the scalp of sorcerers, where it was concealed by the hair. (De la démonomanie des sorcières, 1587.)

‡ Processo originale degli Untori nella peste del 1630. Milan, 1839. 8°.

* Cyrurgica, 1499, fol. 19.

† Œuvres, 1575, fol., p. 662.

the torture, and confessed everything they suggested to him. From that time on these two wretched men vied with each other in manufacturing falsehoods. They implicated even a Count Padilla, the son of the Commandant of the Castle. He was arrested, but having powerful friends, his trial did not take place until long after the execution of Piazza and Mora. It was from the documentary evidence on his trial that Count Verri obtained the full details of the iniquitous treatment of the two victims who had perished. Count Padilla was ultimately acquitted.

Mora, the barber, had a wife and five children; the eldest, a young man, assisting him in his business. The latter was arrested with his father, and the entire contents of the shop were seized and carried to the court. As was usual in those days, the barber dabbled in medicine, and he declared, no doubt with truth, that the various pans and vessels contained remedies for or preservatives from the pest. The sale of these specifics was very extensive. A man who was hanged for robbery during the height of the pestilence confessed, with the rope around his neck, that he had prepared an ointment as a charm against the Anointers. Cusani, in his notes, gives the formula of what became known as Unguento dell' Impiccato, "The ointment of the hanged man." It may take its place with the "Vinegar of the four thieves," which had its origin during the plague of Marseilles. Its composition was supposed to be: Wax, 3 ounces; Olive oil, 2 ounces; Oil ivy, Oil stone, Leaves of Anethum, or dill, Laurel berries, Sage and Rosemary, of each ½ ounce. A little vinegar was added.

It is interesting to observe that these remedies, or preventatives, were composed almost entirely of aromatics, some of which furnish the accepted germicides of our own day. The apertures of the body were to be especially guarded by application of these waters or tinctures. Ambroise Paré recommends that a surgeon called to attend patients with the plague should first be purged and bled. Next he should have two issues made, one at the insertion of the deltoid of the right arm, and another about three fingers' breadth below the left knee. He considerately adds that these need not be made if the surgeon already has any running sore. "For truly," he declares, "we know from experience, that they who have such open sores, have not been subject to the plague, and have taken no harm, though they were every day among cases of it." *

Paré also gives a formula of a "Preservative water," with which the surgeon was to wash his whole body "very frequently," and he adds, "it is a good thing to wash the mouth with it, and draw a little of it up the nose, and put a few drops into the ear."

This preservative consisted of a mixture of rose water, elderflower water, and wine, in which were boiled, by slow heat, the roots of inula, angelica, gentian, bistort and zedoary; also the leaves of sage, rosemary, wormwood and rue; juniper and ivy berries with lemon peel, and the mystic theriac and mithridate were finally added.

As a proof of the danger of contact with the bodies of infected persons, Paré relates in his vivid style how he himself nearly fell a victim to a sudden deadly syncope, the result of the overpowering effluvia which arose from the buboes and carbuncles of a plague-patient, as he uncovered him. Upon regaining consciousness he sneezed violently ten or twelve times, so that his nose bled, and he attributes his escape to "virtue of the expulsive power of his brain, seeing that all his other faculties were dead for the time." *

The barber's acquaintance with Piazza seems to have been limited to occasional visits of the latter to his shop for the usual service of his trade, and they both stated that Mora had undertaken to prepare a pot of his "preservative" for his customer. On this slight foundation was built a superstructure of conspiracy for wholesale murder, by the never-failing power of torture. Once, in his agony, the wretched barber cried to his judges that if they would tell him what they wanted him to say, he would say it! He confessed everything that was insidiously suggested, such as that he had mixed foam from the mouths of those dead of the plague with his ointment, and then declared that Piazza, whose business took him among the dead bodies, had supplied him with the material.

In the account of the trial there is frequent allusion to the "purging the infamy" of the accused. A Roman law, given by Justinian,† provides that gladiators, slaves, and infamous persons like them, when called as witnesses, should be first put to the torture, so as to insure their telling the truth. In like manner, in the Italian laws regulating the legal application of torture, the accused person was declared to be "infamous," and his implication of others in his crime was not to be accepted as proof, unless he maintained his charge while subjected to torture. If he then reiterated his declaration he was said to have "purged his infamy," and his evidence was admitted. Piazza, as he involved others in his accusations, was, on each fresh occasion, tortured to "purge his infamy," and thus make his charges applicable. The degree of suffering inflicted upon him seems to have been much lighter than on other occasions. He had been promised immunity from his sentence by the Auditor of the Court if he made full confession, another instance of the treachery of these officials, for the Governor only could exercise such power.

More than once, Piazza and Mora recanted, and declared that their confessions were false, and uttered only in fear of further torments. A threat of another application of the question, and, above all, the hope that if no longer recalcitrant they might expect some mitigation of the horrible punishmen which had been decreed as their fate, soon reduced them to submission. They were in the hands of men who were destitute of pity. The plague was raging, and the populace, fierce and ignorant, demanded their victims. The Commandant of the Castle, the father of Count Padilla who had been accused of complicity in the alleged crime, demanded of the Court that the execution of the sentence on Piazza and Mora should be delayed in order that they might be confronted with his son and their accusations be met. The judge refused to accede to his request on the ground that "the people were clamorous."

* *Op. cit.*, 663.

* *Op. cit.*, p. 664.

† Digest, *lib.* XX, *tit.* V, *de testibus*, 1, 21.

LA SENTENZA DATA A QVELLI CHE HANNO AVELENATO MOLTE PERSONE IN MILANO L'AN. 1630

Riferito in Senato dal Magnifico Senator Monti Presidente del Magistrato della sanità ch Processo formato contro Guglielmo Piazza e Gio. Giacomo Mora li quali con onto pestifero hanno appestata la Città uduto il Magnifico Presidente e raccolti i voti de Padri il Senato è concorso in questa sentenza

Che li sopranominati Mora e Piazza posti sopra d'un Carro siino condotti al luco solito della Giustitia Nelli andare ne luoghi one hanno delinquto siino tenaghati Avanti la Barberia del Mora si tagli all' uno, et all'altro la mano dritta Si rompino loro l'ossa al solito con la Rota la quale si leui in alto et in quella uiui s intrecciano loro corpi Dopo sei hore si segnino, e subito li loro cadaueri si abbruciino e le ceneri si gettino in fiume La casa del Mora si spiani et in quel largo si drizzi una Colonna la quale si chiami Infame et in essa si scriui il successo ne ad alcuno sia permesso mai piu riedificare detta casa Si dia satisfattione a creditori di detta Casa de beni di condannati, e non bastando siino satisfatti del Publico Li beni del detto Mora e Piazza siino confischino

DESCRITTIONE DELLA ESECVTIONE DI GIVSTITIA FATTA IN MILANO CONTRO QVELLI LI QVALI HANNO COMPOSTO, E SPARSO GL'VNTI PESTIFERI

FIG. 1

When the condemned men found that their examinations were at an end, and that, despite the promise of impunity, they were to be submitted to the full execution of their terrible sentence, they retracted in their confessions to the priest all the charges they had made against other persons, declaring that they were made under the agonies of torture, or in the apprehension of further suffering.

In the collection of medical portraits and engravings in the library of the Surgeon-General's office, at Washington, is an elaborate print, representing in all its details the execution of Piazza and Mora.

The engraving, which is from a copper-plate, is about sixteen inches square. It was published in Rome by the authority of the Nuncio of the Roman College. The engraver was Horatio Colombo. There is no date, but it is probable that it was brought out close upon the event it commemorates.*

The title on the top is (translated), "The sentence pronounced on those who had poisoned many persons in Milan in the year 1630." This is followed by the names of the Magnificos who sat in judgment, and the particulars of the punishment decreed. Each scene in the picture has its letter, which is referred to in an explanatory legend below. The entire disregard of the unities of time and place which characterized such productions is well displayed in this curious engraving. On the right is the shop of the barber Mora, and in front of it the "Column of Infamy" is already erected. A large platform car, drawn by two oxen, exhibits the victims, executioners, and priests. A brazier of live charcoal contains the pincers with which the flesh was to be torn. The barber's right hand is on the block, and a chopper held over the wrist is about to be struck down by a wooden mallet held aloft by the executioner. Further on is seen a large platform, on which the two victims are having their limbs broken by an iron bar, preparatory to their exposure on the wheel for six hours. The wheels are also displayed, one of them already on a pole, with the men bound upon it.

Still further on are the fires consuming the bodies, and, last scene of all, on the extreme left is a fussy little stream foaming under bridges, which is supposed to be a river, and into it a man is throwing the ashes of the two malefactors.

Comment upon this tragic occurrence is needless. It tells its own story and bears its own moral.

A few words may be added as to the mortality of this pestilence and the measures adopted by the authorities to encounter it. Like all statistics of those early times, the estimates are variable, but there are letters from the Sanitá to the Governor, which state the then daily mortality at 500. It is probable that the total number of deaths was about 150,000.

The tribunal of the Sanitá, a body something like a modern board of health, seem to have acted with sense and energy, though impeded by the obstinacy and ignorance of the Senate, the Council of Decurions and the Magistrates. To declare that the plague had appeared in Milan was to drive the people off, and to frighten trade away. The two physicians of the Sanitá, Taddino and Settala, scarcely dared to appear in the streets, and the latter, who was 80 years old, nearly lost his life from the angry mob. Later, when the existence of the pestilence had to be admitted, some strange precautions were adopted. An immense procession was to proceed through the city in honor of San Carlo and to implore his aid, and the authorities ordered the doors of all sequestered houses to be nailed up lest the distempered inmates should try to join the procession. There were 500 such houses, according to the Cavalier Somiglia, who also wrote an account of this fearful time.

Fig. 2.

An immense hospital was constructed to accommodate 2,000 persons, though at one time, in the height of the disease, the number of its patients had increased to 16,000. The pits dug for the dead became filled, and bodies in all stages of putrefaction were lying in houses and in the streets. In despair, the Sanitá applied to two priests who had been efficient in their aid. They promised that in four days all the corpses should be removed. They went into the country, and summoning the people in the name of religion, they succeeded in having three immense pits dug. The *monatti* of the Sanitá were employed to bring out the dead, and in the stipulated time the good fathers had fulfilled their pledge. The persons in the employ of the Sanitá for removing corpses were of three grades. The *monatti* carried the bodies out of the houses and carted them to the pits. The *apparitori*, or summoners (the name is still preserved in the English Ecclesiastical Courts as

* In the Processo originale degl' Untori, Milan, 1839, there is at the end a folding plate, which is a poor copy of this engraving. The editor speaks of the original as "una stampa di quel tempo."

apparitors) went before with a bell notifying the people to bring out their dead. The *commissari* were in control of the other two. It will be remembered that the unfortunate Piazza was a commissario.

Among the precautions taken by physicians for their own protection, while visiting plague-stricken patients, was the adoption of a particular dress. Paré recommends that the material should be camlet, serge, satin, taffeta, or morocco, but not cloth, frieze, or fur, lest these latter should harbor the poison, and death should be thus conveyed to the healthy. Manget, in his Traité de la peste (Genève, 1721, 2 vols.), has a frontispiece to the first volume representing the dress of a doctor during the plague at Marseilles. From his description it seems that the mantle, breeches, shirt, boots, gloves, and hat, were all of morocco leather. The beak attached to the mask was filled with aromatics, the air passing over them in respiration. Figure 2 is a reproduction of this plate from Manget's work. In a recent number of Janus (Amsterdam, 1897, p. 297), M. Reber gives an interesting account of an engraving in his possession, the work of the artist John Melchior Fuesslin, which also represents a doctor at Marseilles during the plague, and is, he thinks, of about the same date as the work of Manget. His engraving is herewith reproduced as Fig. 3. The legend underneath may be translated:

"Sketch of a Cordovan-leather-clad doctor of Marseilles, having also a nose-case filled with smoking material to keep off the plague. With the wand he is to feel the pulse."

In Manget's sketch the *Stecklein* becomes a veritable stick, but the information conveyed by it would probably be quite as useful in the one case as in the other. The appearance of this leather-clad doctor, with his *nez fumant*, could scarcely have been reassuring to the plague-stricken wretch.

Since this address was written I have received the March number of the Bristol Medico-Chirurgical Journal, which contains a notice of the Manget and Reber sketches by Dr. L. M. Griffiths, the accomplished assistant editor. He reproduces the plates from the Janus blocks, and mentions that an amulet of arsenic was worn on the chest in time of plague, as a prophylactic, in the city of Bristol, as well as elsewhere. He quotes Kemp's treatise, 1665, thereanent. Ambroise Paré had, however, recommended this device a hundred years before. It was to be worn over the heart, in order that "the heart might become accustomed to poison, and so be the less injured when other poisons sought it."

SIR JOHN CHARLES BUCKNILL, M. D., F. R. C. P., F. R. S.*

By A. R. Urquhart, M. D., *Perth, Scotland.*

A notable personality has been lost to the medical profession by the death of Sir John Bucknill. During his long career of activity he worthily occupied a prominent position in the specialty of psychological medicine, giving forth no uncertain sound, and commanding respectful attention even from those who were most strenuously opposed to his utterances. He was a man of high ideals, fruitful in resources, indomitable in execution of what he conceived to be right. A masterful man, dealing shrewd blows, and unconscious of defeat.

Sir John Charles Bucknill was born at Market Bosworth, in Leicestershire, on the 25th December, 1817. His father, Mr. John Bucknill, practiced in that town as a surgeon. His younger brother, Alfred, who died at an early age, served in a regiment of the East India Company. He had two sisters, and a half-sister (by his father's second wife), who still survives.

Dr. Bucknill was educated at the grammar school of his native town, and at Rugby, under the great Dr. Arnold. In 1835 he entered University College, London; and, five years later, took the degree of Bachelor of Medicine, at London University. His career as a student was distinguished, and he served as house-surgeon under Liston, at University College Hospital, where Sir John Eric Erichsen and Sir Richard Quain were among his contemporaries.

After resigning that appointment, Dr. Bucknill began the practice of his profession in Chelsea, where he remained for four years. He married, in 1842, Mary Anne, the only child of Mr. Thomas Townsend, of Hill-Morton Manor, Warwickshire. By her he had three sons—Colonel Bucknill, late of the Royal Engineers; Mr. T. T. Bucknill, Q. C., M. P. for the Epsom Divison of Mid-Surrey; and Charles, now dead. Mrs. Bucknill died 1889.

His health having broken down, Dr. Bucknill was advised to live in a warmer climate; and this, no doubt, determined his application for the post of medical superintendent of the Devon County Asylum. He was appointed in 1844, and held office for eighteen years. The Devon County Asylum was designed on a system of radiating blocks, and expressed the latest improvements in construction at that time. Its first superintendent entered on his duties with characteristic energy and conspicuous ability, and soon organized it in accordance with his own ideas. The Committee of Management and the Commissioners in Lunacy were not slow to recognize that the institution had been placed in the front rank of hospitals for the insane. Dr. Bucknill was as active in the scientific duties of his office as he was in the administration of domestic details; while immersed in the study of medico-legal questions, and assiduous in journalistic work, at the same time he found leisure to occupy himself with the organization of the volunteers.

His literary work began in 1851, with a pamphlet on the *Classification and Treatment of Criminal Lunatics.* This was followed in 1852 by another on the *Law and Theory of Insanity.* Dr. Bucknill's first important book was published in 1854—"Unsoundness of Mind in Relation to Criminal Acts," being the first Sugden Prize Essay. It appeared again in a second

* Presented to the Johns Hopkins Hospital Medical Society, June 5, 1898.


Abriß eines in Corduan-Leder bekleideten mit einem von Pest vertreibendem Rauchwerk angefüllten Nasen-Futer versehenen Doctors von Marseille. Der mit einem Stekkem den Puls soll fühlen.

Fig. 3.

edition in 1857. These studies showed the bent of Dr. Bucknill's mind, and to the last he maintained his interest in them, publishing papers on cognate subjects down to 1884. In the Sugden Prize Essay he clearly stated that "responsibility depends upon power, not upon knowledge, still less upon feeling. A man is responsible to do that which he can do, not that which he feels or knows it right to do." In process of time, this position is slowly but surely being assumed by the legal profession, and the difficulties which then embarrassed the administration of justice are now less formidable in practice.

The first number of the *Journal of Mental Science* appeared in 1853, under the title of *The Asylum Journal.* Dr. Damerow, of Halle, had suggested a periodical on similar lines, in 1844, in which year *The American Journal of Insanity* was brought out. He found an active supporter in Dr. Bucknill. The association of medical officers of Asylums and Hospitals for the Insane, at a meeting held in Oxford, in 1852, unanimously resolved to establish their journal, and to confide the editorial labors and responsibilities to Dr. Bucknill, who continued to edit it until 1862, when he was compelled to resign office on his appointment as Lord Chancellor's visitor. Reference to the early volumes will show how he labored to make the journal worthy of its high aims, and what success followed on his devotion to its interests. Year by year, each volume has been prefaced by his eloquent and stirring words, which still incite us "to pursue that knowledge which is to be obtained in the practical departments of science."

His literary abilities and sound judgment were soon recognized, and he became a frequent contributor to the *British and Foreign Medico-Chirurgical Review*, which was then at its zenith. He had the highest opinion of the value of that Review, and counted it an honor to be a contributor. His article on the *Pathology of Insanity*, in 1855, was the germ of his greatest work, in which he was associated with the late Dr. Hack Tuke. The "Manual of Psychological Medicine," published in 1858, at once became a standard authority, and ran through four editions, the last appearing in 1879. Dr. Bucknill's share of this volume comprised the eminently practical sections relating to Diagnosis, Pathology and Treatment. His ripened experience and careful observations betrayed no trace of fatigue, his delineations of disease showed the hand of a master.

In the more immediate duties of his office the same originality of thought and the same determination to advance were obvious. In 1859, the Commissioners in Lunacy reported in favorable terms of his treatment of patients in cottages beyond the immediate precincts of the asylum. The evolution of this method of care has proved successful beyond all question. From the modest cottages at Exminster to the full development of such institutions as Alt Scherbitz, or Toledo, is a far cry; but the tone is triumphant. I do not know if Dr. Bucknill anticipated such far-reaching issues when he laid his modest plans of home-like surroundings for the insane, but I do know that the issues of his plan for National Defense greatly surpassed the imaginings of his fertile brain. When he invited four gentlemen to dinner on the evening of the 27th January, 1852, for the purpose of considering the possibility of raising a corps of Rifle Volunteers in South Devon, he so appealed to men that their new-found interest caused them to enter on the project with heart and soul. The Earl Fortescue, then Lord Lieutenant of the county, received their communication favorably; the Government, through him, accepted their services; and from that small beginning arose the present volunteer force of the country, with a roll of 224,525 efficient men.

While still at Exminster, Dr. Bucknill proceeded to take the degree of M. D., London, and became a Fellow of University College in 1852. Seven years later he was admitted a Fellow of the Royal College of Physicians, where he subsequently served as Censor (1879-81) and as Lumleian Lecturer (1877).

In 1859 and 1860 he published works of more general interest—"The Psychology of Shakespeare," and "The Medical Knowledge of Shakespeare." These were well received, and a second edition of the latter, under the title of the "Mad Folk of Shakespeare," was produced in 1867.

On Dr. Bucknill's appointment as Lord Chancellor's visitor, in 1862, he came to London and resided in the corner house of Cleveland Square, formerly occupied by Lord Playfair. After a time he moved to Wingate street; and, later, to Hill-Morton Manor, where he turned his attention to farming, and served the county as a member of the committee of the Warwickshire Asylum, to which his first assistant, Dr. Parsey, had been appointed medical superintendent.

In 1876, Dr. Bucknill resigned his office under the Lord Chancellor, and began practice as a consulting physician in mental diseases. At the Leeds meeting of the British Medical Association, in the following year, he delivered a presidential address before the section of psychology, entitled *The Priest and the Physician.* It was a powerful oration, and at once recalled attention to one who had been but little before the world during his period of official seclusion. The wide knowledge of men and affairs which Dr. Bucknill had garnered was given forth with no unsparing hand. He delivered a warning message to his colleagues, in advising the mental physician to breathe the pure air of a rational life, for his own sake, and for the sake of his patients; and inculcated the the greater need of understanding incoherence and delusion, and sympathizing with morbid feeling. He uttered the prophetic caution that we should walk with prudence and circumspection in the well-trod paths of medical reticence, forbearance and wisdom. Turning to those clergymen who had, at that time, achieved notoriety in connection with the book entitled *The Priest in Absolution*, he disposed once for all of the attempt to establish an identity between sin and disease. From the assertion that the physician is a naturalist, the priest a supernaturalist, and that no sophistry can bridge the abyss between them, Dr. Bucknill developed arguments in support of his position. This renascence of Heinroth's theory of the common origin of insanity and sin was strangled in his powerful grasp.

About this time, Dr. Bucknill published two little books, which were received with much hostile criticism. He had travelled in the United States in 1875, and his account of "Asylums for the Insane in America" was issued in the following year. The echoes of that controversy have not yet died

away, and I have no wish to re-awaken them now. Dr. Bucknill was a strong man. He held strong opinions and expressed them forcibly. His adherence to the principles and practice of Conolly was most tenacious. Although, in the preparation of the *Manual of Psychological Medicine*, points of difference had arisen between him and his collaborator, Dr. Hack Tuke, these were not obviously stated. The vexed question of mechanical restraint was one of these. As is now well known, the latter never adopted the extreme opinions Dr. Bucknill entertained. No doubt, Conolly set an impress on the minds of those brought into contact with him, and fired their zeal in no common measure. I have heard Dr. Bucknill say that every asylum physician should read every word Conolly published, and in truth, reforms of magnitude are not to be carried through without that overwhelming sense of necessity which rouses public interest and sweeps resistance aside. The time for a drastic remedy had come. I believe, too, at this late date, when the reorganized, reconstructed asylums of America have attained a level of efficiency unsurpassed in any other country, and much evil has been atoned by ameliorated conditions, that the specialty can well afford to admit that Dr. Bucknill's caustic pen was not employed in vain.

As to the other brochure on "Habitual Drunkenness," there will be more difference of opinion. The advance of Socialistic legislation is consequent on the alteration of the political equation. The treatment of habitual drunkards, whether by way of "reformation" or by way of "cure," is in an unsatisfactory state. Proceeding on the dogma that drunkenness is not *per se* a crime, we are on the eve of receiving some enactment dealing with those who mingle inebriety with offenses against the law. It does not appear to us, who see so much of the devastation wrought by this vice, that the moiety of legislation in progress is sufficient; but it may be accepted as an instalment. At the same time, we who occupy no extreme position must admit that Dr. Bucknill's shrewd common sense did much to clear the atmosphere.

His strictures upon private asylums, and suggestions for radical alterations in the care of the insane, were published in 1880, as a reprint of articles which had appeared in the *British Medical Journal*. It was in this direction that Dr. Bucknill diverged most widely from his colleagues. The book is entitled "The Care of the Insane and their Legal Control," and presents opinions and arguments most forcibly expressed. In brief, Dr. Bucknill advocated the abolition of the Commissioners in Lunacy, and would have relegated their duties to the Local Government Board in the case of paupers, and to the Lord Chancellor's office in the case of those possessed of property. This was generally received as an impossible policy, and failed for want of general support. His attack on private asylums, however, has been followed by most untoward results. His demand that the insane should not be "confined as a profitable private business" would at a stroke abolish private treatment. In fact, he did not or would not recognize that every kind of arrangement should be available, and that under efficient supervision the fittest should survive. The state of matters in England, at present, is far from satisfactory, the amended law of lunacy having resulted in grave and increasing evils. The discussion of these would be out of place on this occasion, but any presentment of Dr. Bucknill which would omit reference to his honest opinions and strenuous advocacy of them after a long life of observation and debate, would be partial and misleading.

In April, 1878, the first number of "Brain" appeared. With Dr. Bucknill, Sir James Crichton-Browne, Dr. Ferrier and Dr. Hughlings-Jackson were associated as editors. It was felt that there was room for a journal devoted to neurology, and the brilliant success with which "Brain" began and has continued showed that Dr. Bucknill had rightly judged the necessities of the medical profession in this direction. He continued to share in the direction of this journal for nine years, until it was firmly established as the organ of the Neurological Society.

Later communications to the current periodicals may be mentioned: In 1881, an article on *Lord Chief Justice Cockburn*; in 1882, a paper on the *Responsibility of Guiteau*; in 1884, a lecture on the *Relation of Madness to Crime*.

Dr. Bucknill had many honors showered upon him. He was a member of the Athenæum and Garrick Clubs, a Fellow of the Royal Society, a Justice of Peace for the County of Warwick, and a Governor of Bethlem Hospital. But the crowning mark of distinction of his long and active life was the Knighthood bestowed upon him in 1894. He was then entertained at Exeter by a distinguished company, who met to do him honor, and there to unveil a memorial of the inauguration of the Volunteer Force, which is decorated with a medallion bust of Sir John Bucknill, and bears an appropriate inscription. The Duke of Cambridge, so long the head of the army, in the course of an admirable speech presented him with a scroll commemorative of the occasion, and spoke in high terms of his services.

Sir John Bucknill was a keen sportsman, fond of all outdoor sports, as became one who was possessed of a commanding presence and a robust frame. He was also interested in music and the graphic arts. In early life, he allied himself with Palmerston in politics, but gradually changed to a moderate conservative.

Sir John Bucknill died at Bournemouth, where he spent the last years of his life, on 20th July, 1897, and was buried at Clifton, or Dunsmore, near Rugby. The cause of death was disease of the kidneys and bladder, leading to septic absorption. A photogravure from the Exeter Memorial published in the *Journal of Medical Science* is here reproduced; and Sir John Bucknill's biography is now in preparation by his eldest son.

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MEDICAL FEES IN ANCIENT GREECE AND ROME.*

By Charles Carroll Bombaugh, A. M., M. D., *Baltimore, Md.*

Those who examine with curious interest the 199 surgical instruments found in 1819 in the Via Consularis in Pompeii, and preserved in the National Museum at Naples, or their counterparts recovered from excavations in Rome and collected by Professor Scalzi, will remember that that interest centres in their remote antiquity and in their actual use more than eighteen centuries ago. At the same time the attentive observer cannot forget that they were not originals or prototypes, for the archeologists tell us that twenty centuries before Pompeii was buried by the shower of ashes from Vesuvius, the ancient Egyptians covered the ceilings and walls of the temples at Tentyra, Karnac and Luxor with basso relievos representing surgical operations and the instruments employed, many of which are analogous to the instruments in use at the present day.

Horace says in one of his Odes that there were brave men living before Agamemnon, the Grecian commander. We may quite as confidently say that there were good physicians before Hippocrates. And so, the father of medicine, transcendent as he was, originative, constructive as he was, belonged, let us remember, to the family of the Asclepiadae, the hereditary physicians of Greece, and therefore enjoyed special educational advantages in preparation for his immortal work. Granting that he brought order and law and symmetry out of chaos, the materials must have been ready at hand, for we are assured that observations and descriptions of symptoms were already numerous, and were marked by much acuteness. Granting that we owe to him the conception of the oath which he transmitted to posterity, that the striking portraiture of the true physician which he drew for all time was the outcome of his own creative power, there must have been sources of inspiration behind and beyond. Granting the authorship of his treatise on fractures and luxations, the genuineness of which is conceded, there were expert bone-setters on the stage of action long before his day. The master spirits that sway the multitude do not leap into the arena full panoplied as Minerva sprang from the brain of Jove.

Whether the story of Esculapius comes from the Greek mythology, or whether it is of Oriental origin, it helps the historian to establish the existence of medical men as a separate class among the earliest communities. Such traditions show that as far back as legendary history goes there existed men who made disease and the healing art a special study, and derived their means of subsistence from the practice of their craft.

Let us turn for a moment from history to mythology, from narrative to fable, though perhaps one is as purely legendary as the other. According to the best authorities, the siege of Troy took place about twelve hundred years before the Christian era. Four hundred years later, *i. e.* eight hundred years B. C., Homer wrote the Iliad. One of the first points we note in Homer's account is that medicine in Greece was not subordinated to religion and made a function of the priesthood, as it was in Egypt and in Asiatic countries where the offices of the priest and the physician were combined in the same person. If ever exercised in Greece by religious impostors, it must have been secularized at a very early period. Whatever may have been the familiarity of the cultivated Greeks with domestic remedies and vulnerary herbs, a more advanced knowledge of medical and surgical treatment appears to have been an accomplishment of the heroes of the Iliad. Pope, in his Essay on the character of Homer, says that "the state of war in which Greece lived required a knowledge of the healing of wounds, and this might make him breed his princes, Achilles, Patroclus, Podalirius and Machaon, to the science. What Homer thus attributes to others he himself knew, and he has given us reason to believe not slightly, for if we consider his insight into the structure of the human body, it is so nice that he has been judged by some to have "wounded his heroes with too much science."

Dr. Payne of London, in his History of Medicine, says that "the Homeric heroes themselves are represented as having considerable skill in surgery, and as able to attend to ordinary wounds and injuries, but there is also a professional class represented by Machaon and Podalirius, the two sons of Asclepius, who are treated with great respect. It would appear, too, from the Ethiopis of Archinus (quoted by Welcker and Haeser) that the duties of those two were not precisely the same. Machaon's task was more especially to heal injuries, while Podalirius had received from his father the gift of

* Read before the Historical Club of the Johns Hopkins Hospital, May 9, 1898.

recognizing what was not visible to the eye. In other words, a rough indication of the separation of medicine and surgery."

Assuming that these medical officers were real characters, or, at least, that they were types or representatives of a professional class, it would be a matter of interest to learn what remuneration they received for their services during the ten years' siege of Troy. Let us hope, for the honor of the profession, that they were better paid than was Bernal, the physician of Christopher Columbus on his first voyage. For his seven months' detail for such duty Bernal received a sum equivalent to $37 of our money; that is to say, about seventeen cents a day. What Marco, the surgeon of the expedition, received, we are not told.

Hippocrates was in his prime about four hundred years B. C. Contemporaneous with the father of medicine was another Greek, Herodotus, who was called the "father of history." Herodotus traveled extensively in Asia, Africa and Southern Europe, and in his intercourse with the learned men of the day acquired a large fund of curious information. He refers briefly in his first book, Clio, to the rude beginnings of the medical art among the Assyrians, the Babylonians and the Persians, and the manner in which, in the absence of professional teachers, the facts of experience were accumulated and transmitted. He says: "Such as are diseased among them they carry into some public square; they have no professors of medicine, but the passengers in general interrogate the sick person concerning his malady; that if any person has either been afflicted with a similar disease himself, or seen its operation upon another, he may communicate the process by which his own recovery was effected, or by which, in any other instance, he knew the disease to be removed. No one may pass by the afflicted person in silence, or without inquiry into the nature of the complaint." A cynic might say that this sort of history repeats itself in our day in the gratuitous advice and the infallible formularies that are thrust upon the helpless invalid by officious busy-bodies.

In his second book, Euterpe (84), he points out the germs or rudimentary forms of specialism in medical practice, the limitation to certain specified diseases, or to the diseases of a simple organ or class. He says: "The art of medicine in Egypt is thus exercised: One physician is confined to the study and management of one disease; there are, of course, a great number who practice this art; some attend to disorders of the eyes; others to those of the head; some take care of the teeth; others are conversant with all diseases of the bowels; whilst many attend to the cure of maladies which are less conspicuous."

Not until we come to his third book, Thalia, does Herodotus give us a glimpse of the question of compensation, recompense, requital, fee, honorarium, *quid pro quo*. We are told that the governor of Sardis, a Persian named Oroetes, in a fit of maddening jealousy, conceived the atrocious design of encompassing the death of Polycrates of Samos. He sent a messenger to Polycrates to request a visit from him on some plausible pretext, and the latter, unsuspicious of harm, set sail with a retinue befitting his rank, including Democedes of Crotona, who was reputed to be the most skillful practitioner of his time. When opportunity offered, Polycrates was assassinated, but afterward, on learning the facts, King Darius, of Persia, ordered the execution of Oroetes. Soon after this occurrence Darius, in leaping from his horse, twisted his foot with so much violence as to occasion sprain and luxation of the ankle joint.

Herodotus says: "Having at his court some Egyptians, supposed to be the skillful of the medical profession, he trusted to their assistance. They, however, increased the evil by twisting and otherwise violently handling the parts affected; from the extreme pain which he endured the king passed seven days and as many nights without sleep. In this situation on the eighth day, some one ventured to recommend Democedes of Crotona, having heard of his reputation at Sardis. Darius immediately sent for him; he was discovered among the slaves of Oroetes, where he had been allowed to remain in neglect, and was brought to the king just as he was found, in chains and in rags. He at once applied such strong fomentations and soothing remedies as were used in the treatment of similar cases in Greece, and by these means Darius, who had despaired of ever recovering the entire use of his foot, was not only enabled to sleep, but in a short time was completely restored. In acknowledgment of his cure Darius presented him with two pairs of fetters of gold.

This is the first medical fee of which I find any distinct or specific record in profane history. As to its significance, or to its fitness as a mark of gratitude, we may leave both to inference or to conjecture. If a condition of enforced servitude was to continue, golden fetters would have been quite as irksome as shackles of a baser metal. Thereupon Democedes ventured to ask the king whether, in return for restoring him to health, he wished to double his calamity. This reference to two pairs or sets of fetters pleased the king so much that he sent him to the apartments of the women for his reward. The eunuchs who conducted him informed the women that this was the man who had restored the king to life. Accordingly, they took a jar of gold, filled it with gold coin, and presented it to him. But royal munificence went beyond this mark of regard. A sumptuous house was provided for Democedes at Susa; he was entertained at the king's own table; he was held in the highest estimation, and he was supplied with all that heart could wish except the restriction of not being able to return to Greece. In the course of time it happened that Atossa, daughter of Cyrus and wife of Darius, had a troublesome ulcer on her breast, for which she consulted Democedes. He told her that he was able to cure it, but exacted of her an oath that in return she should serve him in whatever he might require, which, he assured her, would not involve any dishonor. Atossa was cured by his skill, and, observant of her promise and of his instructions, she persuaded Darius, on some artful pretext, to undertake a military excursion to Greece, and to direct Democedes to accompany the expedition both as medical adviser and pilot. Darius directed him to take with him all of his valuables as presents for his father and his brethren, assuring him of gifts of greater value on his return. But the wily physician profited by the voyage to make his escape. To him, as to many another exile, there was no place like home. Moreover, he

had been sufficiently remunerated at home to take off the sharp edge of the Persian temptation.

We are told that in his day, in Greece, the usual fee paid to physicians for incidental visits was very small; in fact, not more than two groats, sixteen cents, or about one-thirtieth of the customary fee in England in our time, one guinea. But remember that it was usual at that remote period for municipalities to hire physicians by the year, and pay them out of the public funds for attendance upon the citizens. When Democedes lived in Ægina his services were engaged at the rate of one talent per annum, about $2000, as near as we can estimate with our limited knowledge of relative values. At Athens his salary from the city treasury was one hundred minae, about $2400. When he afterward fixed his residence at Samos, Polycrates allowed him a pension which, according to the Attic standard of values, amounted to about $2400. But of all special acknowledgments or expressions of gratitude, one reported by Pliny takes the lead. He tells us that Cleombrotus received one hundred talents for the care and recovery of King Antiochus. If the Attic talent of the standard of Alexander is meant, this would amount to £24,375; if the standard of the coins of the Ptolemies, it would amount to £39,375, over $156,000, a sum that seems incredible, and which remains unmatched among the bounties of royalty at the present day.

Every Greek city had not only one or more public medical men in the municipal service, whose duty it was to visit the sick in the city and suburbs, but there was also a large dispensary, *iatrium*, where the practitioner, aided by his pupils, held consultations, performed operations and distributed the needful medicines. Beds were reserved for patients who could not be removed, or for very serious cases. The rich being able to be cared for at home, those who needed the aid of the public dispensary were the poor. Yet in the state of society at that period, the isolated poor, those without patron and "without brothers," as the phrase went, meaning those who were not members of a society having a mutual benefit fund, were not numerous. But what poor there were, we are assured by historians, were faithfully attended to in accordance with the precept of Hippocrates. Inscriptions show that it was an obligation that was gracefully and generously fulfilled. One of these, found at Cos, is an honorary decree regarding a physician who during an epidemic had particularly distinguished himself by his devotion. Another inscription is a decree granting a crown of gold to Metrodorus, who, for twenty years a public physician, has saved many citizens, and now lives in poverty, having refused from them any fees.

Passing on to the Roman Empire, we note that, as Montaigne says in his Essays, "no Roman till Pliny's time had ever vouchsafed to practice physic; that office was only performed by Greeks." It should be added, however, that it was largely in the hands of the slaves of wealthy Roman masters. In the early days of the republic, when the Romans were absorbed in their wars of conquest, medical assistance could only be obtained from persons of servile rank, a fact which held the profession for a long time in disrepute. Nearly two centuries before the establishment of the empire a Greek doctor named Archagathos came and settled in Rome. As Duruy tells us, at first he was welcomed there and received the citizenship. He induced the Senate to apply the public money to the purchase of a house for him where he could treat surgical cases, his practice being limited to the treatment of fractures and dislocations, to amputations, and the dressing of wounds, ulcers and abscesses, internal maladies being left to quacks. For a time he was the fashion, and did a lucrative business, but his methods were so barbarous that he was eventually stigmatized with the epithet Carnifex (butcher). The elder Cato, who was noted for the acerbity of his temper, came out with a broadside against Greek doctors, winding up his denunciation by saying: "They make us pay dearly for obtaining our confidence, and poison us the more easily." Yet Cato himself made some pretension to medical knowledge, and wrote a book on domestic medicine. It was only a jumble of old women's remedies, however, and of such recipes as village sorcerers of later days might recommend.

As we approach the period of the establishment of the empire, or about the commencement of the Christian era, we find that the practice of medicine was still in the hands of the Greek physicians, but as Greece was then under the protectorate of Rome, they were treated with distinguished consideration. Pliny says "the medical art did not harmonize with Roman gravity," whatever that means. In order to attract the Greek physicians to Rome, Cæsar gave them the *jus Quiritium*, and afterward Augustus exempted them from taxation. They were allowed certain special privileges, which the physicians of our day who are by courtesy exempted from jury duty can appreciate. With these concessions, and the attraction of liberal fees from the luxuriously inclined Romans, they flocked from all parts of Greece, but those who were not Athenians, we are told, were obliged to borrow their idiom as well as their recipes from the big-wigs of Athens in order to obtain patronage. They spoke at Rome the language of Athens, just as the French doctors at Paris, in Molière's time, spoke the Latin language. As educated men, their society was welcomed by the rulers and statesmen of Rome. Artorius, for instance, was called the friend of Augustus; Asclapo was the friend of Cicero; Asclepiades was the friend of Crassus, the orator, and so on.

In the course of time Roman citizens became practitioners. Of the education necessary to qualify them for their duties we have no account; we only know that it was under the superintendence of the *archiatri*. This was a favored or superior class, the first physician bearing the title being Andromachus, the medical adviser of Nero. During the reign of Nero the *archiatri* were divided into two classes, the physicians of the different quarters of the city, *archiatri populares*, and the physicians of the palace, *archiatri palatini*. The former were assigned to the relief of the poor, and each city was provided with five, seven or ten, according to its size. Rome had fourteen, besides one for the vestal virgins and one for the gymnasia. The latter, the *sancti palatii*, were men of elevated social position, and of high rank, not only in the exercise of their profession, but as counsellor of the government. Both were paid salaries, and were allowed special immunities and exemptions. Later on, in the time of Hadrian and the Antonines, such concessions were made still more

liberal, and the chief *archiater* ranked as a vicegerent. While the *populares* were obliged to attend their poor patients gratis, they were allowed to receive fees from the rich. They were not appointed by the municipal authorities, but were elected by the people, and while their office was less honorable than that of the *palatini*, it was more lucrative. In the time of Vespasian they had a retiring pension.

With regard to the amount of their income, the students of Roman antiquities have not been able to furnish satisfactory data. We learn from Pliny that at the beginning of the imperial reign such eminent physicians as Albutius, Arruntius, Calpetanus, Cassius and Rubrius made 250,000 sesterces per annum, which is equivalent to £1950, or $9750. We also learn from Pliny that Quintus Stertinius, the favorite of the Emperor Claudius, was content with the honor of serving the the Emperor at the rate of 500,000 sesterces ($19,500) per annum, though his fame was such that he might have made 600,000 sesterces, or $23,500 in private practice. He and his brother, who received the same annual income from Claudius, left between them at their death, notwithstanding large sums they had spent in beautifying the city of Naples, the sum of 30,000,000 of sesterces, equal to $1,170,000.

Among the outward and visible manifestations of gratitude for restoration to health is one which is preserved to this day. Antonius Musa, the physician of Augustus, according to some accounts, effected a radical cure of an obstinate cutaneous affection. Other accounts state that he was instrumental in saving the life of the Emperor. Whatever the precise fact, Augustus had a statue made of Musa, which he placed among his family group of bronze and marble memorials as one of the highest honors he could bestow. To-day, in the Vatican, it retains its place among the clustered family of the Cæsars, but though it is the impersonation or counterfeit presentment of Antonius Musa, it was adopted centuries ago, and is still accepted as the emblem or symbol of Esculapius. In later days, when the Byzantine and Western sections of the empire were alienated, and when Justinian, who called himself defender of the faith, was emperor at Constantinople, there were two Eastern brothers who practiced medicine in Cilicia, named Damian and Cosmas—names that were afterward enrolled in the list of Christian martyrs. They were nicknamed Anargyri, literally, "without money," because they refused recompense for professional services. Whatever was forced upon them, in spite of their reluctance, they turned over to the church, and when they were fortunate enough to cure Justinian of a perilous disease, and he insisted upon a generous reward, they stipulated that he should build churches, which he did on a large scale, and with an enormous outlay of money, in gratitude for his recovery.

In reviewing medical progress under the empire we note frequent foreshadowings of the methods and usages of later times. There were specialists in considerable variety; there were female doctors (unlike Athens, where females were forbidden by law to practice); there were public dispensaries for the treatment of the poor; there were quacks not only among the lower orders of ignorance and presumption, but among men of high degree; there were doctors for the aristocratic set who made fat fees by humoring the caprice and the self-coddling of the valetudinarian, or by ministering to the distempered fancy of the *malade imaginaire*. Doctors signed their prescriptions, and of the seals or stamps which they used there are still in existence 150. There were also apothecaries, who gave advice behind the backs of medical practitioners as ours do, but they charged for their advice as well as their medicines. Then, as now, the instructor of classes of medical students received pay for tuition. This payment was called "minerval," but the term was eventually made more comprehensive, and included the fees paid by patients for attendance. We are warranted in the inference that in the case of some rich patients, the minerval was disproportionately large when measured by the insufficiency of the service rendered; it certainly gave free scope to Martial for his epigrammatic satire. Finally, there were periods in which overcrowding of the ranks remind us of the forcible remark of Addison in the *Spectator*: "I am troubled when I reflect how the profession of physic is overburdened with practitioners, and filled with multitudes of ingenious gentlemen who starve one another."

Medicine in its embryonic or rudimentary state eighteen or twenty centuries ago, and medicine in its present state of advancement and achievement, are as wide apart as the Poles. Yet running through the ages they present certain features in common, and not the least of these is the standing acknowledgment of the homely old maxim of St. Paul, "the laborer is worthy of his hire." But while mercenaries of the Paracelsus stripe, or gold-loving doctors of physic, like Chaucer's in the Canterbury Tales, have always abounded, yet from time immemorial to the present hour, foremost and uppermost is the spirit of self-sacrifice, of self-renunciation, that is ever ready to lighten the burden of sorrow, to lift the heavy and the weary weight of suffering, and to listen responsively to what Wordsworth calls "the still, sad music of humanity."

ENDOTHELIOMA OF THE CERVIX UTERI.

By Elizabeth Hurdon, M. D., *Assistant in Gynecology, Johns Hopkins University.*

The following case of endothelioma is of interest chiefly on account of the rarity of this variety of tumor in the cervix. While, according to Pick's investigations, a large percentage of all endothelial tumors are found in the female generative organs, they are for the most part situated in the ovary, and so far as I can discover but three cases have been described as occurring in the uterus, two of which belonged to the cervix, and we add a third. The first case was reported by Amann, Jr., in his work on neoplasms of the cervix. The patient was a multipara 31 years old. The tumor consisted of a connective-tissue stroma in which were numerous anastomosing cells, strands and masses which contained central lumina. They were

composed of large epithelial-like cells, and in the lumina were numerous leucocytes embedded in fibrin, but no red blood corpuscles were seen. Neither the epithelium lining the cervical canal, nor the gland epithelium showed any proliferation, and by means of serial sections the writer conclusively proved the absence of any relation between the cells of the neoplasm and the cervical epithelium. Amann considered the tumor to be a true endothelioma originating from the endothelium of the lymph vessels in the deeper portion of the cervical mucosa.

A similar tumor also originating in the endothelium of the lymph vessels has been described by Braetz. The patient was a nullipara 18 years old. Attached to the posterior cervical lip was a papillary tumor which macroscopically could not be differentiated from a carcinoma. This tumor also consisted of a somewhat scanty connective-tissue stroma in which were cell strands of various forms containing central lumina. At some points round cells embedded in fibrin were found in the lumina, but more sparingly than in Amann's case. The cervical glands were unaltered and the cylindrical epithelium intact and showed no proliferation.

Ziegler has recently adopted a new classification for the sarcomata which have an alveolar or organized structure. The term endothelioma is practically limited to the tumors which originate from the endothelial lining of the lymph spaces or vessels, and the tumors arising from blood vessels are designated angio-sarcomata, but he states that of the latter group those which come from the endothelium of the vessels may also be called endotheliomata.

It is possible, moreover, that many of the perivascular angio-sarcomata are lymphatic endotheliomata, as it is easily conceivable that the network or loops of lymph channels which surround the blood vessel may be the site of origin of such a growth. In the restricted sense, however, the term endothelioma is still applicable to the new growths of the cervix described by Amann and Braetz, and also to our case, as they all are apparently of lymphatic origin. The remaining case of endothelioma of the uterus described by Pick as occurring in the body is not so clearly of the same nature.

History of the case. Mrs. S. was admitted to Prof. Kelly's private sanatorium, November, 1896.

For about nine years the patient had suffered from attacks of severe pain in the side, radiating down into the bladder, which were supposed to be renal colic. There was no suspicion of pelvic disease until three weeks before admission, when a slight hæmorrhage occurred for the first time since the menopause ten years before. On examination the cervix was found to be hard and choked by a flat mass 2x2 cm., which at first sight looked like a polyp and was discolored and showed white patches on its surface. (The mass which was attached to both the anterior and posterior lips was excised, being too dense to yield to the sharp curette. Surprisingly little bleeding followed, but when the mass was dissected out to the vaginal vault the disease appeared to extend farther.) The uterine body was small, the cervical end being larger than the body. The ovaries appeared normal. The left broad ligament was free. The right side was held by a firm band. No nodules, however, were felt in the broad ligament. The uterus was freely movable.

Operation. After catheterizing the left ureter (the right catheter could not be inserted) abdominal hysterectomy was performed, special care being taken to enucleate the right broad ligament out to the pelvic wall and down to its floor. The most dangerous part of the enucleation was anteriorly, where the vesical peritoneum was pinned to the uterus by adhesions apparently dependent upon the extension of the growth to the base of the bladder. The bladder, however, was dissected free without injury. The uterus was removed with the upper part of the vagina, including extensive tissue at the base of the broad ligaments.

The patient died on the 15th day, apparently of sepsis. Unfortunately, no autopsy could be obtained.

It will be observed how slight the local manifestations were, compared with the advancement of the growth, which had extended beyond possibility of complete removal before the attention was directed to the pelvic organs. This rapidity of growth was also observed in the cases reported by Amann and Braetz. As autopsies were obtained in none of the cases, the tendency to metastasize cannot be determined.

Pathological report. Gyn.-Path. Nos. 1405 and 1442. Dec. 14, 1896.

The specimen consists of the uterus with its appendages. The uterus is 8x5x3 cm. and is smooth and glistening. The cervical portion is enlarged, measuring 4.5x3.5 cm. in diameter, and is markedly indurated. The external os is represented by a crater-like excavation 2.5x2 cm. in diameter, and 2 cm. in depth. The anterior lip has been eaten away and the posterior is thickened laterally, being 2 to 3 cm. in thickness. The floor of the excavation is corrugated and roughened, but there is no evidence of softening nor of friability. The mucous membrane of the upper part of the cervical canal is apparently unaltered, but the walls of the entire cervix and also of the lower segment of the body, particularly on the left side and posteriorly, are thickened and indurated, and on section present a dense fibrillated structure. The uterine cavity has a smooth mucous membrane. On the posterior wall, however, there is a small polypoid thickening, and springing from the centre of the anterior wall is a pedunculated flattened mushroom-like polyp 2 cm. in diameter. The appendages present nothing of interest.

Histological examination. The lower portion of the cervix is covered with stratified squamous epithelium, but on advancing inward toward the apex of the excavation, which macroscopically presented an eroded appearance, the surface is necrotic. Above the necrotic area the cervical canal is lined with normal cylindrical epithelium. The cervical glands are in a few places dilated, but on the whole are practically normal. Penetrating all portions of the cervix extending to the mucous membrane internally, involving the lower portion of the body, and laterally reaching the parametrial cellular tissue are myriads of tubules (Fig. I). These may be dilated to form large alveoli and show some branching, but as a rule they appear as narrow channels, round or oval spaces, or as strands of cells two or three layers thick. Many of the small spaces, and more especially the larger ones, are lined by one layer

of spindle-shaped cells, which resemble normal endothelium, and which in some places are so flat as to be scarcely recognizable. Others of the small spaces, and also some of the

FIG. I. Is a characteristic field, and shows the large and small round or irregular spaces lined by one or more layers of cells. Note the intimate relationship between the cells lining the cavities and the surrounding stroma; in no place do these cells tend to become separated from the wall. The stroma is composed of spindle-shaped cells.

large ones, are lined with one uniform layer of cuboidal cells, having oval, well-stained nuclei. In many places the cells have proliferated and the spaces are lined by two, three or

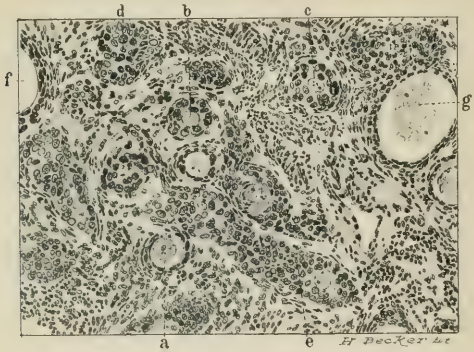

FIG. II. Shows the individual cell elements clearly; *a* represents a cavity lined by one layer of cells, which tend to become spindle-shaped; *b* and *c* are more advanced; the cells are several layers in thickness, and are gradually narrowing the lumen. At *d* a space has become completely filled, no cavity remaining, and *e* portrays a similar mass of cells on longitudinal section. At *f* the space is at one point lined by two layers of cells, a little further on by three layers; *g* is a good example of a dilated space, partially filled with granular material. Note in all these areas, especially *f* and *g*, the intimate relation between the stroma and the cells lining the spaces, also that there is no desquamation of cells. The stroma is, in places, abundantly infiltrated with small round cells.

more layers of cells, or again the cavity is completely obliterated and solid cylinders or nests of cells are formed (Fig. II). Where several layers of cells are present they are usually larger and more spherical or cuboidal, but in general present more or less of their elongated form. Often a tubule is seen lined on one side with two or more layers of large roundish or oval cells, while on the opposite side is a single layer of flat, scarcely visible cells. In such instances the swollen cells are sometimes covered over with a layer of flat cells similar to those lining the opposite wall, thus suggesting a proliferation of the periendothelial cells. Again, a space lined with several layers of large cuboidal or oval cells merges directly into a narrow channel lined with one layer of endothelial-like cells and with difficulty distinguished from the small lymph or blood vessels near by. Surrounding many of the tubules is a narrow zone of hyaline giving the appearance of a sclerotic vessel wall. A notable feature of this tumor is the absence of any tendency on the part of the tumor cells to retract from the surrounding connective tissue, indicating the organic relation of the one to the other. This intimate connection is emphasized in many places by the imperceptible transition of the tumor cells into the connective tissue cells of the stroma. On the other hand, the epithelium of the glands and on the surface of the mucosa exhibits the usual tendency to separate from the underlying tissue. The surface epithelium is quite normal to the margin of the necrotic area, then gradually disappears, and although the mucosa is everywhere invaded by the new growth tubules or cell strands penetrating between the glands in close proximity to them and even encroaching upon the gland cavity, there is no metamorphosis of the epithelial cells into the cells of the tumor. It must be mentioned, however, that at one or two points where the growth reaches the surface there is at first sight an apparent relation between the epithelium and tumor cells, but on careful inspection it is seen that, although the epithelial cells are altered, they are of a quite different type from the cells of the neoplasm. The cell nuclei are large, vesicular, with finely granular or homogeneous character. The protoplasm is somewhat scanty, and it is generally impossible to differentiate the protoplasm of one cell from another. Where the cells are in several layers the nuclei are usually swollen and more faintly stained, scattered between these pale nuclei, however, are others which take an intense diffuse stain. Mitotic figures, both symmetrical and asymmetrical, and showing the various stages of division, are fairly abundant.

The majority of the tubules are empty, some, however, contain desquamated cells, a few small round cells, fragmented nuclei and shadows of cells. Sections from the tissue excised for diagnosis before the radical operation was performed, show fresh blood in many of the spaces, probably due to manipulation, as blood is not found in the tubules in sections from the organ which was removed entire. Careful search fails to reveal clumps of lymphoid cells in tubules, such as Braetz and Amann have described; serial sections, however, were not examined. Nevertheless, it is probable that this tumor has developed from the endothelium of the lymph spaces, a view supported by the general arrangement of the tubules which most frequently show a definite relation to the larger blood vessels. This is most characteristically shown in the deeper portions of the uterine walls, and in the parametrium, where the early

stages of the growth may be studied. The tissue is penetrated here and there by slender cords of cells, which usually contain central lumina, and present numerous ampullar spaces. Occasionally, larger solid cylinders of cells are seen. These cell strands are, for the most part, in the immediate vicinity of the blood vessels, sometimes apparently surrounding the vessel wall, again running parallel with it. Here and there wavy strands, consisting of one or two rows of spindle cells, suggest a transformation of connective issue rather than a tubular formation. At three or four points interesting pictures are seen, as represented in Fig. III. This is, apparently, a cross section of a nerve, which shows nests of tumor cells, evidently developing in lymph channels of the nerve sheath.

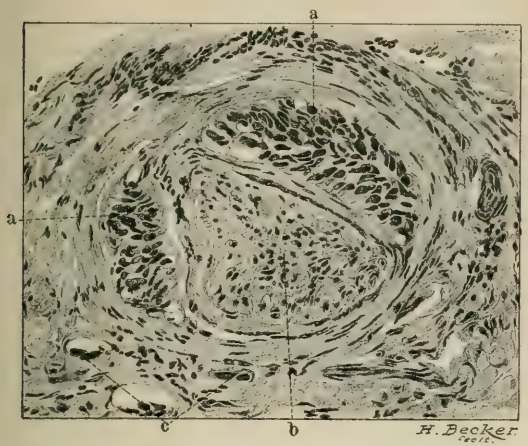

Fig. III. *b* is probably a cross section of a nerve, but a definite statement cannot be made, as further sections could not be obtained for special staining.

a and *a* are masses of tumor cells evidently in the lymph channels of the nerve sheath. A few tumor cells are also found at the point indicated by *c*.

The stroma of the tissue is abundant, is exceedingly dense, and consists, to a great extent, of normal cervical tissue. In the deeper portions there is considerable smooth muscle, and a moderate small round-celled infiltration. Blood vessels are fairly numerous and show marked obliterative endarteritis and arterio-sclerosis. The uterine mucosa is practically unaltered, and the polypi noted above consist of the normal elements of the uterine mucosa. The tubes and ovaries present the usual senile appearance.

This growth presents many characteristics differing from a carcinoma. It was peculiarly dense, even in the superficial portions, while in carcinomata the surface is easily curetted away. The only excresence consisted of a large flat polyp-like mass, with a regular outline, and there were none of the friable papillary outgrowths usually seen in carcinoma.

On histological examination, although there are points of similarity, yet the differences are marked. In the first place, the cervical glands, even in the older portions of the growth, appear normal, while in adeno-carcinoma they usually show cell proliferation and metamorphosis. Secondly, there are no tuft-like ingrowths of the cells, such as are so often seen in carcinoma. Thirdly, many of the spaces, both large and small, are lined with one layer of spindle cells. In adeno-carcinoma it is exceptional to find the epithelium spindle-shaped, and then only where the gland is distended and the epithelium has been flattened by pressure. The tubules in this case offer no evidence of pressure. The cells in general have their long axis running parallel with the circumference, and it is only rarely that cylindrical cells are found. Fourthly, the cells lining the tubules show no tendency to retract from their walls, but, on the contrary, there is an intimate relation between the tumor cells and the surrounding connective tissue, and where retraction of tissue has occurred, a few stroma cells accompany the cells lining the alveoli. In the case described by Braetz there was a sharp demarcation between the tumor cells and the stroma. Fifthly, although the tubules frequently anastomose, the tendency toward branching is not marked.

An arrangement especially emphasized by Braetz is in places observed in our case, that is that the tubules, particularly in the early stages of the growth, pursue a more or less parallel course.

Many of the tubules are surrounded by zones of hyaline, a condition which I have not noticed in adeno-carcinoma of the cervix.

Finally, the growth is widely distributed in the deeper tissues of the organ, the mucosa lining the upper portion of the cervical canal and the uterine cavity being practically free from extension of the growth, while the entire cervical walls and the lower third of the muscular coats of the body are everywhere invaded, and the parametrium is also involved. The extension is always apparently by direct continuity, and not by metastasis.

We are, therefore, dealing with a new growth, characterized by the formation of tubules and cell strands which follow the course of the blood vessels. The cells of the growth, moreover, show a definite relation to the surrounding stroma cells, while the epithelial elements of the tissue are practically normal.

In conclusion I wish to express my hearty thanks to Dr. Kelly for allowing me to report this unusual case.

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ON THE SPECIFIC GRAVITY OF THE URINE DURING ANÆSTHESIA AND AFTER SALT-SOLUTION ENEMATA.

By Thomas R. Brown, M. D., *The Johns Hopkins Hospital.*

Although it is known that under certain conditions a decrease in the specific gravity of the urine is seen, as notably in conditions of hysteria and neurasthenia, yet it is difficult to obtain definite information regarding the amount of this diminution; and to determine the exact decrease under certain conditions has been the object of this investigation, which was undertaken at the suggestion of Dr. Howard A. Kelly.

I.—During Ether Anæsthetization. (*See Chart I.*)

The first series of experiments, twenty-five in number, were carried on in the Gynecological Operating Room of the Johns Hopkins Hospital, and were designed to study the effect of ether anæsthesia upon the urinary specific gravity. The instrument used was the ordinary urinometer, tested and found to be accurate before the commencement of the experiments. In these cases from thirty to fifty minutes usually elapsed from the beginning of the administration of the narcotic to the catheterization of the urethra and the emptying of the bladder just before the commencement of the operation. As the patients had not been catheterizated *immediately* preceding the anæsthetization, there was presumably present in the bladder a certain quantity of urine. In most cases, however, this was very small, as either catheterization or natural voiding had taken place recently, and the urine was not in sufficient quantity to affect very materially the result.

In certain cases, however (cases VI, IX, XVIII, XXI, XXIII), the amount of urine present in the bladder was so great—as evidenced by the fact that by catheterization thirty minutes later, from two to five hundred cubic centimeters were obtained—that the comparatively small quantity secreted during anæsthesia had but little effect upon the specific gravity, and we had for examination urine differing but slightly from the normal urine of the patient, the specific gravity of which was decreased but slightly below the average of that especial case, and the color of which differed but slightly from that of normal urine.

In the remaining twenty cases, on the other hand, the quantity obtained was small, varying between thirty and one hundred cubic centimeters, probably a large part of which was secreted during the administration of the ether. In these cases the urine appeared quite differently; the color varied from a pale straw to that of water barely tinged, and the examination of the specific gravity showed that there was a marked decrease, from 1.0177 (the average of the average specific gravities of the urines of the twenty cases taken on several occasions previous and subsequent to the operation) to 1.066, the average specific gravity of the urines after the administration of ether.

In one of the cases the specific gravity of the just catheterized specimen of urine, *i. e.* at the body temperature, was .999, though on being allowed to stand until it acquired the temperature of the room, at which all the specific gravities were determined, it rose to 1.002. It will thus be seen that one of the effects of ether narcosis is a marked diminution in the urinary specific gravity, and that this is not a typical hydruria can be concluded from the fact that the quantity of urine secreted was not large, being no more than one would expect within the thirty to fifty minutes occupied in the administration of the narcotic.

From this it can be surmised that the effect of the ether upon the kidneys is to diminish markedly the secretion of the solid constituents, while the elimination of water is, in a certain number of cases at least, not so markedly affected. It is of interest, however, to note that in some cases the quantity obtainable was very small—less than ten cubic centimeters, and in these cases, evidently, water-elimination as well as solid constituent-excretion has been very much decreased. It was impossible in this investigation to draw any conclusions regarding the rôle played by the nervous element, as the decrease in the specific gravity was quite as marked in those who took the ether with a stoical calm as in especially neurotic patients.

II.—After Normal Salt-Solution Enemata. (*See Chart II.*)

The second series of experiments—ten in number—were designed to determine the effect of enemata of normal salt solution upon the specific gravity of the urine.

The method employed was as follows: the patient, immediately after voiding urine, was given five hundred cubic centimeters of normal salt solution through a rectal tube passed as far up as possible. In all but one of the cases this quantity was easily retained and caused the patient no discomfort. The patient was not allowed to drink water or any other fluid during the next four hours, and during this period the urine passed was carefully collected. In some cases urine was voided but once, in other cases twice during the four hours, but in them all between two hundred and fifty and four hundred cubic centimeters were voided, *i. e.* between one-half and four-fifths of the quantity given by rectum. The specific gravity fell markedly in all cases, the average fall being .008, from 1.016, the average specific gravity of the urines of the ten cases (each taken several times previously) to 1.008, the average of the specific gravities of the urines voided within four hours from the time the enemata were given. The color of the urine in these cases was exceedingly pale. These cases are in all probability true cases of hydruria, where the diminution in specific gravity is due not to a decreased excretion of solid constituents, but to a marked increase in the elimination of water. While the first series of experiments are of more interest from a scientific standpoint, the second series, showing as they do such rapid elimination of water with decreased specific gravity, suggest the possibility of giving rectal enemata of normal salt solution or water, to increase the flow of urine, and thereby probably to stimulate diuresis in some affections of the kidney, and as a method of internal irrigation, as it were, in some cases of cystitis.

CHART I.

SHOWING THE EFFECT OF ANÆSTHETIZATION UPON THE SPECIFIC GRAVITY OF THE URINE.

Case.	Average sp. gr.	Sp. gr. after anæsthesia.	REMARKS.
I	1.015	1.006	
II	1.020	1.005	
III	1.015	1.004	
IV	1.022	1.007	
V	1.012	1.010	
VI	1.021	1.015	Very large amount of dark-colored urine in bladder.
VII	1.019	1.002	
VIII	1.015	1.007	
IX	1.026	1.018	Large quantity of deeply pigmented urine in bladder.
X	1.025	1.009	
XI	1.022	1.002	
XII	1.022	1.003	
XIII	1.020	1.005	
XIV	1.020	1.010	
XV	1.013	1.008	
XVI	1.008	1.011	
XVII	1.028	1.018	
XVIII	1.018	1.017	Large amount of dark-colored urine in bladder.
XIX	1.013	1.005	
XX	1.018	1.005	
XXI	1.022	1.021	Large amount of dark-colored urine in bladder.
XXII	1.023	1.006	
XXIII	1.022	1.020	Large amount of dark-colored urine in bladder.
XXIV	1.012	1.009	
XXV	1.012	1.010	

Average of av. sp. grs. of the 25 cases.	Average of the sp. gr. after anæsthesia of the 25 cases.
1.01852	1.00932

Average of average sp.grs. of all cases except VI, IX, XVIII, XXI, XXIII.	Average of sp. gr after anæsthesia of of all cases except VI, IX, XVIII, XXI, XXIII.
1.0177	1.00665

CHART II.

SHOWING THE EFFECT OF SALT-SOLUTION ENEMATA UPON THE SPECIFIC GRAVITY OF THE URINE.

Case.	Average sp. gr.	Sp. gr. of 1st specimen voided after enema.	Sp. gr. of 2nd specimen voided after enema.	Sp. gr. of urine voided under 4 hrs. after enema was given.
I	1.015	1.005	1.009	1.007
II	1.021	1.012	1.010	1.011
III	1.015	1.007	....	1.007
IV	1.012	1.008	1.006	1.007
V	1.014	1.008	1.005	1.006
VI	1.019	1.010	1.012	1.011
VII	1.014	1.006	....	1.006
VIII	1.018	1.008	1.008	1.008
IX	1.014	1.005	1.007	1.006
X	1.020	1.013	1.012	1.012

Average of average sp. grs. of the 10 cases.	Average sp. gr. of the 1st voided specimens of the 10 cases.	Average sp. gr. of 2nd voided specimens of the 10 cases.	Average sp. gr. of urine voided within 4 hrs. after giving of enema in the 10 cases.
1.0162	1.0083	1.0086	1.0081

CORRESPONDENCE.

HYDRAULIC PRESSURE IN BLADDER CONTRACTURE.

To the Editor:—It is but voicing the sentiment of the profession, I am confident, to say that all engaged in genito-urinary work are under obligations to Dr. Hugh H. Young for his exquisite study of hydraulic pressure in contracture of the bladder. (JOHNS HOPKINS HOSPITAL BULLETIN, May, 1898.) The value of "vesical gymnastics" to overcome this distressing trouble is emphasized by Dr. Young's article in your May issue, whose perusal I, as I think all teachers of genito-urinary diseases should, heartily recommend to my students.

There are, however, a few details in the article to which I must take exception.

The author employs a nozzle "somewhat similar to those devised by Janet and Valentine." The illustration shows that the nozzle is that of Janet, with two bulbs instead of one. For easy removal from the rubber tube and replacement, I have done away with the bulbs entirely; otherwise Dr. Young's nozzle is exactly like my sharp nozzle, which serves all purposes in the majority of cases. But there are men whose meatus is too large or too small for the sharp nozzle; for those the dome-shaped or flat-topped nozzle is required.

The author says (page 108): "Valentine's complicated nozzle and stop-cock are unnecessary." It would seem from the illustration upon page 109 that a much more complicated apparatus is necessary.

I assume that the author has been imposed upon by some unscrupulous manufacturer, who palmed off an alleged "Valentine Irrigator" for the simple device whose description appears in the *Medical Record* for April 16th, 1898, and which I had the honor of first demonstrating at the Hospital Nécker (Paris) on September 15th, 1897. The principal advantages of this apparatus are:

1. That it requires no change of elevation for irrigating the anterior urethra, the posterior urethra and the bladder;

2. The variations in hydraulic pressure are easily procured by a slight motion of the operator's thumb;

3. Nearly every patient can be irrigated while sitting on a chair; most can urinate without rising, while Dr. Young's apparatus required that the patients are irrigated while lying down. This entails getting from the table and clambering up again for a second or third irrigation;

4. Greater cleanliness, for the simple metal shield which is part of the stop-cock catches the fluid that spurts from the urethra and diverts it into the basin held by the patient. Neither the penis, scrotum or nates of the patient, nor the operator's fingers, save the third and fourth of his left hand, are even moistened by an irrigation.

Still, I must agree with the author that no apparatus beyond a rubber tube is necessary for urethral or intravesical irrigations, provided the operator has the skill which experience gives, to wash the urethra and fill the bladder without even the aid of a nozzle. Yet for convenience and cleanliness, as well as for economy, the majority of the profession use the irrigator I devised.

I am preparing a new article on urethral and intravesical irrigations, in which I shall endeavor to more fully set forth the ideas suggested above. Very truly yours,

FERD. C. VALENTINE,
242 West 43rd Street, New York.

[In reply to Dr. Valentine, I will simply state that although I had the nozzle in question made several years ago, long before I saw the subsequent publications of himself and Janet, I lay no special claim to it, considering it simply a modification of Dr. Halsted's nozzle, which was brought out by him twelve years ago.

We frequently irrigate the bladder without placing the patient on the operating tables, which are pictured in the BULLETIN, and no apparatus could be simpler than a glass percolator suspended on a pulley, which we use and which costs exactly 75 cents for the whole outfit.

The tank of sterile warm water is a "complication" which we deem very important where asepsis is to be practiced. The fact that cystitis has more than once been inaugurated by careless technique in giving bladder irrigations with weak antiseptics during gonorrhœa is sufficient justification for the greatest care. HUGH H. YOUNG.]

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Cocaine Anæsthesia in the Treatment of Certain Cases of Hernia and in Operations for Thyroid Tumors.— Dr. HARVEY W. CUSHING.

The following cases illustrate the great benefit which the use of cocaine affords the operator in dealing with certain conditions when the administration of a general anæsthetic is contraindicated.

Operative interference is oftentimes considered inadvisable in cases of hernia occurring in old people who may be suffering from chronic bronchitis, or in whom pronounced cardio-vascular changes render the administration of ether dangerous.

CASE I. This patient is 67 years of age. He has had a large right inguinal hernia for 10 years, which was not controlled by a truss and which of late has frequently become incarcerated. He is suffering from chronic bronchitis and emphysema, which possibly had been responsible for the recent increase in size of the hernia and the attacks of incarceration. His radial arteries, as you may see, are tortuous and calcified, and there is a systolic murmur at the apex transmitted to the axilla. Two weeks ago to-day the hernia was operated on by the usual Halsted method, but under local anæsthesia. The patient suffered little pain and was sent back to the ward to have his dinner. This is the first dressing. The wound under the silver foil has healed, leaving only a fine linear cicatrix.

Had it not been possible to make use of a local anæsthetic in this case an operation would hardly have been deemed advisable. It is a great relief to the operator to be free from the responsibilities connected not only with the administration of a general anæsthetic to an aged person, but also with the recovery therefrom. In all of these cases a preliminary hypodermic of morphia has been given. The skin at the proposed site of incision has been infiltrated with a weak Schleich's solution. Practically no further cocainization was necessary, which was fortunate, as the infiltration method is hardly applicable to the deeper structures. The patient suffered little pain, and then only during the ligation of vessels, when the internal oblique muscle was divided and when the deep silver mattress sutures were drawn up and tightened. The sac seems to have no sensory nerves worth considering, and it is well recognized that handling a non-inflamed bowel is free from subjective sensation on the part of the patient.

There is another condition of hernia in which the administration of a general anæsthetic is attended with risk. Patients with strangulated hernia are often in such a state of shock that one dreads the effect of etherization, especially when, as is not uncommon in these conditions, vomiting is a prominent feature. The speaker had an unfortunate experience a few months ago with such a case. The patient, an old blind syphilitic with a strangulation of twenty-four hours' duration, died under ether shortly after reaching the operating table. The autopsy revealed a gumma occupying each occipital lobe and advanced arterio-sclerosis. A cocaine operation would doubtless have been free from danger. Furthermore, in these cases it is almost impossible to foretell the condition of the strangulated bowel. The experience at this hospital seems to have been that in cases where resection and intestinal suture is found to be necessary, an immediate anastomosis is attended with a very high mortality. The cases which have recovered are largely those in which an immediate fæcal fistula has been established. The fistula may be closed some weeks later, when the patient's condition will enable him to stand an operation for intestinal suture better than when suffering from the shock of complete strangulation. Under cocaine anæsthesia it is a simple matter to open the sac and divide the constriction, and if the strangulated bowel is no longer viable the establishment of a fistula is a simple procedure. If the condition of the bowel allows of reduction, it is possible at times to complete the operation for radical cure at the time. If the patient's condition prohibits this, the external wound may be closed and a subsequent careful herniotomy performed under general anæsthesia.

CASE II. This patient is 53 years of age. He had a large hernia for 30 years, which under a sudden muscular effort passed his truss and could not be reduced. He entered the hospital 34 hours later, distended, vomiting and in considerable shock. Obstipation was complete. There was a large tender tumor the size of two fists occupying the left groin and scrotum. The patient was given stimulants and morphia, and under cocaine anæsthesia the contents of the sac were liberated, proved viable and reduced. The sac was very thick, adherent, and was excised with some difficulty. The surrounding tissues were so indurated that little attempt was

made to do more than roughly close the wound. There was immediate relief to all symptoms. He returned three weeks ago to have his hernia on the opposite side operated on, and at that time a more perfect plastic was made at the original site where there was evidently some weakness of the wall.

Case III. This colored man entered the hospital ten days ago with a six-hour strangulation. He was in great pain, vomiting and hiccoughing, with a tender pyriform tumor, the size of a fist, in the left groin. He was given morphia, and under cocaine the sac was opened, the constriction divided and a large dark loop of bowel proved viable and reduced. The patient's racial characteristics would not allow of further procedure, and as his condition was good, under primary chloroform anæsthesia the usual operation for radical cure was completed. This is his first dressing.

I was recently called upon to operate alone in the country for a strangulated femoral hernia of three days' duration in a rather feeble woman. The cocaine anæsthesia was most satisfactory, not only for operative purposes, but because the patient could be left alone without waiting for an ether recovery and feeding could be immediately begun.

There is another operation which is often attended with great risk, due to a general anæsthetization. That is thyroidectomy. Patients with enlarged thyroids proverbially take ether badly. The resultant cyanosis makes the operative field a bloody one, and a clean dissection is difficult. Furthermore, as Kocher pointed out in his original paper (Ueber Kropfextirpation und ihre Folgen, Archiv f. klin. Chir., Bd. XXIX, 1883), the tracheas of these patients are often distorted and flattened, so that manipulations of the tumor may completely obstruct respiration by flattening out the already narrow passage. A case was lost at this hospital a year ago from this very cause. A large goitre, when almost enucleated, was lifted partially from its bed, when respiration immediately ceased and all attempts to relieve the pressure and resuscitate the patient were unavailing. A few months ago the speaker had an unpleasant experience while operating upon an Irish setter for the removal of a large hemorrhagic cyst of the thyroid such as Bradley has lately described (Journal of Experimental Medicine, Vol. I, 1896). The animal took ether very badly, the operative field was very bloody, and respiration several times was seriously impeded. On removing the tumor the trachea was found very greatly flattened and pushed far from the median line.

Case IV. This man is 44 years of age. He has had a tumor of the thyroid for ten years, which lately had begun to embarrass his respiration so that he was unable to work. The left half of the thyroid with the tumor was removed a month ago. Shortly before the operation a quarter of a grain of morphia was given. The skin alone was anæsthetized, and the lobe of the thyroid was enucleated in the layer of reticular tissue just outside of that occupied by the large veins to the gland, so that comparatively few and only the large branches at some distance from the gland had to be ligated. The operation was practically bloodless. The large veins, many the size of a pencil, were divided between ligatures. The tying of these ligatures was the only thing which caused the patient pain. Manipulation of the tumor would frequently embarrass his respiration, but he would always give warning of this dyspnœa so that the method of attack could be changed. His chief complaint was of a smothered feeling, so that he had to be constantly fanned and given water to drink. The advantage of a dry and bloodless field was demonstrated at the end of the operation, when the recurrent laryngeal nerve was seen arching up through the last bit of tissue which held the tumor. Had the tissue been blood-stained it would doubtless have been divided. The trachea was quite flattened out and could be readily occluded by slight pressure between the fingers. His recovery was uneventful.

A Word of Warning as to the Indiscriminate Use of Cocaine in the Treatment of Diseases of the Eye.—Dr. Theobald.

I shall not present a paper, but merely make some observations, which seem to me not untimely, in regard to the indiscriminate use of cocaine in the treatment of diseases of the eye. It has come to be quite common for the general practitioner to use cocaine in eye inflammations, the inducement being that it diminishes the pain temporarily and so causes a measure of relief. The conditions in which it is used are various. I have met with many instances in which it was prescribed in simple catarrhal conjunctivitis. There seems to be no indication for its employment under such circumstances, and it is capable of doing much more harm than good, as I shall show by the history of several cases.

Because of its pronounced disturbing effect upon the nutrition of the cornea, cocaine is not a remedy to be used carelessly in eye diseases. It acts, as you know, through the sympathetic nerves, or chiefly in that way, and besides anæsthetizing the eye, it dries the cornea to a remarkable degree. Some authorities say this drying is due to the fact that, as the sensibility of the cornea is annulled, winking does not take place as usual, and so the cornea is not moistened by the action of the lids; but I am sure that this is not the correct explanation. For I have observed that, although the eye be kept closed during the application of cocaine (a precaution which is now usually taken), the cornea will sometimes become quite dry and lose its lustre very soon after the speculum is introduced. This never occurred in the days before we used cocaine, so I think there can be no doubt that the drying does not depend upon the mere lack of winking the lids, but is due to a marked disturbance of the corneal nutrition. Probably the contraction of the vessels of the conjunctiva, and possibly some more direct action of the cocaine upon the lymph spaces of the cornea, disturbs its normal supply of fluids. The result is that the cornea not only becomes dry, but the epithelium becomes loosened, so that it is easily rubbed off, sometimes by the friction of the lids, or from the slightest touch of the instruments being used. Any agent that has so marked an effect as this upon the nourishment of the cornea certainly seems not to be a safe one to use, unless there is a clear indication for its employment.

The field of usefulness for cocaine, apart from its anæsthetic action, is extremely limited. I scarcely think, indeed, there is any occasion to prescribe it as a remedy in eye diseases, though it may be used sometimes to increase the action of other drugs; for instance, atropia, or homatropia, will dilate the pupil more quickly and powerfully if combined with cocaine. Even here I prefer to keep the solutions separate, and to instill the cocaine first and then the atropia. It is also useful as preliminary to the application of astringents or caustics, like the sulphate of copper or nitrate of silver, as it greatly lessens the discomfort, but this is only another phase of its anæsthetic action.

I have picked out one or two rather striking examples of what may happen from its use in some of the conditions I have alluded to.

Case 1. Mr. H. had an acute catarrhal conjunctivitis. A 4 per cent. solution of cocaine had been prescribed for him, to be used every hour. After each instillation there had been a period of comfort, though the discomfort was not great previously; but after he had used the cocaine in this manner for some days he came to me with the central part of the cornea steamy and the epithelium considerably roughened. The nerve endings were thus exposed, and as soon as the temporary effect of each application of the cocaine had worn off he felt a great deal of pain and experienced much photophobia. It was simply a case of catarrhal conjunctivitis, and this unusual condition of the cornea was solely the result of the use of cocaine.

Ordinarily one would prescribe for such a conjunctivitis a weak solution of sulphate of zinc and boracic acid, but here we had to use atropia until the irritation of the cornea had ceased and then give boracic acid. After two or three days of such treatment I heard from him that the eye was rapidly improving.

Case 2. This case occurred only a few weeks ago. A school teacher had a catarrhal conjunctivitis which had lasted about four weeks. She had been using a solution of cocaine in rose water. The eyes were quite irritable and a conjunctivitis that should have gotten well in a very short time was getting worse, and might have persisted indefinitely under this treatment. I prescribed a lotion of opium to be applied over the lids, and a solution of sulphate of zinc and boracic acid to be dropped into the eyes, and in a few days she was well.

Case 3. A few days since I had another case, an acute inflammatory glaucoma, where the chief reliance had been placed on the use of cocaine. Temporary relief had been gained, but of course it had no remedial effect whatever, and its use was unfortunate because the physician was placing reliance upon something that had no effect other than to lessen the pain for a time.

I have thought it worth while to report these typical cases, because I am sure that it is getting to be a very common thing for the general practitioner to prescribe cocaine indiscriminately in eye diseases, and, as I feel that its field of usefulness is so limited, a word of warning upon this point seemed to me not amiss.

On the Pathology of Fragmentatio Myocardii and Myocarditis Fibrosa.*—John Bruce MacCallum.

The normal adult heart muscle consists of rhomboidal branching cells whose protoplasm is made up of fibril bundles separated by sarcoplasm. The fibril bundles possess a narrow striation called Krause's membrane, and a broader one known as Brücke's line. The sarcoplasm is divided into compartments or discs, whose horizontal boundaries are continuous with the narrow striations on the fibril bundles. These compartments have been called sarcoplasmic discs. The protoplasm of the cell then consists of a definite network made up of the fibril bundles and the membranes bounding the sarcoplasmic discs.

The earliest stage in the development of the cell shows an irregular network in the protoplasm. This tends to become more regular, giving rise to disc-like meshes. Some of these break up into smaller ones, and in the angles between them there is an accumulation or a differentiation of the substance of the network, giving rise to longitudinally disposed masses which become the fibril bundles. The discs left are the sarcoplasmic discs. This formation of fibril bundles takes place first at the periphery of the cell, so that the bundles last formed are those nearest the centre of the cell. It is thus probable that the network spoken of in the adult fibre is derived directly from the primitive network of the embryonic cell.

In the extended condition the structure of the fibre is somewhat different from that described. The cells are narrow; the Krause's membranes are further apart; the fibril bundles themselves are closer together; and the Brücke's lines are much more conspicuous than in the contracted muscle. These and some additional minor differences make it easy to recognize an extended fibre.

Fragmentatio Myocardii. In all severe cases of fragmentation there is an uneven extension and contraction of the fibres. Two adjacent cells may be in the states of extension and contraction respectively. Often on following a contracted fibre down to the cement line, one finds the cell on the other side of the cement line extended. This condition is often present also in the same cell, that is, one part of a cell may be extended, while another part is contracted. The breaks which accompany this condition may take place in the body of the cell or in the cement line. In the cell body the lesion is more severe in extended than in contracted muscle.

In addition to these simple breaks there is a definite degenerative process which leads to the disintegration of the part affected, and a consequent fragmentation of the fibre. The initial stage in this process is an extreme extension of the fibre. Following this there are irregularities produced in the rows of striations, and changes in the relation of the sarcoplasm to the fibril bundles. This irregularity increases until no definite arrangement of the fibril bundles can be made out. The fragments of the fibril bundles then gradually disappear. There is finally a complete disintegration of the part and a breaking of the fibre. For this process I propose the name sarcolytic degeneration.

The exact relation between this degeneration and the simple fragmentation is not clear. They occur together and are obviously closely related. The simple breaks do not differ from those produced mechanically. The degenerative fragmentation, however, seems to be a gradual process. It was found in practically all the cases examined, and was the most conspicuous lesion in each instance. Such a wide process of disintegration must throw much of the muscle out of function, and the extra work must be done by the remaining normal muscle. It is conceivable that this unusual strain might cause in the otherwise normal muscle such simple breaks as those described. If this be true the main lesion in fragmentation is the sarcolytic degeneration, while the simple breaks in the various

* Synopsis of a paper read before the Johns Hopkins Hospital Medical Society, to be published in full in the Journal of Experimental Medicine.

locations are the mechanical results of the unusual strain thrown on the muscle which remains undegenerated.

Myocarditis Fibrosa. In fibrous myocarditis the disappearance of muscle takes place by atrophy and degeneration of the cells. This degeneration is brought about by a definite process, which may be described in brief as follows: There is at first a marked increase in the undifferentiated sarcoplasm in the centre of the cell, accompanied by a disappearance of the fibril bundles there. This disappearance of fibril bundles increases until there is left only a single row around the periphery of the cell. These are gradually lost, and only the sarcoplasmic discs remain. The cell at the same time becomes small and somewhat spindle-shaped, and finally disintegrates entirely.

This process is interesting in connection with the histogenesis of the cell. The fibril bundles are formed first at the periphery of the cell, and develop towards the centre, so that those which are formed last are nearest the centre of the cell. As described above, however, it is these centrally placed fibril bundles which are the first to disappear. The degeneration proceeds from the centre out (centrifugally), while the development has occurred from the periphery in (centripetally). The earliest stage in the development is a spindle-shaped cell with simple sarcoplasmic discs, while the latest stage in the degeneration could be described in the same words. The process of degeneration is thus approximately a reversal of the process of development. The first structures formed are the last to degenerate, and the last to develop are the first to disappear.

NOTES ON NEW BOOKS.

Atlas of Legal Medicine. By DR. E. VON HOFMANN, Professor of Legal Medicine at Vienna. Authorized Translation. Edited by FREDERICK PETERSON, M. D., and ALOYSIUS KELLY, M. D. (*W. B. Saunders, Philadelphia*, 1898.)

The first impression obtained in glancing over the highly colored lithographs of suicides and murders is that one has entered the "chamber of horrors," at Madame Tussaud's. A deeper insight shows more clearly the real value of the work from a scientific and medico-legal standpoint.

The first section, comprising malformations of the external organs of generation may be passed without comment, as similar pictures are to be found in a number of text-books on special departments of medicine.

Next in order follow the plates of various hymens, virginal and deflorated, the appearance of the os uteri, normal and pathological, uteri in the earliest stages of pregnancy, the lesions following instrumental and other forms of abortion, pictures of the degree of ossification of the epiphyses of the bones of full term and immature fœtuses, and the lungs of new-born infants. A very large and interesting section is devoted to illustrations of injuries of the skull bones, the hole fractures, so frequently met, claiming especial attention. Injuries of the lungs, brain and intestines are depicted in colored plates.

Injuries to the body inflicted in suicidal or murderous attempts, punctured wounds of the stomach, intestine and skull by different instruments, together with plates of gunshot wounds, occupy a considerable space.

Colored illustrations of suicides by hanging, burning, and other lethal means, the appearance of the body after several days' suspension by the neck, and the distribution of the hypostases and the appearance of the skin after long immersion in water, are all reproduced.

The best section of the book, as well as the one having the best plates, is devoted to the pathological conditions of the organs following intentional or accidental ingestion of the irritant poisons, concentrated and dilute acids, corrosive sublimate, caustic potash, potassium cyanide, arsenic and phosphorus. The gross pathological appearances of the stomach, liver, intestines and kidneys are faithfully depicted in natural colors, and this section is one of the most useful of the work.

The illustrations throughout the book are rather unequal in merit, and a number could have been omitted without detriment. The description of the plates and figures is freer from the idioms of the original language, than is ordinarily found in translations, and marks the careful supervision of the editors. H. J.

Report on Bubonic Plague: Being a report based upon observations on 939 cases of Bubonic Plague, treated at the Municipal Hospital for Infectious Diseases, at Arthur Road, Bombay, from September 24, 1896, to February 28, 1897. By KHAN BAHADUR N. H. CHOKSY, Extra Assistant Health Officer, Bombay Municipality. (*Reprint: Bombay*, 1897.)

Choksy's observations give us a clear and comprehensive idea of the nature of the fearful scourge that visited western India in 1896–7, and recurred with even greater violence in 1897–8.

Apart from the difficulties of properly caring for the patients brought to the hospital, the staff had to contend against the prevalent superstition in the minds of the patients' friends, who circulated rumors to the effect that patients were killed, their hearts removed and sent to the Queen in order to appease her wrath at the disfigurement of her statue in the city. A raid was finally made on the hospital by 1000 mill hands, who desired vengeance for the alleged killing. Several of the staff and patients were injured by stones thrown, and the mob was dispersed only after police interference. The death rate in the 939 cases observed was 73.26 per cent., or, excluding those who were brought in a moribund condition, 60.34 per cent. Mr. Choksy notes that the death rate was lower among the meat-eating patients than among the vegetarians. The clinical report is the most interesting and is very complete. Three types of the disease were found to be the most prevalent: (a) Pestis Simplex, (b) Pestis Septica (in which the blood is affected with the plague bacillus), (c) Pestis Pulmonalis, in which the lungs are primarily affected. This was at once the most insidious as well as the most infectious and the most fatal form of the plague. In Aoyoma's report of the Hongkong Plague (see J. H. Hospital Bulletin, Sept., 1896) but one case of pneumonia, as a complication, was recorded, while in Bombay it was of frequent occurrence, the most distressing symptom being dyspnœa, due to œdema of the lungs. In further contrast to the report of Aoyoma, Mr. Choksy's observations indicate that not more than 5 per cent. of the patients showed evidence of infection through breach of surface, in spite of the fact that most of the patients were accustomed to going barefooted and had many cracks in the soles of their feet. Pus from incised buboes, the sputum, and inspiration, are noted as methods of infection.

Almost every patient showed the typical *facies pestica*, a peculiar look of fright or sadness, which, together with the hesitating speech usually observed in plague patients, formed an important means of diagnosis.

55 (48 per cent.) of the buboes were in the femoral or femoro-inguinal regions, and in connection with these glandular swellings, lymphangitis was frequently observed. In the Hongkong epidemic, Aoyoma reports that this was a rare complication.

Choksy declares that "in no other disease is the disproportion in the normal ratio between pulse, temperature, and respiration so divergent." For instance, with a temperature of 105° the extremities might be icy cold, the pulse very quick, and so weak that it was often scarcely perceptible. Aoyoma, on the other hand, noted that plague patients usually showed a pulse of good volume. Serum therapy does not seem to have been very effective. Yersin's curative serum Choksy regards as having been a failure, and Dr. Haffkin's as only partially successful. Dr. Lustig's serum, however, gave good results in the few cases where it was tried, although the routine treatment of the hospital was always continued.

Fifty-four autopsies are reported, each case showing hæmorrhages in every conceivable and inconceivable part of the body.

A complete set of typical temperature, pulse and respiration charts is appended to the report.

THE JOHNS HOPKINS MEDICAL SCHOOL. SESSION 1898-1899.

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GENERAL STATEMENT.

The Medical Department of the Johns Hopkins University was opened for the instruction of students October, 1893. This School of Medicine is an integral and coördinate part of the Johns Hopkins University, and it also derives great advantages from its close affiliation with the Johns Hopkins Hospital.

The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter.

Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have acquaintance with Latin and a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry, and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the

REGISTRAR OF THE JOHNS HOPKINS MEDICAL SCHOOL, BALTIMORE.

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BULLETIN

OF

THE JOHNS HOPKINS HOSPITAL.

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CONTENTS.

DEVELOPMENT OF THE HUMAN INTESTINE AND ITS POSITION IN THE ADULT.*

By Franklin P. Mall, *Professor of Anatomy, Johns Hopkins University.*

Our knowledge of the early development of the human intestine is very complete, and at first thought it seems impossible to contribute anything new to it; yet, when we consider the topographical anatomy of the adult intestine, we are struck by the fact that there is dispute regarding the position of its various parts, and nothing is known about the development of its convolutions.

The aim in this study has been to follow the successive stages of the development of the human intestine, loop by loop, from the simplest form in the embryo to the adult. As a result, it has been found that the various loops of the adult intestine, as well as their position, are already marked in embryos of five weeks, and that the position of the convolutions in the adult is as definite as the convolutions of the brain.

The present study is closely associated with one recently published upon the development of the human cœlom, and the embryos here described were also published in part at that time.† In that paper the shifting of the viscera was emphasized in connection with the development of the cœlom, while in this paper only the convolutions of the intestine are considered.

The set of specimens in my possession is fairly complete, as all the important stages are represented. It is self-evident that a subject like this can be studied only by resorting to models, as a simple comparison of sections gives no opportunity to study the loops. A number of important stages were selected and modeled according to the method of Born. A list of these embryos is given in the accompanying table:

Table of Embryos Modeled.

No.	Length in mm. V. B.	Length in mm. N. B.	Diameter of Model.	From Whom Obtained.
XII	2.1	1.9	100.	Dr. Ellis, Elkton, Md.
II	3.	7.	67.	Dr. C. O. Miller, Baltimore.
IX	17.	14.	50.	Dr. Eyclesheimer, Chicago.
X	24.	20.	25.	Dr. W. S. Miller, Madison, Wis.
VI	24.		25.	Dr. C. O. Miller, Baltimore.
XLV	28.	19.	25.	Dr. Douglas, Nashville, Tenn.
XXXIV	80.	60.	10.	Dr. Ellis, Elkton, Md.
XLVIII	130.	110.	10.	Dr. Wilson, Worcester, Mass.

These models were then compared with one another, in order to follow the growth of the loops from stage to stage, using as guides the outline of the intestines in the sections and the blood-vessels, as well as the dissections of other embryos and those of the adult.

The loops which appeared to be homologous in the various models were next painted with the successive colors of the spectrum, beginning with the duodenum, and ending with the

* This paper has appeared in German in the Festschrift für Professor Wilhelm His zum 22. October, 1897, Archiv für Anatomie, Supplement-Band, 1897.

† Mall, Journal of Morphology, vols. 12 and 14.

cæcum. In this way, loops whose position were at first obscure, were finally found to have meaning. It is noteworthy that the successive stages in the development fit into one another accurately, showing that the first loops in the embryo are destined to form certain loops in the adult, and that this primary folding is in no way a haphazard process.

EARLY FORMATION OF THE ALIMENTARY CANAL.

The observations, upon the human embryo, of the first formation of the alimentary canal from the entoderm have now been extended to the very earliest stages.* In Graf Spee's embryo v. H. the entoderm lines the whole of the umbilical vesicle, and is in no way incorporated within the body of the future embryo. In fact, its plane is curved away from the entoderm, and is just the reverse of its direction in a later stage.

The next older stage is found in Graf Spee's embryo Gle, in which there is shown the beginning of the fore-gut. These two stages, given by Graf Spee, are the important ones to make our knowledge of the development of the alimentary canal complete, and from them we can easily follow through the successive stages until the adult form is reached.

After Graf Spee's embryo Gle, we have next to observe the constriction of the umbilical vesicle from the entoderm. The beginning of this constriction is already well marked in Kollmann's† embryo Bulle, my embyro No. XII,‡ and His's§ embryos SR and Lg. Unfortunately, we have no data regarding the extent of the alimentary canal in Kollmann's embryo Bulle, nor His's embryo SR. My embryo XII, however, is of about the same stage as the other two, and it has been cut into sections which are about perfect. The history of this embryo, as well as its cœlom, have been described by me recently, so I need not repeat them at this time.

EMBRYO No. XII. (2.1 mm. LONG).

The Figures 1 and 2, on Plate I, give the external form of the embryo, as well as the extent of the alimentary canal, which was taken from a reconstruction. The entoderm is already divided into fore-gut, mid-gut, and hind-gut. The fore-gut marks the pharynx, from which there are four diverticula on the dorsal side (Br′, Br″), one on the ventral side (T), and two near the mouth (M and S). These diverticula mark the first two branchial pouches, thyroid gland, mouth and Seessel's pocket respectively. At the junction of the pharynx and the umbilical vesicle there is a large diverticulum of the entoderm into the septum transversum, L, the beginning of the liver.

The hind-gut is a sharply defined cavity lodged in the tail of the embryo, communicating on the one hand with the allantois, All, and on the other with the neural tube by means of the neurenteric canal, N. C.

The attachment of the umbilical vesicle to the body indicates the extent of the mid-gut from which the future intestine is to arise. The cœlom is already beginning to be incorporated into the body to form the body cavity, and in the region of the liver and the omphalo-mesenteric vein the peritoneal cavities of the two sides of the embryo communicate freely, showing that at this early stage there is no complete ventral mesentery as has been described. This communication, marked O, gradually approaches the communication above the allantois, O′, and ultimately cuts off the umbilical vesicle altogether. A stage just before the umbilical vesicle

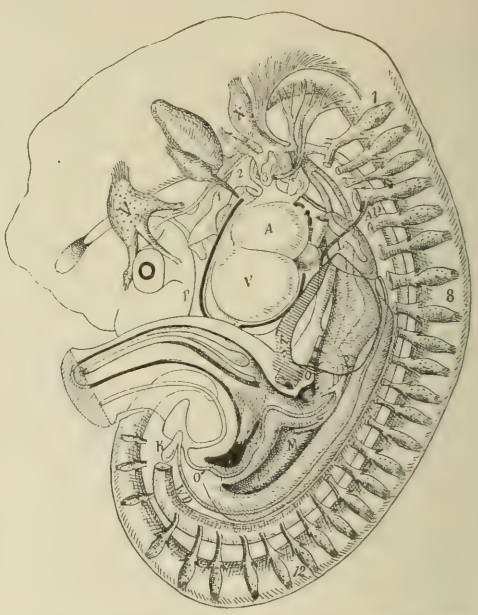

FIG. A.—Reconstruction of Embryo No. II. Enlarged 17 times. V and X, fifth and tenth cranial nerves; 1, 2, 3 and 4, cast of the branchial pockets; 1 and 8, first and eighth cervical nerves; 12, twelfth dorsal nerve; A, auricle; V, ventricle; L, lung; S, stomach; P, pancreas; WD, Wolffian duct; K, kidney; M, mesentery; ST, septum transversum; O, openings which communicate with the peritoneal cavity on the opposite side.

is completely separated from the embryo is represented in Fig. A, taken from embryo No. II.* By comparing Figs. 1 and A it will readily be seen that the spaces marked O and O′ in the two embryos are the same.

The intestinal canal of embryo II is given in Fig. 3. The drawing was made from the right side and gives the irregularity of the tube more accurately than my previous figures have done. The part between the liver duct and the cæcum, of course, marks the extent of the small intestine, and the part behind this, the large intestine. At this early stage, therefore, the cæcum is distinctly outlined. Attached to the small intestine there is this marked umbilical stem, but the vesicle no longer communicates with the intestinal canal. From the

* Graf Spee, His's Archiv, 1889 and 1896.
† Kollmann, His's Archiv, 1889 and 1891.
‡ Mall, Journal of Morphology, vol. 12, 1897, p. 417.
§ His, Anatomie mensch. Embryonen, 1885.

* Mall, Jour. of Morph., vol. 5; and vol. 12, p. 429.

umbilical stem there hangs down an extensive papilliform process which, from its appearance in section as well as its presence in younger embryos, shows that it is nothing more than an island of vessels and villi from the umbilical vesicle. These seem always to be incorporated within the body at this point and degenerate later on.

Thus far it is very easy to follow the formation of the intestine, when the embryos already described by His are also taken into consideration. My embryos, Nos. XII and II, are from the end of the second and fourth weeks respectively, so it takes about two weeks for the intestine to become outlined after the entoderm is incorporated within the body of the embryo. The intermediate stages have all been described by His in his great monograph. In his Atlas the external form of embryos intermediate to XII and II is given, and in the text the alimentary canal of embryos Lg, BB, Lr and R is again pictured in woodcuts. They all show the gradual constriction of the stem of the umbilical vesicle to form the intestinal tube between it and the liver.

As the umbilical vesicle is being separated from the intestine, all of the viscera are moving from the anterior end of the embryo towards its tail. This is also the case with the diaphragm and the origin of the cœliac axis and the superior mesenteric arteries from the aorta.* A comparison of figures A and 1 shows that the whole stem of the umbilical vesicle in embryo XII must have moved toward the tail through the space of at least ten body segments to have gained the position it holds in embryo II.

At the same time that the intestine is bending towards the ventral median line the loop is also beginning to turn upon itself, so that the aboral end moves towards the left side, and the oral end to the right of the body. This process is already beginning in embryo II, Fig. 3, but rapidly becomes more marked, as is beautifully shown by the His embryos and their models made by Ziegler. By this process the loop is separated into right and left halves, the left half to form the large intestine, and the right half, the small intestine. In a short time, however, as the loop grows longer and longer, not all of the left half is occupied by the large intestine, as the cæcum is now no longer in the middle of the loop.

EXTENSION OF THE LOOP INTO THE CORD.

As the loop of intestine enlarges it extends immediately into the umbilical cord, as was first shown by Meckel† for the human embryo. To what extent this is common to the mammals is not known, but my experience is that it is frequently found in other mammals, and from the examination of many pigs' embryos I can state that in them a portion of the intestine always extends into the cord.

Figures 4, 5 and B are from embryo IX, a specimen about five weeks old. The intestine extends into the cord as a single loop, with the plane of its mesentery horizontal to the long axis of the body. In general its arrangement is much like that of His's embryos S1, Sch*, KO† and RM‡. It is noticed in the figures that the large intestine lies altogether within the sagittal plane of the body, a position it retains until the intestine is returned to the peritoneal cavity proper. The right half of the loop has a number of small bends in it, which are of great importance in the further development of the intestine. I have marked them with the numbers 1, 2, 3, 4, 5 and 6 in order to follow them with greater ease in the drawings of older embryos.

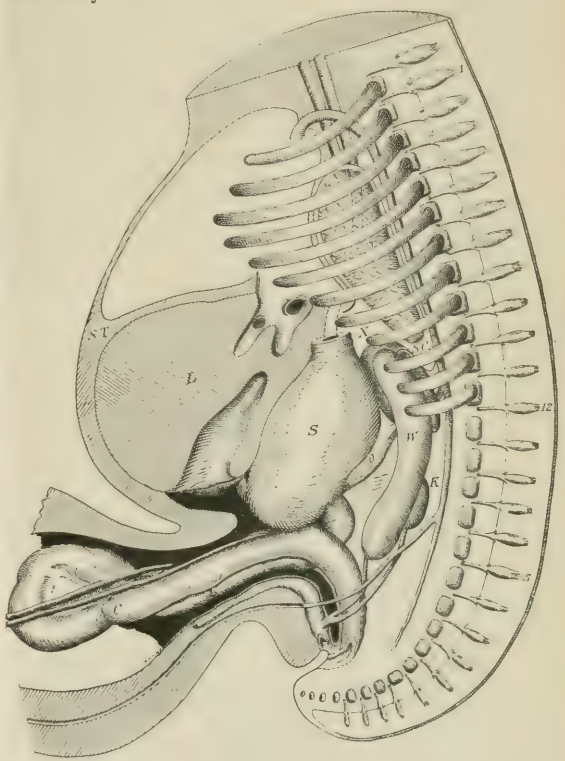

Fig. B.—Reconstruction of Embryo No. IX. Enlarged 20 times. ST, septum transversum; L, liver; S, stomach; C, cæcum; W, Wolffian body; K, kidney; 1 to 12, dorsal ganglia; O, omphalo-mesenteric artery; SC, suprarenal capsule; X, communication between pleural and peritoneal cavities.

In the middle of the mesentery of the loop and in the median line lie the omphalo-mesenteric vein and artery. At the point where these vessels cross the intestine, Fig. 4, u, we have a landmark which is of use in comparing the intestine of this embryo with that of older embryos. The point of communication between the umbilical vesicle and the intestine also represents the position of the persistent Meckel's diverti-

* Mall, Jour. of Morph., vol. 12, pp. 441 and 442.
† Meckel, Meckel's Archiv, 1817.

* His, A. m. E., III, p. 19.
† His, Abhandl. d. sach. Gesch., XIV, Taf. II, Fig. 3.
‡ His, ibid. XV, p. 677.

culum. If the adult intestine is about six meters long, and if the distance from the cæcum and Meckel's diverticulum is about one meter, then the length of the intestine between the omphalo-mesenteric vessels and the cæcum is about one-sixth of the whole intestine. In both embryos IX and X, as well as in His's embryos S_1 and Sch, the extreme bend of the intestine (Fig. 4, u) marks one-sixth the distance from the cæcum to the duodenum.

The blood-vessels to this whole loop within the umbilical cord arise from the omphalo-mesenteric or the future superior mesenteric artery. When this is compared with the arterial supply in the adult intestine it is again found to correspond. In this early stage the omphalo-mesenteric artery supplies the same portions of the intestine that the superior mesenteric artery does in the adult. Not only by the form of the large intestine, but also by its blood supply can we divide it into two portions, that portion which is at right angles to the body, supplied by the superior mesenteric artery, and that parallel with the body and supplied by the inferior mesenteric artery.

The relation of the intestine and liver to the body of the embryo is given in Fig. B.

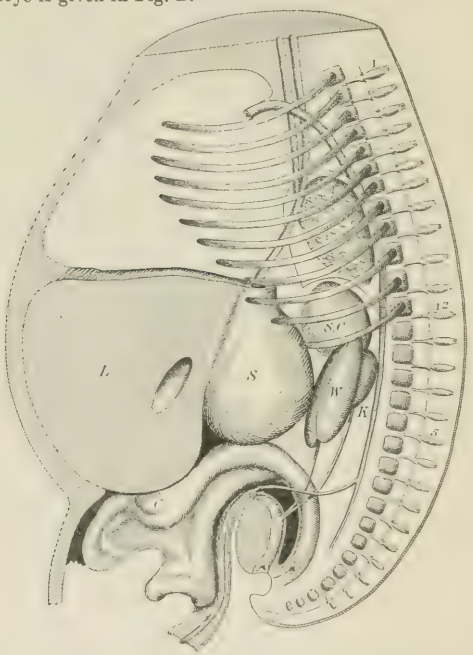

Fig. C.—Reconstruction of Embryo No. X. Enlarged 8 times. 1 to 12, dorsal ganglia; SC, suprarenal capsule; W, Wolffian body; K, kidney; L, liver; S, stomach; C, cæcum.

BEGINNING OF THE CONVOLUTIONS.

A stage somewhat older than the one just described is given in Figures 6, 7 and C. In comparing Figures B and C it is seen that the liver has descended decidedly; it has moved away from the head to the extent of at least three segments. While in embryo IX the septum transversum is opposite the eighth dorsal nerve, and the lower edge of the liver opposite the first lumbar nerve, in embryo X the septum is opposite the eleventh dorsal, and the lower edge of the liver opposite the second sacral nerve. In other words, the septum has descended three segments and the lower edge of the liver six segments. Not only has the liver descended through its absolute growth, but the whole organ has descended also. This movement has had a marked effect upon the form of the large intestine, and the direction of the intestine in general, as the figures will readily show.

While this movement is taking place the convolutions are also becoming more and more distinct. Every loop as outlined in embryo IX is more marked in embryo X. In general, the twisting has become more pronounced as the cæcum is approached. The loops 1, 2 and 3 are only slightly more bent in X than in IX, while the loops 4, 5 and 6 have become much more sharply defined. In general, the length of the loops has doubled itself while the diameter of the intestine increased but one-third.

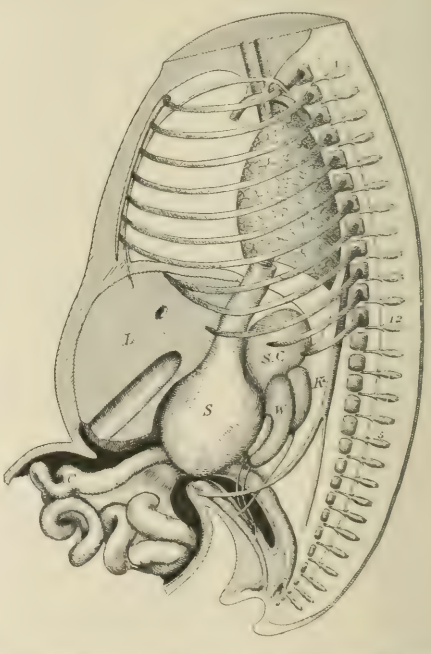

Fig. D.—Reconstruction of Embryo No. VI. Enlarged 8 times. S, stomach; SC, suprarenal capsule; C, cæcum; K, kidney; W, Wolffian body.

The next embryo (VI) I have modeled is only slightly larger than No. X. I give the same views for this embryo as I gave for Nos. IX and X. Fig. D compared with Fig. C gives the general relation of the intestine to the body. The large intestine has not changed its position much; it has

elongated, but has not increased its diameter. There is now added to the cæcum a marked vermiform appendix. The stomach has descended more than before, the great omentum forming a sac and extending well over the large intestine.

A comparison of Figs. 6 and 7 with Figs. 8 and 9 shows the growth of the small intestine. The duodenum is still bulged at its stomach end and only the lower portion of it is as small as the rest of the intestine. This enlarged duodenum is so decided that, at first sight, one might think it belongs to the stomach, but since the liver and pancreatic ducts open into it in all the specimens, there is no doubt but that it belongs to the intestine. Of course there is the possibility of these ducts shifting, but this seems to me very improbable.

The second portion of the intestine, 2, is now curved towards the dorsal side of the embryo, and, as in embryo X, this is also the case with its mesenteric attachment. We are all familiar with this portion of the intestine in section, as it has this hooked mesentery showing that the intestine has bent backward. The next portion, 3, is bent upon itself to such an extent that it rolls around on the dorsal side of the omphalo-mesenteric artery, to project to the left side of the clump, as shown in Fig. 8. It also has the hooked mesentery in section, as the mesentery is very much bent upon itself.

It has been customary for embryologists in discussing sections of the intestine with me to call this portion of the intestine the duodenum, on account of its position, as well as for its very characteristic mesentery. At first I was strongly inclined towards this view, but more mature consideration of models convinced me that both the loops 2 and 3 are finally transferred to the left side of the body to form the upper part of the jejunum.

The fourth portion of the intestine, Fig. 8, 4, has its beginning in the earlier embryo on the left side of the mesentery as shown in Fig. 6. It is readily seen by the comparison of the two figures that the loop 4, in Fig. 8, is only an exaggeration of the same in Fig. 6. While this loop begins on the left side it ends on the right. In all the figures the extreme bend of the loop 4 is marked a, and a comparison of the figures will readily show that this is always the homologous loop.

Following the loop 4 there is the loop 5, which is altogether on the right side in embryo X, Fig. 6, and about equally distributed on both sides in embryo VI. In both Figs. 6 and 8 the end of the loop 5, b, approaches the loop 3, and this relation is also present in Fig. 10. In the figures this point is marked b, and the similarity of this loop in them is very apparent. Loops b and 3 are just touching in Fig. 6, while in Fig. 8, through the elaboration of loop 4 and its gliding to the right side of the mesentery, the loop 5 has been brought nearly in contact with loop 3. At any rate the relations of loops 5 and 6 to the umbilical vein in both figures show that the numbering of the two loops is not far amiss.

The loop b in Figs. 4, 6, 8 and 10 holds the same relation to the cæcum and umbilical vessels in all four embryos. This point seems to be the fixed point for the loop on the right side of the mesentery as the point marked a is for the left. Between b and the cæcum the intestine is thinner and the loops are smaller than in the upper part of the intestine. For this reason as well as for the fact that there is no sharp landmark other than the umbilical vessels between loop b and the cæcum, I have classed this whole region as one group and marked it with the single number 6.

The convolutions in embryo XLV, Figs. 10 and 11, are only an exaggeration of those of embryo VI. The loops 1, 2 and 3 are much the same as before. The loop 1 is again defined by the extent of the head of the pancreas. The loops 2 and 3 together are now S-shaped instead of a simple curve as in embryo VI. My interpretation of this is that the loop 3 is held in place by the opening of the umbilical cord, as at this point the intestine leaves the body, while the loop 2 is beginning to rotate to the left side of the body with the rest of the intestine. The loop 4 on the right side has enlarged, however, and has pushed its way in between the loops 3 and 5. On the left side the loop 4 has made for itself another twist, so it now appears as several loops. The loop 5 is much as it was before, only it has increased its length somewhat. It is easy to see the loop 6 of embryo VI converted into that of embryo XLV by imagining x in Fig. 9 to be drawn over to the opposite side to form x in Fig. 10. In so doing x′ and x″ remain back to form the loops marked the same in Fig. 11. In addition to this the loop y in Fig. 9 has become bent over to the left side to form y in Fig. 11.

All these twists and curves in the small intestines of the four embryos just described can be followed fairly well in the figures, and the reader may think that there is considerable imagination required to do this. Any one, however, who may study the models in which the corresponding loops have been marked as in the figures will not doubt regarding the accuracy of this description. It is a most remarkable fact that four specimens should correspond as well as they do here. Were the whole affair more or less haphazard no comparison whatever could have been made.

ROTATION OF THE SMALL INTESTINE.

A comparison of embryos II, IX, X, VI, His's Pr and KO, shows that the change in position of the intestine and its future twisting is due to the descent of the abdominal viscera, accompanied by the relatively rapid growth of the small intestine. The following table gives the measurements of the intestines in these embryos as well as the level of the stomach and the cæcum. The measurements of the intestine of embryos Pr* and KO† have been taken from the illustrations given by His and are only approximations. The position of the stomach here given is its lowest measurements including the omental bag.

Table giving the Position and Length of the Small Intestine.

Number of Embryo.	Position of Stomach.	Position of Cæcum.	Length of Intestine. Small.	Large.
II	1 Dorsal	9 Dorsal	1.7 mm.	1.5 mm.
Pr	5 "	10 "	3.	1.5
KO	8 "	12 "	4.	3.
IX	3 Lumbar	5 Lumbar	9.	3.7
X	5 Lumbar	3 Sacral	19.	7.
VI	1 Sacral	1 Sacral	34.	8.
XLV			52.	8.

* His, Atlas, Theil III, Taf. 1, Fig. 4.

† His, Abhandl. d. K. S. Ges. d. Wiss., 1888, Bel. XIV, No. 7.

A study of this table by comparing it with the illustrations shows that the intestine is gradually elongating and at the same time being pushed towards the pelvis by the large liver and other organs descending upon it. In No. II the intestinal canal is still a comparatively straight tube, but in Pr and KO it is already well bent, is much larger than in No. II and is pushed into the cord. In No. IX it is located in the cord. From No. II to No. IX the small intestine has increased its length five times and the large intestine over two times, and the space which they should occupy within the body has remained the same. Under these conditions the intestine must escape if it has a chance, and the cœlomic space within this cord naturally receives it. This movement of the intestine is due to mechanical causes and, were the cœlom of the cord not there to receive it, the intestine no doubt would make room for itself within the body. I do not think that the umbilical ducts had anything to do with it any more than to keep the opening in the cord open, for, before the intestine begins to enter the cord, its connection with the duct is severed.

After the intestine has entered the cord, No. IX, Fig. B, the small intestine grows rapidly, as the table and Figs. C and D show. Embryos IX, X and VI are all about the same size, but no doubt VI is considerably older than IX; the organs are all firmer and more developed, and the small intestine has increased its length considerably more than the large intestine. The organs have all been pressed down to the pelvis as far as they will go, as Fig. D. shows. In so doing the large intestine makes a sharp bend in the neighborhood of the fourth lumbar segment, in all of the embryos given in the above table. This bend, therefore, may be looked upon as a fixed point toward which the viscera descend, but beyond which they do not go. Of course after the intestine is in the cord the loops may descend lower, but within the body this is a very fixed point.

After the intestine is within the cord its further elongation and its mesenteric attachment causes it to be thrown into coils, as shown in the plates. The large intestine lies, however, in the sagittal plane of the body, partly within the body and partly within the cord. It does not grow as rapidly as the small intestine; and, as the small intestine is folded into coils, the whole begins to rotate around an axis which is identical with that of the large intestine. By this process the small intestine is gradually turned from the right to the left side of the body, and in so doing is rolled under the superior mesenteric artery. This takes place while the large intestine has an antero-posterior direction and before there is any transverse colon. This latter is the result of a kinking which is to follow, and is in no way formed by a shoving of the large intestine over the small, as given in the Hertwig diagrams.

RETURN OF THE INTESTINE TO THE PERITONEAL CAVITY.

Although it is comparatively easy to understand how the intestine leaves the peritoneal cavity to enter the cord, it is extremely difficult to see how and why it returns. When the intestine enters the cord the communication of cœlom with the body cavity is very free and the intestine is small, but when the intestine returns to the body cavity the intestine is large, while the opening is small, Fig. D.

In embryo No. II, and in younger embryos, the belly stalk is very large and contains within it no muscles nor permanent blood-vessels of the abdominal walls of the future individual. It is not until the muscles wander, carrying with them their nerves and to a certain extent their blood-vessels, that the belly wall is finally completed.* In embryo No. VI, for instance, the rectus abdominis is about half-way around from the dorsal to the ventral median line, thus leaving a large area between the two recti, which is little more than a membrane. It seems that, until the abdominal walls are fairly completed, the intestine remains within the cord, and, at the last moment before the two recti come together in the middle line, the intestine returns to the peritoneal cavity.

In very young pigs' embryos, when the mammary ridge is still over the muscle plates, I have found that the segmental arteries form an anastomosis with one another throughout the extent of this ridge. This artery goes through a series of muscles which have just been split off from the muscle plates. As the embryos grow, the mammary ridge wanders towards the ventral median line† and carries with it this anastomosis of segmental arteries and the portion of muscle plates which are destined to form respectively the internal mammary, deep epigastric arteries and the rectus abdominis muscles. The nerve connections of the various segments of the rectus are formed as the muscle is splitting off from the muscle plates, and in this way the origin of the different parts of the rectus is indicated, as already shown by Nussbaum. What I have here described for the pig can also be verified for the human embryo, and this will make it plain how the lateral body walls are formed from the belly stalk.

But the closing off also takes place from above downwards. In an early stage, while the septum transversum is still in the neck, the umbilical vesicle also extends upwards. The heart is first closed off by the beginning of the membrana reuniens, and the ventral wall is completed by the amnion moving over the embryo from left to right.‡ Then the umbilical vesicle is pinched off from above downwards, corresponding with the descent of the liver and other viscera. In embryo II the stalk extends from opposite the third dorsal vertebra to opposite the second sacral, while in embryo IX it extends from opposite the second lumbar segment to opposite the fourth sacral. In other words, the oral end of the stalk has receded eleven segments, and its aboral end two segments; or the whole stalk is moving away from the head, and its attachment to the body is rapidly becoming smaller and smaller. Later the growth of the abdominal walls is greater between the cord and the pelvis, as shown by the sections made by Merkel.§

At one time I thought of the possibility of the expansion of the cœlom of the cord and its incorporation with the abdominal cavity, and this was also carefully investigated. Were this

* See also Nussbaum, Verhandl. d. anat. Ges., 1894, '95 and '96.

† O. Schultze, Anat. Anz., Bd. 7; and Verhandl. d. phys. med. Ges. Würzburg, Bd. 26.

‡ Mall, Journal of Morphology, vol. XII.

§ Merkel, Abhandl. d. k. Ges. d. Wiss. in Göttingen, Bd. 40.

the case it would be necessary to find stages in which the rectus abdominis had wandered up into the stalk to incorporate it and to enclose the intestine within it. No such stage has ever been found, while on the contrary the recti nearly close the communication between the stalk and peritoneal cavities, before the intestine slides back into the body.

The return of the intestine into the body must take place very rapidly, for I have never seen a specimen in which it is in the process of returning. Embryos 40 mm. long either have the intestine in the cord or in the peritoneal cavity, and, if it is in the latter, the communication between the cord and peritoneal cavity is open and surrounded by a thin membrane, showing that it also is being closed. This membrane now closes the whole opening, and later the recti muscles wander into it to complete the abdominal walls.

Since I was unable to find the desired stage in the human embryo, I examined a number of pigs' embryos, hoping in this way to find stages in which the intestine is returning to the peritoneal cavity.

In a pig's embryo 12 mm. long a single loop of intestine extends into the extra-embryonic cœlom, beyond the cord and on the right side of the body. It is still in communication with the umbilical vesicle, which, in turn, is attached to the ventral body wall over the heart. As the loops of the intestine increase in number in older embryos, they make room for themselves below the liver and in front of the Wolffian body, for, unlike the human embryo, there is considerable space in this region. In general the greater number of loops remain within the body cavity of the embryo, and the loops within the cord are not numerous. The increase of loops within the body cavity and their rotation seem to draw upon the loops within the cord, so that when the embryo has reached 35 mm. in length, the loops have all returned to the body cavity.

No doubt, in the human embryo some similar mechanism is present in the return of the loops to the peritoneal cavity, but, as the critical stage has not yet presented itself, this question must be left open for future observation.

POSITION OF LOOPS AFTER THE INTESTINE HAS RETURNED TO THE PERITONEAL CAVITY.

Although it is extremely difficult to understand how the intestine returns to the peritoneal cavity, it is not difficult to recognize the various loops after their return. Unfortunately I have not been able to study carefully a good stage between embryos XLV and XXXIV, as the various specimens of this stage at my disposal were not perfect, or if so, the series of sections were broken. It was not until a number of good specimens had been spoiled for this present purpose that I found that, by removing the ventral abdominal walls, good series could be obtained. If this is not done, the intestine is very liable to be imbedded poorly, and as a result the sections are not perfect. Dissected specimens, on the other hand, cannot be relied upon, for, when once handled, it is impossible to replace the intestines to their original position with certainty, unless they have been modeled as soon as the abdominal walls were removed. Of course dissection is an extremely good method of control, but for a comparison of the loops I think that no method will improve the model. Then it was found that all the loops represented in No. XLV are again recognizable in XXXIV, and on this account it is believed that an intermediate stage is unnecessary, unless that stage is one in which the intestine is in process of returning from the cord to the peritoneal cavity.

A comparison of Figs. 10 and 12 shows that the loops of XLV are again represented in XXXIV. The marked change is that the mesentery of the large intestine has increased greatly. The loops of the upper part of the intestine have rolled completely to the left of the superior mesenteric artery, and the loops which were formerly within the cord have now been transferred *in toto* to the right side of the body. While this has been taking place the stomach has been enlarging also, and by the tilting of the intestine the pyloric portion of the stomach, d, has come nearer the cæcum, about to the point marked d' in Fig. 10.

This shifting of the loops, half to the right and half to the left side, as well as the sliding down of the stomach towards the cæcum, has finally locked the duodenum (loop 1) around the root of the mesentery, as shown in Figs. 12 and 13. As the loops come out on the left side, Fig. 12, we have the beginning of the second group of loops (2) of the intestine. The deeper layer of these loops, not shown in the figures, is a single curve lying immediately in front of the mesocolon. The loops 3 together can easily be imagined as arising from the same as in Fig. 10 by a simple bending of the portion on the dorsal side of the large intestine towards the ventral median line. The loop 3 which lay formerly on the right side of the body is now altogether on the left side. In the illustration, with the exception of its ending in loop 4, it cannot be recognized as the loop 3 of Figs. 10 and 11. In the models, however, the loop 3 forms a distinct cluster situated between the loops 2 and 4, and therefore, by exclusion, it must represent the loop 3 of embryo XLV.

The similarity of the loop 4 in embryos XLV and XXXIV is very striking. Its beginning, the arrangement of convolutions and their position are much the same in both embryos, if the change in position of the intestine in the older embryo is taken into consideration. The next cluster I have marked 5, and the remaining portion 6. The loops 6 are again smaller, and their diameter is less than those of the upper part of the intestine.

In this embryo we can see pretty well the adult form of the intestine, only that the mesentery is transverse to the body rather than diagonally downward toward the right side. In this embryo we also see the relation of the intestine to the mesentery better than in the adult. At this time the mesentery is relatively simple, as but few secondary adhesions have taken place. Unraveling this stage into the one represented by embryo XLV, we can fully understand the relation of the mesentery to the abdominal viscera. These two stages represent beautifully the arrangement of the intestine in the dog and monkey respectively.

The following table gives the length of the various loops of intestine in the embryos described. The measurement was taken along the distal border of the intestine and therefore is considerably longer than along the mesenteric border. But this is a border easily measured, and the length of the hard-

ened intestine is considerably less than where it is taken out fresh and stretched. The table shows that the lower end of the intestine grows more rapidly than the upper end until the intestine is returned to the peritoneal cavity, when the upper end of the intestine grows more rapidly.

LENGTH IN MILLIMETERS OF THE DIFFERENT PORTIONS OF THE INTESTINE IN THE DIFFERENT EMBRYOS STUDIED.

No. of Embryo.	Small Intestine.						Large Intestine.	Total Length. Small Intestine.	Total Length. Whole Intestine.
	1	2	3	4	5	6			
II	—	—	—	—	—	—	1.5	1.7	3.2
IX	1.6	1.2	1.2	1.3	1.4	2.4	3.7	9.1	12.8
X	2.	2.6	2.6	3.6	2.4	5.8	7.	19.	26.
VI	1.8	2.9	3.8	7.4	7.2	10.8	8.	33.9	41.9
XLV	3.6	3.2	5.6	13.2	9.2	17.3	8.	52.	60.
XXXIV	11.	39.	50.	89.	67.	110.	50.	366.	416.
XLVIII	22.	62.	70.	150.	95.	175.	86.	474.	560.
Infant [1]	—	—	—	—	—	—	570.	2100.	—
Adult [2]	—	—	—	—	—	—	—	5372.	—

[1] After Weinberg. [2] After Sernoff.

It is not difficult to follow the development of the intestine from embryo XXXIV to the adult, by simple dissection; but, in order to be more certain of the relation of the deeper layers of the intestine of an older embryo, I had the intestine of a four months' fœtus modeled. In this, however, the mesentery was not included, as the loops only were desired. The intestine was removed from the body *in toto*, and carefully imbedded in paraffin, after which it was cut into sections 100 μ thick. These were drawn upon wax plates, at a scale of ten, thus making each plate one millimeter thick. The intestine outlines were then cut out, and the remaining frame-work of wax plates was carefully piled, and the cavities cast with plaster of Paris. After the plaster had set, the wax was melted in hot water, leaving the plaster cast of the intestines enlarged ten times.

Figs. 14 and 15 are drawings of this model, and they show about what would be expected in a stage more advanced than embryo XXXIV. The large intestine has become more extensive, the transverse colon having become bent forward, and the descending colon having a very marked S in it before it passes over to the rectum. The intestines, as a whole, are shifted more to the left side of the body, so that the colon encircles the intestine rather than simply marks its border. The lower part of the small intestine is filled with a great quantity of meconium at this stage, showing that vermicular action must take place at this early time, as all this substance has been propelled downward to the cæcum. This same condition I have noticed in other embryos of the same stage.

The loops have shifted somewhat over one another, but one could not unwittingly separate the model so that it would not fall into its respective groups. This separation is given in Fig. 15.

It is evident that the loops are now shifting and adjusting themselves to the space they have to occupy. The loops 2 and 3 are still recognizable, while the loop 4 has been pushed back of them and extends over about as great an area as loop 6. The loop 5 lies about in the middle line, is more to the left than in the younger specimens, and is destined, ultimately, to lie in the left iliac fossa. The loop 6 will descend into the pelvis when the pelvis becomes large enough to hold it, making room for the green, which is shifted to the right side and to the umbilical region. All this will be accomplished with the descent of the cæcum to form the ascending colon, thus bringing about the re-arrangement of the position of the loops by a rotation of the lower end of the intestine toward the pelvis.

POSITION OF THE INTESTINE AFTER BIRTH AND IN THE ADULT.

It is relatively easy to follow the intestines in an older fœtus or in a new-born child after they have been hardened in formalin or other substances which keep the intestines sufficiently in place while they are being handled. I have examined the intestines by this method in a number of new-born children, and have found them much the same as in fœtus XXXIV and XLVIII. The intestine passes over and back along its mesenteric attachment from left to right, while in fœtus XXXIV and XLVIII, the direction of the mesentery of the intestine is at right angles to the axis of the body, in the new-born this attachment is from the left hypochondriac region diagonally downward towards the right iliac fossa, with a curve somewhat towards the right fossa. This makes its course a curved line, which is also curved spirally around the body. While above it is left and deep, below it is right and superficial. The intestine now is attached along this line, crossing and recrossing it, over and back again from duodenum to cæcum. In so doing, the convolutions above lie to the left of the mesentery, and are piled upon one another, making the planes of their circles at right angles to the body, while below and to the right they lie in front of the mesentery, and the planes of the convolutions are perpendicular to the body.

For the adult I have examined the intestines of about 50 cadavers, in which 41 were not diseased nor adherent in any way. Of them, one-half were negroes. The intestines were all coagulated in position, the cadaver being on its back, with about 1.5 to 2 kilos of pure carbolic acid. It was injected in 33 per cent. solution to preserve the subjects for dissection. After the abdominal cavity was opened the position of the intestines was either sketched or photographed and then the intestines removed, loop by loop, making a tracing of their course at the same time. In this way the general course of the intestine was followed. In removing the loops it was found that in nearly all specimens they came out as distinct groups, as for instance the group on the right side of the body was usually one loop crossing the middle line but twice; once to communicate with the loops above, and once with those below. To follow the intestine in this way the method was amply sufficient, but free-hand modeling or corrosion gives a much more satisfactory result. The models of three specimens which I have made in this way have proved to be of great value in gaining a clear idea of the position of the intestines. A large number of diagrams, sketches, photographs, and models were compared with one another till I was finally able to convert them into a common scheme, by which I have been in the habit of demonstrating the course of the intestines to students, and then immediately verifying

it on the cadaver. In doing this, it is necessary to be prepared for the variations, and these again can be classified.

WORK OF HENKE, SERNOFF AND WEINBERG.

It was generally believed that the intestines within the abdominal cavity had no definite position until a few years ago, when Henke* demonstrated that this was not the case. A glance at the various standard text-books on anatomy shows that there is a tendency among them to locate the main groups of the small intestine in fairly definite portions of the abdominal cavity. Gegenbaur† gives an illustration copied from Luschka in which the jejunum and ileum are located respectively in the upper and lower portions of the abdomen. In the text he expressly states that the jejunum is located in the upper portion of the abdominal cavity and extends down to the left iliac fossa. The ileum, however, is located in the lower portion of the abdominal cavity and in the pelvis, and extends over to the right iliac fossa. Hoffmann‡ gives an excellent illustration of the coils of the small intestine, locating the jejunum mainly in the umbilical and left iliac regions, with the ileum within the pelvis and lower abdominal regions. Similar descriptions are given by Testut§ and by Quain,‖ with the exception that they are more cautious about locating definite loops. Quain states, "the jejunum lies above and to the left side of the ileum, but the coils are so irregular that the position of any individual loop offers but little clue to the part of the intestine it belongs," while Testut states that the position of the intestine changes, due to the muscular contraction, and so on.

The first decided step in advance to locate the position of the intestine was made by Henke when he studied carefully the spaces in which the intestine may lie. He found that the abdominal cavity may be divided into four compartments, the greater of which lies within the concavity of the diaphragm and is filled with the organs which are more or less firmly fixed with ligaments. The other three compartments are separated from one another by the ridge formed by the two psoas muscles and by the vertebral column. This makes a right and left compartment and a lower compartment which extends into the pelvis. Into these three compartments the intestine must accommodate itself, and Henke thinks it has a fairly definite position. He is cautious enough, however, to state that under certain conditions the loops may shift from one space to another, but what the regularity of the position is, or what the rule of the shifting, is difficult to determine from Henke's paper. His illustrations, however, are very good, but, according to my experience, do not represent the normal type of the intestine. Of course, we could not expect them to do so, for the number of cadavers he studied carefully appears to have been but three.

Henke's method of study was to make sketches of loops of intestine and then to remove them, sketching again the loop below. By combining the drawings he finally outlined the course of the intestine from the duodenum to the cæcum. Of course, he examined a great number of intestines in fresh cadavers, but it is difficult to trace the course of the intestine in them, as the slightest disturbance will make one's result uncertain. While, therefore, he gives very little certainty regarding the course of the intestine, he states definitely that the course of the loops on the left side is horizontal to the body, while on the right side it is perpendicular.

A few years later Sernoff* studied a few cadavers more carefully and with more accurate methods than Henke, but did not verify Henke's result. Sernoff injected the cadaver with a large quantity of chromic acid, and in this way the intestine and mesentery were hardened in position. Then, after opening the abdominal cavity, a cast was made of the intestine, and finally the surface loops were stained with fuchsin. In this way the surface loops were marked after disturbing the intestine for purpose of exploration and measurement. Next the intestine was removed, showing the form and position of the mesentery which was left within the body. The method throughout is accurate, but the number of specimens is not numerous enough for any generalization of the position of the loops. Only two records of intestines in normal position are given, and although Sernoff believes that these are diametrically opposed to each other in position, I think it is not difficult to see that there is a great similarity in them. The fact that a higher loop may be on the right of a lower one in one case and the reverse in another does not necessarily overthrow a general scheme. Also, it is not of much significance regarding the general course of the intestine that in specimens 2 and 3 (he does not picture No. 2) the direction of the convolution is not horizontal above and to the left and perpendicular below and to the right.

Recently Weinberg† has studied a number of specimens in new-born infants very carefully. He gives good illustrations and descriptions of ten specimens which were studied with the method employed by Sernoff. In general, Weinberg's specimens are all after the same plan, showing that the intestine goes over and back, antero-posteriorly, beginning at the upper left side and ending in the lower right side. In seven specimens out of the ten the large upper segment of the jejunum lay in the left upper part of the abdominal cavity. In three specimens, only a short portion of the jejunum lay in the left hypochondriac fossa and the rest came up in contact with the ventral abdominal wall. The direction of the loop in this region was mainly transverse to the body, and, in general, the extent of them was about two-fifths of the length of the small intestine. Following these loops there is a group of irregular convolutions which lie in the left iliac fossa, and include the middle fifth of the intestine. Then the intestine crosses the left psoas muscle, and the remaining two-fifths of the small intestine lie between this and the right psoas, as well as on the right side of the abdominal cavity. The direction of the convolutions of this portion is mainly perpendicular. The extent of the intestine which comes in contact

* Henke, His's Archiv, 1891.
† Gegenbaur, Anatomie, 1890, Bd. 2, S. 59.
‡ Hoffmann-Rauber, Anatomie, 1886, Bd. 1, S. 557.
§ Testut, Anatomie, 1894, t. 3, p. 505.
‖ Quain, Anatomy, 1896, vol. 3, pt. 4, p. 103.

* Sernoff, Internat. Monatsch. f. Anat. u. Phys., 1894.
† Weinberg, Internat. Monatsch. f. Anat. u. Phys., 1896.

with the anterior abdominal wall is about one-third of its whole length, which corresponds with the measurements given by Sernoff for the adult.

In general, Weinberg's results confirm Henke's and give for my purpose the important intermediate stage between the fœtus and the adult. I have also examined the intestine of a number of new-born babies after they had been hardened *in situ* in formalin or in carbolic acid and can confirm the work of Weinberg.

In describing the direction of the loops of the intestine in the various portions of the abdominal cavity it is not well to state the direction of the external loop to the body cavity, for this loop may be only the connecting link between two more important loops above and below. The main loops must be isolated whether they are superficial or deep, and the plane of the circle which they describe makes the general direction of the loop. If the intestine makes a continuous spiral, then the direction of any one of the loops is about parallel with the circles the loops describe; but if the spiral reverses itself, then the connecting loop is at right angles with the plane of the circles. If this is not considered, it may be that the superficial loops are perpendicular, while the main loops are transverse to the body axis.

POSITION OF THE INTESTINE IN FORTY-ONE CADAVERS.

The cadavers had all been carried in the supine position for at least two kilometers over the rough cobblestones of Baltimore before they were delivered at the laboratory, and this shaking may account for the regularity of the arrangement of the intestine. They were then injected with about 1.5 to 2 kilograms of carbolic acid crystals in the form of a 33 per cent. solution into the femoral artery. This coagulates completely the abdominal and thoracic viscera. After that the bodies were frozen and some of them were not studied until two years later, while most of them were opened at about the end of a year. The older bodies are preferable, as the surplus water has evaporated and the tissues are fairly dry and somewhat hard.

In all of these specimens the general direction of the intestine was diagonally across the abdomen from the left hypochondriac space towards the right iliac fossa, usually diverging once or sometimes twice towards the right side of the abdomen and always towards its end, into the cavity of the pelvis.

The general form and position of the mesentery is well shown in Fig. 17, as well as in Figs. 5 and 8 by Sernoff. These figures show the large curves made by the mesentery to attach itself to the loops, first on one side of the root of the mesentery and then on the other. I have tried to follow rather the greater groups of convolutions, for it is hopeless to attempt to number every individual loop.

In 21 of the specimens the arrangement of the loops was after the same plan; therefore I shall consider this the normal, and the arrangements of the intestine in the other specimens as variations of this plan. In these specimens the jejunum first arranged itself into two distinct groups of loops situated well up in the left hypochondriac region. Each group made more than a complete circle, and both of them came in contact with the anterior abdominal walls. They are marked 2 and 3 respectively in Fig. 16, the loop 2 being the one which communicates with the duodenum. After this the intestine passes through the umbilical region to the right side of the body. This loop is marked 4 in the figure. Then the intestine recrosses the median line to make a few convolutions in the left iliac fossa (5), after which it fills the pelvis and lower abdominal cavities between the psoas muscles (6). The course of the intestine which has been pictured in Fig. 16 is given in Fig. 18.

When now this arrangement of the intestine is compared with that of fœtuses XXXIV and XLVIII, as well as with Weinberg's specimens, it is fairly easy to see the gradual transformation of XXXIV into the adult type. Fig. 12 still shows the intestine about equally distributed on both sides of the body, with the cæcum still very high. In Fig. 14 there is already a marked descent of the cæcum towards the future pelvis. In comparing these two figures it is to be observed that Fig. 12 is a ventral view and Fig. 14 a view from above. The outlines of the stomachs in the two figures will show from what point the models have been drawn.

When we pass from these two specimens to the figures of Weinberg, we see a similarity between them and most of his figures, but in a number of them the intestines have begun to shift more and more. In general there is a tendency for the irregular lines of mesentery to bend towards the left iliac fossa, for, with the descent of the cæcum, the whole mesentery is rotating towards the left side. Weinberg's Fig. 18 shows this well. Hand in hand with this movement one or more loops move towards the right side of the body, as his Figures 11 and 19 show. As yet there is no marked pelvic cavity to take the lower end of the ileum, and as soon as the pelvis is large enough to hold it, we can easily imagine the intestine pictured by Weinberg in Figs. 5, 9, 11, 16, 17, 18 and 19 to be converted into my Fig. E by a simple descent of the ileum into the pelvic cavity. The other few specimens may be considered as variations.

In a shifting of this sort it is probable that the middle loops of the intestine would be transferred to the right side, while the upper half would remain on the left side, and the lower half in the pelvis and lower abdominal regions. According to Sernoff's three measurements, on an average 41 per cent. of the length of the intestine is on the left side, 41 per cent. in the pelvic cavity and about 18 per cent. on the right side. In embryos IX, X, VI and XLV the loops 2, 3 and 4 together are shorter than the loops 5 and 6, while in XXXIV and XLVIII, these first three groups are somewhat greater in length than the lower two. In the younger embryos it was the ileum which grows more rapidly, while in the older embryos the jejunum is beginning to overtake the ileum. So from these measurements, as well as from the indication in Figs. 12 and 14, it is the loop 4 which is destined to cross the middle line and to take its position on the right side of the body.

Henke showed that it is not difficult to separate the intestine into two great groups, the dividing line of which is the left psoas muscle. This, usually, is also the limit between the loops 4 and 5, as shown in Fig. 16. The diagrammatic

PLATE I.

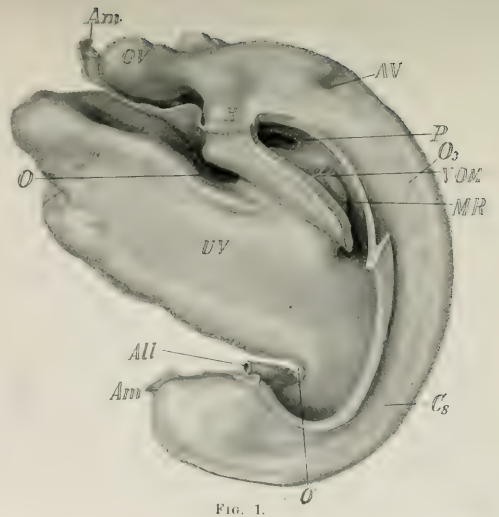

Fig. 1.

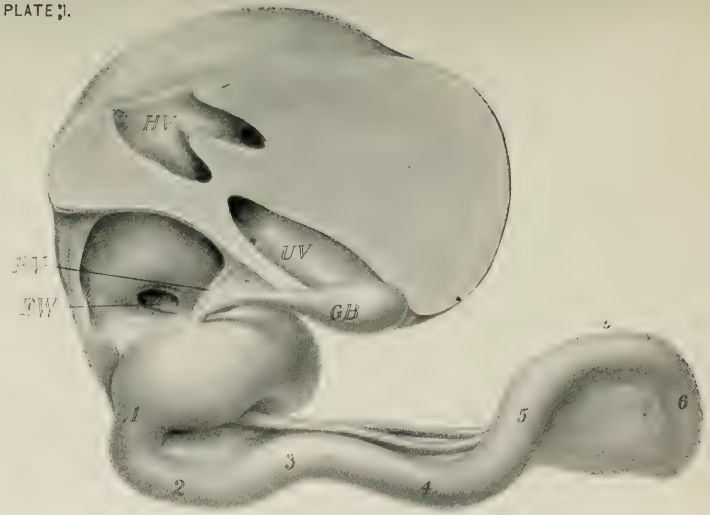

Fig. 4.

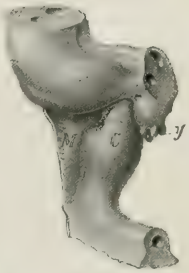

Fig. 3.

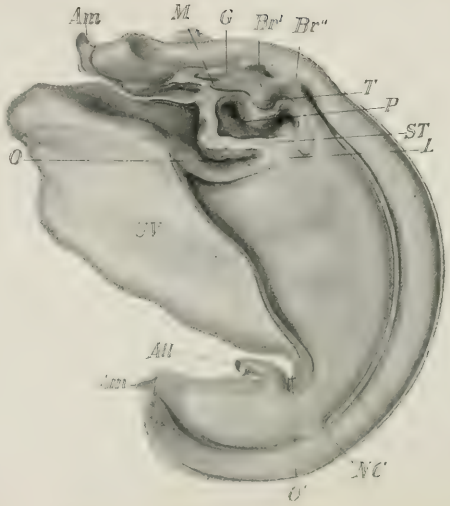

Fig. 2.

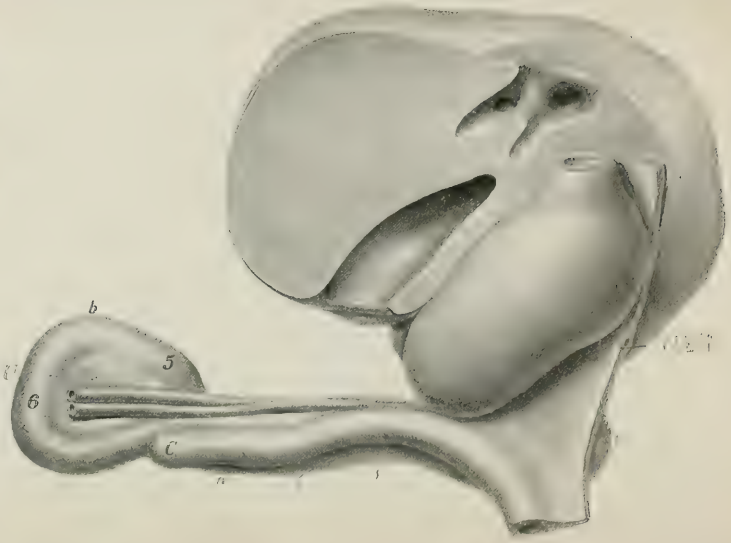

Fig. 5.

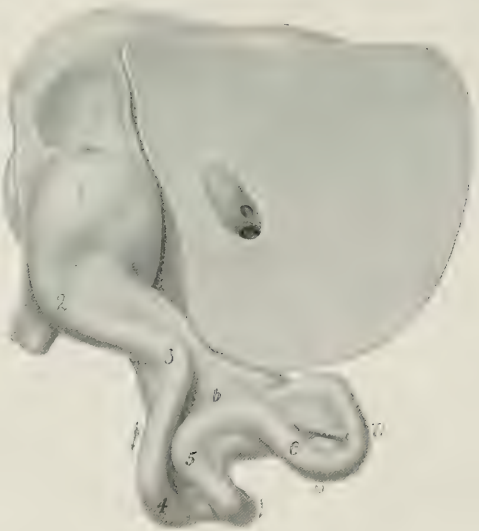

FIG. 6.

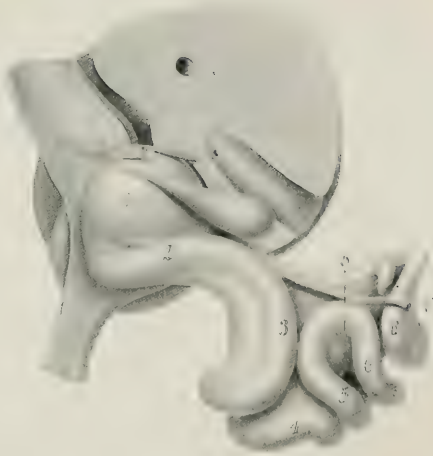

FIG. 8.

FIG. 7.

FIG. 9.

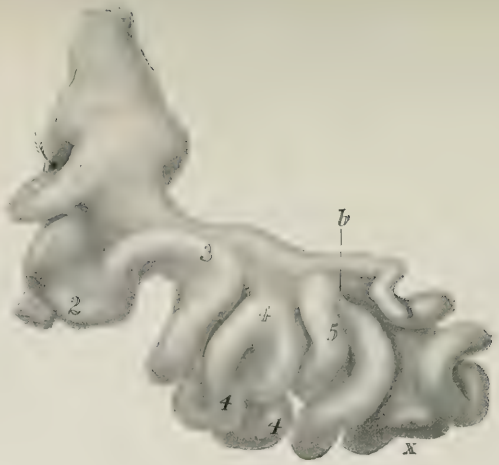

Fig. 10.

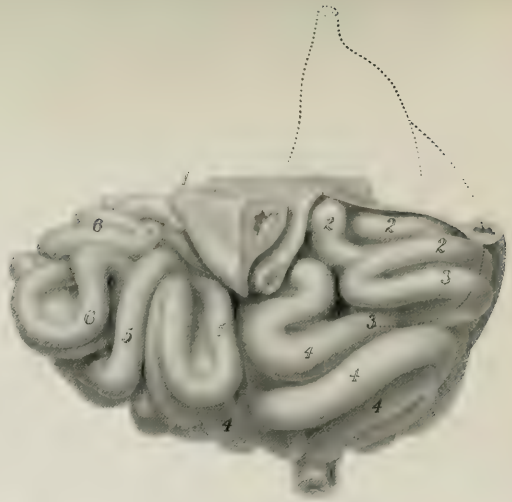

Fig. 12.

Fig. 11.

M. Brödel del.

Fig. 13.

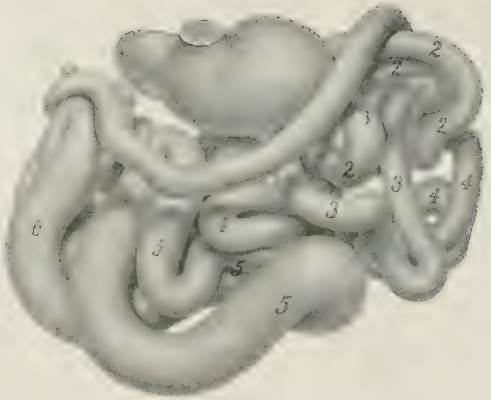

Fig. 14.

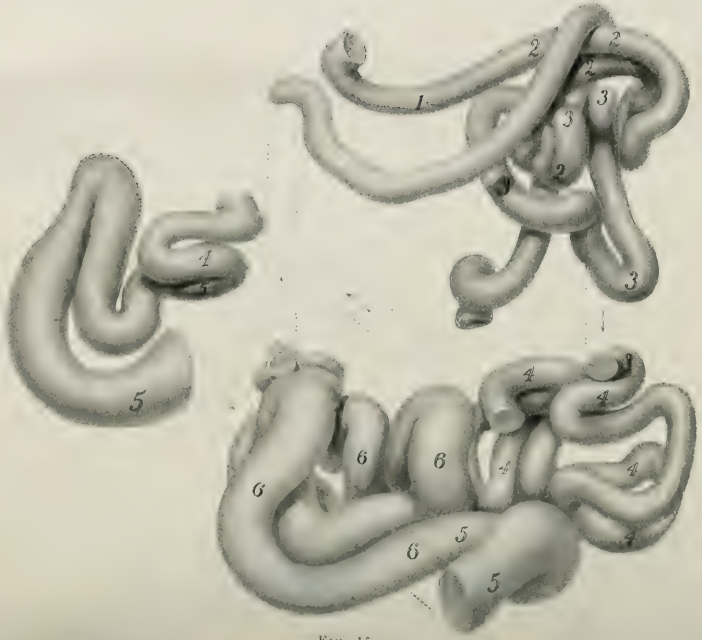

Fig. 15.

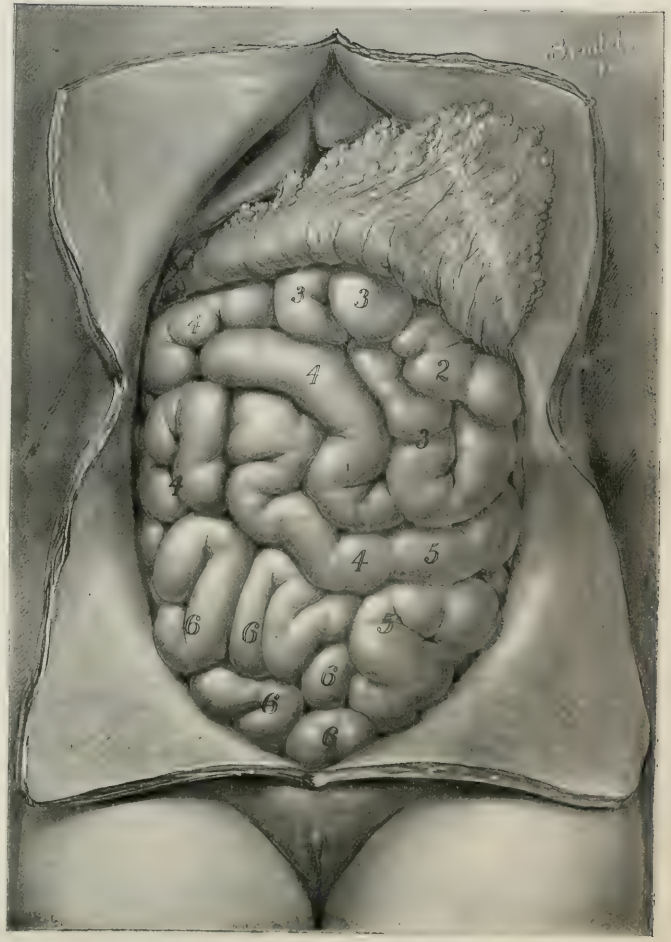

Fig. 16.

M. Brodel del.

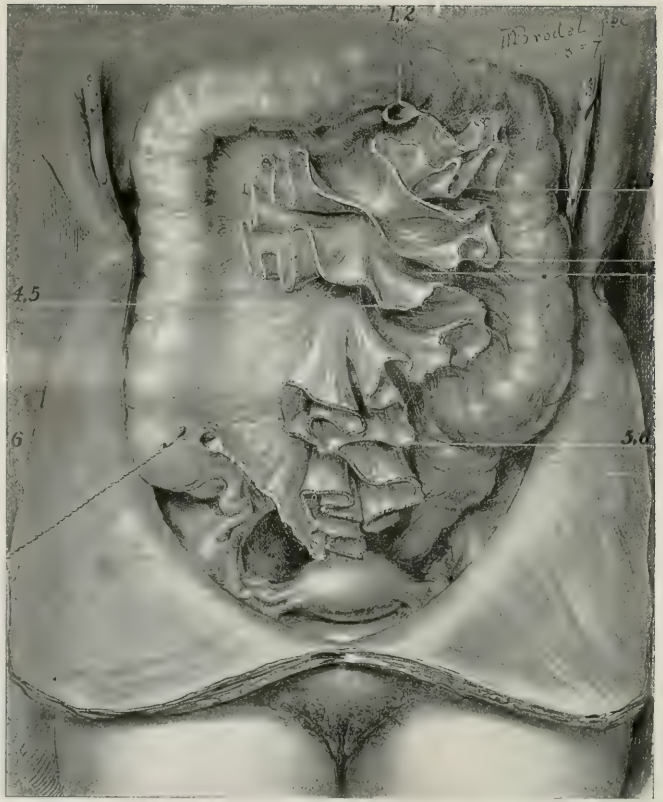

FIG. 17.

M. Bradel, del.

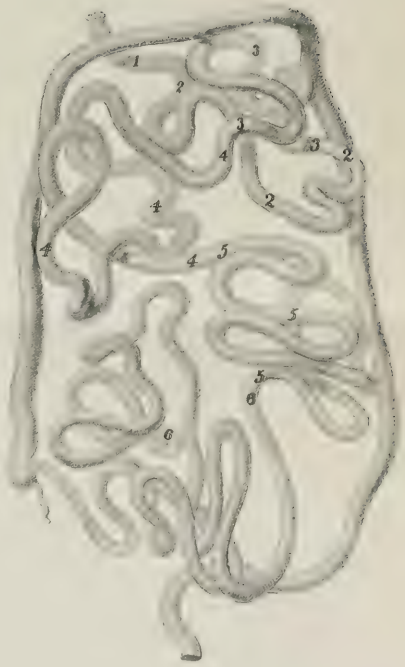

FIG. 18.

Fig. E shows this still better between loops 4 and 5. When the loops 5 are within the pelvis this separation made by the psoas is still more marked. Also in those specimens in which the position of the intestine is as in Fig. E, the loop 4 can be lifted towards the left side, making a beautiful demonstration of the attachment of this loop. A glance at Fig. 17, as well as at Sernoff's Figs. 5 and 8, will easily explain why this should be so.

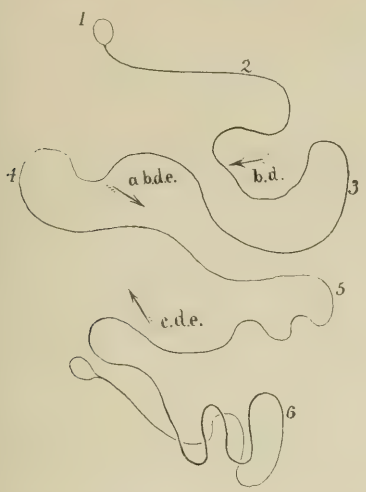

Fig. E.—Scheme of the intestine. The arrows indicate the variations. The variations a and bb were most frequent; the variation e least frequent.

VARIATIONS IN THE POSITION OF THE INTESTINE.

One of the most common variations I have found is one in which there were no intestines on the right side of the peritoneal cavity. The loop 4 had been transferred to the left side of the body, as indicated in Fig. E by the arrow a. Otherwise the intestine had its usual position. It is this loop which is so easily isolated and, probably on this account, it is readily displaced by an enlarged cæcum or ascending colon. It may possibly be that this loop can be shaken to the left side, and this could easily be tested by experiment. In one of these specimens the sigmoid flexure of the colon filled the right side of the abdominal cavity.

The second variation, as well as the first, occurred six times. It is marked by the arrows bb in Fig. E. The loop 4 was again displaced to the left side, and the loops 2 and 3 were displaced to the right side. In other words, the very upper part of the jejunum formed the loop on the right side of the body.

The third variation occurred five times. In these specimens the intestine had its normal position, with the exception that an additional loop arose out of the pelvis and filled a portion of the right side of the body, as indicated by the arrow c. Sernoff's specimen, pictured in Figs. 3, 4 and 5, is to be included with this group.

The next variation occurred two times. It is indicated by the arrows d in Fig. E. The large loop 4 was again drawn to the left side, and the space it formerly occupied was filled by two loops, one from the upper part of the jejunum, and the other from the lower part of the ileum.

The last variation occurred once. It is marked by the arrows e. The loop 4 was displaced and its place taken by a large loop which arose from the ileum within the pelvis. Henke's specimen B seems to belong to this group, if I can judge by his illustrations.

MARKED VARIATIONS.

The variations given above all fit within the common scheme and can easily be explained. In all of my specimens I found but one extreme variation, and in this the intestine crossed the middle line at the beginning of the jejunum and then filled the right fossa. From here it descended immediately into the pelvis and filled it and the lower abdominal cavity completely. Then it left the pelvic cavity and filled the left fossa, extending up to the beginning of the duodenum. When it had reached this point it took a fairly direct course along the descending colon over the floor of the pelvis, and passed directly to the cæcum. Henke* has also described a variation practically identical with this. Weinberg† has also described one similar to this, only that the jejunum descends immediately to the pelvis and then gradually rises to the left side, and finally over to the right side. What kind of a mechanism can bring about this extreme variation is not possible to state.

It could be asserted that these few instances of marked variations indicate the normal, but in my specimens it is one in forty-two; in Weinberg's, one in ten; and in Henke's specimens it is not stated how many cadavers were examined carefully.

SHIFTING OF THE INTESTINE.

Henke has stated that the loops of the intestine may shift from one of the abdominal fossæ to the other, and, no doubt, this is true. We are familiar with the fact that a distension of any of the pelvic viscera pushes all of the loops of intestine out of the pelvis,‡ and emptying it again allows the loop to descend to the floor of the pelvis. So likewise a distension of the colon or a certain number of loops of small intestines will displace a certain number of loops from their natural position. Since, however, the intestine was located after one plan in 41 cadavers, I do not think it probable that ordinary shaking will displace any number of loops. Pure mechanical disturbances, as by returning the intestines after operation, will also be overcome by the intestines shifting about to their normal position, guided by the attachment of the mesentery, its length and the space within the abdomen. To give this last question a thorough test I made a number of experiments upon dogs. In these animals the intestine is closely rolled up in a very regular fashion below the stomach, and the whole is carefully tucked in by the very large omentum. Upon opening an animal, one is struck with the neatness and accuracy of the

* Henke, His's Archiv, 1891, p. 101, Taf. IV, Fig. 12.
† Weinberg, Internat. Monatsch. f. Anat. u. Phys., 1896.
‡ Among others, Garson, His's Archiv, 1878.

adjustment of the omentum, and it is easily disturbed by handling. When, however, the intestine and omentum are withdrawn through an abdominal wound, they are disturbed to such an extent that it is impossible to return them to the abdominal cavity as they were found, with the omentum covering them. After the intestines have been pushed into the abdominal cavity in a haphazard way and the animal sewed up, using all antiseptic precautions, the loops as well as the omentum readjust themselves as they were before, provided no marked inflammation takes place. So in the dog, the intestine and omentum seek their normal position after they have been disturbed.

PLATE I.

Fig. 1.—Profile view of Embryo No. XII. Enlarged 38 times. The body wall over the heart has been cut out. Am, amnion; UV, umbilical vesicle; OV, optic vesicle; AV., auditory vesicle; O_3, third occipital muscle plate; C_8, eigthth cervical muscle plate; H, heart; P, pericardial cavity; VOM, omphalo-mesenteric vein; MR, membrana reuniens; D, D′, openings which connect the peritoneal cavities of the two sides with each other.

Fig. 2.—Same as Fig. 1, but half of the model has been removed to show the extent of the ectoderm and entoderm. Br′, Br″, first and second branchial pouches; M, mouth; S, Seessel's pocket; T, thyroid; L, liver; NC., neurenteric canal.

Fig. 3.—Intestine of Embryo II, viewed from the right side. Enlarged 34 times. C, cæcum; M, mesentery; y, remnant of yolk sac.

Figs. 4 and 5.—Intestine and liver of Embryo IX. Enlarged 25 times. C, cæcum; OMA, omphalo-mesenteric artery; HV, hepatic vein; UV, umbilical vein; PV, portal vein; FW, foramen of Winslow; GB, gall bladder.

PLATE II.

Figs. 6 and 7.—Intestine and liver of Embryo X. Enlarged 12½ times. U, position of umbilical vessels; C, cæcum; FW, foramen of Winslow.

Figs. 8 and 9.—Intestine and liver of Embryo VI. Enlarged 12½ times.

PLATE III.

Figs. 10 and 11.—Intestine and stomach of Embryo No. XLV. Enlarged 16 times.

Figs. 12 and 13.—Intestine of Embryo No. XXXIV. Enlarged 4 times. Viewed from the ventral side. In Fig. 13 certain loops have been lifted off to show the deeper loops.

PLATE IV.

Figs. 14 and 15.—Intestine of Embryo No. XLVIII. Enlarged 2½ times. The view is from the ventral and cephalic side of the model. The mesentery was not included in the model. Fig. 15 is a dissected model to show the deeper loops. The lower part of the intestine is enormously distended with cell debris, etc., showing that vermicular action is present at this early stage.

Fig. 16.—Usual position of the intestine in the abdominal cavity. Although this is an actual specimen, it represents the condition in twenty-one out of forty-one cadavers. The numbers in the figure mark the parts which are homologous with the loops correspondingly numbered in the other figures.

PLATE V.

Fig. 17.—Usual position of the mesentery.

Fig. 18.—Course of the intestine. This figure is taken from a model made from the same cadaver from which Figs. 16 and 17 were drawn.

ON THE HISTOGENESIS OF THE STRIATED MUSCLE FIBRE, AND THE GROWTH OF THE HUMAN SARTORIUS MUSCLE.

By John Bruce MacCallum.

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In a previous paper* I described the structure and histogenesis of the heart muscle cell of mammals. The process of development, as demonstrated in embryo pigs, was found to be quite definite, and in order to complete this work I have studied the heart muscle of a series of lower vertebrates, taking representatives from the various large classes. The definite stages in the histogenesis of the muscle cell, confirmed by its comparative histology, made it seem possible to determine the method of growth of a muscle as a whole; that is, to learn by what means a small embryonic muscle gradually becomes large, as in the adult. Such a study of the heart seemed to present many difficulties which that of a simpler system of muscles would not. I therefore turned to the striated muscle of other parts of the body, the so-called voluntary muscles, and with this problem in view I studied the histogenesis of the striated muscle fibre of the thigh in embryo pigs. In these a process was demonstrated which proved to be essentially the same as that found in heart muscle, with differences made necessary by the difference between the respective adult tissues. Knowing, then, the course of growth of the individual muscle cells, I have endeavored to determine the relation of this to the growth of the muscle as a whole. In order to begin with the simplest problem, I have chosen the sartorius muscle, as it seemed to show less complexity of structure than many other muscles. Two sides of this problem presented themselves. On the one hand it was necessary to determine how far the growth in size of the muscle as a whole was caused by increase in the number of fibres, and how far it was due to a mere growth in size of the individual cells. On the other hand it was necessary to make out the relation between the various stages in the histogenesis of the muscle cell and these two methods of growth. These problems I have endeavored to solve by the study of a series of human embryos, using the sartorius as the

*J. B. MacCallum, On the Histology and Histogenesis of the Heart Muscle Cell. Anatomischer Anzeiger, Jena, Bd. xiii, No. 23, 1897, S. 609–620.

type of a simple muscle. For the sake of clearness I will give the results of this work under three headings, as follows:

I. Synopsis of the work already done on the histogenesis of the heart muscle cell, supplemented by a study of its comparative histology.

II. The histogenesis of the voluntary striated muscle cell.

III. The growth of the sartorius muscle and its relation to the histogenesis.

I.—HISTOGENESIS AND COMPARATIVE HISTOLOGY OF HEART MUSCLE.

As described in the article referred to above, the adult human heart muscle is made up of rhomboidal branching cells whose processes come together end to end. The protoplasm of each cell consists of a number of darkly staining columns, running longitudinally, which are separated by unstained substance. The columns are commonly called fibril bundles, and the unstained substance is the sarcoplasm. With special methods of staining, particularly by Kolossow's osmic acid method, a definite relation can be made out between these two parts of the cell. The fibril bundles present regular striations in the form of darkly staining lines. Narrow striations, the so-called Krause's membranes, alternate with broader bands which are known in voluntary muscle as Brücke's lines. The Krause's membranes, however, do not belong to the fibril bundles alone. They can be seen also extending across the sarcoplasm, as shown in Fig. 1. The sarcoplasm is thus divided into compartments which are limited horizontally by membranes continuous with the narrow striations on the fibril bundles. In cross-section (Fig. 2) the muscle fibre is seen to be made up of dark masses, the cross-sections of fibril bundles, separated by sarcoplasm which is divided into definite circular or polygonal areas. The compartments of the sarcoplasm, then, are disc-shaped, and I have proposed for them the name sarcoplasmic discs. As described, they are bounded by membranes which are continuous with the fibril bundles at definite points, namely, at the narrow striations or Krause's membranes. It will then be seen that there is a definite network in the cell made up of the fibril bundles and the membranes bounding the sarcoplasmic discs.

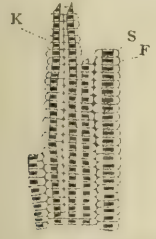

FIG. 1.—Longitudinal section of Adult Human Heart Muscle. *K*, Krause's membrane; *S*, sarcoplasmic disc; *F*, fibril bundle.

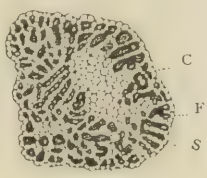

FIG. 2.—Cross-section of Adult Human Heart Muscle. *C*, central sarcoplasm; *F*, fibril bundle; *S*, sarcoplasmic disc.

The stages in the embryo leading up to this adult structure explain the relation of the fibril bundles to the sarcoplasm. The earliest stage in the development shows an irregular network in the cell protoplasm with no fibril bundles. This network tends to become more and more regular until the meshes are of the form of large discs. Some of these break up into smaller ones, and in the nodal points of the network there is an accumulation or differentiation of its substance, giving rise to longitudinally disposed masses. These become what in the adult are known as fibril bundles, and the discs left are the sarcoplasmic discs. This formation of fibril bundles takes place first at the periphery of the cell, so that those which are the latest to appear are nearest the centre of the cell. It is apparent, then, that the continuous network spoken of in the adult fibre, made up of the fibril bundles and the membranes bounding the sarcoplasmic discs, is developed directly by a process of differentiation from the primitive protoplasmic network of the embryonic cell. The gradual acquirement of a special function has so altered this network that a complicated structure is formed out of an extremely simple one.

The study of the heart muscle of lower animals gives an interesting repetition of some of the stages of this process. Although the structures met with in the comparative histology of the organ do not make up an uninterrupted sequence as in its histogenesis, yet there is a sufficient resemblance to confirm the results obtained in embryonic tissues. Hearts from animals representing the various large groups of vertebrates were studied. Of the fishes several species were obtained, among which were the larval lamprey (Ammocœtes), the adult lamprey, and several kinds of Teleosts. The Amphibians were represented by the frog and the toad, while of the reptiles the snake and turtle were used. Several species of birds were studied, such as the English sparrow, the crow, and the common fowl.

In the heart of Ammocœtes the muscle cells are small and spindle-shaped. In some of them no fibril bundles can be seen, but most of the cells show a single row of very narrow fibril bundles at the periphery. The rest of the cell is made up of sarcoplasmic discs. In the lamprey the structure is similar, while in the higher fishes, such as the pickerel, the cells are considerably larger and the fibril bundles are more conspicuous. In longitudinal sections the individual fibril bundles are quite similar to those in adult mammalian muscle. The same striations are present, and the same relation of these to the sarcoplasm exists. In the frog and toad the structure of the heart muscle differs only slightly from that described in fishes. The cells are larger, and the fibril bundles are closer together, tending to form large irregular columns. The nucleus is in the centre of the cell, and the fibril bundles are only at the periphery. The heart muscle of the Reptilia, as shown in the turtle and snake, is made up of cells which are not markedly different from those of the Amphibian heart. The fibril bundles at the periphery of the cell are large and conspicuous, and in many cells there are smaller ones more centrally placed. In the birds, however, there is a very decided advance on the structures described so far. The cells are very large, almost as great as the adult mammalian fibre. In cross-section they resemble the structure described in mammals. The nucleus is in the centre and the rest of the

cell is almost filled with fibril bundles. These are in the form of flat bands around the periphery, as in mammalian muscle, and are separated by sarcoplasmic discs. There is a very great difference between these cells and those found in the hearts of Fishes, Amphibians and Reptiles. As regards the structure of the heart muscle, then, the classes of Vertebrates are divided into two groups, one comprising the Fishes, Amphibians and Reptiles, and the other the Birds and Mammals. It will be noticed that these groups are the cold-blooded and warm-blooded animals respectively; and it is possible that in addition to the control of the temperature by the central nervous system, there is a relation between the heat regulation and the degree of development of the circulatory system. The mammalian embryo *in utero* resembles the cold-blooded animals in the fact that its temperature is the same as that of its surroundings. They are under similar conditions in this respect, and the structure of the heart muscle is almost identical. Although the transition from the structure of the heart muscle of lower to that of higher animals is not perfectly gradual, yet the comparative histology corresponds roughly with the histogenesis of the cell. The Fishes, Amphibians and Reptiles, which in other respects are clearly lower than the Mammals and Birds, possess also an embryonic type of heart muscle. The heart of an adult fish, for example, is made up of cells which are almost identical with an early stage in the development of the mammalian fibre. While the comparative anatomy and the embryology of many organs run parallel to one another, it is interesting to note that this same relation holds good even in the internal structure of a single cell, and that the most minute details of the cell structure in the adult heart muscle of the lower animals are identical with those in embryonic mammalian tissue.

II.—HISTOGENESIS OF THE VOLUNTARY STRIATED MUSCLE FIBRE.

In order to determine the course of development of the voluntary striated muscle cell I have used a series of human embryos and one of embryo pigs. Of the former I used the sartorius muscle in each case, and in the latter the muscles in the front of the thigh. The human series consisted of embryos of the following lengths in millimeters from vertex to breech: 10, 30, 75, 102, 130, 170 and 200. The series of pig embryos was made up of specimens of the following lengths in millimeters: 25, 34, 45, 57, 64, 70, 75, 100, 125 and 150. The sartorius of an embryo rabbit 35 mm. in length was also studied.

The embryos, which were obtained in a fresh condition, were treated according to Kolossow's osmic acid method,* and the sections afterwards stained in safranin. Those which were already hardened in formalin, alcohol, or Müller's fluid, were cut in paraffin, and the sections treated by a method somewhat similar to Kolossow's. They were immersed in 2 per cent. osmic acid for three or four minutes, and then transferred to Kolossow's reducing fluid and left until the precipitation was complete. They were then stained in safranin to differentiate the nucleus. Sections stained in this way show the protoplasmic structure with great clearness.

In an embryo pig 25 mm. long the voluntary muscle has quite an undifferentiated character. The sartorius in a cross-section of the leg cannot be recognized with certainty. There are merely small groups of spindle-shaped cells with a loose connective tissue between. In the muscle cells there are no fibril bundles, and the protoplasm is very scanty as compared with that in the adult cell. If in a cross-section the cell has its nucleus cut through, the protoplasm is hardly visible. It is seen only as a narrow rim around the centrally placed nucleus. The cross-section of a cell above or below the nucleus shows a definite network which divides the cell into small circles. These correspond with the structures spoken of as sarcoplasmic discs. This is shown in Fig. 3.

FIG. 3.—Cross-section of Voluntary Muscle from the Thigh of an Embryo Pig, 25 mm. long. *A*, cell showing the nucleus; *B*, cell showing sarcoplasmic discs.

FIG. 4.—Cross-section of Voluntary Muscle from the Thigh of an Embryo Pig, 45 mm. long, showing fibril bundles at the periphery of the cells.

The muscle of an embryo pig 34 mm. in length is somewhat farther advanced in development. The bundles of cells making up the individual muscles are quite distinct and separate. The cells themselves show a centrally placed nucleus, and protoplasm which is very slightly differentiated. In some places fibril bundles can be made out at the periphery of the cell, but these are not very distinct.

In an embryo pig 45 mm. in length the muscle cells contain definite fibril bundles. These are present in a single row around the periphery of the cell, as shown in Fig. 4. The nucleus is still situated in the centre of the cell. The protoplasm near the nucleus contains no fibril bundles, and is divided into sarcoplasmic discs as described before. In longitudinal sections the fibril bundles are seen to be definitely related to the sarcoplasm in the way described above. The horizontal boundaries of the sarcoplasmic discs are membranes continuous with the fibril bundles at the narrow striations.

Very similar cells are found in the muscle of an embryo 57 mm. long. The fibril bundles, however, are somewhat more conspicuous. In embryos 64 mm. and 70 mm. in length the muscle cells contain, in addition to the peripheral row of fibril bundles, scattered fibril bundles nearer the nucleus. In many cells nuclei are seen, both at the periphery and in the centre.

* A. Kolossow. Ueber eine neue Methode der Bearbeitung der Gewebe mit Osmiumsäure. Ztschr. f. wissensch. Mikr., Brnschwg., Bd. ix, 1892-3, S. 38-43.

In the muscle cells of an embryo pig 75 mm. long, the peripheral and central nuclei are seen very clearly. These differ somewhat in appearance. The peripherally placed nucleus stains deeply and uniformly, and has a solid appearance. The central nucleus, however, is large and vesicular. It possesses a definite nuclear membrane, and the chromatin network is delicate and distinct, as shown in Fig. 5. In some places the outline of this nucleus grows irregular. What finally becomes of it it is difficult to say. The nuclei in adult muscle cells are all peripherally placed, and have an appearance resembling the peripheral nucleus described here.

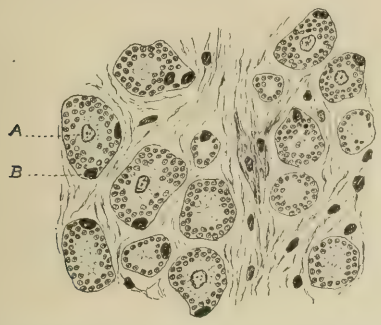

FIG. 5.—Cross-section of Voluntary Muscle from the Thigh of an Embryo Pig, 75 mm. in length. *A*, central vesicular nucleus; *B*, peripheral solid nucleus.

In a pig 100 mm. long the appearance of the muscle cells is not essentially different. The fibril bundles are more numerous and somewhat closer together. The muscle cells of an embryo 150 mm. in length, however, are entirely filled with fibril bundles. The sarcoplasm is not abundant. In some of the cells the central nucleus cannot be made out, while in others it is still present.

In adult muscle the nuclei are all at the periphery of the cell. In longitudinal sections the fibre consists of fibril bundles separated by a very small amount of sarcoplasm. The fibril bundles possess alternating narrow and broad striations. In many cases the narrow striation (Krause's membrane) can be seen extending across the sarcoplasm, dividing it into compartments. This is approximately the same structure as that which has been described in heart muscle. In the latter, however, the sarcoplasm between the fibril bundles is so abundant that the narrow striations form disc-shaped compartments, or sarcoplasmic discs. In voluntary muscle the sarcoplasm is very scanty, and the discs are so encroached upon by the growth of the fibril bundles that they are hardly recognizable. As in heart muscle, the lines dividing the sarcoplasm are continuous with the fibril bundles at the narrow striations.

The course of the development, as shown in the series of human embryos, is made up of stages which are very similar to those described in the embryo pig. In human embryos 10 mm. and 30 mm. in length the muscle cells contain no fibril bundles. In embryos 75 mm. and 102 mm. long there is a single row of fibril bundles around the periphery of the muscle cell. The nucleus is of a vesicular character and is situated in the centre of the cell. In an embryo 130 mm. long the muscle cells contain a vesicular central nucleus and one or more solid deeply staining peripheral ones. There are fibril bundles in the central part of the cell as well as at the outside. The muscle of an embryo 170 mm. in length is made up of cells which are very similar to those of an embryo pig 150 mm. long. The cells are filled entirely with fibril bundles, and the centrally placed nucleus is not often present. In older embryos, in the new-born, and in the adult subjects, the nuclei of the muscle cells are all at the periphery.

The course of development, then, seems to be quite definite. Beginning with a cell which contains only a protoplasmic network, the extremely complex voluntary muscle fibre is gradually formed. The first step is an accumulation of the network at definite places around the periphery of the cell, giving rise to fibril bundles. This accumulation takes place in the angles of the network, so that the meshes remain as discs between the fibril bundles. The membranes, bounding these discs horizontally, are continuous with the narrow striations on the fibril bundles. The formation of fibril bundles goes on until they occupy a large part of the cell. The sarcoplasm in this way becomes gradually replaced, and in the adult cell it is very inconspicuous. At the same time the nuclei undergo changes. The cell which at first contains only a centrally placed nucleus acquires other nuclei which are situated at the periphery. It is possible that the latter are derived from the centrally placed nucleus which is finally lost.

It seems that the same hypothesis is applicable here as was suggested for the development of heart muscle. It simplifies the conception of the structure of striated muscle very greatly to consider the fibril bundles and the membranes bounding the compartments in the sarcoplasm, as derived from the primitive network found in the muscle cells of very young embryos.

These results show that the same process of growth takes place in all kinds of striated muscle cells. The adult structure of voluntary muscle is, however, somewhat different from that of heart muscle, and as a consequence the later stages in the development are different. One of the most noticeable differences is the position of the nucleus. Why it should remain in the centre of the cell in heart muscle, and in the voluntary muscle cell be situated at the periphery, is difficult to determine. Until more is known concerning the relation between the function of the cell protoplasm and that of the nucleus, this can only be the subject of hypothesis.

Since the beginning of the differentiation is the same in both heart muscle and voluntary muscle, the development of the power of contraction must run a somewhat similar course. If this be so, it is conceivable that contractions in definite directions begin when the irregular network of the primitive cell becomes made up of regular membranes at right angles to one another. When there is need of more perfect and stronger contractions, it is probable that the power for this is brought about by a strengthening of the network in the direction of the contractions. This strengthening takes place by an accumulation of the substance of the network, which gives rise to

fibril bundles. Why this should always take place first around the periphery of the cell is not clear. It is true, however, not only in the development of the heart muscle and the voluntary muscle cells, but also in the evolution of the heart muscle in lower animals. It is possible that there is a relation between this peripheral disposition of the fibril bundles and the spindle-like form of the cells. The fibril bundles, on account of their position, are curved in correspondence with the outline of the cell. On contraction, therefore, the pull is not only in the long axis of the cell, but also at an angle to this. Thus the cells acting together exert an influence on one another, which would not be the same if the fibril bundles, which are probably the chief agents in contraction, were situated in straight lines in the long axis of the cell. If this be so, the force which acts at an angle to the long axis of the cell must control the whole contraction, just as two muscles opposing one another make a more delicate mechanism than a single muscle. It is possible that this is of advantage in the early stages of the development. An hypothesis concerning such a subject must necessarily be vague and unsatisfactory. All that can be said with certainty is that there seems to be both in the histogenesis and comparative histology of the muscle cell a tendency for the fibril bundles to be formed first at the periphery of the cell. If the fibril bundles are the special contractile elements, it seems that it is of advantage to have the mechanisms for contraction as near the outer part of the cell as possible. The same thing is seen in the adult heart muscle fibre, for although nearly the whole cell is filled with fibril bundles, those at the periphery are many times as large as the ones which are nearer the centre.

III.—GROWTH OF THE HUMAN SARTORIUS MUSCLE.

In applying the process of development of the voluntary muscle fibre as described above, to explain a special muscle, I have endeavored to determine the relation between the growth of the muscle as a whole and the growth of the individual cells. The sartorius muscle was chosen for study because of its apparent simplicity of structure, and because its general characters in the adult vary within narrow limits. The fact that this definite and simple structure is developed gradually from a small group of embryonic cells, indicates that the growth takes place by a definite and simple process. In order to determine the exact nature of this process I have made estimations of the number of fibres to be found in cross-sections of the sartorius muscles taken from adults and from a series of human embryos.

Methods of Study.—Sections were taken from adult human sartorius muscles at the upper, middle, and lower thirds. Similar sections from the sartorius of a new-born babe were cut. Muscles were also used from a series of human embryos varying in length from 74 mm. (vertex to breech) to the stage shortly before birth. In these only the middle third was studied. Sections were cut in both celloidin and paraffin, celloidin being used mainly for the larger muscles. Various methods of staining were employed, but chiefly hæmatoxylin and eosin or safranin.

In obtaining the number of fibres found in a cross-section no effort was made to actually count them. All that was aimed at was to obtain as accurate an estimate as possible with methods which would entail the least number of errors. The most simple procedure seemed to be to compare the area occupied by the muscle-section as a whole and the average area occupied by a single fibre. This ratio must represent approximately the number of fibres. Thus the exact area of the whole cross-section was obtained and from this was subtracted the area of the connective tissue, giving the area of true muscle substance. The average area occupied by a single muscle fibre was then determined. The number representing the area of the muscle substance divided by that representing the area of one muscle fibre must be the number of fibres contained in the cross-section.

The sections of the larger muscles, adult and new-born, were projected on a screen with a projection lantern, and the outlines of the muscle and connective tissue carefully traced on a sheet of paper fastened to the screen. A slide ruled in millimeters was projected at the same time in order to obtain the exact magnification. This gave only the amount by which the length of a line was magnified, and in order to obtain the magnification in area this number was squared. A planimeter was used to determine in square millimeters the area of the muscle bundles in the tracing. This number divided by the magnification in area gave the actual area of the cross-section of the muscle.

For the smaller muscles a somewhat different method was employed. The sections were projected by means of a camera lucida and Leitz 3 objective, on a paper ruled in square millimeters. An exact tracing was taken as before of the muscle and the connective tissue in the section. At the same time a scale of hundredths of a millimeter was projected with the same power in order to obtain the magnification. The area of the tracing was got by counting the millimeter squares contained in it. At the edges only those squares were counted outside whose centre the line of tracing passed. The area of the connective tissue was similarly determined and subtracted from the area of the entire section. This gave the area of the muscle substance contained in the section. As a check on this the area of the muscle substance was directly counted. The actual area of the muscle was got as before by dividing the area of the muscle tracing by its magnification in area.

The actual area of one muscle fibre was determined by projecting the section upon a known ruled area by means of a camera lucida and a Leitz 7 objective. With a scale of hundredths of a millimeter a square was projected whose sides were .1 mm. in length. Its area therefore was .01 sq. mm. With the same power the muscle fibres were projected into this square and traced off. The fibres falling in the square were then counted and the number was divided into .01 sq. mm. This gave the average area occupied by one muscle fibre.

These two determinations were made for each section, so that all that was required to obtain an estimation of the number of fibres contained in the section was to divide the area of the muscle by that of the fibre.

Results of the Estimations.—The sections of the adult sartorius muscles were projected with a magnification of 14.5

diameters, that is, the area was magnified by 210.25. In the two muscles taken from the same subject the area in each case was greater in the middle third than in either the upper or lower third. In the right sartorius the area of the muscle tracing of the upper third was 19,880 sq. mm.; that of the middle third 24,490 sq. mm. and that of the lower third 18,390 sq. mm. In the left muscle the tracing of the muscle substance in the upper third contained 16,000 sq. mm., the middle third 22,760 sq. mm., and the lower third 18,250 sq. mm. In the new-born the muscle tracing of the upper third contained 2260 sq. mm., of the middle third 2430 sq. mm., and of the lower third 2040 sq. mm. These were all magnified to the same degree. This seems to show that the muscle substance in the sartorius is in the form of a spindle. There is a greater amount of muscle in the middle than at the two ends.

For comparison with the muscles of the embryos, only the middle of the sartorius was used in each case. The tracing of the middle third of the first adult sartorius contained, as mentioned above, 24,490 sq. mm. The magnification in area was 210.25, so that the actual area was 24,490 ÷ 210.25, or 116.48 sq. mm. The number of fibres in .25 sq. mm. of the muscle section was found to be 305, so that the area represented by one fibre .25 ÷ 305 = .0008196 sq. mm. The number of fibres, then; in the cross-section would be 116.48 divided by .0008196, which equals 142,118.

By a similar calculation the actual area of the section of the second adult sartorius muscle was found to be 108.252 sq. mm. The number of fibres in .25 sq. mm. was 315, and the area occupied by one fibre was .0007936 sq. mm. It follows from this that the number of fibres in the section is 108.252 ÷ .0007936, which equals 136,406. The number of fibres in the sartorius of the new-born babe was estimated by both the methods described. The results were slightly different. With a magnification of 14.5 diameters, and measured by the planimeter, the actual area was found to be 11.557 sq. mm. Magnified 14 diameters and projected on millimeter paper, the result was 12.316 sq. mm. The number of fibres in .01 sq. mm. was 98, and the area occupied by one fibre .000102 sq. mm. Then the number of fibres, according to one calculation, would be 113,304, and according to the other 120,745. This shows that the estimations are subject to an error of about 1 to 17, or somewhat less than 6 per cent.

Considering the individual variations, the number of fibres in the muscle of the new-born babe is approximately the same as that in the adult muscle. After birth, then, the growth in the number of fibres cannot be very great.

The largest human embryo studied was one which measured 200 mm. from vertex to breech. The actual area of muscle in the cross-section of the sartorius was 8.417 sq. mm. The area represented by one fibre was found to be .0000555 sq. mm. The number of fibres is 151,657. The greatness of this number can be accounted for only by supposing that the muscle would have been an unusually large one if it had become adult. It suggests, however, that there is little or no growth in the number of fibres after birth.

TABLE GIVING THE MEASUREMENTS, AND THE NUMBER OF FIBRES IN CROSS-SECTIONS, OF THE SARTORIUS MUSCLES OF THE FOETUS AND ADULT.

Number of Subject.	Length of Body.		Dimensions of Muscle in Millimeters.	Area of Muscle-tracing in Cross-Section	Magnification in Areas.	Actual Area.	Number of Fibres in a known Area.	Area represented by one Fibre.	Number of Fibres.
Adult No. 74 (right)	180 cm.		580x18x9	24490 sq. mm.	210.25	116.48 sq. mm.	305 in .25 sq. mm.	.0008196 sq. mm.	142118
Adult No. 74 (left)	" "		580x21x8	22760 "	210.25	108.252 "	315 " " "	.0007936 "	136406
New-born	50 "		140x7	2430 "	210.25	11.557 "	98 " .01 "	.000102 "	113304
				2414 "	196	12.316 "			120745
	Vertex Breech.	Nape Breech.							
Embryo No. A	200 mm.	130 mm.	52x6	1212 "	144	8.417 "	180 " " "	.0000555 "	151657
" No. 98	170 "	106 "	42x6	1474 "	256	5.7578 "	223 " " "	.00004484 "	128408
" No. 65	130 "	75 "	34x2.5	5901 "	5776	1.02164 "	442 " " "	.0000226 "	45205
" No. B	102 "	65 "	28x3	6565 "	6400	1.02578 "	254 " " "	.00003937 "	26055
" No. 64	74 "	46 "	19x1.5	4142 "	10816	.382858 "	170 " " "	.00005882 "	6509

The younger embryos were studied in the same way. One measured 170 mm. from vertex to breech. The actual area of muscle in the cross-section of the sartorius was 5.7578 sq. mm. The area occupied by one fibre was .00004484 sq. mm. The number of fibres, then, was 128,408. This number is approximately the same as that determined for the new-born and adult subjects. The muscles described thus far contain practically the same number of fibres in a cross-section. The differences can be accounted for by individual variation and by the nature of the estimation.

In the sartorius of an embryo 130 mm. from vertex to breech, the actual area of muscle in a cross-section was found to be 1.02164 sq. mm. The area occupied by one fibre was .0000226 sq. mm. The number of fibres, then, was 45,205. There is a very decided difference between this and the muscle last described. The number is less than one-third of that present in the adult muscles and in those of older embryos. It seems fair to conclude that in embryos between 130 mm. and 170 mm. in length the fibres found in the cross-section of the sartorius muscle increase in number as well as in size.

In the sartorius of an embryo 102 mm. from vertex to breech there was found a still smaller number of fibres. The actual area of muscle in a cross-section was 1.02578 sq. mm. and the area occupied by one fibre .00003937 sq .mm. The number of fibres, then, was 26,055. The difference between 45,205, which was the number found in the embryo 130 mm. long, and 26,055 is too great to be accounted for in any way but by an actual growth in number.

The sartorius from an embryo 74 mm. from vertex to breech gave in the cross-section an actual muscle area of .382858 sq. mm. The area represented by one fibre was .00005882 sq. mm. The number of fibres, then, was found to be only 6509. This number is less than one-quarter of that found in the embryo 102 mm. long, and about one-twentieth of the number in an adult.

These figures are put together in the preceding table. The adult muscles are placed at the top, and following these the embryonic muscles in the order of their measurements.

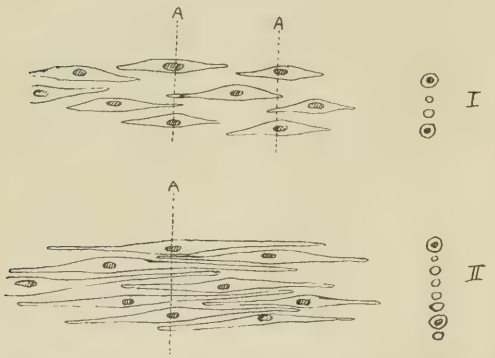

FIG. 6.—Diagram illustrating the Growth of Muscle. It shows the possible growth in the number of cells in a cross-section of a muscle, without a corresponding increase in the number of cells in the entire muscle. At the right the cells are represented as cross-sections taken in each case on the plane *A*.

It seems clear from this table that the growth in number of fibres, or at least the increase in the number found in a cross-section, takes place at a definite period. This increase in the number of fibres cut in any given cross-section might be brought about in two ways. There might be an actual increase in the number of fibres in the muscle as a whole, or there might be merely a growth in length of the fibres. This would cause them to grow past one another, so that a greater number would be cut in any one cross-section. This is illustrated in the diagram above, Fig. 6. In I and II there is the same number of fibres, but in II they are longer and have grown past one another. As a consequence the section A contains many more fibres in II than it does in I.

It is very possible that both of these processes go on at the same time. All that can be determined, with such methods as have been used here, is the growth in the number of fibres found in a cross-section of the muscle. This growth begins at a definite place in the development of the embryo. If the fibres ran the whole length of the muscle it would be a simple matter to determine the point at which the multiplication of the cells ceased; for then the number of fibres found in a cross-section would be the number contained in the whole muscle. In an embryo 140 mm. in length, however, longitudinal sections of the sartorius show that the fibres certainly do not run the whole length of the muscle. This is seen also in teased preparations. All that can be said, then, is that at a certain stage in the development, namely, in embryos between 130 and 170 mm. in length, the increase in the number of fibres found in a cross-section ceases. Since this increase is brought about by the two processes spoken of above, it is probable that the actual multiplication of cells ceases some time previous to this stage. If this be true, there are as many fibres present in the sartorius muscle of an embryo 170 mm. long as there are in the adult muscle. After this stage the growth in size of the muscle must be a growth in the size of the fibre.

It is to be emphasized, however, that the estimations given here are not of the number of fibres in the muscle as a whole. They are merely estimations of the number found in cross-sections, so that any suggestions as to the growth of the muscle as a whole are based on the supposition that the increase of the cells is uniform throughout the muscle. I have observed no indication whatever of special growing points in the sartorius muscle. In cross-sections the number of fibres is approximately the same in all parts of the muscle, although the tendons at each end make the number there somewhat less, as shown above. In the various embryos all the cells in any one section seem to be at the same stage of development. In longitudinal sections no growing points can be made out, and when karyokinetic figures are present they are not confined to any one part of the muscle. If the growth is proved to be uniform throughout the muscle, an increase in the number of the cells in the whole muscle must cause an increase in the number found in a cross-section. Indeed, the number found in a cross-section might increase after the actual number of fibres in the muscle had ceased to grow; for, as shown above, the cells in growing in length might pass one another and more of them would be cut in any section. If this be true, a small embryonic muscle, after a certain stage, becomes a large adult muscle, not by an increase in the number of cells, but by a growth in their size. This bears indirectly on other questions, and may prove of interest in connection with muscular hypertrophy. If the very enormous increase in size which the sartorius muscle undergoes during development can take place simply by a growth in the size of the individual cells, it is probable that such a small increase as is present in a muscle hypertrophied through exercise must be due to the same cause. It also seems probable that hypertrophy of the heart is due to growth in the size of the fibres rather than to an increase in their number. These are problems, however, which require special methods for their solution.

It is interesting to note the relation between the histogenesis of the cell and the growth in the number of cells in the sartorius. It will be seen on comparison of the figures given above, that the increase in the number of fibres ceases approximately when the fibre has become filled with fibril bundles, and the nuclei have become situated at the periphery of the

cell. In a human embryo 170 mm. long the muscle cells resemble the adult cells in every way except in size. This stage also marks the point at which the increase in the number of fibres found in a cross-section ceases. Embryos between 130 mm. and 170 mm. in length show the transition between the embryonic and adult types of muscle cells, and this is also the period at which the number of fibres stops growing. It will be remembered that in embryos 130 mm. in length the nucleus is centrally placed and vesicular in character, while in an embryo 170 mm. long the muscle cells contain only peripherally disposed nuclei. There is, possibly, a relation between the position of the nucleus and the power of the cells to produce new fibres.

The course of growth of the sartorius muscle may be epitomized somewhat as follows: At an early stage in the development, the cells are small and spindle-shaped, and scattered in loose bundles. At first there are no fibril bundles, and the nucleus is centrally placed. Subsequently the fibril bundles appear around the periphery of the cell. The cells multiply and increase in bulk until the embryo is between 130 mm. and 170 mm. in length from vertex to breech. At this stage the bundles of cells become more compact, and the cells themselves are filled with fibril bundles as in the adult. The nucleus is situated at the margin of the cell. The fibres now grow in length and thickness, but probably no longer increase in number. In embryos smaller than 170 mm. in length there is a regular increase in the number of fibres found in a cross-section. After this, however, the number remains approximately constant.

The study of the sartorius as the type of a simple muscle can only be a step towards the explanation of more complex muscles. When accurate methods of estimation have been employed in the study of muscles of more intricate character, and the results considered in connection with the process of histogenesis of the muscle fibre, a more definite idea of the growth of muscle in general may be arrived at.

FURTHER OBSERVATIONS ON THE CHEMICAL NATURE OF THE ACTIVE PRINCIPLE OF THE SUPRARENAL CAPSULE.

BY JOHN J. ABEL, M. D.

[*From the Pharmacological Laboratory of the Johns Hopkins University.*]

In my first paper on the chemistry of the suprarenal capsules, in which I reported in detail on researches carried out with the help of Dr. A. C. Crawford, I was able to show that the blood-pressure raising constituent can be separated from aqueous extracts of the capsules in the form of a benzoate, and that this remarkable substance is not, as has been maintained, either pyrocatechin or an immediate derivative of it, and v. Fürth,* in an interesting paper published after, announces the same conclusion. We also gave as our opinion that this substance is to be classed with the alkaloids, founding this opinion on facts stated at length in our paper.

It is my purpose to give in the following brief paper an outline only of certain new observations made in the past year on this chromogenic substance or blood-pressure raising constituent.†

The extract used had been prepared with warm water slightly acidulated with sulphuric acid, and it was then concentrated in vacuo until the extract from 50 kg. of fresh suprarenals was reduced in volume to about 10 liters. This condensed extract was then heated to 80°, the coagulated proteids were filtered off and the clear filtrate benzoated in fractional portions. It was found to be unnecessary to remove the proteids entirely.

The crude, sticky mixture thus obtained, which consisted of the benzoates of our chromogen, of inosit, possibly also of carbohydrates, creatine and other substances, was then washed thoroughly with water and then dissolved as far as possible in warm glacial acetic acid. A considerable residue remained undissolved. The acetic acid solution was poured into much ether, and again a great deal of material was precipitated. The acid ether solution was first repeatedly shaken out with water, causing a further deposition of resinous matter, and then with a solution of sodium hydrate until all the acetic acid was removed and only a clear but slightly colored ether solution of a benzoate remained. These repeated washings caused copious deposits to fall out.

The ether solution was again washed with water and then once or twice with a 10 per cent. solution of sulphuric acid, followed with water. This washing with acid was now discontinued as it caused the benzoate of the chromogen to fall out in the form of a sticky resin.

It will be seen that by the above processes a number of foreign benzoates are removed; thus, the benzoate of inosit being insoluble in glacial acetic acid and that of grape sugar in ether.

When the benzoate of the chromogen had been treated as stated the ether was removed by distillation, and a yellowish, sticky benzoate remained which became brittle when allowed to dry in the air in thin layers. By boiling its alcoholic solution with animal charcoal, further purification was effected, so that when small quantities of this alcoholic solution were allowed to evaporate bunches of prismatic crystals were deposited. Many different solvents have been tried, but from none does it crystallize with enough difficulty to leave a mother-liquor.

Nevertheless, I have been able to learn something as to the

* Hoppe-Seyler's Zeitschr. f. physiol. Chem., vol. 24, p. 142.

† It is a pleasant duty to acknowledge that this research would have been impossible but for the liberality of Messrs. P. D. Armour & Co., of Chicago, who have supplied me with large quantities of a concentrated aqueous extract of the suprarenals of the beef prepared according to my direction. My thanks are also due to Prof. A. G. Manns, chief chemist of the firm, for the care he has taken in preparing these solutions and for the interest he has taken in the scientific aspects of the subject.

composition and nature of the chromogen, the assumed blood-pressure raising constituent. In order to isolate this substance, the benzoate as obtained from the washed ether solution was decomposed with water in an autoclave under a pressure of 8–12 atmospheres. A clear, slightly straw-colored solution is thus obtained, which, when freed from benzoic acid and from a certain amount of a black resin which is deposited here as well as in other methods of decomposing the benzoate, gives all the well-known color and reduction tests of a fresh aqueous solution of the glands with one difference, which is that the addition of a little ammonia and iodine water no longer gives the characteristic rose-pink color, but instead, a vivid green. In all other respects the chromogen appears to be unaltered. A little ammonia, however, is set free during the hydrolytic decomposition just described, but whether this is derived from our substance or from some benzoate still contaminating the benzoate of the chromogen cannot as yet be stated.

When all the benzoic acid has been removed from the solution of the benzoyl product as taken from the autoclave, the cautious addition of very dilute ammonia, drop by drop, causes a copious precipitation of a substance which falls out in a flocculent precipitate much as does casein when precipitated from milk with acetic acid. The precipitate rapidly darkens and must be removed with the help of a suction filter as rapidly as possible.

It is washed with a little water, then with cold absolute alcohol and ether, and immediately ground up in agate mortars while it is still moist with ether. On drying it becomes a light grayish powder. This is the free chromogen with such slight modification as has occurred during the hydrolysis of its benzoate. When dry it is almost insoluble in water as also in a whole series of organic solvents; it is very soluble in warm dilute acids, in cold glacial acetic acid and in acetic anhydride. Dilute solutions in slightly acidulated water give an intense green color with ferric chloride or with ammonia, and they reduce ammoniacal silver solutions. Such solutions, exposed to the air, gradually deposit a brown precipitate, and this goes on until but little of the chromogen is left.

The behavior of the substance toward the halogens, which all precipitate it from its solutions, and toward the numerous alkaloidal reagents, I hope to report on at some future date. I shall only say here that a little of the dried chromogen obtained by breaking up the benzoyl product with acids as described in my first paper and which still gives the rose-pink color with ammonia and iodine water, strikes a rich plum color when treated with a drop of sulphuric acid or with Mandelin's reagent, reminding one of the effect of similar tests on strychnine. The chromogen as derived from its benzoate by hydrolysis in the autoclave does not give this color, but an olive-green followed by pink, which gives place to dirty hues.

Strong alkalies decompose the substance, boiling it with alcoholic solutions of potassium hydrate and chloroform brings out the nauseating odor of a carbylamine. On attempting to isolate this volatile substance by distillation, it was found to be decomposed, and on again treating the distillate with alcoholic potash and chloroform, the carbylamine was regenerated, thus showing that a primary amine had been split off when the chromogen was treated in this way.

SKATOL: A DECOMPOSITION PRODUCT OF THE CHROMOGEN.

On fusing the substance with powdered potassium hydrate and then diluting with water, the penetrating odor of skatol rises from the solution. When this solution is shaken out with ether and the ether allowed to evaporate, little globules remain having an intensely fœcal odor, and when these are dissolved in concentrated hydrochloric acid the solution at once takes on the fine characteristic pink color always seen when even small quantities of skatol are thus treated.

An alcoholic solution of these globules gives to a pine sliver, moistened with hydrochloric acid, a rich dark red color; a solution in benzol to which picric acid in benzol is added immediately deposits a picrate, not in crystals but in the form of reddish droplets, and an aqueous solution treated with sulphuric acid and potassium nitrite gives the whitish turbidity seen when skatol is similarly treated. Salkowski's reaction was also obtained, though imperfectly, as the production of intense colors in this test demands more substance than was left at my disposal.

The characteristic odor of this decomposition product, together with its chemical reactions, would make it appear that we have either skatol itself or one of the isomeric indols.

Some importance must be attached to this discovery, since, taken with the various reactions of the chromogen, the results of the elementary analyses and such facts as that dry distillation yields benzoic acid, amines, etc., and heating with zinc dust yields pyrol, it clearly enables us to classify the chromogen, in a preliminary way at least, among complex aromatic bases not very dissimilar from the alkaloids. The results of combustion analyses show that its empirical formula is $C_{17}H_{15}NO_4$, thus approaching in elementary composition some of the alkaloids.

The composition of pseudomorphine, for example, is represented by $C_{17}H_{19}NO_4$, that of cocaine by $C_{17}H_{21}NO_4$, that of sanguinarine by $C_{20}H_{15}NO_4$, and that of benzylidene collidine dicarboxyacid by $C_{17}H_{15}NO_4$, and among these alkaloids sanguinarine is noteworthy for its power to raise the blood pressure.*

In this connection, too, it is of interest to note that Stöhr† has shown that skatol is liberated when strychnine is heated with calcium oxide, and that Hoffmann and Königs‡ have obtained indol from tetrahydroquinoline by passing its vapor through a tube heated to redness.

ANALYTICAL RESULTS.

The results of the elementary analyses are as follows:

0.145 gm. of substance, dried in vacuo at 100° C., gave 0.3675 gm. CO_2 and 0.0684 of H_2O or 69.12% C and 5.24% H.

A second analysis made with 0.1862 gm. of substance, prepared at a different time and with slight modifications, gave 0.473 gm. of CO_2 and 0.0102 gm. of H_2O or 69.28% C and 6.09% H.

A nitrogen estimation, using substance prepared at the same time as that used in the second carbon and hydrogen analysis, gave the following results:

*H. Meyer, Arch. f. exp. Pathol. u. Pharmakol., XXIX, 426.
† Berichte d. Deutsch. chem. Gesellsch., vol. 20, p. 1108.
‡ Ibid., vol. 16, p. 738.

0.1784 gm. of substance gave 7.8 cc. of N at 21° C. and under a barometric pressure of 761 mm. of mercury. In this estimation, therefore, the N amounts to 5%.

Putting these results in tabular form, we have

	I.	II.
C =	69.12	69.28
H =	5.24	6.09
N =		5.00

Calculating for an empirical formula, we find that the expression $C_{17}H_{16}NO_4$ meets the requirements, since theory demands for

C	68.68
H	5.05
N	4.71

The agreement between the percentages demanded by this formula and the results obtained by analysis is as close as could be expected, since we are dealing with an amorphous substance and one in which the percentage of both H and N is very low.

In all of the above analyses a correction of 9.2 per cent. in the weight of substance given is made for ash. In spite of the fact that the benzoate itself is entirely free of ash, the amorphous chromogen obtained from it has carried down much mineral matter derived from the utensils used in the cleavage experiments and in subsequent manipulations.

The acetate of the new substance was also prepared and analyzed. The results thus far obtained are not fully in accord with the above formula, but this is due to the fact that the acetate decomposes during drying at 100° C. in vacuo. Acetic acid appears to be given off under these circumstances, and thus the C, H and N content is much changed from that required by the formula thus given. I do not doubt that when analyses are made with the avoidance of this loss the results will be concordant.

Not being able to repeat this part of the work at present, owing to lack of material, I here append the results of analyses made with an acetate which was constantly losing weight. The acetate was prepared by dissolving the free base in glacial acetic acid, and allowing this acid solution to flow in a thin stream into ether. The acetate is at once completely precipitated and may readily be collected, washed and dried. The percentages obtained on analyses were

C = 58.16
H = 5.82
N = 5.04

whereas the diacetate $C_{17}H_{15}NO_4(C_2H_4O_2)_2$ requires

C = 60.43
H = 5.51
N = 3.36

The analytic data for the above percentages of C, H and N are as follows:

0.153 gm. of acetate gave 0.3263 gm. of CO_2 and 0.0802 gm. of H_2O; 0.2046 gm. of the same material gave 9.1 cc. of N at 20.5° C. and under a barometric pressure of 754.6 mm. of mercury.

The method of preparation of the acetate does not tend to diminish the ash, and fusing the substance on platinum foil showed its presence in at least as large amounts as in the free base. In the absence of direct estimates for ash, it was thought fair to assume its presence to the extent of at least 10 per cent., and the weights here given have been corrected in accordance with this assumption.

I have already remarked that an analysis of the benzoate of the chromogen as thus far prepared showed it to contain C = 72.54%, H = 5.54%, N = 3.46%.

The analytic data are as follows:

0.2966 gm. of substance dried in vacuo at 80° C. gave 0.78895 gm. of CO_2 and 0.14785 gm. of H_2O. 0.29656 gm of the same material gave 8.7 cc. of N at 18.25° C. and under a barometric pressure of 760 mm. of mercury.

The monobenzoate of $C_{17}H_{14}NO_4$ is $C_{17}H_{14}NO_4.CO.C_6H_5$ and requires that

C = 71.82%
H = 4.74%
N = 3.49%

whereas our analysis gives

C = 72.54
H = 5.54
N = 3.46

This discrepancy in the carbon and hydrogen percentages is readily accounted for as the amorphous resinous benzoate analyzed is exceedingly difficult to dry to constancy of weight, and is, furthermore, perhaps not quite free from foreign benzoates. The results of analyses, nevertheless, point to the conclusion that we have the monobenzoate of the new base before us.

The above-named methods of isolating the active principle are far from being as satisfactory as could be desired. The resinous substance found in the autoclave on decomposing the benzoyl product always retains a considerable amount of the base. This may be extracted with dilute sulphuric acid and may then be precipitated with ammonia. This precipitation is, however, incomplete—a considerable amount of the base always remaining in solution. A considerable loss also occurs during the washing of the free base with water and alcohol, the latter agent especially dissolves considerable of the moist precipitate. The high ash content of the free base and of the acetate is also a most undesirable feature of the methods above described. Had there not been a tolerably fair agreement in the analytical results for the free base, its benzoate and acetate, with good reasons for the divergence in the case of the acetate, I should have hesitated to publish my results at this time.

I have lately found in sodium picrate a good agent for the complete precipitation of the base from its solutions in dilute mineral acids. The picrate is fairly soluble in a number of organic solvents, as, for example, alcohol, acetic ether and methylal, and may be precipitated from its solutions in these agents by the addition of much ether. On redissolving and reprecipitating a yellow picrate is obtained which leaves no ash when burned on platinum foil, and which, I believe, can be made to crystallize. It is my intention to give, in the near future, a more detailed description of the properties of this picrate with analyses and molecular weight determinations.

SUMMARY.

To summarize the results of this investigation in a few words: The active principle of the suprarenal capsule has been isolated in the form of a powder of a light gray to brownish color, whose percentage composition is expressed by the formula $C_{17}H_{15}NO_4$. A primary amine and a methylindol are easily split off from its molecule by treatment with powdered alkalies.

Should molecular weight determinations prove that the above formula correctly expresses the molecular weight of the new base, it will be seen that its molecule can contain

only one substituted benzene ring in addition to the nitrogenous complex of atoms from which the skatol is derived. Oxidation and substitution experiments are, however, still necessary before more definite statements can be made as to the constitution of this compound.

In its native state, as found in the suprarenal capsule, this substance differs by one chemical reaction only from its state as described in this paper. Chemically considered, the difference in composition between its native state and as here described must be very slight. And yet this difference which is just marked enough to give a greater stability to the substance is also great enough, apparently, to deprive it of its power to raise the blood-pressure, for, in the physiological experiments, thus far made, small quantities of the new base were found to be inactive in this respect.

I wish to express my thanks to my assistant, Dr. Walter Jones, for the valuable assistance rendered in making the analyses recorded in this paper.

THE LOBULE OF THE SPLEEN.

By Franklin P. Mall.

(*From the Anatomical Laboratory, Johns Hopkins University.*)

When the whole vascular system of the spleen is studied in connection with the trabecular system, it is found that the two together outline distinct masses of spleen pulp about one millimeter in diameter. These may easily be likened to the liver lobules, and for this reason I name them the lobules or the anatomical units of the spleen.

If a piece of fresh spleen is washed out by crushing it between the fingers in flowing water, it is found that the trabeculæ and veins outline spaces which were filled with pulp. They are best demonstrated by macerating the whole spleen in water at ordinary room temperature until the pulp is very soft. Then, by cutting off the small end of the organ, the debris may be washed out, leaving the capsule, larger veins and trabeculæ. A specimen obtained in this way may then be stained with acid fuchsin, washed with alcohol, distended and dried. Then with transmitted light the lobules are plainly seen as vesicles immediately below the capsule. By first injecting the spleen with either colored celloidin or agar-agar before macerating, the relation of the arteries and veins to the lobules can be determined. This is possible because neither the celloidin nor agar-agar is destroyed by the process of maceration. Thick sections made from such specimens may be immersed in xylol or mounted in Canada balsam.

It is found by studying numerous specimens of this sort, as well as those made by injecting cinnabar into the arteries and ultramarine blue into the veins, that the artery always penetrates the lobule and passes along its center, while the vein is intimately related to the trabeculæ and remains on the periphery of the lobule. In the case of the lobules lying immediately below the capsule, the artery enters the side as far away from the capsule as possible, as shown in the figure. The end of the lobule at which the artery enters I shall term the proximal side, while that opposite will be designated the distal side of the lobule. The deeper lobules of the spleen, then, have a distinct relation to the artery and not to the capsule. The Malpighian corpuscle usually lies in the proximal end of the lobule, but, in case it is very large, it may distend the lobule and cause it to bulge.

On an average there are 80,000 lobules in the spleen of a dog weighing 10 kg. In smaller spleens there may be as few as 25,000, while in larger spleens there may be 200,000. In all cases they are clustered together around the terminal branches of the artery in the same manner as the lobules of the lung are around the bronchus and the lobules of the liver around the hepatic vein. In order to understand the structure of the spleen it is necessary to study one lobule only, and for its anatomy the relations of the lobules to one another.

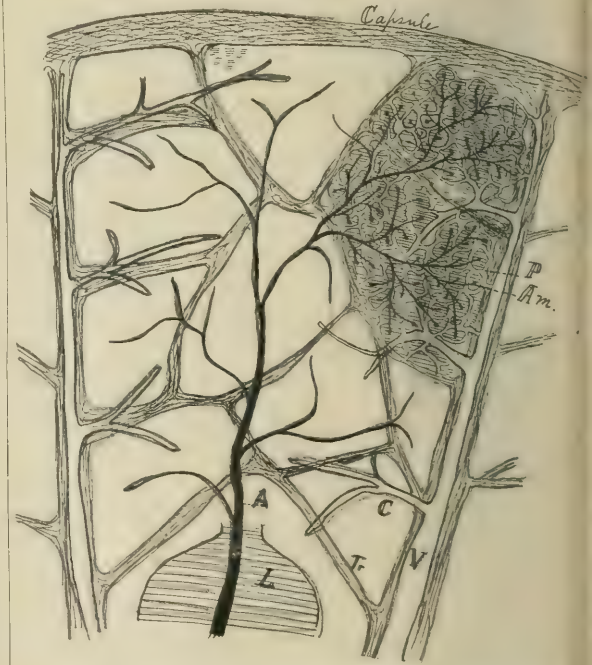

Fig. 1.—Diagram of the Lobule of the Spleen. *A*, artery in the centre of the lobule; *V*, interlobular vein within the interlobular trabeculæ; *Tr*, intralobular trabeculæ; *L*, Malpighian follicle; *C*, intralobular collecting vein; *P*, intralobular vein plexus which surrounds the pulp cords or histological units; *Am*, ampulla of Thoma.

The accompanying figure is a diagram of an average lobule drawn to scale. In no case can a picture like this be gotten from a single section, as the artery and two veins are never in the same plane. Moreover, the branches from the artery, as well as those from the vein, radiate from the main stem and pass in all directions. Practically all of the interlobular veins

are covered by interlobular trabeculæ, but there are numerous interlobular trabeculæ which are solid. In the periphery of each lobule there are three main interlobular trabeculæ, each of which sends three branches into each of the three surrounding lobules. The intralobular trabeculæ communicate with one another within the lobule, thereby dividing the lobule into about ten compartments. The relation of the veins to the lobule is much like that of the trabeculæ. In fact, it is the relation of the trabeculæ to the veins which makes the lobule. The large veins of the spleen cannot be said to lie within the trabeculæ, although their walls are thick, are continuous with the trabeculæ and give rise to them. The points which mark the separation of the smaller veins from the trabeculæ mark the boundary of the lobule (see diagram). As the venous branches leave the lobule they are at first independent of the intralobular trabeculæ, but near their exit they are related to them. The intralobular collecting veins also aid to divide the lobule into the ten parts, spoken of above. Of course the artery is distributed to the lobule from a direction opposite to that of the veins. The tendency is for veins and arteries of the same order to remain as far separated from one another as possible. The central artery of the lobule gives rise to about ten branches, each of which passes into one of the ten compartments of the lobule and through its centre. All of the above can be demonstrated best with granular injections, thick sections and low magnification.

If an interstitial injection of the spleen is made with an aqueous solution of Prussian blue, or if the blue is injected into the vein, it is found in either case that the venous plexus of the lobule is completely filled. This plexus is indicated in the figure giving its relation to the surrounding structures. It divides the spleen pulp into small areas or the histological units as I call them. In fact, however, these areas are not isolated, but communicate with one another as do the cavities of a sponge. Since the histological units run together to form cords of spleen tissue, I term them collectively pulp cords. Thick sections which leave the venous plexus intact show the optical section of the pulp cords or the histological units, while very thin sections cut the venous plexus and demonstrate the pulp cords. The terminal arteries ramify in the pulp cords and along their course, give off numerous small branches which end in a dilatation, the ampulla of Thoma. The beginning of the ampulla always lies in the centre of a pulp cord. As a rule a number of the minute branches arise from each terminal artery and radiate in all directions. I have been able to obtain complete injections of the vascular system of the spleen only after the organ has been distended to its maximum by ligating the vein half an hour before killing the animal or by making an artificial œdema with gelatin by injecting it into the veins. By both methods all the intercellular spaces within the pulp cords become enormously distended. In spleens prepared in either of the above ways the ampullæ and their communications with the veins may be filled by injecting an aqueous solution of Prussian blue into the artery. If carmine or some such fluid is used it will only add another color to the fluids in the pulp spaces. The blue, however, precipitates easily and with it, it is often easy to obtain complete injections. The specimen is made still better if the venous plexus is marked by injecting chrome yellow into the vein before injecting the blue into the artery. The gelatin-spleens are best cut on the freezing microtome and mounted in glycerine, as alcohol causes too much shrinkage of the gelatin. The injections show that the ampullæ have a tendency to communicate with ampullæ from neighboring arteries, while other branches communicate directly with the veins. Yet judging from the amount of extravasation which is always present the walls of the ampullæ must be very porous.

Carmine gelatin injected into either the artery or vein will cause an œdema of the pulp; in case it is injected into the artery it will ultimately run out of the vein, while when injected into the vein it will never run out of the artery. When cinnabar is injected into the artery, the greater part of it passes directly over into the vein, while a small portion of the granules pass into the tissues. When it is injected into the vein a considerable quantity passes into the intercellular spaces of the pulp cords, showing that the walls of the vein are pervious. Solutions of nitrate of silver injected into the artery show that the endothelial coat becomes incomplete at the beginning of the ampulla. The first two-thirds of the ampulla are lined with spindle-shaped cells lying upon a delicate framework of reticulum. Throughout the last third, at the junction with the vein, no cell boundaries can be demonstrated, nor can this portion of the ampulla be injected from the vein. In fact it appears as if this portion of the ampulla were cut up by fibrils of reticulum passing across it. Silver injected into the veins shows that the complete layer of cells ends at the point of junction of the intralobular plexus with the intralobular collecting veins. Throughout the plexus the cell walls are incomplete and the endothelial cells are spindle-shaped, the space between them being large enough to allow cinnabar granules to pass easily, ultramarine blue granules with difficulty, and chrome yellow granules not at all. The openings in the veins are largest in the neighborhood of the Malpighian follicles.

The reticulum extends throughout the lobule, supplies the framework for the ampullæ and the venous plexus, and is continuous with the reticulum of the lymph follicles surrounding the arteries. Its arrangement is such that an œdema distends the lumina of the veins out of proportion to those of the pulp spaces. The reticulum is very delicate and elastic. It can be stretched to double its length and when relaxed it will return to its former shape. It is easily destroyed with acid or with alkali, and is digested with pancreatin. This last reaction makes of it a new variety of reticulum. While this reticulum is so delicate and easily destroyed, the reticulum of the trabeculæ and capsule is most resistant. In fact, it is more resistant than that of the lymphatic gland or of the mucosa of the intestine. We have therefore within the spleen two extremes of reticulum, the most resistant and the least resistant.

The microscopic anatomy shows that the ampullæ and venous plexus have very porous walls which permit fluids to pass through with great ease and granules only with difficulty. In life the plasma constantly flows through the intercellular spaces of the pulp cords, while the blood corpuscles keep within fixed channels. Numerous physiological experiments which I have made corroborate this view.

A more detailed account of the facts enumerated above, together with illustrations, is being prepared for publication.

THE DEVELOPMENT OF THE BILE-CAPILLARIES AS REVEALED BY GOLGI'S METHOD.

By William F. Hendrickson.

(*From the Anatomical Laboratory of the Johns Hopkins University.*)

As the diverticula of epithelial cells grow from the mid-gut and surround the omphalo-mesenteric veins to form the liver there is from the first a duct present, the primitive bile-duct. In the further growth of the liver these diverticula anastomose again and again to form the main bulk of the liver of the embryo. To what extent bile-capillaries are present in these masses may in part be determined by treating the livers of small embryos with Golgi's method, and at the suggestion of Dr. Mall I have made numerous tests with this method to determine its value in the study of the development of the bile-capillaries.

The lobule is formed rather late in the development of the liver. In the younger livers the portal and hepatic veins have each for themselves their own regions of tissue about them, which in no way interlace. A later shifting and new formation of vessels is required before we have any indication of a lobule. Human embryos of the fourth week have already formed the main bile-ducts and hepatic artery along the branches of the portal vein, but I have been unable to demonstrate any bile-capillaries in human or in pig's livers from embryos less than 5 cm. long.

Although it is probable that the bile-capillaries are formed directly from the lumina of the liver sprouts from the mid-gut, yet it is impossible to prove this by means of Golgi preparations. The pictures obtained by this method are just the reverse of those expected when the question is considered from the standpoint of embryology. The first bile-capillaries stained by Golgi's method are found immediately about large portal branches in embryos 5 cm. long. From this stage on the pictures show a gradual spreading in both peripheral and central direction until bile-ducts are reached on the one hand and the intralobular plexus on the other. It may be that the Golgi method stains only those bile-capillaries which contain secretion.

My successful specimens were obtained from human as well as pig's embryos 5 cm. long, and longer. A great many specimens were made from pig's livers, repeated tests having been made to stain the capillaries in the livers of young embryos. The great quantity of these embryos at my disposal allowed me to make many Golgi specimens of livers in which the artery, the portal vein, or both had first been injected in order to determine the vessel about which the first capillaries appeared. In addition to this I made serial sections usually about 50 μ thick.

The first Golgi pictures are obtainable in the livers of pigs 5 cm. long (Fig. 1). Human embryos of the same size show a much more advanced network of bile-capillaries (Fig. 4). Yet repeated tests upon livers from pigs 5 cm. long always gave only a few capillaries in the immediate neighborhood of a large vein, which proved to be a branch of the portal vein. Specimens made by injecting either the portal vein or hepatic artery with a small quantity of Prussian blue before staining by Golgi's method always gave the same result, *i. e.* that the bile-capillaries are first stained in the immediate neighborhood of the branches of the portal vein.

Fig. 2 is from a pig's embryo 6 cm. long. It shows the bile-capillaries somewhat more extensive, they having encircled the portal branch. In an embryo a little larger, Fig. 3, the capillaries have grown still more, for those encircling different portal branches nearly meet. In addition to this extensive spreading each main bile-capillary has upon it many small side twigs. It appears as if the first meshes enclosed bile-capillaries are cut up by these side branches shooting across from one capillary to the other as the meshes enlarge by the multiplication of liver cells. Only in some way like this could the proper number of bile-capillaries keep pace with the growth of the liver.

The process described in livers of pig embryos up to 8 cm. long must have all preceded the condition found in the liver of a human embryo 5 cm. long, for in the pig's liver and the human liver in these two respective stages the degree of development of the bile-capillaries is much alike. A glance at Figs. 3 and 4 will readily show this. The network of the human liver, however, is much larger than that of the pig, but this seems to be the case throughout development.

Fig. 5 represents the extent of the bile-capillaries in a pig's embryo 15 cm. long. We find here that the bile-capillaries growing about one of the branches of the portal vein have become continuous with those about like branches in the neighborhood. The only indication left of the manner of growth of the bile-capillaries is seen in the relative size of their meshes. The meshes next to the veins are smaller than those situated farthest from the vessel about which the bile-capillaries arose. This figure illustrates again the progressive subdivision of the meshes formed by the bile-capillaries. The meshes near the veins are more dense than those farther distant, and this is easily understood since we know that those around the veins appeared first.

In the human embryo 10 cm. long the bile-capillaries are again as far advanced as those in pig's embryos 15 cm. long. Their relative size and extent are shown in Fig. 6, which may be compared with Fig. 4, taken from a human embryo 5 cm. long.

Fig. 7 is from a pig's embryo 21 cm. long, and Fig. 9 from a human fœtus at term. Both of these specimens show the network of capillaries distributed quite uniformly throughout sections, and at first thought it appears as if the growth of the capillaries was complete. But in the adult, both pig and human, the livers are considerably larger and the network is still smaller (Fig. 8).

If we had in the embryo's liver all the rudiments of the lobules of the adult liver it would not be so difficult to interpret these various pictures described above. In the livers of young embryos the portal and hepatic veins are in opposite ends of the liver, the portal being on the distal side and the hepatic on the proximal. When the liver is in this stage the

FIG. 1.—Pig, 5 cm. long.

FIG. 2. Pig, 6 cm.

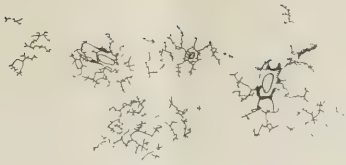

FIG. 3.—Pig, 8 cm.

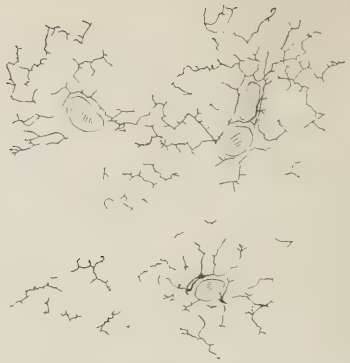

FIG. 4.—Human, 5 cm.

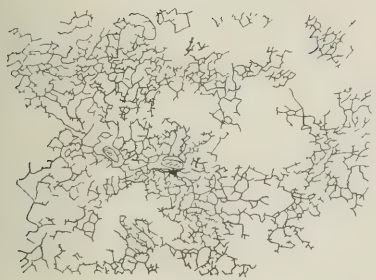

FIG. 5.—Pig, 15 cm.

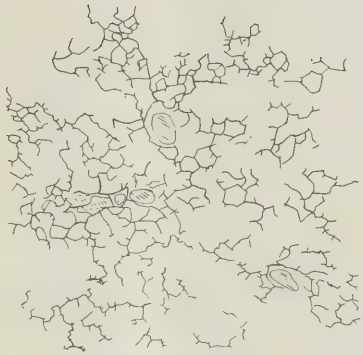

FIG. 6. -Human, 10 cm.

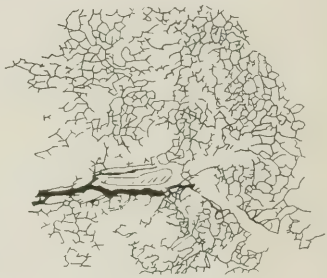

FIG. 7.—Pig, 21 cm.

FIG. 8.—Adult pig.

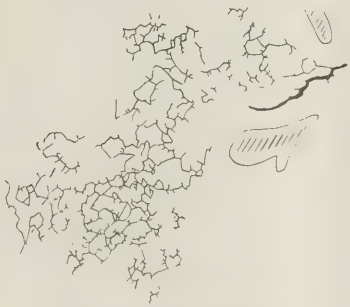

FIG. 9. Human fetus at term.

FIG. 10.—Pig, 8 cm.

FIG. 11. Pig, 16 cm.

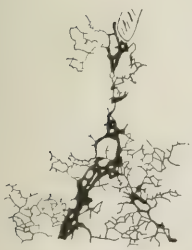

FIG. 12.—Pig, 16 cm.

FIG. 13.—Pig, 19 cm

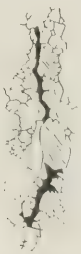

FIG. 14. Pig, 16 cm

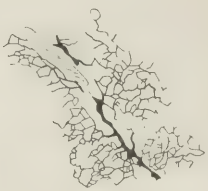

FIG. 15 Pig, 20 cm

Hendrickson, del.

bile-capillaries are first stained about the branches of the portal vein, although these veins cannot be called interlobular at this time. In the further growth of the vessels the hepatic veins invade the region occupied by the portal and vice versa. This process goes on, by what method we know not, until the lobules are finally formed. It is evident then that in the growth of the liver, as in bone, we must have destruction going on hand in hand with growth. Not only is this true during embryonic life, but Dr. Mall also informs me that a similar process is taking place in the lobule after it is formed. In this latter instance the liver lobule is constantly undergoing destruction in its centre and being regenerated at its periphery.

These facts complicate our problem considerably and make it practically impossible for us to interpret our specimens correctly. It appears, however, that in the further development of the liver the bile-ducts grow longer and longer at the expense of the bile-capillaries. At best the Golgi specimens indicate this, and, therefore, I can describe this process.

In the liver of a pig's embryo 8 cm. long, the bile-capillaries immediately about the portal vein are somewhat more marked than those more distant. This is shown in transverse section in Fig. 10, and in longitudinal section in Fig. 11. This process is still more advanced in embryos 16 cm. long (Fig. 12), and in a measure we can speak of this large black capillary as a bile-duct. At first the dilatation is even and regular (Fig. 11), but soon it becomes irregular, the meshes become smaller and smaller until a number of capillaries together form a distinct bile-duct. The successive stages of this process are shown in Figs. 13, 14 and 15, and the completed duct is shown in Fig. 8. When the duct is completed the bile-capillaries communicate in great part only with its tip, and not all along its course as in the case of the younger ducts. This question, however, needs further investigation in normal as well as in diseased livers.

PLATE.

In all the figures the outlined and striated space is a branch of the portal vein. All the figures were drawn with the camera and are enlarged 53 times.

A STUDY OF THE MUSCULATURE OF THE ENTIRE EXTRA-HEPATIC BILIARY SYSTEM, INCLUDING THAT OF THE DUODENAL PORTION OF THE COMMON BILE-DUCT AND OF THE SPHINCTER.

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The idea that there is a sphincter muscle about the orifice of the ductus communis choledochus has been held since the time of Glisson. In the year 1887, however, Ruggero Oddi, an Italian, had cause to inquire more particularly into the subject. He found that no extended research had been made in this connection, and that the idea of a sphincter muscle of the common bile-duct was based for the most part on conjecture. Oddi accordingly undertook a careful study of the subject and used two methods: (1) maceration, (2) sectioning and microscopic examination.

With the maceration method he examined and described the sphincter muscle of the dog, which he regards as typical, and this description is followed by some observations regarding the differences observable in the sphincter muscle of the sheep, ox and hog. Oddi does not attempt to demonstrate the sphincter muscle in man by this method.

He studied also serial cross-sections of the duodenal portion of the common bile-duct of the dog and other animals, and describes them briefly.

The importance of such studies for the clinician interested in diseases of the biliary passages is obvious, and it is to be regretted that Oddi's material did not permit him to extend his studies to the bile-ducts of man. He states, it is true, that he has studied sections of the human bile-duct, and that he found sphincter fibres around the end of the bile-duct; otherwise his research deals entirely with tissues derived from animals.

In view of this fact a reworking of the subject with particular reference to human beings has seemed desirable, and the present work was therefore, at the suggestion of Dr. Lewellys F. Barker, undertaken. This report includes, it is believed, as full an account of the musculature of the biliary passages of man as the methods employed will permit of, and also contains references to a number of points hitherto unstudied in the structure of the biliary passages of animals.

I.—History.

II.—Methods employed.
- (a) Maceration with a mixture of nitric acid, glycerine and water.
- (b) Maceration with Ranvier's alcohol.
- (c) Stained celloidin and paraffin sections.

III.—The Musculature of the Biliary Passages in the Dog.
- (a) Gall-bladder.
- (b) Cystic duct.
- (c) Hepatic duct.
- (d) Common bile-duct.
- (e) Place of union of cystic, hepatic and common bile-ducts.
- (f) Duodenal portion of common bile-duct.

IV.—The Musculature of the Biliary Passages in the Rabbit.
- (a) Gall bladder.
- (b) Cystic duct.
- (c) Hepatic duct.
- (d) Common bile-duct.

(e) Place of union of cystic, hepatic and common bile-ducts.
(f) Duodenal portion of common bile-duct.

V.—The Musculature of the Biliary Passages in Man.
(a) Gall-bladder.
(b) Cystic duct.
(c) Hepatic duct.
(d) Common bile-duct.
(e) Place of union of cystic, hepatic and common bile-ducts.
(f) Duodenal portion of common bile-duct.

VI.—Conclusions.

VII.—Index Lettering of the Figures.

I.—HISTORY.

For convenience the literature will be divided into two groups.

(*a*) That concerning the smooth muscle of the gall-bladder, cystic, hepatic and common bile-ducts.

(*b*) That on the structure of the duodenal portion of the common bile-duct.

ad (*a*) In 1761 Duverney* described the gall-bladder of man and divided its wall into four coats, the second coat being the muscular. The fibres which composed it were diversely arranged, some being longitudinal, others transverse or oblique. The fibres near the neck of the gall-bladder showed a circular disposition, and might be regarded as a sphincter.

In 1829, Wilson† declared that the presence of muscle fibres in the gall-bladder and the gross bile passages had not been demonstrated.

Koelliker‡ considered the musculature of the large bile-ducts to be but very little developed in man. He could not find a trace of muscle in the hepatic duct or in its branches. Bundles of smooth muscle were found, however, in the ductus choledochus and in the ductus cysticus, but not in sufficient quantity to justify the description of a muscular coat.

Only in the gall-bladder was a true muscle coat to be seen; here the muscle bundles crossed in all directions; still those running longitudinally and transversely predominated.

Tobien§ stated that muscle fibres are present in the human gall-bladder and that they run in all directions. The cystic duct, similar to the hepatic duct of man, contains no muscle. The presence of a ring of muscle fibres in the cystic duct near the gall-bladder was, however, confirmed by him. This ring of muscle is made up of contiguous muscle fibres, no connective tissue penetrating between them. He cites Glisson* and Duverney as supporters of the view that a sphincter of the gall-bladder exists, and names G. H. Meyer† as being of the opposite opinion.

Eberth‡ found in man and in the cat and dog, smooth muscle in the gall-bladder only. In each case the muscle fibres run for the most part in a circular direction; longitudinal and diagonal bundles are, however, present.

Luton§ describes the middle coat of the biliary passages as consisting of fibrous connective tissue, in which are some muscle fibres. In general the muscle fibres are not abundant, especially in the hepatic duct, cystic duct and common bile-duct. In the gall-bladder he finds a thin muscular coat, the fibres of which take two courses, viz. longitudinal and transverse.

MacAlister‖ believes that muscle fibres are present in what he calls the fibro muscular coat of the human gall-bladder. The muscle fibres run both circularly and longitudinally, but those of the latter direction constitute only about one-fourth of the whole number. In his description of the valvular folds of the cystic duct, he states that some muscle fibres are present in the bases of the upper valvular folds, but they do not seem to exist in the lower folds, *i. e.* those nearest the common bile-duct.

Paulet¶ found in the connective tissue of the biliary passages some contractile cells. The number present was not sufficient to form a continuous coat. Moreover, according to his statement the muscle fibres become less numerous as the calibre of the tube becomes larger. They are scanty in the cystic, hepatic and common bile-ducts of man. The gall-bladder also contains a certain number of smooth muscle cells, but never sufficient, at least in normal cases, to form a distinct coat.

According to Variot** the human gall-bladder contains a network of smooth muscle fibres, the interstices being filled with connective tissue. The common bile-duct exhibited in one case (human adult) discontinuous longitudinal muscular fasciculi; in another case (human adult) only a few circular bundles. In the dog, two superimposed strata of smooth muscle fibres were found which, very thick near the ampulla of Vater, became gradually thinner as the gall-bladder was approached. Between these strata of muscle is interposed a nervous apparatus analogous to that of the intestine.

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*Duverney (J.-G.) Oeuvres anatomiques. Paris, 1761, t. ii, p. 234.

†Wilson (C.) Observations on the mechanism of the biliary system. Edinb. M. & S. J., 1829, xxxi, 107–114.

‡Koelliker (A). Ztsch. f. wissensch. Zool. Leipz., 1848, S. 61–62.

§Tobien (A. I.) De glandularum ductibus efferentibus, ratione imprimis habita telæ muscularis. Dissertatio Inauguralis, Dorpat, 1853, S. 17.

*Glisson (Francis.) Anatomia hepatis; cui praemittuntur quaedam ad rem anatomicam universe spectantia. Et ad calcem operis subjiciuntur nonnulla de lymphæ ductibus nuper repertis. 16°. Hagæ, A. Leers, 1681.

†Meyer (G. H.) De musculis in ductibus efferentibus glandularum. Berl., 1837, p. 31.

‡Eberth (C. J.) Ztsch. f. wissensch. Zool., Bd. xii, 360, 1862.

§Luton (A.) Biliaires (voies). N. dict. de méd. et chir. prat., Par., 1866, v, 33–101.

‖MacAlister (A.) Contributions to the comparative anatomy and physiology of the gall-bladder. Med. Press and Circ., Dubl., 1867, n. s. iv, 129 and 150.

¶Paulet (V.) Biliaires (voies). Dictionnaire encyclopédique des sciences médicales. Paris, 1868, vol. ix, p. 295; 314.

**Variot (G.) Sur les nerfs des voies biliaires extra-hépatiques. Jour. de l'anat. et physiol., etc., Par., 1882, xviii, 600–610.

Sappey* in describing the structure of the human gall-bladder states that with the connective tissue composing the tunica conjunctivale and which forms a loose feltwork structure, are mixed some very delicate elastic fibres and some thin fasciculi of smooth muscle, scanty in man but more abundant in some mammals. The human cystic duct contains a plexiform arrangement of smooth muscle fibres. The ductus communis choledochus exhibits a structure identical with that of the other bile-ducts. In the hepatic ducts the diameter of which is 0.5 mm. or more he sees smooth muscle fibres which extend throughout the whole extent of the biliary passages. These fasciculi even in the large branches are very delicate and much separated. They exhibit a plexiform arrangement.

Cruveilhier† was not able to see the muscle fibres which other authors describe in the human gall-bladder, and ignored the possibility of the presence of muscle in the human cystic, hepatic and common bile-ducts.

Henle‡ believes the human gall-bladder contains smooth muscle fibres which interlace with one another. He finds no muscle in the human cystic, hepatic, and common bile-ducts, and considers the accumulation of ring-shaped muscle fibres described by Tobien as a sphincter vesicæ fellæ, to belong not so much to the cystic duct as to the neck of the gall-bladder. Henle experimented upon a beheaded man to determine the contractility of the biliary passages but with negative results.

Testut§ finds in the human gall-bladder smooth muscle fibres interlacing in all directions and bound together by connective tissue. In the cystic duct, only longitudinal muscle bundles are seen. The common bile-duct contains in its walls smooth muscle, well developed near the ampulla of Vater but on ascending the duct; this becomes less and less prominent until the muscle is even entirely absent at certain points in the duct.

Gegenbaur‖ states that in the connective tissue of all the human bile passages (cystic, hepatic and common bile-ducts) smooth muscle cells are to be found. In the wall of the gall-bladder they form a very thin coat, network like in character. Sometimes an indistinct longitudinal and circular coat can be made out.

Schäfer and Symington¶ state that the human gall-bladder contains plain muscle fibres which assume for the most part a longitudinal direction but some run transversely. They believe that the cystic and hepatic ducts also contain longitudinal and circular muscle fibres.

ad (*b*)—The presence of a sphincter muscle about the duodenal extremity of the common bile-duct was suspected as early as 1681. In that year Glisson** gave the following description:

"Quamprimum autem ductus hic communis utranque exteriorem intestini tunicam perrupit, adeo laxe eum interior tunica complectitur, ut digito huc illuc facillime dimoveri queat: hujusque mobilitatis ratione rem quamlibet ab intestino illapsuram arcet: quemadmodum id exploratu facile est, si modo, aperto intestino, acum aut specillum exiguum illac immittere coneris. Videbis enim, vario huc illuc subterfugio, spem omnem penetrationis eludere; nisi forte statim ipsum centrum illius, stylo tetigeris.

Præterea, ne quid ab intestino in ductum hunc illabatur, ipsa insertionis obliquitas in causa est: quic quid enim illo vorsum tendit, atque ingredi conatur, id simul eodem nisu interiores intestini tunicas versus exteriorem comprimit, ipsumque adeo aditum præcludit: idque eo magis, quo vis illata potentior fuerit.

Denique, regressus omnis in ductum communem præpeditur a fibris anularibus, quæ non modo orificium ipsum, sed & totum obliquum tractum obsident. Quemadmodum enim fibræ istæ anulares sese facile extendunt, quoties humor biliosus diutule repressus copiaque jam adauctus ad exitum properat; ita quoque, elapso semel superfluo humore illo, eædem penitus connivent, transitumque omnem impediunt, donec humoris plusculum denuo collectum fuerit, quod fores illarum effringat. Dari autem ejusmodi fibras anulares hinc constat: Si intestinum ex adverso orificii hujus aperueris, bilemque in illud digitorum opera adegeris, videbis statim ab exclusa bile orificium illud sponte sua denuo occludi; quod sane cirra ejusmodi fibrarum opem, fieri nequaquam posset. Similiter, si insertioni huic specillum indideris, idemque mox inde extraxeris; orificium jam dictum spontanes motu contrahi cernes. Ideoque crediderim aditum hunc eo nomine cum anisphinctere convenire, licet minore cum molimine clausura illic peragatur: nempe, si quando ab incumbente humore copioso molestia aliqua illata fuerit, mediantibus fibris hisce anularibus transitum ei concedit, denuoque in angustiam pristinam sese contrahit.

Ductus communis in ove aliter, quam in homine in intestinum inferitur. Quippe in illa, unicæ integræ spatio inter intestini tunicas prorepit, priusquam in illius cavum aperitur; tumque fissuram efformat, quæ per intestini longitudinem deducitur. Fissura haec laxa & spongiosa protuberantia, ab interiore intestini tunica enata, utrinque protegitur: adeo ut, si quidpiam altrinsecus in illam impingat, id eam protinus translabatur, hiatumque occludat. Ipsa tamen insertionis hujus obliquæ in ovibus longitudo, præcipue impedimento est, quo minus aliquid ab intestinis in ductum hunc communem regrediatur; quoniam enim orificium ejus in oblongam fissuram desinit, fibris ejusmodi anularibus nihil opus erat. Neque etiam insertio hæc in ovibus æque laxe huc illuc oberrat, atque in homine id fieri diximus: ac propterea, quoniam aliis jam dictis auxiliis destituitur, æquum erat, ut itineris longitudo, tunicarumque an invicem arcta compressio, illorum absentiam compensarent."

In 1869, Von Luschka* examined the intestinal portion of the common bile-duct of man and found a longitudinal open-

* Sappey (M. P. C.) Traité d'anatomie descriptive. Paris, 1889, t. iii, p 273.

† Cruveilhier (J.) Traité d'anatomie descriptive. 5 ed., 8°, Par., 1867–74.

‡ Henle (F. G. J.) Handbuch der systematischen Anatomie des Menschen. 8°. Braunschweig, 1856–73.

§ Testut (L.) Traité d'anatomie humaine, etc. Paris, 1889–91.

‖ Gegenbaur (C.) Lehrbuch der Anatomie des Menschen. 5. Aufl. 8°. Leipzig, 1892.

¶ Quain's Anatomy. 10. ed. London and New York, 1892.

** Op. cit.

* Von Luschka (H.) Die Pars intestinalis des gemeinsamen Gallenganges. Vrtljschr. f. d. prakt. Heilk., Prag., 1869, ciii, 86-100.

ing in the outer longitudinal coat, and a transverse opening in the inner circular muscular coat of the intestine which gave passage to the duodenal portion of the common bile-duct.

In 1887, R. Oddi* undertook to demonstrate the sphincter of the common bile-duct. He says: "I have found that no one has made a research upon this subject, although some, either by imagination or conjecture, have assumed the existence of such an arrangement."

Oddi employed in his investigation the macerating fluid proposed by Marcacci—a mixture of equal parts, by volume, of concentrated nitric acid, glycerine and water. The duodenal portion of the common bile-duct (of the dog, sheep, ox and hog) was examined with the best results. Oddi did not examine human specimens with this method. He mentions the following points as the result of a study of macerated specimens from animals belonging to different species. The course of the common bile-duct which runs across the intestinal tunic varies with the animal. Around the last part of the common bile-duct, almost in proximity with the mouth of the duct, he sees a muscular ring; this ring, after the removal of some delicate loops which run from its external surface to become lost in the muscle of the intestine, can be considered as independent.

Little by little, as the point of entrance of the common bile-duct into the intestinal wall is approached, the fusion of the circular fibres of the common bile-duct with the intestinal wall becomes more intimate, so that the common bile-duct cannot any longer be elevated. This may be due to the fact that of the circular fibres of the common bile-duct some run off to become implanted on the circular muscle of the intestine; like cords, fastened at the two poles of an oval, they go to become fixed at two firm points opposite one another in order to attain support. After these bonds have been cut the common bile-duct with its circular fibres can be isolated for some distance, up to the point where it plunges through the circular muscular fibres of the duodenum. Here the bile-duct raises the circular muscle fibres of the duodenum, forming a wedge-shaped opening. Oddi says it must be noted that in the animals examined by him, these fibres (sphincter fibres) did not appear always equally disposed, but necessarily assumed that form and disposition which could best adapt itself to the form and course of the common bile-duct in the intestine. Thus, in the sheep and the ox, where the common bile-duct runs parallel to the intestinal axis, they are hidden and parallel to the intestinal fibres; in the dog, in which case the common bile-duct runs obliquely to the axis of the intestine, they are oblique and less hidden; while in the hog, where the common bile-duct has a course like a "C", they are so strangely disposed as to be difficult to describe.

Oddi studied microscopically, sections cut transverse or perpendicular to the axis of the intestine of various animals at different levels. The following descriptions of the dog and sheep are given as typical. In a section taken at the point where the common bile-duct has just entered the muscular wall of the intestine, there is seen externally the stratum longitudinale of the muscular coat of the intestine, and just internal to this the stratum circulare which presents a button-hole-like arrangement of its fibres through which the common bile-duct is seen to pass; the bile-duct is thus embraced by two muscular coats (formed by the buttonhole-like arrangement of the fibres of the stratum circulare), which reunite at its poles. Between the poles of the common bile-duct and the angle of reunion of the two muscular layers, there remains a triangular space, the base of which is formed by circular muscle fibres which both on the exterior and on the interior are inextricably mixed with the two circular muscular layers above mentioned. At the side of the circular muscle fibres just described are seen longitudinal fibres quite noticeable in section.

If the section be taken a little nearer the middle of the course of the common bile-duct, it is seen that the internal muscular layer has become thinner, while the external has acquired greater volume. Between the two layers the section of the duct can be seen, surrounded by a true muscular ring which is not intimately related with the two intestinal muscular layers. The muscular ring of the duct seems, in the section, to be entirely independent.

A section near the mouth of the common bile-duct shows that the division of the circular muscular layer of the intestine no longer exists—the ring described remains only in slight contact with the inner surface of the fibres of the stratum circulare of the intestinal muscular tunic. A continuation of the longitudinal fasciculi at the poles of the common bile-duct is also seen.

Oddi next proceeds to give some points distinguishing the animals examined from one another. A characteristic disposition of the muscle is, he says, proven for the rabbit. The muscular ring which envelops the common bile-duct appears in a section transverse or perpendicular to the long axis of the intestine. He emphasizes this fact, for it demonstrates, he thinks, the independence of these fibres from those of the intestine. In man, owing to the fineness of the muscle fibres, the disposition is not characteristic. Nevertheless, the circular as well as the longitudinal fibres (at the poles of the lumen of the common bile-duct) are very manifest. The circular fibres, however, cannot be followed for a great distance around, since, for the more part, they become lost in the connective tissue which supports the mucous membrane in its numerous anfractuosities. The fibres here mentioned have but little relation to the muscular layers of the intestine.

As to a special disposition of the muscular fibres at the mouth of the pancreatic duct, Oddi states that in the duodenum of a dog prepared by Marcacci's method of maceration, he was able to see at the mouth of the pancreatic duct (which is obliquely distant about two inches from the mouth of the common bile-duct) some special fibres disposed in a ring, very delicate and quite distinct from the intestinal muscular coats. This arrangement was confirmed by transverse and longitudinal sections taken at the mouth of the pancreatic duct.

II.—METHODS EMPLOYED.

In the present investigation three methods were employed to demonstrate the smooth muscle of the biliary passages.

* Oddi, R. Di una speciale disposizione a sfintere allo sbocco del coledoco. Ann. d. Univ. libera di Perugia. Fac. di med. e chir., 1886-7, ii, 249–264, 1 pl. Also, Reprint, Perugia, 1887.

(*a*) The most important of these, in some respects, is the method used by Marcacci* for demonstrating the musculature of the papilla mammæ. The method consists in macerating the tissue to be examined in a mixture of equal parts by volume of concentrated nitric acid, glycerine and water.

In applying it to the present study, the vertical portion of the duodenum was cut out and ligated at its two extremities. A cannula was introduced into the ductus choledochus and the above-mentioned mixture was injected into the intestine until its walls were well distended. The common bile-duct was next ligated and the entire specimen placed in a vessel full of the same macerating mixture. After a certain period of time the tissue was removed and placed in water. The intestine having been cut open on the side opposite the mouth of the common bile-duct, the mucous membrane was removed quite easily with forceps. The water was changed and the specimen allowed to remain thus for 24 hours. At the end of this time the specimen is ready for examination. The muscle fibres have the color and brilliancy of raw silk and, having absorbed water, stand out quite beautifully.

To demonstrate the muscle of the gall-bladder, cystic duct, hepatic duct and common bile-duct, the gall-bladder and hepatic duct were dissected from the liver; the hepatic duct was ligated and after ejecting the bile through the common bile-duct by pressure on the gall-bladder, the macerating mixture was injected up the common bile-duct until the walls of the gall-bladder were distended. The common bile-duct was then ligated and the whole mass placed in a vessel containing the same macerating mixture. The rest of the process is the same as for the duodenal specimen.

The period of macerâtion in nitric acid, glycerine and water has to be varied according to the delicacy of the specimen.

(*b*) Another method employed with advantage was that of maceration in Ranvier's alcohol. This method was found most useful in making permanent preparations of the gall-bladder. The gall-bladder, having been cut open, was allowed to macerate in Ranvier's alcohol for a week or ten days. The specimen was then removed and the epithelial cells brushed away with a stiff camel's hair brush. The serous coat and outer connective tissue coat were removed with forceps. The specimen was then stained with alum carmine or with hæmatoxylin and eosin and mounted in Canada balsam with the mucosal side down. This gives a bird's-eye view of the arrangement of the muscle in the wall of the gall-bladder.

(*c*) The third method employed was that of fixing, embedding, sectioning and staining the various parts. The specimens were fixed in absolute alcohol, formalin, or corrosive sublimate and imbedded in celloidin or paraffin. The principal stain used was that suggested by Van Gieson since the differentiation of minute quantities of smooth muscle from the surrounding connective tissue by this stain is quite exquisite. Other methods of staining were, however, employed for purposes of comparison.

* Marcacci (A). Il muscolo areolo-capezzolare. Gior. di R. Accad. di med. di Torino. 1883, 3. S., xxxi, 743-753. Also, Transl.: Arch. ital. de biol., Turin, 1883. iv, 292-254.

III.—THE MUSCULATURE OF THE BILIARY PASSAGES IN THE DOG.

(*a*) *Gall-bladder.*—Specimens macerated in a mixture of nitric acid, glycerine and water showed the arrangement of smooth muscle to be plexiform. The circular or transverse fibres are most numerous. The gall-bladders macerated in Ranvier's alcohol showed an arrangement exactly like the above. Longitudinal celloidin sections cut from the body of the gall-bladder, showed smooth muscle running in three directions, transverse, longitudinal and diagonal. Fig. 1.

Most of the muscle bundles run around the gall-bladder in a transverse direction, *i. e.* in a direction perpendicular to the long axis of the gall-bladder. The muscle bundles are not arranged in definite and regular coats; the transverse, longitudinal and diagonal bundles mingle without conformity to any rule. The muscle bundles are more or less separated from one another by a certain amount of connective tissue, but since the individual muscle bundles overlap, there are few if any places in this coat where muscle is entirely absent.

(*b*) *Cystic duct.*—Macerations in a mixture of nitric acid, glycerine and water revealed the presence of both transverse and longitudinal muscle fibres. In celloidin sections cut parallel to the long axis of the tube smooth muscle can be demonstrated running in three directions, transverse, longitudinal and diagonal. Fig. 2.

The absolute amount of transverse and longitudinal muscle is about equal. The diagonal muscle fibres are many fewer in number. The general arrangement of the smooth muscle bundles is plexiform. The connective tissue penetrates between the muscle bundles to a degree relatively greater than in the gall-bladder. Fig. 3 is taken from one of the valves of Heister. It is the largest fold found in this specimen and presents an arrangement of muscle which is much more accentuated in human specimens (*vide infra*). No such arrangement was found in the cystic duct of the rabbit.

In the cystic duct of the dog portions of the longitudinal muscle bundles curving around and running out into the valve can be made out. Other bundles of muscle, having origin apparently in the circular or transverse fibres of the cystic duct, run out into the valve. The report of the study of the Heisterian valves of human beings is accompanied by a detailed account of this arrangement.

(*c*) *Hepatic duct.*—Longitudinal muscle fibres were found in specimens macerated in a mixture of nitric acid, glycerine and water. Longitudinal sections of the hepatic duct showed only longitudinal fibres. Fig. 4. The fibres are but few in number and the disposition of the muscle is such that there can be no talk of a continuous coat.

(*d*) *Common bile-duct.*—Macerations in a mixture of nitric acid, glycerine and water showed a few longitudinal muscle fibres. Longitudinal celloidin sections showed smooth muscle running in three directions, longitudinal, transverse and diagonal. Fig. 5. The longitudinal bundles are most numerous, the transverse bundles next in number, the diagonal bundles being least numerous. The muscle fibres do not form a complete coat; they are found scattered amongst much connective tissue.

(*e*) At the place of *union of the cystic,* hepatic and common

bile-ducts, no extraordinary muscular arrangement was seen. Each duct preserved its normal structure, the wall of each gradually merging into that of the others.

(*f*) *Duodenal portion of the common bile-duct.*—That portion of the duodenum which contains the duodenal papilla having been macerated in a mixture of nitric acid, glycerine and water as described above, was examined in the following manner: The intestine was cut along its longitudinal axis on the side opposite the duodenal papilla and laid open. The mucous membrane was removed and with it the muscularis mucosa. The appearances at this stage are represented in Fig. 6.

From the point where the common bile-duct enters the intestine *A* to the point *R*, the muscle fibres of the inner circular muscular coat of the intestine are seen to pass over the common bile-duct. From the point *R*, to the point *O*, an irregular arrangement of muscle bundles is seen to exist. This arrangement resembles in shape more or less that of a mark of interrogation placed in a horizontal position. The structure has its origin (1) partly in the fibres of the inner circular muscular coat of the intestine, (2) partly in fibres which lie under the inner circular muscular coat and which arise from the median line of the bile-duct and (3) partly from the ring of muscle surrounding the mouth of the bile-duct. The fibres after this origin run forward (*i. e.* towards the lower end of the duodenum) and, passing under the fibres of the inner circular muscular coat of the intestine, blend with the fibres of the outer longitudinal muscular coat.

Out of eight specimens I found no two cases in which this irregular arrangement was alike. A description of the mode of origin and termination of these muscle bundles is accordingly of but little value, although an exact determination was made in each case.

Continuing from the point *O* to the mouth of the common bile-duct *M*, one can see muscle fibres running around the end of the common bile-duct. A careful examination of this region shows that a complete ring of muscle surrounds the mouth of the common bile-duct. At the same time, close observation reveals a certain number of muscle fibres running off from the two sides of this annulus of muscle. These latter are in reality part of the ring of muscle and after separating from the ring at its sides bend abruptly forward, *i. e.* towards the lower end of the duodenum. This ring of muscle with the lateral muscle bundles arising from it constitutes the sphincter of the ductus communis choledochus.

In Fig. 6 the muscle bundle seen coming off from the non-pancreatic* side (see *X*) of the annulus of muscle corresponds with the arrangement usually found. At first sight there seems to be no corresponding bundle for the other side (*i. e.* pancreatic side) of the muscle ring. It will be remembered, however, that the structure similar to a mark of interrogation had its origin in part in some fibres of the muscle ring about the mouth of the common bile-duct. These fibres of origin, in this case, take the place of the muscle bundle which runs off at the pancreatic side of the muscle ring. The fasciculus on the pancreatic side of the muscle ring must terminate, after running forward a short distance, as described above in connection with the termination of the structure resembling a mark of interrogation—by passing under the fibres of the inner circular muscular coat of the intestine and blending with the fibres of the outer longitudinal coat. The fasciculus on the non-pancreatic side of the muscle ring, after running forward a short distance, curves slightly to the pancreatic side and finally terminates by mixing superficially with the fibres of the inner circular muscular coat of the intestine. The manner of termination of these lateral fasciculi of the annulus about the mouth of the common bile-duct varies somewhat. They end:

(a) By mixing superficially with the fibres of the inner circular muscular coat.

(b) By passing more or less abruptly under the fibres of the inner circular muscular coat and becoming lost among the fibres of the outer longitudinal coat.

(c) One lateral fasciculus may resemble description given under (a); the other may resemble that given under (b). An illustration of this is given in Fig. 6.

After this preliminary study an incision was next made along the median line of the common bile-duct extending from the point *A* to the point *R*. The fibres of the inner circular muscular coat of the intestine were then peeled off the bile-duct on both sides of the incision. The structure shown in Fig. 7 was revealed. Along the median line of the common bile-duct, a number of muscle fasciculi can be seen to arise. From this origin the muscle bundles run down and forward (towards the lower end of duodenum) over both sides of the common bile-duct. As the fibres on either side of the common bile-duct run forward they unite, forming a relatively large bundle of muscle on each side of the bile-duct and in direct contact with it.

The manner of termination of these bundles of muscles (running parallel with the bile-duct) varies somewhat. They end:

(a) By running forward and around under the ampulla of Vater, becoming continuous with fibres of the inner circular muscular coat of the intestine.

(b) By running forward, turning away from the bile-duct and blending with fibres of the inner circular muscular coat of the intestine.

(c) By running forward, passing under the annulus of muscle about the mouth of the common bile-duct and becoming lost among these fibres.

(d) One side ends according to (b); the other side according to (c).

The mode of termination in Fig. 7 corresponds to that described under (c).

At the point *O*, Fig. 7, some fibres of the inner circular muscular coat bend around the common bile-duct forming a U-shaped curve. This is the place of entrance of the common bile-duct into the muscle of the inner circular muscular coat of the intestine.

The common bile-duct is finally teased completely away and the muscle fibres of the inner circular muscle coat are revealed. These muscle fibres are found to be present from the point *A* to the point *M*, Fig. 6. It will be remembered that fibres of

* The terms non-pancreatic and pancreatic are used here to discriminate between the two sides of the bile-duct. The pancreatic side is so called because the common bile-duct is usually joined on this side by the duct of Wirsung.

the inner circular muscular coat pass over the common bile-duct from the point *A* to the point *R*. Removal of the remaining fibres of the inner circular muscular coat discovers the outer longitudinal muscle coat of the intestine. In Fig. 8, the point *F* represents the arrangement of the fibres of the outer longitudinal muscle coat of the intestine at the place of entrance of the common bile-duct into the intestinal wall.

In addition to this general description the following points deserve to be mentioned. In some specimens at the pancreatic side of the mouth of the common bile-duct additional muscle bundles more or less involved with some already described can be made out. The resulting structure suggests a *point d'appui*. One never sees such a *point d'appui* developed on the non-pancreatic side.

In all cases the course of the common bile-duct through the wall of the duodenum is slightly oblique with reference to the inner circular muscle coat of the intestine; in most cases the course is also slightly curved—the convex side being the pancreatic side of the common bile-duct.

The Duct of Wirsung.—Speaking relatively, the duct of Wirsung was found in many cases to run among the muscle fibres of the *point d'appui* situated at the pancreatic side of the mouth of the common bile-duct. The duct of Wirsung joins the common bile-duct at its extreme end; the pancreatic and common bile-duct opening side by side. The annulus of muscle fibres about the mouth of the common bile-duct accordingly also embraces the mouth of the duct of Wirsung.

In Fig. 8, point *W*, the arrangement of the outer longitudinal muscle coat of the intestine at the point of entrance of the duct of Wirsung into the intestinal wall is illustrated.

A study of serial cross-sections of the duodenal portion of the dog's common bile-duct.—Two sets of serial sections were prepared and examined. The specimens were stained in bulk with borax carmine and embedded in paraffin. The following drawings are taken from sections at different points in the course of the common bile-duct through the intestinal wall. They begin near the duodenal papilla and pass back towards the point of entrance of the duct into the intestinal wall. (Figs. 9 to 13).

Fig. 9 is made from a cross-section taken through the duct of Wirsung and the common bile-duct near their junction. Most interest attaches to the appearances in the submucosa. Here are to be seen two openings with irregular contours. The one to the right—the larger—is the lumen of the ductus communis choledochus. The other is the lumen of the duct of Wirsung. Surrounding these lumina, so as to embrace them, are bundles of smooth muscle. The figure shows one muscle bundle traversing the space between the two lumina and connected above and below with other muscle bundles in such manner as to form a double ring of muscle embracing the two ducts. The ring of muscle here shown corresponds to the muscle ring about the mouth of common bile-duct found in macerated specimens. Examination of second set of serial sections in this region showed the muscle ring embracing both the common bile-duct and the duct of Wirsung, but in this instance no distinct bundle of muscle could be seen traversing the space between the two lumina. Apparently no one has suspected, up to the present time, the existence of this double muscle ring embracing the mouths of the common bile-duct and the duct of Wirsung.

On both sides of this double ring of muscle one can make out muscle bundles cut transversely. In two or three places the bundles of the muscle ring are connected with these transversely cut fibres. These bundles (transversely cut) as well as others seen below lying on the inner surface of the inner circular muscular coat of the intestine, represent sections of those lateral fasciculi which in macerated specimens are seen to have origin in the ring of muscle about the mouth of the common bile-duct and to bend around and run down in the duodenum (see *X*). Other sections show these lateral fasciculi terminating by mixing superficially with the muscle fibres of the inner circular muscular coat. It is to be noted that the lumen of the common bile-duct is partially filled with folds of mucous membrane at this point.

Fig. 10 is taken at a point further away from the mouth of the common bile-duct. In this section only one lumen is present, that of the common bile-duct. The lateral fasciculi which have origin in the ring of muscle about the mouth of the common bile-duct, and which bend around and run down the duodenum are, however, shown here quite well. The mass of muscle to which the lateral fasciculus runs (on the left) probably represents the *point d'appui* noted in the macerated specimens.

Fig. 11 is taken at a point about midway in the course of the common bile-duct through the intestinal wall. The structures show the division of the inner circular muscular coat of the intestine. Part passes over and part passes under the common bile-duct. Where the two parts of the inner circular muscular coat unite on either side of the common bile-duct to form the complete inner circular muscular coat again, muscle fibres can be seen running from the upper to the lower part. This occurs on both sides, and there is, therefore, a complete ring of muscle around the duct. This arrangement must not, however, be regarded as perfectly symmetrical. Furthermore, some sections in this region show a simple decussation of fibres of the upper division with fibres of the lower division of the inner circular muscular coat. This latter arrangement (decussation on both sides of the common bile-duct) seems to hold entirely for the second set of serial sections. On both sides of the lumen of the common bile-duct, muscle bundles in transverse section are seen. These represent those bundles of muscle which have origin in the median line of the common bile-duct and afterwards run forward parallel with the long axis of the tube (see *N*).

Fig. 12 shows those muscle bundles which arise in the median line of the common bile-duct. They are seen here only on the right, running down over the side of the bile-duct (see *N*); it should be noted, however, that this arrangement is bilateral. The bundles of muscle cut transversely represent those muscle bundles which run forward, parallel with the common bile-duct, after taking their origin in the median line of the bile-duct.

Fig. 13 is taken at a point where the bile-duct has almost left the intestinal wall. The inner circular muscular coat passes entirely over the common bile-duct at this point. At the sides are seen large masses of longitudinal muscle fibres. These are the fibres of the outer longitudinal muscle coat which

have been pushed aside to allow passage to the common bile-duct.

IV.—THE MUSCULATURE OF THE BILIARY PASSAGES IN THE RABBIT.

(*a*) *Gall-bladder.*—The nitric acid, glycerine and water macerations show only transverse muscle fibres.

Specimens macerated in Ranvier's alcohol, and longitudinal celloidin sections reveal a muscular arrangement practically identical with that found in the dog. There seems, however, to be relatively more muscle in the gall-bladder of the rabbit than in that of the dog.

(*b*) *Cystic duct.*—Only transverse muscle fibres are seen in specimens macerated with nitric acid, glycerine and water. Longitudinal celloidin sections show the absolute amount of smooth muscle in the walls of the cystic duct to be small, and that the muscle fibres run in three directions, longitudinal, transverse and diagonal. The transverse muscle fibres are most numerous, the longitudinal fibres next in number and the diagonal fibres least of all. Connective tissue penetrates between the muscle bundles to a relatively greater degree than in the gall-bladder.

(*c*) *Hepatic duct.*—No muscle fibres were found in macerations with nitric acid, glycerine and water. Longitudinal celloidin sections showed a very small amount of muscle. The muscle fibres follow three directions, longitudinal, transverse and diagonal. The longitudinal fibres are most numerous. The transverse and diagonal fibres are about equal in number but there are very few of either variety. There is much connective tissue here between the muscle.

(*d*) *Common bile-duct.*—Muscle fibres could not be detected in nitric acid, glycerine and water macerations. Longitudinal celloidin sections show longitudinal and transverse muscle fibres. The former are much more numerous than the latter. The absolute amount of muscle present in the walls of the common bile-duct is, however, very small.

(*e*) No extraordinary muscular arrangement was found at the place of union of the hepatic and cystic ducts with the common bile-duct.

(*f*) The *rabbit's duodenum* was macerated in a mixture of nitric acid, glycerine and water. After the mucous membrane had been removed the structure represented by Fig. 14 was found. The course of the common bile-duct through the intestinal wall is parallel to that of the fibres of the inner circular muscular coat. This is just the reverse of what is found in the dog. At the first glance, one can see that the greater part of the duodenal portion of the common bile-duct is covered with muscle fibres of the inner circular muscular coat.

Some of these fibres of the inner circular muscular coat run up on the common bile-duct (see *A*), continue for some distance and terminate abruptly near the orifice of the duct (see *R*). Other fibres of the inner circular muscular coat run up on the duct, continue forward a short distance, but finally bend, some to one side, others to the opposite side (see *C*) and running down over the side of the duct, become continuous with the fibres of the inner circular muscular coat. The presence of some fibres of the inner circular muscular coat just under the ampulla of Vater is to be noted (see *CS*).

Fig. 14 also shows a sphincter muscle about the orifice of the common bile-duct (see *S*). This sphincter is composed of a muscular ring which surrounds the orifice of the duct. Some fibres instead of running completely around the orifice, run off at the side of the ring and bending forward become continuous with the fibres of the inner circular muscular coat.

The fibres of the inner circular muscular coat were next removed (except at *CS*). The arrangement seen is represented in Fig. 15. The common bile-duct is seen penetrating the outer longitudinal muscular coat. The outer longitudinal muscle at the point of entrance of the common bile-duct (see *A*) covers some muscle fibres which run around the common bile-duct embracing it. Immediately after penetrating the outer longitudinal muscular coat the bile-duct can be seen to be encircled with smooth muscle. Those muscle fibres nearest the point of entrance of the common bile-duct, run around or encircle the bile-duct without bending forward (see *IR*), but as the orifice of the duct is approached the muscle fibres which embrace the bile-duct, after running down over the side of the duct, bend forward more and more.

Thus it will be seen that in all cases, the muscle fibres described embrace the duct but with the difference pointed out above, namely, that those fibres nearest the point of entrance of the common bile-duct do not bend forward as they pass under the common bile-duct, while those nearer the orifice of the bile-duct do bend forward as they pass under it. All the muscle fibres just mentioned doubtless have a sphincter function, but if we regard the sphincter muscle of the dog we will find it homologous with the sphincter fibres *S* of the rabbit. Therefore, the rabbit has not only a sphincter similar to that of the dog, but it possesses also other fibres which subserve in all probability the same or a similar function.

The muscle fibres encircling the common bile-duct were now cut along the long axis of the duct. The mucous membrane of the duct was removed and an arrangement represented in Fig. 16 was found. At this point it is well to recall that the fibres marked *CS* in both Fig. 15 and Fig. 16 are those fibres of the inner circular muscular coat which lie immediately in front of and also under the ampulla. These muscle fibres (see Fig. 16, *CS*) run under the ampulla and there decussate irregularly, so that the fibres of the one side pass to the other side, and then curving upward and backward around the common bile-duct, embrace it. Here is seen the origin or termination of those muscle fibres which embrace the common bile-duct and bend forward as they pass under the bile-duct. Passing from this place of decussation, back toward the point of entrance of the common bile-duct into the intestinal wall, one finds the continuation of those muscle fibres which simply embrace the duct without bending forward as they pass under it (see Fig. 16, *IR*).

The muscle fibres of the outer longitudinal muscular coat, which lie in front of the ampulla and under the fibres marked *CS* have no connection with the muscular arrangement of the duodenal portion of the common bile-duct. Further back, however, near the decussation of the fibres *CS*, the fibres of the outer longitudinal muscle coat seem to be more or less involved in the general decussation. Some of the fibres of the outer longitudinal muscle coat run up to the side of the bile-

duct, then bend around and run forward on it and at its side toward the ampulla. Others, when they reach the side of the duct, plunge inward and mingle with those bundles which embrace the common bile-duct.

Serial cross-sections of the duodenal portion of the common bile-duct of the rabbit.—Two sets of serial sections were prepared and examined. The principal points of interest are presented in the following cuts which are taken at different levels in the duodenal portion of the common bile-duct. The first figure corresponds to a section taken nearest the orifice of the common bile-duct, the others are taken at successively different levels throughout the length of the duct.

In Fig. 17, at first glance, the course of the common bile-duct in the intestinal wall is seen to be parallel to the inner circular muscular fibres. The duct is situated in the submucosa of the intestine, and is seen to be surrounded by muscle bundles. The smooth muscle embraces the common bile-duct, but on each side of it some muscle fibres, instead of running under the duct, turn forward and the cross-sections of the individual smooth muscle cells indicate the fact that they have continued as a part of the fibres of the inner circular muscular coat (see *X*). Between the mucous membrane of the common bile-duct and the inner circular muscular coat of the intestine are seen muscle bundles which run transverse to the course of the common bile-duct. These fibres correspond to that portion of the sphincter which runs under the common bile-duct. Comparison shows that the inner circular muscular coat (see *CS*) has lost few if any muscle fibres at this point. This is a fact which will have more importance in connection with the decussation of the fibres of the inner circular muscular coat. It should be noted that the fibres marked *CS* correspond to those marked *CS* in the macerated specimen. At this level of the common bile-duct the lumen is occupied to a considerable extent by folds of mucous membrane.

Fig. 18 has been taken at a level in the duodenal portion of the common bile-duct, further from the orifice than Fig. 17. The structures to be noted have passed from the submucosa into the tunica muscularis of the intestine. The large lumen of the common bile-duct is conspicuous (see *B*) and to the right, the first indication of the duct of Wirsung is met with. If we begin the description at the extreme left of the figure, just beneath the submucosa are to be seen a large number of muscle fibres in cross-section (see *CI*). These are present, but in diminished number throughout more than one-half the breadth of the section. These fibres belong to the inner circular muscular coat of the intestine which at this point does not quite cover the bile-duct.

Toward the extreme right are seen large bundles of transversely cut muscle fibres (see *CI*). Running to join these last named bundles, are muscle fibres cut diagonally and longitudinally. The longitudinally cut muscle fibres apparently arise from the outer longitudinal muscle coat of the intestine and running over the common bile-duct finally bend around and become continuous with the transversely cut inner circular muscular fibres *CI*. If we again examine the extreme left of the figure, there are to be seen fibres cut longitudinally (see *LI*) immediately under the inner circular muscle coat. These represent the outer longitudinal muscular coat. In this particular section there is a division of the fibres of the outer longitudinal muscular coat. Some pass over the duct and then bend around as described above to become continuous further forward with the inner circular muscle coat. Others run as if to pass under the bile-duct but suddenly terminate. In their place one sees transversely cut muscle fibres which extend for a considerable distance to the right and then suddenly stop (see *LF*). Where these fibres (*LF*) stop we find longitudinally cut muscle which represents the outer longitudinal muscle coat of the intestine (see *LI*). The explanation of the structures last mentioned is probably to be found in the circumstance that the muscle fibres of the outer longitudinal muscular coat on either side of the long axis of the common bile-duct bend around and, converging, run forward in the direction of the ampulla of Vater. The fibres marked *LF* represent those muscle bundles which run forward. The transversely cut muscle fibres marked *CS* represent fibres of the inner circular muscle coat. These are the continuation of the fibres marked *CS* in Fig. 17 and correspond to the *CS* fibres of the macerated specimen. At this level the decussation of the inner circular muscle fibres as described in the macerated specimen ought to be seen, and as a matter of fact this decussation corresponds to those muscle bundles of the figure which have not already been described. They run up on the right as diagonally cut muscle. The segments of diagonally cut muscle show that successive bundles have been cut. Running under the bile-duct is another large muscle bundle. To the left of the bile-duct are still other bundles of diagonally cut muscle. I believe that all these bundles come from the *CS* fibres of Fig. 17 and that their particular arrangement is due to the decussation and subsequent embracing of the common bile-duct by them. This arrangement will be better understood by referring to the macerated specimen. This series of sections did not show muscle running between the lumen of the common bile-duct and the lumen of the duct of Wirsung, to form a double sphincter. Examination of the second set of serial sections, however, at about the same level as that represented by Fig. 18, proved this structure to be present. Here were found muscle bundles arising on the outer side of the common bile-duct from the region of the decussation of the inner circular fibres and running inward between the common bile-duct and the duct of Wirsung they finally were seen to terminate by blending with fibres on the inner side of the common bile-duct. These last-named muscle bundles had origin amongst the decussating fibres of the inner circular coat and then curved around the common bile-duct to the inner side of the same and finally blended in part with those fibres which have been described as running between the common bile-duct and the duct of Wirsung.

Fig. 19 is taken at a level still more remote from the duodenal papilla. Passing from the inner side of the intestine toward the outer side we see the mucosa of the intestine, the inner circular muscular coat of the intestine (see *CI*) and the outer longitudinal muscle coat (see *LI*). The lumen of the common bile-duct is prominent (see *B*) and to the right that of the duct of Wirsung. Around the bile-duct longitudinally cut muscle bundles are arranged. They embrace the duct and represent (1) independent muscle bundles embracing the duct

and (2) fibres of the outer longitudinal muscle coat (shown to the extreme right in the drawing) which have run up on the surface of the bile-duct.

Outside the bile-duct and the muscle bundles embracing it are seen muscle fibres cut transversely. On the left, diagonally cut bundles are found running toward this transversely cut muscle. These diagonal bundles represent those fasciculi of the outer longitudinal muscle coat which have curved around at the side of, and also on, the common bile-duct and then have run forward toward the ampulla of Vater (see *LF.*)

In Fig. 20 the typical intestinal wall is shown. The common bile-duct is outside the intestinal wall and a few longitudinal and diagonal muscle bundles are to be seen in its wall. These must be regarded as stray fibres running up on the bile-duct from the intestine and not as fibres of the proper fibro-muscular tunic of the common bile-duct.

V.—THE MUSCULATURE OF THE BILIARY PASSAGES IN MAN.

(*a*) *Gall-bladder.*—What has been said concerning the gall-bladder of the dog may be repeated of the gall-bladder of man. Fig. 21.

(*b*) *Cystic duct.*—Macerations in a mixture of nitric acid, glycerine and water showed the arrangement of smooth muscle to be plexiform. Longitudinal celloidin sections of the cystic duct demonstrated smooth muscle running in three directions, viz. transverse, longitudinal and diagonal. Fig. 22. The transverse bundles are most numerous; the longitudinal and diagonal bundles are about equal in number. In that portion of the cystic duct nearest the neck of the gall-bladder, the amount of muscle is considerable, but this gradually diminishes in amount as the common bile-duct is approached. At the junction of the cystic, hepatic and common bile-duct the quantity of muscle present is very small. These sections also show muscle fibres in those folds of the cystic duct which are known as the valves of Heister. The fact that muscle is present in these folds has been noted before by only one person (A. MacAlister) and he does not undertake to describe the course pursued by the muscle bundles.

In a set of serial longitudinal sections of the entire human cystic duct, I have found the arrangement represented by the following schema. Fig. 23. This schema, based upon study of the serial sections, shows:

(1) That the transverse muscle bundles of the cystic duct are not limited to the wall proper, but at the level of the valves of Heister also run around in the valve in a circular direction. It is just as if the wall of the duct had been invaginated at this level and as a result the circular muscle fibres were carried out into the fold thus formed.

(2) That most of the longitudinal muscle bundles of the cystic duct continue down the duct without entering the valve, but still there are some of these bundles which (having reached the level of the valve) bend around at almost right angle and run out into the fold.

(3) We have no evidence that the diagonal fibres take any part in the musculature of the valves of Heister.

We believe, therefore, that the transverse muscle bundles predominate in the valves of Heister. Those valves nearest the common bile-duct are quite small and either contain very little muscle or none at all.

(*c*) *Hepatic duct.*—The description of the rabbit's hepatic duct applies without any addition to the hepatic duct of man. Fig. 26.

(*d*) *Common bile-duct.*—The muscle fibres could not be detected with certainty in nitric acid, glycerine and water macerations. Longitudinal celloidin sections revealed a small amount of muscle. The direction followed was not only transverse but also longitudinal and diagonal. The number of transverse and longitudinal fibres was about equal; the oblique muscle fibres were least numerous. Much connective tissue was found between the muscle fibres. Fig. 27.

(*e*) *Point of union of cystic, hepatic and common bile-ducts.*—Each duct preserved its typical structure.

(*f*) Preliminary to the description of *the duodenal portion of the human common bile-duct*, it will be well to state that many individual variations in structure occur but that these variations do not alter the general anatomical bearing of this region.

The following drawings have been made from a typical specimen macerated in a mixture of nitric acid, glycerine and water.

Fig. 28 shows the entrance of the common bile-duct *B* and the duct of Wirsung *W* into the intestinal wall. We see a simple separation of the fibres of the outer longitudinal muscular coat of the intestine *LI.* The common bile-duct and the duct of Wirsung pass through this separation. At *F* we find muscle fibres arising from the outer longitudinal muscular coat. These fibres run up on the common bile-duct and becoming gradually less and less marked, finally disappear. This arrangement is bilateral. The fibres marked *IR* represent some bundles of muscle which (shown in Fig. 30, *IR*) form an independent ring of muscle around the common bile-duct between it and the duct of Wirsung.

At *H* are seen muscle fibres which run almost entirely around the duct of Wirsung, but as these fibres approach that side of the pancreatic duct nearest the common bile-duct, they turn abruptly and run up on the duct of Wirsung in a longitudinal direction. They gradually diminish in volume as they ascend the duct. This structure is bilateral. See also Fig. 30, *H.*

Fig. 29 represents the structures seen upon removal of the mucous membrane from the intestinal wall in the region of the duodenal papilla. The inner circular muscular coat of the intestine is represented by *CI.* The first point to demand attention is the penetration of the inner circular muscular coat by the common bile-duct. At the spot of penetration there is a simple separation of the muscle bundles of the inner circular muscle coat. It should be noted that the human specimen differs from the arrangement found in dog. It will be remembered that in the latter animal, the inner circular muscle coat forms a tube-like structure which embraces the common bile-duct for a considerable distance. In man the common bile-duct plunges immediately through the muscle layer which composes the inner circular muscular coat.

At *S* are bundles of muscle running around the common bile-duct (see also Fig. 30, *S*). These are independent rings of muscle which embrace the duct. Now, if we look further

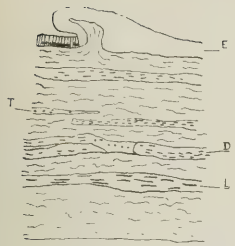


FIG. 1.—Longitudinal section of the gall-bladder of dog. × 30.

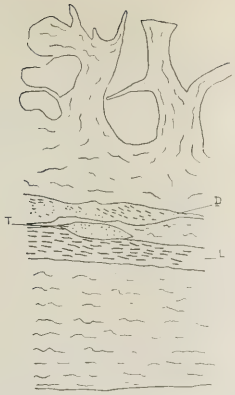


FIG. 2.—Longitudinal section of the cystic duct of dog. × 30.

FIG. 3.—Longitudinal section of the cystic duct of dog, showing the musculature of a Heisterian valve. × 30.

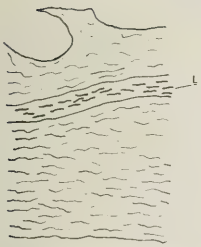


FIG. 4.—Longitudinal section of the hepatic duct of dog. × 30.

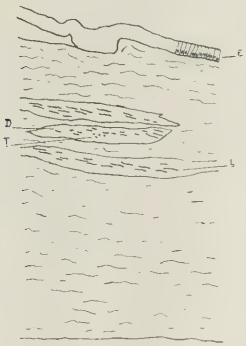


FIG. 5.—Longitudinal section of the common bile-duct of dog. × 30.

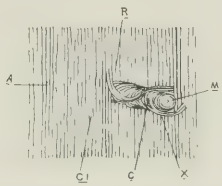


FIG. 6.—Macerated duodenal portion of the common bile-duct of dog. The mucous membrane, muscularis mucosæ and submucosa of the intestine have been removed. × 4.

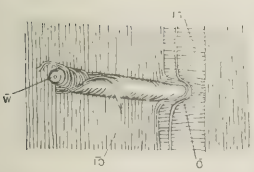


FIG. 7. - Macerated duodenal portion of the common bile-duct of dog. Part of the circular muscular coat of the intestine has been removed. × 4.

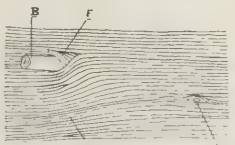


FIG. 8.—Macerated duodenal portion of the common bile-duct of dog. The relation of the common bile-duct to the longitudinal muscular coat of the intestine is shown. × 4.

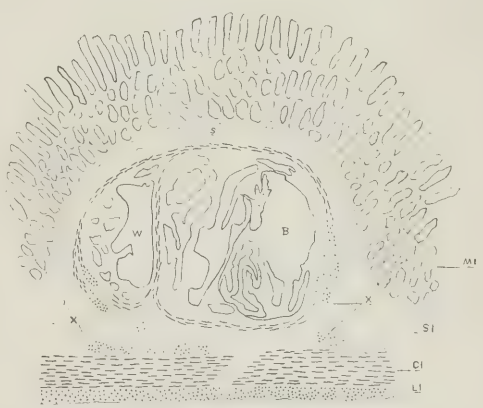


FIG. 9.—Cross-section near the orifice of the duodenal portion of the common bile-duct of dog. × 30.

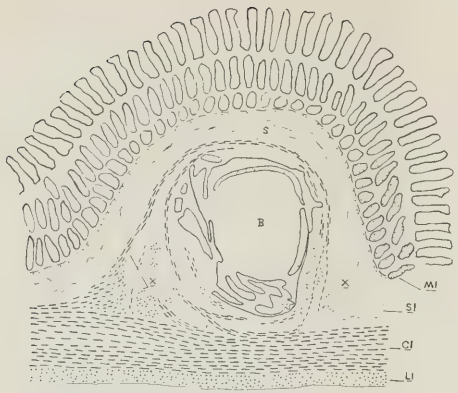


FIG. 10.—Cross-section somewhat removed from the orifice of the duodenal portion of the common bile-duct of dog. × 30.

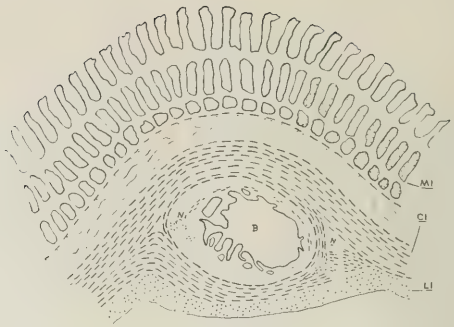


FIG. 11.—Cross-section near the middle of the duodenal portion of the common bile-duct of dog. × 30.

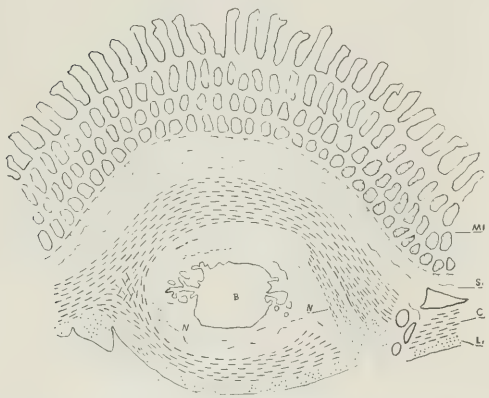


FIG. 12.—Cross-section somewhat removed from the middle of the duodenal portion of the common bile-duct of dog. × 30.

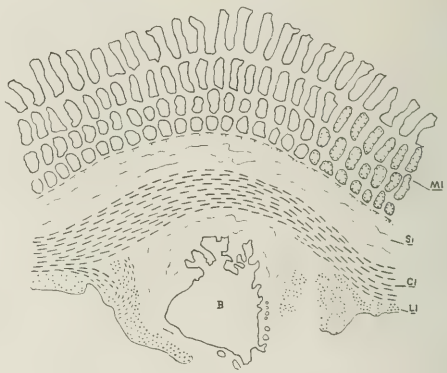


FIG. 13.—Cross-section at the entrance of the common bile-duct into the intestinal wall of dog. × 30.

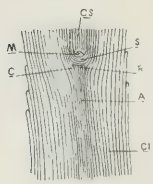


FIG. 14.—Macerated duodenal portion of the common bile-duct of rabbit. The mucous membrane, muscularis mucosæ and submucosa of the intestine have been removed. × 4.

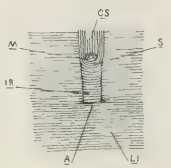


FIG. 15.—Macerated duodenal portion of the common bile-duct of rabbit. The greater part of the circular muscular coat of the intestine has been removed. × 4.

FIG. 16.—Macerated duodenal portion of the common bile-duct of rabbit, showing the distribution of the *CS* and *IR* fibres. × 4.

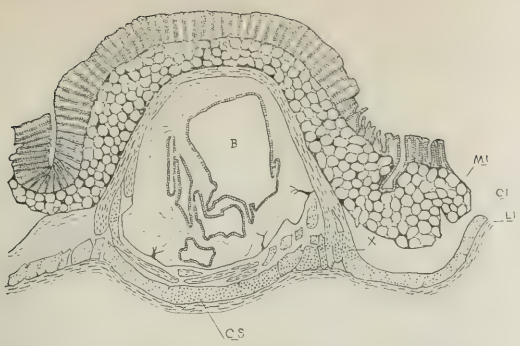


FIG. 17.—Cross-section near the orifice of the duodenal portion of the common bile-duct of rabbit. × 40.

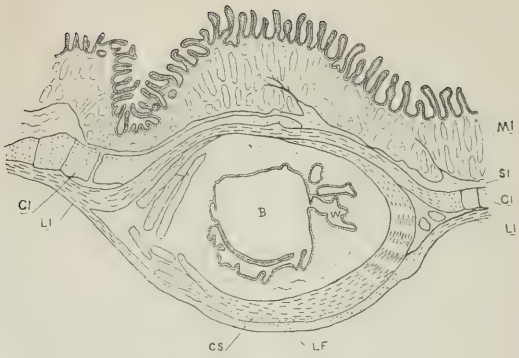


FIG. 18.—Cross-section somewhat removed from the orifice of the duodenal portion of the common bile-duct of rabbit. × 40.

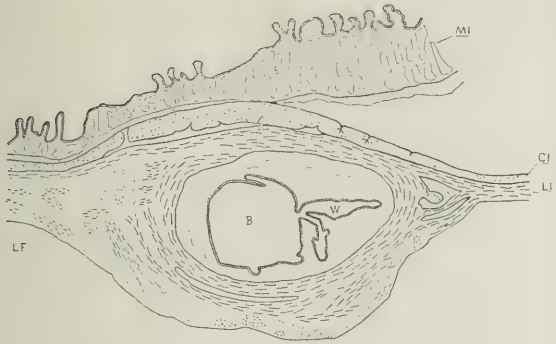


FIG. 19.—Cross-section near the entrance of the common bile-duct into the intestinal wall of rabbit. × 40.

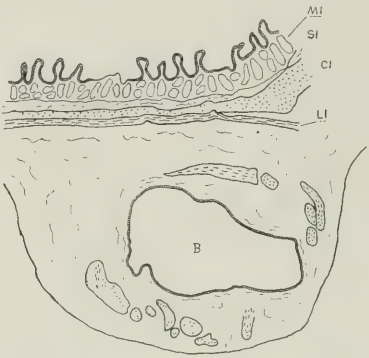
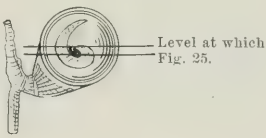


FIG. 20.—Cross-section at the entrance of the common bile-duct into the intestinal wall of rabbit. × 40.



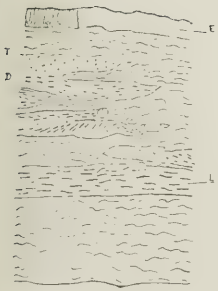


FIG. 21.—Longitudinal section of the gall-bladder of man. × 30.

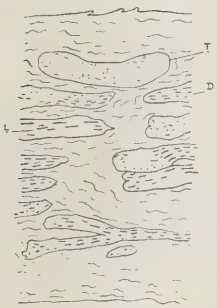


FIG. 22.—Longitudinal section of the cystic duct of man. × 30.

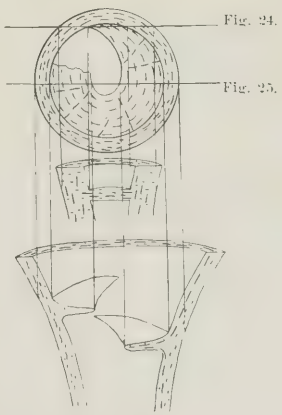


FIG. 23.—The cystic duct of man, showing the Heisterian valve; also, a diagram of the musculature of the Heisterian valve.

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FIG. 24.—One of the longitudinal serial sections of the cystic duct of man. See Fig. 23. × 30.

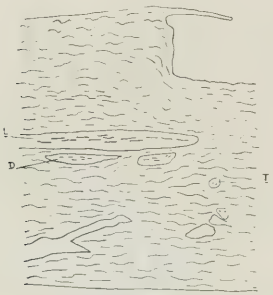

FIG. 26.—Longitudinal section of the hepatic duct of man. × 30.

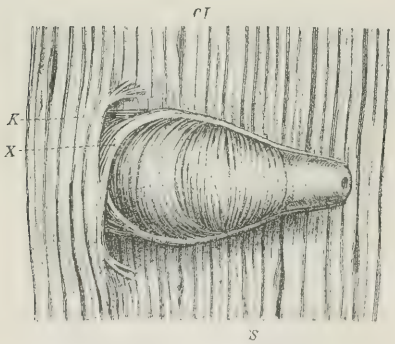

FIG. 29.—Macerated duodenal portion of the common bile-duct of man. The mucous membrane, muscularis mucosæ and submucosa of the intestine have been removed. × 5.

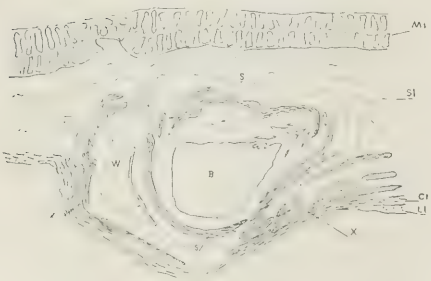

FIG. 31.—Cross-section near the orifice of the duodenal portion of the common bile-duct of man. × 30.

FIG. 25.—One of the longitudinal serial sections of the cystic duct of man, showing the musculature of a valve of Heister. See Fig. 23. × 30.

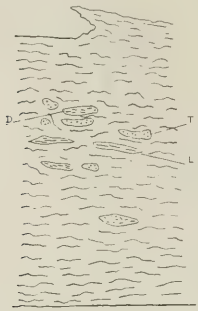

FIG. 27.—Longitudinal section of the common bile-duct of man. × 30.

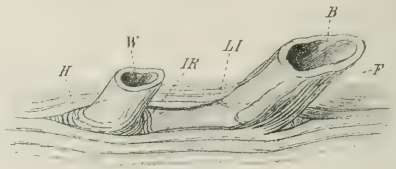

FIG. 28.—Macerated duodenal portion of the common bile-duct of man. The relation of the common bile-duct and the duct of Wirsung to the longitudinal muscular coat of the intestine is shown. × 5.

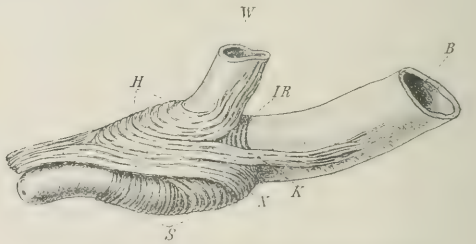

FIG. 30.—Macerated duodenal portion of the common bile-duct of man. All of the intestinal coats have been removed. × 5.

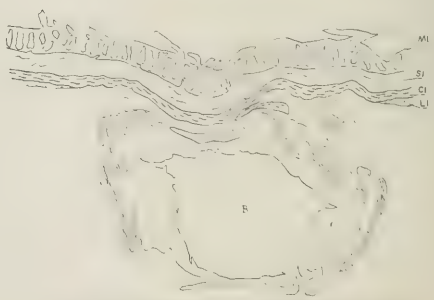

FIG. 32.—Cross-section at the entrance of the common bile-duct into the intestinal wall of man. × 30.

back on the common bile-duct, near the point at which it penetrates the inner circular muscular coat, we observe muscle bundles *X* which do not run entirely around the duct. These muscle bundles are very intimately mixed with the independent muscle rings which completely embrace the duct. The former, however, upon reaching the level of the inner circular muscle coat, turn abruptly forward and under the bile duct, and after running for some distance toward the duodenal papilla finally end in the connective tissue of the submucosa of the intestine (see also Fig. 30, *X*). This arrangement is bilateral. The drawing shows that this arrangement of muscle about the common bile-duct begins at a point before the duct penetrates the inner circular muscular coat. In this particular specimen, a muscle bundle of the inner circular muscular coat curves around and becomes continuous with the fibres marked *X*. It may be well to note that the *X* fibres did not terminate in all cases according to this description. In several cases these fibres, after turning forward and under the common bile-duct, decussated with similar ones from the opposite side and after such decussation became continuous with the fibres of the inner circular muscular coat of the intestine. In one case the *X* fibres after turning forward suddenly plunged through the inner circular muscle coat and became continuous with the fibres of the outer longitudinal muscle coat of the intestine.

Another point observed in some specimens but not in this one is worthy of mention. In some specimens after dissecting away the *S* fibres, a few longitudinally and diagonally disposed fibres were seen. These had origin in those fibres of the outer longitudinal and inner circular muscle coat which lie over the common bile-duct when viewed as in Fig. 29. Finally in Fig. 29 a bundle of muscle fibres *K* can be seen on each side of the common bile-duct running parallel with it. These bundles arise on the surface of the common bile-duct (Fig. 30, *K*) and are covered by the *F* fibres of Fig. 28. In this case they run forward from under the inner circular muscular coat (see Fig. 29, *K*) and bend around beneath the common bile-duct, becoming continuous with each other, thus forming a loop around the duct of Wirsung, Fig. 30, *K*. In other specimens these *K* fibres originate in the same way but terminate by running under the common bile-duct and decussating there with similar fibres from the opposite side.

Fig. 30 shows the muscular arrangement about the end of the common bile-duct and the duct of Wirsung after all fibres of the outer longitudinal and inner circular muscle coats have been removed. The common bile-duct and the duct of Wirsung have been drawn in the same position as they occupied in Fig. 28, but removal of the muscular coats of the intestine permits of a view of the various structures in profile. All the structures here shown have been described more or less fully under Figs. 28 and 29.

After an examination of *serial cross-sections of the duodenal portion of the human common bile-duct,* we have selected two of them for illustration since they represent the principal points. The first figure (Fig. 31) is taken near the level of union of the common bile-duct with the duct of Wirsung. The structures of interest are situated in the submucosa of the intestinal wall. The large opening—to the right—is the lumen of the ductus communis choledochus; the narrow slit—to the left—represents the collapsed lumen of the duct of Wirsung. At the point *X*, muscle bundles cut in cross-section and sometimes diagonally are seen. These bundles represent those fibres of the sphincter muscle which do not run entirely around the common bile-duct. They become detached at the side of the duct from the sphincter proper and turn forward. These bundles then run forward, under the common bile-duct and gradually approach the bundles of the opposite side; they finally end free in the connective tissue of the submucosa near the orifice of the common bile-duct. These bundles correspond to the *X* fibres of the macerated specimen. It is probable that the *K* fibres of the macerated specimen are also included among the bundles described above, but we have not been able to distinguish them in the sections from the others.

The remaining bundles of muscle about the common bile-duct belong to the sphincter muscle proper: they correspond to the *S* fibres of the macerated specimen. A bundle of muscle fibres cut longitudinally is seen running between the lumen of the duct of Wirsung and that of the common bile-duct. I consider this to be a bundle of the sphincter muscle and believe that it corresponds to the "double sphincter" arrangement found in the dog and rabbit, and described above.

The second section (Fig. 32) represents the common bile-duct just before it has penetrated the muscle coats of the intestine. Around the common bile-duct are seen muscle bundles cut transversely. These represent the *K* fibres of the macerated specimen. No muscle fibres arising from the outer longitudinal muscle coat and running up on the common bile-duct can, however, be demonstrated in this specimen.

VI.—CONCLUSIONS.

The principal results of this research may be briefly summed up in tabular form; under the various heads only the most general findings are mentioned.

	Dog.	Rabbit.	Man.
	Distribution of the muscle bundles.	Distribution of the muscle bundles.	Distribution of the muscle bundles.
(a) Gall-bladder	Transverse* Longitudinal Diagonal	Transverse Longitudinal Diagonal	Transverse Longitudinal Diagonal
(b) Cystic duct	Transverse Longitudinal Diagonal	Transverse Longitudinal Diagonal	Transverse Longitudinal Diagonal
Valves of Heister	The transverse fibres of the cystic duct run around in the valves of Heister in a circular direction. The longitudinal fibres bend at a right angle and run out into the valve. Diagonal fibres apparently do not enter the valves of Heister.		
(c) Hepatic duct	Longitudinal	Transverse Longitudinal Diagonal	Transverse Longitudinal Diagonal

*These terms are used with reference to the long axis of the duct.

(d) Common bile-duct	Transverse Longitudinal Diagonal	Transverse Longitudinal	Transverse Longitudinal Diagonal
(e) Place of union of the cystic, hepatic and common bile-ducts	Each duct preserved its typical structure; the wall of each gradually merging into that of the others.	Each duct preserved its typical structure; the wall of each gradually merging into that of the others.	Each duct preserved its typical structure; the wall of each gradually merging into that of the others.
(f) Duodenal portion of the Common bile-duct	A sphincter muscle exists.	A sphincter muscle exists.	A sphincter muscle exists.

VII.—INDEX LETTERING OF THE FIGURES.

B, Common bile-duct.
CI, Circular muscular coat of the intestine.
CS, Fibres of the circular muscular coat of the intestine which have a distribution indicative of a secondary sphincter.
D, Diagonal muscle.
E, Epithelium.
GB, Next to gall-bladder.
IR, Independent rings of muscle embracing the common bile-duct.
K, Fibres which arise on the common bile-duct and run around the duct of Wirsung to become continuous with similar fibres of the opposite side.
L, Longitudinal muscle.
LI, Longitudinal muscular coat of the intestine.
LF, Fibres of the longitudinal muscular coat of the intestine which turn and run forward toward the ampulla of Vater.
M, Mouth of the common bile-duct.
MI, Mucous membrane of the intestine.
N, Muscle bundles which have origin in the median line of the common bile-duct and afterwards run forward parallel with the long axis of the duct.
NB, Next to common bile-duct.
S, Sphincter fibres.
SI, Submucosa of the intestine.
T, Transverse muscle.
W, Duct of Wirsung.
X, Those fibres of the sphincter which become detached laterally and run down the intestine.

DEVELOPMENT OF THE INTERNAL MAMMARY AND DEEP EPIGASTRIC ARTERIES IN MAN.

By Franklin P. Mall.

(*From the Anatomical Laboratory of the Johns Hopkins University.*)

The great importance of the fact that the main arteries of the vertebrates arise directly from the aortic arches has been shown repeatedly in ontogenetic and phylogenetic studies. Furthermore, it gives us a scientific basis for the explanation of the numerous variations which may occur while this simple system of arteries is being transformed into the complex system as found, for instance, in man.

While the modification of the aortic arches is taking place, certain arteries become larger, others disappear, while in others the direction of the circulation is reversed. The laws governing these changes have been discussed extensively by Thoma in his numerous communications. It is the law of use and disuse expressed in this instance by *rapidity*. For a given vessel at a given time in its development there is a certain rapidity of circulation through it at which it ceases to grow. If the rapidity of the circulation is increased the vessel becomes larger; if it is diminished the vessel becomes smaller; if the circulation comes to a standstill the vessel disappears altogether. This law is constantly at work throughout development in the grown animal and in all pathological changes. It does not appear to govern the first growth of the capillaries but it governs the growth of the vessels after the circulation in them is once started.

Any one who has studied the growth of the blood-vessels extensively in living animals as well as in fixed preparations is well aware of the fact that blood-vessels are constantly being formed and destroyed. This process is so extensive that at almost any stage of the development of an animal we may safely say that more blood-vessels have disappeared than are present at that time.

With the above ideas clearly in view, I have studied the extension of the blood-vessels into the body-walls of the embryo to see whether or not some secondary system, regular like the aortic arches, appears to be subsequently converted into the main arteries of the body-walls and the extremities. That the vertebral artery is formed by the union of a number of branches from the descending aorta has been shown by His,* by Froriep† and by Hochstetter.‡ These branches are the segmental arteries from the aorta while it is still in the branchial region. The aorta soon shifts away from the branchial region with the bending of the head and the development of the neck. While this is taking place the segmental arteries unite at their distal ends to form the vertebral artery while the communicating branches are gradually broken off as shown in Fig. 1, *V*, from a human embryo of the fourth week. This process continues down to the seventh cervical segmental artery, where it ceases. At this point the subclavian artery arises, Fig. 1, *S*, as shown by Hochstetter. From now on for a few segments the process is very difficult to follow, but further on throughout the thoracic region of the embryo the process is simple. This is easily accounted for by the perfect segmental arrangement of this portion of the body throughout its development.

There are, however, two other sets of segmental arteries in the thoracic region of the body which appear before this set is formed and gives rise to the arteries of the body-walls. The first set is already well developed in embryos at the end of the second week.§ They arise from the aorta and pass immediately to the umbilical vesicle, there to break up into a plexus which is collected by the omphalo-mesenteric veins. Soon these arteries disappear and the omphalo-mesenteric artery takes their place. These vessels are of course on the mesial side of the cœlom.

* His (W.) Anat. mensch. Embryonen. III. Zur Geschichte der Organe, Leipz., 1885.

† Froriep (A.) Arch. f. Anat. u. Physiol., Anat. Abth., Leipz., 1886, S. 69–150.

‡ Hochstetter (F.) Morphol. Jahrb., Leipz., Bd. xvi, 1890.

§ Mall (F. P.) J. Morphol., Bost., Vol. xii, 1896–7, Fig. 16.

Before this first system has disappeared, and before the permanent intercostal vessels have appeared the second set of segmental arteries arises from the descending aorta, passes on the lateral side of the cœlom into the membrana reuniens, as is indicated to us by a figure given by von Kölliker,* as well as by the description of His.† Von Kölliker pictures a cow's embryo with the whole membrana reuniens filled with a minute plexus of veins which radiate from the myotomes towards the umbilical cord, while His describes this same region in the human embryo as filled with branches of the umbilical vein which empty into the sinus reuniens above, and into the umbilical vein below. According to His's description they arise when the communication between the umbilical veins and the sinus reuniens is severed. Although the picture given by von Kölliker does not correspond with His's description it does not contradict it, nor is it peculiar to the cow's embryo. I have in my collection a well-preserved human embryo (No. LXXVI), in which the membrana reuniens is filled with a plexus of veins much like

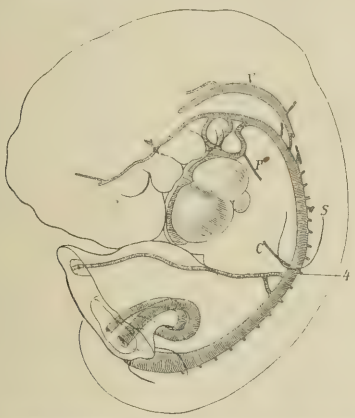

FIG. 1.—Arterial system of a human embryo four weeks old (No. II). Enlarged 10 times. *V*, vertebral artery; *P*, pulmonary artery; *C*, cœliac axis; *S*, subclavian artery; 4, fourth dorsal segmental artery.

that in the cow's embryo. The specimen was taken from the uterus seven hours after the death of the woman, and without opening, the ovum was hardened in absolute alcohol. All the vessels down to the capillaries are filled with blood, thus making it an excellent specimen for the study of the blood-vessels. It represents a stage somewhat more advanced than the one pictured by von Kölliker, as the plexus of veins does not cover the whole membrana reuniens. The ventral wall over the heart near the liver contains no vessels, while the membrana reuniens covering the upper end of the heart is filled with a plexus of vessels which communicate with the capillaries of the mandibular arch. There is an extensive plexus through the arm and lateral body walls which extends through the membrana reuniens covering the liver, and finally encircles the cord and communicates with the umbilical veins.

The specimen just described is about 22 days old and, although I have six other good embryos between 14 and 28 days old, I find no such plexus in the membrana reuniens, although in all but one of them (14 days) the arm shows a rich plexus of capillaries filled with blood. In stages older than four weeks I find no blood-vessels in the membrana reuniens with the exception of that portion encircling the cord, where there is a rich network of veins. Although I have a number of excellent specimens of five or six weeks, the membrana reuniens over the heart and liver contains no blood-vessels until it is invaded by the ventral plate, which is accompanied by the development of the intercostal vessels. In pigs' embryos this extensive membrane is also free from veins, with the exception of the zone encircling the cord, which again has a venous plexus more marked, however, than in the human embryo.

It appears, then, that during the third week of development, while the umbilical veins still empty into the sinus reuniens, an extensive plexus is formed throughout the greater extent of the membrana reuniens, which receives blood from the aorta on its dorsal side, and empties it into the umbilical vein on its ventral side. As the umbilical vein changes its position to enter the liver, this circulation through the membrana reuniens is broken up as the much earlier circulation through the umbilical vesicle was broken up.

The earliest collecting vein for the descending aorta is the omphalo-mesenteric vein; next, it is the umbilical vein, and finally, when the abdominal walls are completed, it is the cardinal. This in turn is partly converted into the vena cava inferior.

The permanent arterial system is already well outlined in embryo II (Fig. 1). The aortic arches and segmental arteries are sufficiently well marked to permit one to number them. The vertebral artery is in process of development, it being formed by a union of a number of segmental arteries, as shown by His, by Froriep, and by Hochstetter. The seventh cervical segmental artery gives rise to the subclavian artery. The lower cervical, all the dorsal and lumbar segmental arteries, are concerned in the development of the thoracic and abdominal walls. Fig. 1 illustrates the extent of the arteries. It shows a simple arrangement from the vertebral to the hypogastric artery. The lower lumbar arteries are not shown. A section of this embryo is given in Fig. 2. It shows the relation of a segmental artery to the myotome. The segmental arteries supply primarily the spinal cord and ganglia by two groups of branches, one near the middle line and one more lateral. A more ventral group of segmental arteries supplies the Wolffian body. The blood from all these groups of arteries is collected by the cardinal veins.

The lateral group gives rise to the intercostal arteries by first supplying the myotome, and, as this grows into the membrana reuniens by a process of budding, the vascular loop follows it. In so doing the loop is first on the dorsal side of the sympathetic and finally on its lateral side, thus making the sympathetic cord cross the intercostal arteries and veins on their ventral side, as is the case in the adult.

No sooner has the vascular loop extended to the lateral side of the sympathetic cord than it begins to anastomose with

*von Kölliker (A.) Grundriss der Entwicklungsgeschichte des Menschen und der höheren Thiere. 8°. Leipzig, 1880. S. 103, Fig. 85.

† His (W.) Anatomie menschlicher Embryonen. III, Zur Geschichte der Organe. Leipzig, 1885, 8°. S. 206, also Fig. 130.

neighboring segmental loops, as single vessels near the subclavian and hypogastric arteries, and as a plexus midway between these two. This gives us at this early period a complete lateral anastomosis from the subclavian artery to the femoral, as Fig. 3 shows. It remains only for this system to shift around towards the median line with the muscle, nerves and ribs to form the condition of things as found in the adult.

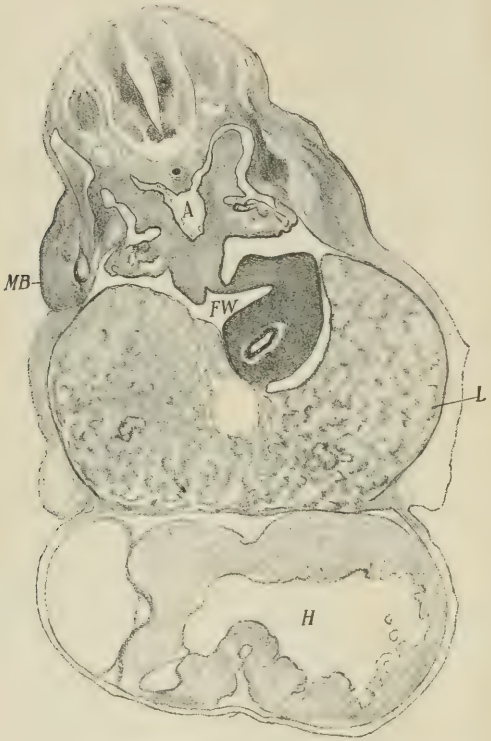

Fig. 2.—Section through a human embryo four weeks old (No. II). Enlarged 55 times. *A*, aorta; *FW*, foramen of Winslow; *MB*, membrana reuniens; *L*, liver; *H*, heart.

Fig. 3 shows that the upper and lower segmental arteries of the series do not correspond at this early time with the same in the adult. Above, the superior intercostal is missing, while below, there is only a small fourth lumbar artery present, and it arises from the middle sacral. Ilio-lumbar and circumflex-iliac arteries are altogether wanting, and I should judge from the relation of the arteries in this embryo, that the arch formed by the ilio-lumbar and circumflex-iliac is of secondary origin and has nothing to do with the segmental arteries. That they form anastomoses with the lower lumbar arteries in the adult can be explained in other ways.

The hypogastric artery is present long before the segmental arteries are formed near its junction with the aorta, and on this account we can no more call the trunk of the common iliac artery segmental than we can apply the same term to the descending aorta. We can only locate its origin in the neighborhood of the fourth lumbar artery.

Hochstetter has settled definitely that the subclavian is a branch from the seventh cervical segmental artery.* Between the seventh cervical and the third dorsal we have three segmental arteries. In Fig. 1 the segmental arteries in this region are all simple with the exception of the seventh, which sends a large branch into the arm. From this stage to the one pictured in Fig. 3 there is a jump, but in it we see the intermediate stage between Fig. 1 and the adult.

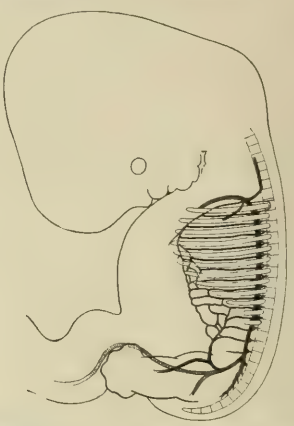

Fig. 3.—Arterial system of a human embryo six weeks old (No XLIII). Enlarged 5 times.

All of the arteries below the vertebral are destined to pass behind the sympathetic, and it is excluded only on account of its direction. In Fig. 3 the eighth cervical segmental passes on the ventral side of the nerve, which shows conclusively that it must either be a new artery or a secondary connection between the eighth segmental and the subclavian. Since the first and second intercostal arteries pass behind the sympathetic in this embryo and in front of it in the adult, we must accept Hochstetter's opinion that the superior intercostal is formed by secondary connections between the upper intercostals and the subclavian. If the old connection remains, it forms the arteria aberrans.

I stated above that the sympathetic lies in front of the subclavian, while in the adult it lies in a great part behind it. Hochstetter explains this change of position by a wandering of the trunk of the artery through the group of embryonic nerve cells. In early embryos the sympathetic system resembles a group of sprouts from the segmental nerves which cross the segmental arteries, and the sympathetic cord is of secondary formation. This cord grows very rapidly during the fifth and sixth weeks, to form a great mass of cells extending from the vagus gang-

* Hochstetter numbers the segmental arteries to correspond with the vertebræ above them. Throughout I number the arteries with their accompanying nerves. He states that the subclavian arises from the sixth segmental, this being the same artery that I call the seventh cervical segmental.

lion to the adrenals, connecting all of the branches with the segmental nerves to make of them rami communicantes. This all goes on hand in hand with the descent of the heart into the thorax. At the same time the arm is rotating towards the ventral median line, and drags with it the subclavian artery. In so doing the subclavian is dragged into the sympathetic cord in its earliest stage, thus allowing the greater portion of the cord to be developed on its dorsal side. The portion of the sympathetic which from the first lies on the ventral side of the subclavian becomes the ansa subclavia.

The descent of the heart into the thorax on the inside with the descent of the arm over the clavicle on the outside of the body causes great tension on the upper intercostal arteries, and favors the new formation of blood-vessels in a more direct line. This is the reason why the main branch of the superior intercostal is a secondary and direct artery from the subclavian.

The simple diagram, Fig. 4, shows the origin of the main arteries of the trunk from the aortic arches and segmental arteries. This compared with Figs. 1 and 3 will explain itself. In the diagram the vessels which remain are black; those which disappear, outlined; and those new formed, striated.

Résumé :—While the aortic arches are forming, the arteries arising from the descending aorta pass on the mesial side of the cœlom to the umbilical vesicle, and the blood passing through them is collected by the omphalo-mesenteric veins. Soon the segmental arteries arise, unite and shift backwards in the head region to form the vertebral artery. In the trunk they also unite within the lateral body-wall to form the internal mammary and deep epigastric arteries. This anastomosing arch, lying immediately below the tips of the ribs and the rectus abdominis muscle, wanders with them to the ventral middle line, the communicating branches forming the intercostal arteries. The whole course of the anastomoses between the tips of the segmental arteries takes on in its wandering the shape of the letter Z (Fig. 4), the upper angle marking the origin of the subclavian. With the rotation and descent of the arm the subclavian is dragged partly through the sympathetic cord; the origin of the superior intercostal is shifted, by the formation of a new anastomosis, from the dorsal to the ventral side of the sympathetic cord.

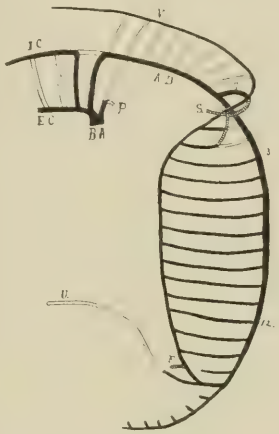

FIG. 4.—Diagram to show the development of the arteries of the trunk from the aortic arches and segmental arteries. The arteries which remain are black; those which degenerate are outlined; those newly formed are striated. *I. C.*, internal carotid; *E. C.*, external carotid; *B. A.*, bulbus aortae; *P.*, pulmonary artery; *A. D.*, descending aorta; *V.*, vertebral; *S.*, subclavian; *F.*, femoral; *U*, umbilical; 7, seventh cervical; 3 and 12, third and twelfth dorsal.

The first vein collecting the blood from the abdominal aorta is the omphalo-mesenteric; next the umbilical, and finally, the cardinal assumes this function.

TWO INSTANCES IN WHICH THE MUSCULUS STERNALIS EXISTED.—ONE ASSOCIATED WITH OTHER ANOMALIES.

HENRY A. CHRISTIAN.

(*From the Anatomical Laboratory of the Johns Hopkins University.*)

During the past winter, two specimens of the musculus sternalis were found in the dissecting rooms of the Anatomical Laboratory of the Johns Hopkins University, and at the suggestion of Dr. Mall I make the following report of them. Both specimens occurred double in well developed white, male cadavers.

That the simple report of such anomalies can have little value in itself, is fully recognized; but by recording such cases material will be accumulated, from which in the future generalizations can be drawn and perhaps some light thrown on the origin of such muscles as well as of the general body musculature. Realizing this I report the following two cases, which have perhaps an additional interest in that each represents a distinct form of this anomaly and one is further associated with a series of variations confined to the regions from which the sternalis arises.

Specimen I.—The M. sternalis is well developed on both right and left sides. Unfortunately, however, an incomplete autopsy has partially mutilated the muscle of the right side, thus somewhat obscuring its true relations. However, as seen, the two muscles appear symmetrical and about equally developed. As shown in (Fig. 1) these supernumerary muscles have their origin in part by tendinous fibres arising from the lower two-thirds of the manubrium sterni medial to the origin of the M. pectoralis major, in part by fibres continuous with the tendinous attachment of the sternal portion of the M. sterno-cleido-mastoideus. The larger number of the fibres arising from the tendon of the M. sterno-cleido-mastoideus cross to

the tendon of the M. sternalis of the opposite side, those from the right side passing ventral to those from the left, while a part are continuous with the tendon of the same side. The tendon thus formed continues to the second intercostal space, where the muscle fasciculi begin and soon spread out into a flat thin muscle about three centimeters in breadth. This muscle, slightly increasing in breadth, continues down to the fifth intercostal space, where it ends by an insertion into the fascia covering the M. rectus abdominis, a little below its point of origin. In its course the M. sternalis lies over the sternal origin of the M. pectoralis major and receives its nerve supply from a branch (anterior cutaneous) of the III intercostal nerve, which perforates the M. pectoralis major and becomes lost in the substance of the M. sternalis.

Specimen II.—On the right side the muscle arises from the tendon of the M. sterno-cleido-mastoideus and the thick fascia over the sternum (Fig. 2), extending as low down as the second rib. In addition a fasciculus arises from the second rib. This smaller fasciculus joins the main muscle on its lateral side in the region of the fourth rib. The main tendon becomes muscular at the third rib, from which place it continues down to be inserted into the fifth rib about three cm. from the sternum. In the third intercostal space this muscle receives a very minute filament from the anterior perforating cutaneous branch of the intercostal nerve, and also a larger twig from the outer cord of the brachial plexus. This latter nerve may be traced for 6 cm. running on the M. pectoralis major. It then pierces the M. pectoralis major over the third rib to continue upward between the M. pectoralis major and M. pectoralis minor to the upper border of the latter, where after passing beneath the acromial branch of the acromio-thoracic artery, it ends by joining the outer cord of the brachial plexus.

On the left side a much smaller fasciculus arises from the fascia over the first interspace. This soon becomes muscular, spreading out into a very thin muscle, which is inserted into the fifth rib. The nerve supplying this muscle can be traced to the anterior thoracic nerve, having a very similar course to that of the nerve supplying the muscle of the right side.

The musculus sternalis was noted by Cabrolius in 1604, and first accurately described by Du Puy in 1726. From the time of Du Puy down to the present, literature furnishes descriptions of about 175 well authenticated cases—a number apparently sufficient to enable us to safely generalize.* Unfortunately, however, none of these early descriptions note the innervation. Although Hallet (1848) reported a case receiving its nerve supply from the III, IV and V intercostal nerves, and Malbranc (1876) by electrical stimulation on living subjects found a M. sternalis supplied from the intercostals, and another from the anterior thoracic, Cunningham was the first to fully recognize the value of the nerve supply in studying the origin of this muscle. This view is fully supported by recent studies in comparative myology as well as by the study of the development of the skeletal muscles. This information being recent the earlier writers make no mention of the nerve supply, and their reports are, from our present point of view, of scarcely more than historical interest, showing only the various forms that may occur. Since it appears that "all of the muscles arising from a myotome are always innervated by branches of the nerve which originally belonged to it" (Mall), it is evident that the origin of a muscle variation can only be studied to advantage when its nerve supply is given. Reviewing the literature from this standpoint I find that in but eighteen instances the nerve supply of the M. sternalis is given. To these I add two, making twenty in all, as shown in the accompanying table.

Can we infer anything as to the origin of this anomaly from these twenty specimens tabulated below? That there have been many views as to the origin of this muscle, is shown by the various names (M. sternalis, M. presternalis, M. episternalis, M. sternalis brutorum, M. rectus thoracicus, M. rectus thoracis, M. rectus sternalis, M. accessorius ad rectum) which from time to time have been applied to it. The main hypotheses which have been advanced regarding the origin of this muscle are as follows:

(a) It is an upward extension of the M. rectus abdominis.

(b) It is a downward extension of the M. sterno-cleido-mastoideus.

(c) It is a remnant of a panniculus carnosus and to be associated with the platysma myoides in man.

(d) It is an aberrant portion of the M. pectoralis major.

In 1876 Bardeleben concluded from the standpoint of morphology that not one but several different muscles had been described under the name of M. sternalis, and that of 120 cases, which he tabulated, 7 per cent. were varieties of the M. rectus abdominis, 21 per cent. of M. pectoralis major, 55 per cent. of M. sterno-cleido-mastoideus and 6 per cent. skin muscles.

Of the earlier cases reported, it is possible that some may have been genuine cuticular muscles, but that a muscle, which we would now class as M. sternalis, could have such an origin is not possible since it lies in a plane deeper than the platysma myoides, the representative of this class in man. Further to be an aberrant portion of this cuticular muscle, it should be innervated from above the brachial plexus, a condition which we have not as yet found to exist. That it is not a strictly downward extension of the M. sterno-cleido-mastoideus, though the majority of the muscles are connected by their tendons of origin with the M. sterno-cleido-mastoideus, we conclude from the fact that it does not have a similar nerve supply.

* The following will show the relative frequency of occurrence of this anomaly:

Wood	7 examples in	175	cadavers.
Turner	21 " "	650	"
Gruber	5 " "	95	"
Macalister....	21 " "	350	"
Le Double....	33 " "	722	"
Christian.....	2 " "	70	"
Total.	89 " "	2062	"

About 4⅓ per cent.

TABLE GIVING THE ORIGIN, INSERTION AND INNERVATION OF THE MUSCULUS STERNALIS.

Observer.	Side.	Origin.	Insertion.	Nerve Supply.	Remarks.
1. Fick, A. A. VI–S. 601.	R.	Tendons of sterno-mastoid on both sides and upper digitations of pectoralis major on both sides.	Rectus sheath at VI and VII ribs, digitations of ext. oblique arising from V rib and from fascia over sternum at level V rib.	III and IV intercos.	Intra vitam contracted with sterno-mastoid in raising head.
2. Fick.	R.	Digitations of pectoralis major by means of two horizontal tendons to right and left at upper edge III rib.	Rectus sheath at VI and VII ribs and fascia of lowest digitations of pectoralis major.	IV intercos.	
3. Fick.	R.	Tendon left sterno-mastoid, few fibres from tendon right sterno-mastoid, manubrium sterni and upper digitations of pectoralis major of both sides.	Rectus sheath at V and VI ribs and fascia of pectoralis major and fasciculi to III, IV and V ribs.	II, III and IV intercos.	Motion with sterno-mastoid observed.
	L.	Manubrium sterni and upper digitations of pectoralis major of both sides.	Rectus sheath at VI rib, and a deeper layer to V rib and intercostal membrane between V and VI ribs.	III and IV intercos.	
4. Bardeleben, A. A. III–S. 324.	R.	Tendon sterno-mastoid.	Rectus sheath at VI rib and two thin fasciculi to left pectoralis major.	II and III intercos.	
5. Bardeleben.	R.	Right tendon sterno-mastoid.	Rectus sheath at VI rib.	II and III intercos.	
	L.	Both tendons of sterno-mastoid.	Rectus sheath at VI rib.	II and III intercos.	
6. Bardeleben.	R.	Right tendon sterno-mastoid.	Rectus sheath at VI rib.	II intercos.	
7. Bardeleben.	R.	Manubrium sterni.	Rectus sheath.	II intercos.	
	L.	Manubrium sterni.	Rectus sheath.	II intercos.	
8. Bardeleben.	R.	Fascia of pectoralis major at II rib and left sterno-mastoid.	Rectus sheath at V rib.	III intercos.	
9. Bardeleben.	R.	Right sterno-mastoid and some fibres from left pect. major.	Rectus sheath.	III intercos.	
10. Bardeleben.	(?)	Manubrium sterni.	Rectus sheath.	III and IV intercos.	
11. Bardeleben.	(?)	Manubrium sterni.	Rectus sheath.	III (?) intercos.	
12. Shepherd, Jour. Anat. and Phys. XIX–p. 311.	L.	Both sterno-mastoids and right pectoralis major.	IV costal cartilage, border of sternum opposite V and VI ribs and aponeurosis of ext. oblique.	Int ant. thoracic.	Anenceph.
13. Shepherd.	L.	Sterno-mastoid.	III costal cartilage and border of sternum.	Ant. thor. (?)	
	R.	Sterno-mastoid and sternum opposite II and III rib.	Fasciculus into lower segment pectoralis fascia continuing with fibres of pector., lower end of sternum and ensiform cart.	Ant. thor. (?)	
14. Shepherd.	L.	Sternum opp. II rib.	Aponeurosis of ext. oblique.	Int. ant. thor. and III intercos.	
15. Shepherd.	L.	Sterno-mastoid and right pector.	III costal cartilage.	Int. ant. thor.	
16. Shepherd.	L.	Pect. major over manubrium sterni.	IV costal cartilage and fasciculus into fascia over pectoralis major.	Int. ant. thor.	
	R.	Pect. major over manubrium sterni.	A slip to fasc. over pect. maj. and a second to same lower down.	Int. ant. thor.	
17. Shepherd.	R.	Manubrium sterni.	Pectoralis major and sternum opposite IV costal cartilage.	Int. ant. thor.	
	L.	Manubrium sterni.	One fasc. to III cost. cart., a second to lower sternum and third to fasc. over pect. major.	Int. ant. thor.	
18. Wallace, Jour. Anat. and Phy. XXI–p. 153.	R.	Right tendon sterno-mastoid and few fibres from left pectoralis major.	III, IV, V and VI costal cartilages and border of sternum.	Ext. ant. thor.	
19. Christian, Specimen I.	R.	Manubrium sterni and both tendons of sterno-mastoid.	Rectus sheath at V rib.	III intercos.	
	L.	Manubrium sterni and both tendons of sterno-mastoid.	Rectus sheath at V rib.	III intercos.	
20. Christian, Specimen II.	R.	Tendon of sterno-mastoid, fascia over manubrium sterni and a small fasciculus from II rib.	V costal cartilage.	Branch from Brachial plexus and a small twig from intercos.	
	L.	Fascia over I interspace.	V costal cartilage.	Ant. thoracic.	

Between the two remaining hypotheses there has been much discussion. Bardeleben advanced the theory that it belonged to the same plane of muscles as the M. rectus abdominis and M. sterno-cleido-mastoideus, and Testut the theory that it represents a connecting link between the M. obliquus abdominis externus and M. sterno-cleido-mastoideus, a condition normally found in the snake. However, Le Double claims that this latter condition does not hold and that the muscle found in the snake is represented in man by a deeper layer. It is probable that there is no exact analogue of this muscle in the lower animals. In some animals, as the Armadillo, beaver and Echidna the M. sterno-cleido-mastoideus extends down on the sternum (Turner) but not so far as the VI rib, and there is no connection with the M. rectus abdominis, which lies in a deeper plane. In all cyano-morphous primates (Keith) a M. supra-costalis anterior occurs which is a digitation of the M. rectus abdominis arising from the I rib, but this lies beneath the M. pectoralis major. However there can be no doubt that Bardeleben was justified in his conclusion that a close relationship exists between the M. sternalis and the M. rectus abdominis since he and others have reported undoubted cases where the M. sternalis received its nerve supply from the intercostal nerves in a manner similar to the M. rectus abdominis.

This view of Bardeleben was generally accepted until P. S. Abraham reported some cases in anencephalic monsters, receiving nerves from the brachial plexus through the anterior thoracic branches. Soon after this Cunningham reported similar cases from adult cadavers. Such a nerve supply suggested a close relationship with the M. pectoralis major and from the fact of the long course of the nerve through and over the M. pectoralis major and from the recurrent course of many of the lower anterior cutaneous branches of the intercostal nerves perforating the fascia beneath the M. sternalis to run around the inner border of this muscle, it was concluded that it is an aberrant portion of the M. pectoralis major which had rotated inward and downward to this present position. This conclusion seems to be fully in accord with the facts and to be justified by the nerve supply which we regard as the link between present position and the myotome from which it arose. That this muscle is really often innervated from the brachial plexus is further shown by the contraction of the M. sternalis when the brachial plexus is electrically stimulated.

Here then we have two views as to the origin of this muscle, conflicting but both apparently well justified. Can these views be in any way harmonized? From the twenty cases tabulated above it is readily seen that these muscles divide naturally into two classes, one with a fixed insertion into the middle ribs or margin of the sternum and supplied by nerves from the brachial plexus, the other with a less fixed insertion into the sheath of the rectus and a nerve supply from the perforating branches of the intercostal nerves, the origin of the two classes being very similar. From this we conclude that in the musculus sternalis we have a muscle functionally always the same —probably antagonistic to the triangularis sterni—but that we have included under one term two distinct muscles, one closely related to the M. rectus abdominis, and the other an aberrant portion of the M. pectoralis major, the former supplied from the intercostal nerves and arising in the embryo from thoracic myotomes, the latter supplied from the brachial plexus and arising from cervical myotomes. Therefore, from the standpoint of innervation and development we agree with the results obtained by Bardeleben that the name M. sternalis has been used as a general term and that it should be reserved for those presternal muscles associated with the M. pectoralis major, while the name M. rectus thoracis should be applied to those related to the M. rectus abdominis.

The cadaver from which specimen No. 1 was taken showed a number of additional muscle anomalies in the region of the course of travel which must have been followed by M. sternalis in its development. When one sees a marked anomaly he should look for and will frequently find associated variations. These may indicate the forces at work to produce variation, and for this reason I enumerate those which accompanied Specimen I.

Musculus cleido-hyoideus.—A M. cleido-hyoideus (Fig. 3) is found on the left side, occurring with no variations in the M. sterno-hyoideus, M. sterno-thyroideus or M. omo-hyoideus. It occurs as a thin narrow ribbon of muscle fibres more delicate than the M. omo-hyoideus. It arises from the body of the hyoid bone just above and overlapping the external third of the M. sterno-hyoideus and internal half of the M. omo-hyoideus. From this origin it passes downward and slightly outward to be inserted into the clavicle just posterior to the clavicular insertion of the M. sterno-cleido-mastoideus. Just before reaching the clavicle the muscle spreads out fan-like to be inserted by an aponeurosis about twice the breadth of the muscle and extending along the clavicle from a little internal to the middle point of the insertion of the M. sterno-cleido-mastoideus to a point about one cm. external to its insertion.

Quite frequently the M. omo-hyoideus gives off a slip to be inserted into the clavicle and consequently this muscle may be regarded as an aberrant portion of the M. omo-hyoideus here entirely split off except at its very origin. Its nerve supply is apparently the same as that of the M. omo-hyoideus, a fact supporting this view of its histogenesis.

M. sterno-thyroideus.—On the left side the M. sterno-thyroideus is normal as to its size and attachment. The muscle of the right side is fully twice as broad as that of the left and somewhat thicker. Its origin from the sternum is normal. Its insertion is by three heads, each more or less distinct. Of these the inner is inserted as usual on the inferior surface of the oblique ridge of the thyroid cartilage and represents in size and insertion almost the normal muscle. The middle head continues up closely associated with the outer border of the M. thyro-hyoideus, which latter is somewhat narrower than the one of the opposite side. Most of the fibres of this head are inserted into the anterior inferior and middle border of the hyoid bone, while a few are inserted into the middle part of the superior border of the thyroid cartilage. The outer head consists of a distinct ribbon of fibres running up to be inserted into the deep cervical fascia and sheath of the carotid artery intimately blending with these structures. The main part of the muscle is supplied by a branch from the hypoglossal loop, while the middle and outer heads receive fibrils from a branch of the hypoglossal nerve given off above that to the M. thyro-hyoideus.

M. hyo-cornicula laryngis (*M. hyo-cartilago santoriniana*).—

FIG. 1.—Sketch showing the attachment of the M. sternalis in Specimen No. I.

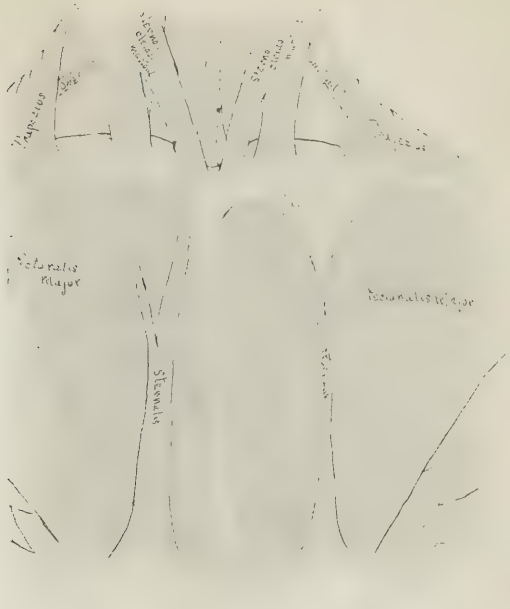

FIG. 2.—The attachment of the M. sternalis in Specimen No. II.

FIG. 3.—The neck of Specimen I, to show the attachment of the M. cleido-hyoideus to the clavicle.

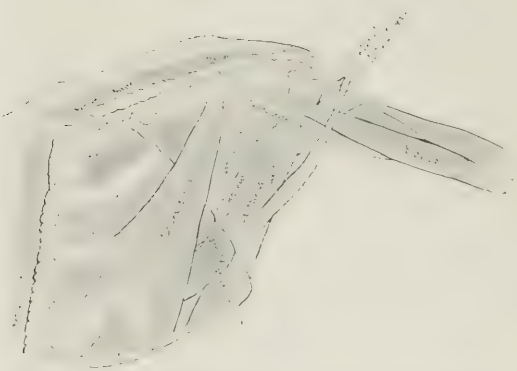

FIG. 4.—The axilla of Specimen No. I, to show the slip from the M. latissimus dorsi to the pectoralis major.

Christian, del.

Arising on the right side from the tendinous portion of the M. digastricus, where it is held down to the hyoid bone by a strong loop of fascia, is found a small muscle about one cm. wide, nearly cylindrical in shape and running downward and outward around the larynx for about 6 cm. to be inserted into the fascia about the cornicula laryngis (cartilage of Santorini). Its nerve supply consists of a fine fibril arising from the hypoglossal nerve.

M. trapezius.—The M. trapezius of the right side gives off a fasciculus about 5 cm. wide and 1.5 cm. thick which is inserted into the clavicle at the inner part of its middle third just external to the origin of the clavicular portion of the M. sterno-cleido-mastoideus. This fasciculus extends upward to join the anterior border of the main portion of the M. trapezius about 10 cm. from its insertion into the occipital bone. No special distinct nerve supply could be found for this fasciculus.

M. latissimus dorsi.—On each side of the subject the M. latissimus dorsi (Fig. 4) possesses an accessory tendon of insertion. The larger normal tendon passes as usual beneath the axillary artery and brachial nerves while the accessory tendon passes over, thus forming an arch for the nerves and vessels. The regular head is inserted into the bicipital groove of the humerus while the accessory one is inserted along with the tendon of insertion of the sternal portion of the M. pectoralis major into the anterior bicipital ridge. The tendinous fibres of this latter are intimately associated with the pectoral tendon for about 2 cm. and then separating pass down as a rounded tendon to join the muscle fasciculi which come off from the main muscle about 6 cm. from its humeral insertion. The accessory head thus formed is about one-fifth the size of the other tendon, which is normal and 7.5 cm. in length.

The two heads form a triangle with the long and short heads of the M. biceps and M. coraco-brachialis as a base. Through this pass the axillary artery and vein, the median, musculo-spiral, ulnar, internal cutaneous and lesser internal cutaneous nerves. So far there is almost perfect symmetry in these structures on the two sides of the cadaver, but the nerve supply to each head is apparently different, though the ultimate origin of the individual nerve fibres from the cord may possibly be quite the same.

The accessory head of the M. latissimus dorsi of the left side is supplied and apparently solely supplied by a rather small nerve entering the muscle substance. This can be traced up to the lower border of the M. pectoralis minor, there to join a nerve which is unmistakably the internal anterior thoracic, since it supplies the M. pectoralis minor sending some of its fibres through this muscle to supply the M. pectoralis major. On this side of the body the internal anterior thoracic nerve arises by two divisions and probably receives fibres from the VII and VIII cervical nerves.

On the right side, at first sight, the accessory head would seem to receive its nervous supply from the II and III intercostal nerves, since two stout branches from these sources enter the muscle substance. However, on closer examination, these appear to pass through the muscle substance without giving off any fibres to the muscle and to end further on as cutaneous nerves. As no other definite nerve fibre could be traced to this head, it must be supplied by a fibre from the middle or long subscapular nerve, running up in the muscle substance from the main muscle body. If this be the case these fibres would ultimately have about the same source in the cord as those supplying the accessory head on the left side as may be seen by comparing the diagrams of the two plexuses.* On the right side the long subscapular nerve arises from the posterior cord of the plexus just after this cord receives a branch from the inner cord. Thus this long subscapular nerve probably consists of fibres from the VII and VIII cervical nerves, the same nerves as those supplying fibres to the accessory head of the M. latissimus dorsi of the left side through the branch from the internal anterior thoracic nerve.

On neither side does the M. latissimus dorsi receive a slip from the tip of the angle of the scapula.

M. extensor carpi radialis accessorius.—This muscle occurs only in the right arm. Its origin is from the radial side of the M. extensor carpi radialis longior by a slip separating about 4 cm. from the origin of this muscle. About 5 cm. above the annular ligament this slip becomes muscular. Just above the ligament it passes under the tendon of the M. extensor carpi radialis longior to be inserted with the M. extensor carpi radialis brevior into the base of the metacarpal bone of the middle finger. It is innervated by a branch of the musculo-cutaneous nerve.

M. extensor digiti tertii.—Occurs only in left hand. Its origin is from the posterior shaft of the ulna below the origin of M. extensor indicis. Its tendon passes down with that of the M. extensor indicis through the same compartment in the annular ligament, and is inserted finally into the tendon of the M. extensor communis digitorum belonging to the middle finger and on its ulnar side. Its nerve supply is from the posterior interosseous branch of the musculo-spiral nerve.

Scapula.—On either side of the body, the tip of the acromial process is separate from the scapula, being connected to the spine of the scapula by a firm ligamentous band of connective tissue surrounding the proximal ends of bone lying in juxtaposition. The ends of the bones are covered with cartilage, and all are so firmly bound together that very little motion is possible.

All of these eight variations, in addition to the M. sternalis, are along the course the diaphragm takes in its excursion, during development, from the neck to its permanent location. It is to be noted that all this takes place before the embryo is four weeks old, and that at this time the muscles are just beginning to be formed from the myotomes.

Aug. 22, 1898.

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ON THE PATHOLOGICAL CHANGES IN THE SPINAL CORD IN A CASE OF POTT'S DISEASE.

By Sylvan Rosenheim.

(*From the Anatomical Laboratory of the Johns Hopkins University.*)

That scientific advances go hand in hand with improvements in the methods of research has nowhere been better demonstrated, perhaps, than in the study of the central nervous system. Early in this century much was accomplished by mere dissections and sectioning of the various parts of the nervous system, but the greatest strides have occurred since Weigert, in 1884, published his method of staining the myelin sheaths of the nerve fibres. Of the various methods employed to isolate the tracts in the spinal cord, that depending on the degeneration following severance of the connection between a nerve fibre and its trophic centre, namely, the cell-body from which it arises, has been one of the most important.

It is this method of study which has been utilized in the present case, in which the spinal cord was pressed upon by a tuberculous exudate. The methods of Weigert and Marchi have both been employed. It has been possible, by a combination of the two methods, to determine the extent of the degeneration following the compression, and to distinguish the more recent degenerations from those which occurred at an earlier date.

The case is also interesting in view of the light it throws upon some of the more recent problems in connection with the study of the spinal cord, especially

(1) The finer histological changes about the site of primary lesion, and

(2) The paths which descend in the dorsal funiculi.

I wish to thank Dr. Barker for his aid in this study.

CLINICAL HISTORY.

The patient, H. H., a female, colored, æt. 15 years, entered Professor Osler's wards of the Johns Hopkins Hospital October 10, 1895, complaining of loss of power in the legs.

Family History.—Father and mother living and well. One of her brothers, who died at the age of 7 years, had contraction of the lower extremities, similar to that from which the patient suffers, one month before his death. Grandmother, on the paternal side, died of a "heavy cough"; she was very emaciated before death. An aunt on the mother's side is a consumptive.

Personal History.—Patient has had no scrofulous breaking down. Menstruation not yet established. At the age of 6 years the patient was gradually attacked with loss of sensation in the feet, which was shortly afterwards followed by loss of power, and she was confined to her bed for three weeks, when she gradually regained power. She was able to run, walk and skip, and was in good health up to last February. Every winter she suffers from a cough, which lasts until the spring to return again the following winter. Thick white expectoration is associated with the cough.

Present Condition.—In February, 1895, the patient was attacked by influenza. She was ill until March 1st, when she was well enough to get up but found she had no power in the legs. Shortly after this the legs became flexed upon the thighs and the thighs upon the abdomen. This has been the condition for most of the time since, the muscles becoming relaxed only when the patient is asleep or very quiet. The

bowels and bladder have been voluntarily controlled, micturition being frequent, about four times at night, five times during the day. The bowels are constipated, not moving sometimes for a week. About one month ago the movements of the bowels as well as micturition became involuntary. This lasted up to two weeks ago, when the involuntary condition ceased but the movements became frequent. Her mind has been clear all along. There has been no trouble with the eyesight, no pain in the head, and no pain in the back. The floor feels like a cushion. The upper extremities have at no time been affected. There is no cough at present.

Physical Examination.—Rather thin but generally fairly well developed colored girl. Somewhat pale. Tongue covered with a white coat. Pupils equal. No nystagmus. Movements of the eyes normal. Chest is rather flat; costal margin is prominent in right parasternal line. Over the upper right chest is a wound situated nearer sternum than axilla, measuring 5x2.5 cm. In the centre of this wound is a sinus in which a probe inserted passes upwards and inwards about 3 cm. to dead bone. Dead bone evidently in the sternum. Probe also passes behind sternum.

Lungs.—Front: Expansion very poor on both sides. Percussion fairly good. Breath sounds clear over right front. Slightly tubular in apex of right axilla. No râles are heard.

Back: Impaired resonance over both upper backs. At the left apex, breath sounds are somewhat tubular. At the base, percussion note is better, but everywhere expiration is somewhat blowing, particularly in left axilla. In this region vocal fremitus is absent, and breath sounds, as well as voice sounds, are distant.

Right lateral decubitus: A distinct bulging can be seen in the left flank. It measures about 8x4 cm. On palpation it is distinctly fluctuating. Hypodermic needle inserted withdraws a thick, cloudy fluid which, on microscopic examination, is found to consist of broken down cells and granular debris.

There is no marked irregularity of the spine, and apparently no pain anywhere on firm pressure. No bed sores.

Heart.—Point of maximum impulse somewhat diffuse over fourth and fifth spaces from the sternum to nipple line. At the apex the sounds are clear. Soft systolic murmur in the second left space. Aortic area clear.

Abdomen.—Muscles held rigidly; spleen distinctly palpable.

Muscular Power and Sensation.—Muscular power in the arms good, flexors stronger than extensors. Reflexes present at elbow, but not so easily obtainable at wrist. Movements of the facial muscles fairly good. Legs are strongly flexed on thighs and thighs somewhat on abdomen. Almost constant clonus in muscles of left thigh. On attempting to straighten the legs, they are found quite spastic, and clonus is increased. Considerable wasting in the calf muscles, not so marked in the thighs. Patient cannot voluntarily flex the legs upon the thighs. When the legs are extended there is still slight clonus in left flank; not so much in the right.

Sensation markedly impaired. Sensations of heat and cold are almost entirely gone from the umbilicus down. Sensation of touch much impaired. There is a region of hyperæsthesia in the back, extending from a little above the ilia and stretching over the gluteal muscles.

The patient was operated on November 2, 1896. The lumbar abscess was incised and packed. The condition of the lower extremities did not improve. The patient gradually became weaker, and died February 13, 1897.

AUTOPSY.

The autopsy was made by Dr. Flexner February 14, 1897. The following notes have been extracted, by permission, from the protocol in the Pathological Laboratory:

Anatomical Diagnosis.—*Tuberculosis of the spine. Extradural exudate. Compression myelitis. Paraplegia. Tuberculosis of sternum. Intestinal tuberculosis. Paralysis of bladder. Pyo-cystitis, pyo-ureteritis, pyelitis, pyelo-nephritis, bronchitis. Lateral curvature of the spine to the left in lower part.*

Muscles of feet and legs apparently very much atrophied. Thigh muscles also atrophied, the right more than the left.

On the right side, the pelvis is apparently thrown forward and rotated inward. Crest of the ilium is prominent, and right extremities are rotated inwards. The face shows no emaciation, contours rounded, lower jaw protuberant. The dura covering the brain is moderately adherent to the skullcap. The superior longitudinal and lateral sinuses contain recent clots. Pia and arachnoid are normal. No visible tuberculosis in the pia.

The *spinal cord* in two distinct situations is the seat of an extra-dural infiltration. The first begins about 2 cm. below the lower edge of the cervical enlargement and extends for a distance of about 5 cm. downwards; it is composed of dense caseous infiltration which averages 4–5 mm. in thickness. The second one begins above the lumbar region and extends over it and below it; it is thicker than the upper, but of the same nature. Both completely infiltrate the subdural areolar tissue.

The cord corresponding to the caseous infiltration is, in the cervico-thoracic region, distinctly softened. The roots of the spinal nerves (motor and sensory) pass through the exudate.

The exudate in the lumbar region has not compressed the spinal cord.

Heart.—Slight fatty degeneration in the intima of the aorta just above the valves.

Lungs.—Emphysematous and œdematous. Pus in bronchi.

Kidneys.—Capsule congested. Beneath the capsule and throughout the kidneys are white areas about the size of miliary tubercles. The kidney substance is soft and œdematous. On section, the cortex is greatly swollen. Striæ obliterated. Mucous membrane of the pelvis and ureters is congested, and shows ecchymoses.

Bladder.—Enormously distended; contains thick pus. Walls thin.

Spleen.—Enlarged; substance soft on section. A few tubercles seen. Tubercles are occasionally met with in mesentery and omentum.

Intestines.—Swollen solitary follicles in the ileum with excavated centres. Ulcers near the valve, edges raised, surrounded by congested mucous membrane. Tubercles visible in the clear congested base.

Spine.—The bodies of the second, third and fourth thoracic vertebræ are eroded, softened, crumbly, and infiltrated with caseous pus. The transverse processes of the second and third

lumbar vertebræ are similarly affected. The bodies of these vertebræ are only superficially diseased, however, and this affection is in the locality of the extra-dural exudate. Sternum eroded. Manubrium and gladiolus can be separated.

Muscles of the Back.—Along the spinal column the muscles are invaded by irregular sinuses and collections of pus-containing caseous material.

METHODS OF EXAMINATION.

The spinal cord was immediately put in a mixture of equal parts of formalin (5 per cent.) and Müller's fluid. The brain, including the medulla, was put into 5 per cent. formalin.

Four slabs of tissue were taken from each segment of the spinal cord, two pieces across the entrance and exit of the nerve roots, and two pieces between the nerve roots, so that when, in the description, a certain segment is designated, a level between the nerve roots above and below the number of the segment mentioned is indicated. Of these four slabs, two pieces were used for Weigert's method and two for Marchi's method of staining, comparative information being thus obtained.

The degeneration of nerve fibres, as is well known, can be divided into two periods—that before and that after the absorption of the disintegrated myelin. The former corresponds to the breaking up of the myelin sheaths into fat droplets; these stain black in Marchi's fluid. The latter corresponds to the stage shown best by Weigert's method, in which there has been absorption of the myelin, and hyperplasia of the glia. Thus the method of Marchi shows those fibres which have only recently degenerated, while Weigert's method gives information regarding those that have been degenerated for some time. As will be seen later, the picture obtained by these two methods differed considerably in parts. In general, the Weigert method revealed the greater alterations in this case, owing to the length of time which had elapsed since the beginning of the compression.

The roots of the spinal nerves on both sides, to as low a level as the twelfth thoracic inclusive (excepting the fourth cervical pair, which were accidentally lost), were likewise stained separately by the Weigert and Marchi methods.

For a more exact study of the pathological changes, especially in the softened region, additional stains were used—hæmatoxylin and eosin, hæmatoxylin and carmine, Upson's carmine, Van Gieson's stain, and Mallory's stain. Good results were also obtained by counter-staining Marchi specimens with Upson's carmine.

FINDINGS ABOUT THE REGION OF COMPRESSION.

As the protocol of the autopsy states there were two areas of extra-dural tuberculous exudate. The upper area alone led to compression of the cord.

The region of compression extends between the eighth cervical and the fourth thoracic nerves, thus involving about three segments of the spinal cord.

With low amplification (10 diameters), a section across the upper part of this region shows that the cord has been compressed dorso-ventrally, much more on the right than on the left side. The outline of the gray matter is faintly preserved; the white funiculi contain many bands of sclerotic tissue, more marked in the dorsal funiculi. Many small holes in the tissue also occur here. About the middle of the site of compression the cord is much compressed laterally and broadened dorso-ventrally. The gray matter is much distorted, the ventral horns being greatly shrunken; the dorsal horns can be followed for only half their extent. The white matter shows much sclerotic tissue, the holes above mentioned and numerous dilated blood-vessels. In the region corresponding to the lower part of the lesion there is remarkable distortion of the spinal cord. In the ventral half a normal contour is approached, but the dorsal half narrows to a blunt point at the tip of the left dorsal horn. The ventral horns are much shrunken, the dorsal horns are united for the ventral half of their extent; they then separate at an angle of about 60°, the right horn being much curved. The white matter abounds in sclerotic tissue and holes; the dorsal funiculi are destroyed in their ventral halves, their place being occupied by the united dorsal horns.

General Appearances at the Site of the Compression. See Figs. XIII and XIV.

1. Although the disintegration of the white matter has been very extensive, numerous axis-cylinders staining deeply with acid fuchsin can be seen. The nerve fibres illustrate all stages of disintegration. Many are much swollen and of irregular shapes. Some are entirely devoid of myelin sheath. In other fibres the myelin sheath is still present, but the normal concentric rings are absent. In only a few fibres are the normal concentric rings preserved. Vacuoles are found in many of the nerve fibres. They occur in various parts of the myelin sheath, but are found especially just peripheral to the axis-cylinders.

The axones show various changes. Some are swollen and very irregular in shape. At times only part of the axis-cylinder stains, giving rise to bizarre appearances. Some of the axis-cylinders refuse to take on the stain, and the nerve fibres are represented by homogeneous feebly staining masses. Many of the fibres have disappeared, leaving holes to represent them. In Marchi specimens, counter-stained in Upson's carmine, the disintegrated myelin is represented by smaller and larger black balls.

2. The neuroglia is much increased in amount (Fig. XIII). It helps to yield the intense red color seen in all the specimens stained in carmine. It occurs in fine and coarse bands in the lower part of the region of compression, giving rise to the reticulated appearance of the white matter. It is also much proliferated in the gray matter in the middle region of the compression, the dorsal cornu having been converted into masses of sclerotic tissue. Here the ventral fissure is filled with dense connective tissue, and the sclerotic tissue in the white matter can be seen to radiate from this. Many neuroglia-nuclei are seen, some small and round, staining homogeneously with carmine, and surrounded by a small colorless area; others, larger, oval or irregular in shape and granular. Here and there, scattered in the network of neuroglia, are masses of ball-like material, which take on a slight pinkish color in specimens stained by Van Gieson's method. In some

of these there is seen an irregularly shaped nuclear-like body, which takes on a faint pink stain.

3. The blood-vessels are numerous throughout the white and gray matter and in the fissures of the cord. They are much dilated and packed with blood corpuscles. Their walls stain intensely red in carmine, and around them are aggregations of cells with round and polymorphous nuclei. These vessels, with their thickened walls, give rise to the coarse bands found at the upper part of the region of compression. There has been considerable hemorrhage at the lower part of the region of compression. Throughout the white matter are many extravasated red blood corpuscles. They are massed in large heaps in the dorsal funiculi along the periphery and next to the broken up dorsal cornu. Scattered in the white and gray matter, are numerous polymorphous nuclear leucocytes. The blood-vessels at this level are much dilated and are full of corpuscles, most of them red.

4. The ganglion-cells show various changes in the region of compression. At about the level of the first thoracic and eighth cervical segments many of the cells are swollen, their protoplasm staining a homogeneous pink color in carmine. There is no trace of the normal tigroid masses, although these are well seen in sections from areas both above and below the compressed portion. The nucleus in some of the cells is displaced to the edge of the cell, being almost colorless, but containing a deeply staining nucleolus. The cell outlines are not sharp, and the protoplasmic processes are not seen. At the level of the second thoracic segment, only a few distorted ganglion-cells are to be seen. In Marchi specimens, counter-stained in Upson's carmine, these stain a homogeneous pink color, and contain numerous small intense black granules. At the level of the third thoracic segment there are but a few indefinitely outlined cells devoid of Nissl bodies, but containing numerous black granules. At the level of the fourth thoracic segment the cells are again more numerous, but Nissl bodies are to be made out only in some, and in many the nucleus is displaced to the side of the cell.

5. There is a proliferation of the cells lining the central canal at the level of the first, second and third cervical nerves. The cells here are a couple of layers thick, in parts occluding the lumen of the tube. From the third to the sixth cervical segments, the lumen of the canal is patent and lined by a single layer of high columnar cells. From the sixth cervical segment down to the sacral cord there appears to have been proliferation of these cells most extensive about the region of compression, being several layers thick there. The lumen is occluded from the first to the fifth thoracic segments. The cells in the proliferative area have lost their columnar appearance.

6. The holes, which have already been mentioned, are found far above and below, but are much more numerous at the site of the compression. These holes have been described before by Krauss,* who attributes their occurrence, probably correctly, to the action of formalin on the tissues, which he thinks causes a contraction of the neuroglia. In this way, he says, using a 10 to 15 per cent. solution of formalin, the hardened cord has a honeycomb appearance. The fact that these holes are more numerous around the region of compression, in the present case, makes it evident that a softened condition of the cord aids a great deal in effecting this appearance. Some of these holes are empty, some are partly filled by the products of disintegration and absorption of the nerve tissue. The following types and variations of the contents of the holes may be mentioned.

In or about the centre of a hole is a round body containing a nucleus, which stains well in nuclear dyes, surrounded by clear, homogeneous, non-staining, small globules. They are seen in specimens stained by all the methods used. They are the familiar compound granular corpuscles. Variations of this type occur, the granules taking on in carmine and Van Gieson specimens a faint pink tinge, giving the protoplasm of the cell a homogeneous or somewhat reticulated appearance. Vacuolic areas occur in these. This variation may be due to dissolving out of the fat.

In sections prepared by all the methods (including Marchi specimens, counter-stained in carmine) there are seen in the holes, bodies, some the size and shape of axis-cylinders, others much larger and of irregular shapes, which stain homogeneously and deeply in carmine, eosin and acid fuchsin. They are the so-called corpora amylacea.

There are seen in Marchi and Weigert specimens in the holes, small black droplets and larger black balls.

With Van Gieson's stain some of the holes are seen to be filled with indistinct globules of various sizes, which take on a faint yellowish tinge. In Weigert specimens, counter-stained in Upson's carmine, these are seen more distinctly, and take on a blackish coloration.

The picture presented is that of a myelitis of some duration, showing in different parts of the lesion the forms of white and red softening. The most common of the microscopical appearances are well known; these consist in the disintegration of the myelin into fat droplets, swelling of the axis-cylinders, swelling and disintegration of the ganglion-cells, together with an inflammatory exudation and an infiltration with blood corpuscles. Some of the fat granule cells seen are characteristic. Corresponding with the long duration of the inflammation there has been an extensive proliferation of neuroglia, giving rise to interlacing fibrils and dense sclerotic tissue.

MICROSCOPIC EXAMINATION OF CERTAIN LEVELS ABOVE THE LESION.—ASCENDING DEGENERATION.

The appearance of a section at a given level varies with the method of preparation. In the following descriptions the method is indicated, and when the degeneration field at any one level varies according to different methods several sections will be described. The degenerated fibres are shown in specimens stained by Marchi's method, as black droplets of irregular contour, which on high magnification are seen to take the place of the myelin sheaths of the nerve fibres. The appearance varies according to the magnification used. Some degenerations are so clearly defined as to be readily studied with a magnification of 10 diameters; in others the degenerated

* Krauss, W. C. Formalin as a hardening agent for nerve tissues. Trans. Am. Micr. Soc., 1895, Buffalo, 1896, vol. xvii, pp. 331-335.

fibres are so few and scattered, as to require a higher magnification.

The degeneration field is indicated in the Weigert preparations by a lightening or lack of color. Where only a few scattered fibres have undergone degeneration, it is often impossible by Weigert's method to determine their absence.

First Thoracic Segment.—Upper part stained by Marchi's method and Upson's carmine.

The shape of the cord is tolerably well preserved here; the gray matter is of normal configuration, but is not very sharply marked off from the white substance.

Dorsal funiculi: These show degeneration over the whole cross-section, but not completely. The degenerated fibres are more closely aggregated in the ventral half, but even here there is much intervening matter, partly of a fibrous nature, which stains deeply with carmine. A few axis-cylinders are seen on the periphery. Throughout are many dilated blood capillaries.

Lateral funiculi: In the regions of the fasciculus cerebrospinalis lateralis (lateral pyramidal tract) and the fasciculus cerebellospinalis (direct cerebellar tract) are seen scattered degenerated fibres. The zone thus occupied does not quite reach the lateral horn of the gray matter. Neuroglia tissue is found between the degenerated nerve fibres, and throughout, but more numerous towards the periphery, are large holes, some empty, some filled with material, as before described. But few axis-cylinders are found, staining a bright red color. Extending ventralward from the region of the fasciculus cerebellospinalis is a marginal strip, reaching the ventral median fissure, containing a few degenerated fibres, the number being more numerous in front.

Eighth Cervical Segment.—Weigert-Pal preparation. The shape of this section closely resembles that of the last.

Dorsal funiculi: Seen by the naked eye the dorsal funiculi appear much lightened throughout, excepting a narrow strip on the periphery stretching between the tips of the dorsal gray horns. Microscopically, the degeneration is confirmed. One sees numerous minute holes, probably representing degenerated dorsal root fibres, greatest in extent along the middle third of the septum. Throughout, however, are found numerous well-stained fibres, and along the periphery they all appear of a normal color.

Lateral funiculi: Here the lightened or degenerated area occupies the peripheral half of the column, extending from the tip of the dorsal gray horn to opposite the lateral gray horn. Many holes appear in this region. No lightening occurs in the fasciculus ventrolateralis superficialis (Gowers' tract).

The Marchi specimens show degenerated fibres in practically the same areas in the dorsal funiculi. In the lateral funiculi degenerated fibres are scattered in the peripheral half, being very scattered in the fasciculus ventrolateralis superficialis.

Seventh Cervical Segment, Weigert-Pal preparation. See Fig. VIII.

Dorsal funiculi: The degenerated area no longer occupies the whole breadth of the dorsal funiculi. A relatively large area of healthy fibres intervenes between it and the dorsal gray horn. Considering both sides of the degeneration together, the lightened area has the shape of a tennis racquet, the end of which next the dorsal gray commissure is slightly expanded. As at the preceding level, the majority of the degenerated fibres occur along the ventral half of the septum.

Lateral funiculi: The lightened area, less intense than in the dorsal funiculi, extends from the tip of the dorsal gray horn to the emergence of the ventral roots. In its dorsal part it occupies the lateral third of the lateral column; in the region of Gowers' tract it is slightly broader, occupying about half the breadth of the column. The lightening seems to consist in a feebleness rather than a lack of staining. Between Gowers' tract and the direct cerebellar tract is a band of fibres staining more deeply.

The Marchi specimen shows a similar distribution of the degenerated fibres in the dorsal funiculi, with a few scattered degenerated fibres in the lateral part of the fasciculus cuneatus (Burdachi). In the lateral funiculi, there are but scattered degenerated fibres in the lateral pyramidal tract, direct cerebellar tract, and Gowers' tract; they are most numerous at the periphery of the cord.

Fifth Cervical Segment, Weigert preparation. See Fig. VII.

Dorsal funiculi: The degenerated area occupies now a little more than the fasciculus gracilis. Considering both sides together it is bottle-shaped, the part resting next the dorsal gray commissure being slightly expanded. The lightening is more marked in the ventral half.

Lateral funiculi: The degenerated area extends from the tip of the dorsal horn to the exit of the ventral root. Next the dorsal horn, it occupies the peripheral third of the lateral column for a short distance; it then narrows, and opposite the lateral gray horn it again expands, occupying half the breadth of the column.

Marchi specimens stained in carmine show a marked increase in neuroglia among the degenerated fibres in the dorsal fasciculi. Here also are seen many axis-cylinders staining intensely red. Burdach's fasciculus contains a few scattered degenerated fibres. In the lateral column the degenerated zone is about the same shape as in the Weigert specimen, the direct cerebellar being more affected. In the region of the fasciculus ventrolateralis superficialis (Gowersi), the degenerated fibres are more scattered.

Third Cervical Segment, Weigert preparation. See Fig. V.

Dorsal funiculi: The lightened area is restricted to the fasciculus gracilis (Golli), occupying the dorsal three-fourths. Considering both sides together the area is triangular in shape with the base at the periphery. There is a small peripheral part next the dorsal median septum which is scarcely at all lightened.

The entering dorsal roots on both sides show lightening, more marked on the right side. There is also lightening of Lissauer's fasciculus.

Lateral funiculi: The degenerated zone extends from the tip of the dorsal gray horn to the ventral roots, occupying the peripheral half of the lateral column. It is much more intense in Gowers' tract. In the region of the fasciculus cerebellospinalis (direct cerebellar tract) the degeneration is

more marked a little inwards from the periphery of the cord. Next the periphery there is a band of almost normally staining fibres. Notwithstanding the degenerated fibres in the dorsal roots, the collaterals entering the gray matter appear to be of normal number and to be well stained.

The Marchi specimen (Fig. VI) shows in addition to the triangular area in Goll's fasciculus scattered degenerated fibres in the fasciculus cuneatus, more numerous on the periphery.

In the lateral funiculi it is to be especially noted that more degenerated fibres are visible in the fasciculus cerebellospinalis (direct cerebellar tract) than farther ventralwards. The degeneration of this tract is better defined here than in the sections lower down.

Second Cervical Segment, Weigert preparation. See Fig. III.

In the dorsal funiculi the degeneration is the same as that described for the third cervical segment.

In the lateral funiculi the fasciculus cerebellospinalis and the fasciculus ventrolateralis superficialis are degenerated in about the same region as seen at the third cervical segment; the band of more deeply staining fibres along the periphery next the fasciculus cerebellospinalis is very well marked. Besides these degenerations there appears to be a slight lightening in the lateral funiculi extending along the outside of the lateral gray horn. It is not very marked, and blends with the area of healthy fibres separating it from the fasciculus of Gowers.

The Marchi specimens (Fig. IV) at this level show blackened fibres in the entering dorsal roots.

First Cervical Segment, Weigert preparation. See Fig. I.

Dorsal funiculi: A surprising change has occurred in the shape of the degenerated field. Considered as before, the triangle has lengthened dorso-ventrally, the apex again reaching the dorsal gray commissure. The shape is not strictly triangular, as there is a slight concavity on each side next the fasiculus cuneatus (Burdachi). The dorsal half of the area is not as much lightened as the rest.

Many unstained fibres are seen in the dorsal roots on both sides. Lissauer's fasciculus also shows considerable lightening.

Lateral funiculi: Here the degenerated zones are separated a little ventral from the tip of the dorsal horn by a band of less lightened tissue. The dorsal portion embraces Lissauer's fasciculus, and is separated from the periphery by a narrow strip of almost normally staining white matter. The ventral part starts a little behind a line drawn across the lateral gray horns, and extends to the emergence of the ventral roots, occupying the lateral half of the column. There is also a slight lightening next the lateral gray horn.

The Marchi specimen (Fig. II) from this segment represents a little higher level, namely, at about the lowest part of the decussation of the pyramidal tract.

In the dorsal funiculi a few degenerated fibres are seen on the dorsal periphery of the fasciculus cuneatus.

The degeneration in the fasciculus cerebellospinalis is well marked, the shape of the area differing slightly from that last described, being much thickened next the tip of the dorsal gray horn. In the region of the fasciculus ventrolateralis superficialis there are but few scattered degenerated fibres.

MICROSCOPIC EXAMINATION OF CERTAIN LEVELS BELOW THE LESION.—DESCENDING DEGENERATION.

Fourth Thoracic Segment, Marchi specimen. See Fig. IX.

The entire degeneration is so distinct that the individual degenerated fibres can be seen with a magnification of ten diameters.

Dorsal funiculi: The degeneration assumes a peculiar shape, which may be considered as a union of a septal degeneration and a degeneration of the comma of Schultze. The former begins at a point on the dorsal median septum and running ventralwards broadens out to join the comma tract. The latter is separated by a narrow interval from most of the dorsal horn, but touches the dorsal gray commissure and the nucleus dorsalis (Clark's column), where it is broadest. From here it tapers off going dorsalwards, extending about three-fourths of the distance between the commissure and the periphery in the fasciculus cuneatus. The degeneration though intense is not complete.

Lateral funiculi: The fasciculus cerebrospinalis lateralis contains many degenerated fibres, and also many holes as described before. Some degenerated fibres appear on the periphery in the region of the fasciculus cerebellospinalis. Besides these, there is a small zone of scattered degeneration in the fasciculus lateralis proprius, next to the pyramidal tract.

The ventral funiculi contain scattered degenerated fibres. Numerous holes appear in the ventral and lateral funiculi, being more abundant along the periphery.

In the Weigert specimen, the degeneration occupies practically the same area. The comma zone is more lightened than the area of septal degeneration in the dorsal funiculi.

Fifth Thoracic Segment, Weigert preparation. Fig. X.

Dorsal Funiculi: There is a narrow degenerated strip in the fasciculus cuneatus, beginning near the gray matter constituting the nucleus dorsalis (Clarkii) and extending dorsalwards half the breadth of the fasciculus. The lightening is plainly visible, but not intense.

In the lateral funiculi, there is typical degeneration of the fasciculus cerebrospinalis lateralis (lateral pyramidal tract).

Marchi Specimen: No blackened fibres are seen in the dorsal funiculi. The pyramidal degeneration occupies the same area as that in the Weigert preparation. In the ventral funiculi, there are a few scattered fibres extending from the ventral median fissure to the emergence of the ventral roots, occupying the lateral half of the funiculus.

Sixth Thoracic Segment, Weigert specimen. See Fig. XI.

It is to be noted that the strips of degeneration in the dorsal funiculi are seen for the last time at this level.

From this point on the pyramidal tract degenerates in its well known form, being restricted at the beginning of the intumescentia lumbalis to the lateral two-thirds of the lateral funiculus. Here it is separated from the gray matter by a band of sound fibres.

SUMMARY OF THE ASCENDING DEGENERATION.

1. *Dorsal Funiculi.*—Starting at the level of the first thoracic segment the degenerated area occupies the whole of the dorsal funiculi but is not complete. Some fibres particularly on the periphery are spared. Traveling up, the degenerated area is narrowed by the entering dorsal roots, so that at the level of the seventh cervical segment it assumes the shape of the tennis racquet before described; at the level of the fifth cervical segment it is bottle-shaped, occupying now little more than the region of the fasciculus gracilis (Golli). It is to be noted in comparing the Weigert-Pal and Marchi specimens that the parts shown to be most sclerosed by the former method, namely, the ventral and medial parts, show by the latter a lessened number of blackened myelin sheaths; whereas the blacker parts in the Weigert's specimens, the dorsal part, show some blackened sheaths. In general, the distribution of the degeneration, as shown by the two methods, is the same. At the level of the third cervical segment the degenerated area is triangular in shape, occupying the dorsal three-fourths of the fasciculus gracilis. At the first cervical segment the degenerated triangle has lengthened dorso-ventrally, again reaching the dorsal gray commissure. In the medulla, the fasciculus gracilis is much degenerated, and the degenerated fibres can be followed directly into the nucleus funiculi gracilis.

Besides this typical ascending degeneration, there is to be seen in the Marchi specimens, at the level of the first, second and third cervical segments, a narrow marginal degeneration in the fasciculus cuneatus. Farther down at the fourth and fifth cervical segments a few degenerated fibres are seen in this region. It is also to be noted that the dorsal roots at the level of the first, second and third cervical segments are partially degenerated.

2. *Fasciculus Cerebellospinalis* (*Direct Cerebellar Tract*).—The degeneration of this fasciculus corresponds to a definite area at the level of the eighth cervical segment. Below, the degenerated fibres of this fasciculus are mingled with those of the lateral pyramidal tract and of the fasciculus lateralis proprius. At the lower part of the eighth cervical segment it occupies the lateral half of the lateral column, extending as far forward as a point opposite the lateral gray horn. In ascending, the area of this degeneration, as seen in the Weigert preparations, remains narrow in its dorsal half, broadening out a little dorsal to the lateral gray horn, where it joins the fasciculus ventrolateralis superficialis (Gowersi.) (In the Marchi specimens the zone remains narrow until it reaches the lateral gray horn.)

The shape has completely changed at the level of the third cervical segment. For a short interval in front of the tip of the dorsal horn it is very narrow, it then broadens, and is compact and well marked midway between the dorsal and lateral gray horns. At this level there is a zone of darker staining fibres next to the periphery in the Weigert specimen, a little ventral to the tip of the dorsal gray horn. The Marchi specimen shows a well defined degeneration there. Ascending, the degeneration lessens very much in the Weigert specimens. At the first cervical segment, a sound band of fibres is interposed between the periphery and the degenerated area, as seen in the Weigert specimens. Here the degenerated area consists of a small part projecting from the tip of the dorsal horn, and separated from the periphery by the band of sound fibres mentioned. In the Marchi specimen at this level the relations are very different from those met with in the Weigert preparations; the degenerated area, which is very well defined, is very broad next the dorsal horn, and narrows to a point as it extends ventralwards. This latter shape is preserved at the lower part of the medulla, as seen in the Marchi specimens.

3. *Fasciculus Ventrolateralis Superficialis* (*Gowersi*).—The description of this fasciculus corresponds to the Weigert specimens, as the degeneration of this tract is not well marked in the specimens prepared by the method of Marchi. The degeneration is first plainly visible at the lower part of the seventh cervical segment, where it extends from the direct cerebellar tract to the emergence of the ventral root. It occupies here the peripheral half of the lateral funiculus, but is not very well marked at this level. Ascending it undergoes but slight change in shape. At the third cervical segment it becomes more intense, and is separated from the direct cerebellar tract by a band of darker color (less degenerated). This relation is seen also at the first cervical segment.

SUMMARY OF DESCENDING DEGENERATION.

1. *Fasciculus Cerebrospinalis Lateralis* (*Lateral Pyramidal Tract*).—The degeneration in this tract begins at the fourth thoracic segment, where it is well marked, and is slightly removed from the neck of the dorsal horn. Descending it becomes smaller, the interval between it and the dorsal horn becoming widened. Corresponding to the change in shape of the cord in the lumbar region, it becomes narrowed from side to side and broadened dorso-ventrally. The degeneration continues down to the conus terminalis; at the lower sacral region it can be plainly seen in the Weigert specimens, but it is no longer sharply outlined.

2. *Fasciculus Ventralis Proprius and Fasciculus Lateralis Proprius* (*Ventrolateral Ground Bundles*).—The degeneration in the ground bundles is most evident in the Marchi specimens. It begins at the level of the fourth thoracic segment, where it occupies the entire ventral and part of the lateral funiculus. It rapidly diminishes in size, and has entirely disappeared at the level of the seventh thoracic segment.

3. *Septal Degeneration.*—This is an intense degeneration extending along the dorsal median septum from the dorsal gray commissure to near the periphery of the cord. It can be made out in Weigert specimens for but one segment below the lesion.

4. *Comma of Schultze.*—This is seen beautifully at the level of the fourth thoracic segment, one segment below the lesion. The head of the comma almost touches the dorsal commissure, and joins on the other hand the septal degeneration before described. The head is more intensely degenerated than the tail end, which does not reach the periphery of the cord. At the level of the fifth thoracic segment, the degenerated areas occupy two small strips in the fasciculus cuneatus reaching to the gray matter. The tract is last seen as a similar less intense degeneration at the sixth thoracic segment.

COMPARISON OF THIS CASE WITH OTHERS IN THE BIBLIOGRAPHY.

A feature of this case, very little described and figured in the literature, is the appearance of the holes left empty by the degenerated nerve fibres. The peculiar pictures seen are to be regarded, in general, as different stages in the disintegration of the nerve fibres. V. Babes* describes and figures some of these, namely, the hyaline masses occupying part of the holes. He says that the latter are probably derived from swollen axis-cylinders. The study of the present case confirms this view, as all stages between the degenerating fibres and the hyaline masses can be seen. He also pictures the holes, which are, in his cases, entirely filled with fat droplets.

E. A. Homén,† in Babes' Atlas, describes the process of the degeneration of the nerve fibres as it occurs experimentally in dogs. According to him, the first change to take place occurs about four days after the lesion, and consists of a swelling and granulation of the axis-cylinders. These lose their power of staining with the usual dyes, but stain strongly with acid fuchsin. This, according to Homén, harmonizes with the theory which assumes the cell to be the trophic centre, since the axis-cylinder is the first to suffer from the disconnection of the nerve fibre with it. This statement differs from that of Müller. Müller‡ noted in a case of myelitis of tuberculous origin, that certain axis-cylinders colored deeply in specimens stained by Van Gieson's method; he found further that the myelin sheaths, corresponding to these intensely staining axis-cylinders, are those which stain by Marchi's method. He takes this as evidence of the strong vitality of the axis-cylinders, and says that they can withstand destructive influences for a longer time than the myelin sheaths. In the present case, many deeply staining axis-cylinders were seen about the site of compression in sections stained by Van Gieson's method. In specimens stained both by Marchi's and Van Gieson's methods, some of the axis-cylinders in the degenerated fibres refuse to stain, and others stain but feebly.

The changes in the axis-cylinder are followed by a fragmentation of the myelin sheath, which begins in the part of the myelin immediately adjacent to the axis-cylinder and extends peripheralwards (Homén). This harmonizes with the fact that in the present case vacuolar areas were frequently found surrounding the axis-cylinder. In ten or twelve days the fibres first affected are, Homén declares, broken up into a granular mass. About this time, or a few days later, there begins to be a reaction on the part of the neuroglia, manifested by karyokinesis and proliferation of the neuroglia cells. About the twenty-first day, the corpora amylacea first appear. About the same time a few leucocytes and compound granular cells are met with.

Dorsal Funiculi.—This case confirms and adds to the history of secondary degenerations in this region. The ascending and descending degenerations concern fibres of both exogenous and endogenous origin. It has been long known that the fibres of exogenous origin after entering the dorsal funiculi bifurcate; the long ascending limbs of bifurcation are displaced so as to occupy a position more medial and dorsal as they pass up. Thus, a compression in the lower region of the cord causes an area of degeneration in the dorsal funiculi, which in ascending becomes gradually smaller in size, assuming in the cervical region a triangular shape with the base of the triangle at the periphery of the cord. The peripheral distribution of this and other long tracts led Flatau* to formulate the law "that the short fibres of the cord run in close relation to the gray matter, while the long fibres select a position nearer to the periphery of the cord."

What is exceptional in the present case is the fact that the apex of the triangular shaped degeneration does not reach the dorsal gray commissure at the level of the third cervical segment, whereas higher up in the region of the first cervical segment it has become lengthened dorso-ventrally, again reaching the dorsal gray commissure. In Schultze's† cases, in two of which the lumbar cord was diseased, in one the cauda equina affected, and in the other there was a complete transverse lesion of the lower thoracic region, this dorso-ventral lengthening of the degenerated area was not seen. It is not pictured by Gombault and Philippe.‡ It is shown, however, in a case of Darkschewitch's,§ in which the cauda equina was pressed upon by a pachymeningitis. In his case the dorso-ventral lengthening was pictured high up in the cervical cord. The apex of the degenerated triangle in the fasciculus gracilis, in Spiller's‖ case, in which the compression was exerted at the cervico-thoracic junction of the cord, did not reach the dorsal gray commissure in a section taken just below the pyramidal decussation.

Concomitant with this dorso-ventral lengthening of the degenerated area, we find degenerated fibres in the dorsal roots of the first, second and third cervical nerves. The question naturally arises, is there any connection between these two facts. That this lengthening of the degenerated area is due to these degenerated dorsal root fibres is negatived both by the result of section of the cervical dorsal roots and

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*Babes, V. Verschiedene Formen der Entartung und Entzündung des Rückenmarkes. Atlas d. path. Histol. d. Nervensyst. Berl., 1896, Lfg. vi, S. 20-35.

†Homén, E. A. Die histologischen Veränderungen bei der (experimentellen) secundären Degeneration des Rückenmarkes. Atlas d. path. Histol d. Nervensyst. Berl., 1896, Lfg. vi, S. 5-19.

‡Müller, L. R. Ueber einen Fall von Tuberculose des oberen Lendenmarkes mit besonderer Berücksichtigung der secundären Degenerationen. Deutsche Ztschr. f. Nervenh., Leipz., 1896-7, Bd. x, S. 273-291.

*Flatau (E.) Das Gesetz der excentrischen Lagerung der langen Bahnen im Rückenmark. Ztschr. f. klin. Med., Berl., 1897, Bd. xxxiii, S. 55–152.

†Schultze. Beitrag zur Lehre von der secundären Degeneration im Rückenmarke des Menschen nebst Bemerkungen über die Anatomie der Tabes. Arch. f. Psychiat., Berl., 1883, Bd. xiv, S. 259-390.

‡Gombault, A. et Philippe. Contribution a l'etude des lésions systématisées dans les cordons blancs de la moelle épinière, Arch. de méd. expér. et d'anat. path., Par., 1894, t. vi, H. 365-424.

§Darkschewitsch, L. O. Zur Frage von den secundären Veränderungen der weissen Substanz des Rückenmarks bei Erkrankung der Cauda equina. Neurol. Centralbl., Leipz., 1896, Bd. xv, S. 5-13.

‖Spiller, W. G. A microscopical study of the Spinal Cord in two cases of Pott's Disease. Johns Hopkins Hospital Bulletin, Balt., June, 1898.

the study of human cases, in which either the cervical roots were degenerated or there was a lesion of the upper thoracic or cervical cord; these results teach us that the ascending branches of the cervical dorsal roots remain throughout their entire course in the funiculus cuneatus. That the degenerated fibres are not longitudinal association paths seems untenable in light of the case reported by Mme. J. Dejerine and J. Sottas* of medullary syphilis of the cord, extending from the third to the eleventh thoracic roots. The authors found the fasciculus gracilis entirely degenerated, and they concluded from this and other cases that the fasciculus gracilis is composed entirely of ascending dorsal root fibres, and that it does not receive in its course any fibres of endogenous origin. The dorso-ventral lengthening of the degenerated area is readily understood, if the view that some fibres of the fasciculus gracilis end in the gray matter of the upper cervical region is correct.

Comma of Schultze.†—Our knowledge concerning the endogenous paths in the cord is not so satisfactory. The path, known as the comma of Schultze, had been seen as early as 1866 by Bouchard, and later by Strümpell, but it was first made the object of especial study by Schultze in 1883. Among several cases of degeneration in the spinal cord from compression, he found the comma shaped area in only one instance, extending as two parallel lines, two and one-half centimeters below the lesion.

The origin of the fibres in Schultze's comma is still a disputed point. Schultze assumed that they came from the dorsal roots, and the same view has been held by Bruns, Lenhossék, Singer and others. Gombault and Philippe, Tooth, Marie and others maintain that they do not come from dorsal root fibres, as the comma is found degenerated in lesions of the cord itself. It is to be noted, however, that dorsal root fibres, that have already entered the cord, or their descending limbs of bifurcation, might be involved in a lesion of the cord itself.

That degeneration of the comma tract is, in this instance, not due to lesions of the dorsal roots outside the cord is proved by the present case, where all the root fibres are perfectly healthy for no less than eight segments above and for all the segments below the lesion. The fibres must arise then from the tracts in the ventral or lateral funiculi of the cord, from descending fibres of the dorsal roots which have already entered the cord, or from the cells of the cord. Now, as a matter of fact, no one has seen or imagined the least connection between the tracts in the lateral and ventral funiculi and the comma tract, or between the ventral roots and the comma path. Against the view that the bulk of the path is constituted of descending limbs of bifurcated dorsal root fibres is its long course, since, as shown by Hoche, degenerated fibres of the comma tract may be traced for ten segments below the site of the lesion, while it is generally believed that the descending branches of the dorsal root fibres run down but a short distance (von Lenhossék). The bulk of the path is then, in all probability, made up of fibres which arise in cells situated in the gray matter of the cord, a view which is made all the more probable by the close relation which has been proven to exist between this path and the gray matter.

Within the last year there has appeared an article by Zappert, in which he supports the view that the path is composed of fibres partly of exogenous and partly of endogenous origin. He studied the cord of a luetic child which had died a few days after birth. There was inflammation of the pia mater in the cervical region, compressing the ventral and dorsal roots in this region and causing their degeneration. The cord itself was intact. Besides other degenerations, he found an intense degeneration of the comma of Schultze, reaching as far as the lower third of the thoracic cord. He therefore believes that the greater part of Schultze's comma is made up of fibres of exogenous origin.

The path is now recognized as a long path. Schultze, as mentioned, found it for only a short distance below the lesion. In the present case it was seen but for three segments below the lesion, probably because the Weigert method is not delicate enough to demonstrate the sparsely scattered degenerated fibres lower down. Hoche, Bruce and Muir, and others, by means of Marchi's method, in cases of recent injury, have proven conclusively that the path extends for ten or more segments below the lesion; in one case Hoche followed it down into the lumbar cord, although below, the fibres were very scattered.

The method used, and the fact that the authors did not follow the degeneration closely enough, led to the erroneous view of Gombault and Philippe, who thought that the comma tract was connected with the oval field of Flechsig. They explained the change in position by saying that higher up the oval-field fibres are pushed aside, in a way analogous to the formation of the fasciculus gracilis.

The fibres of Schultze's comma probably end, as pointed out by Hoche, in the gray matter of the dorsal horn, as they re-

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* Dejerine, J., et J. Sottas. Sur la distribution des fibres Endogènes dans le cordon postérieur de la moelle et sur la constitution du cordon de goll. Comp. rend. Soc. de biol., Par., 1895, 10 s., t. ii, pp. 465-469.

† The following bibliography dealing with the comma of Schultze has been consulted :—

Schultze. Beitrag zur Lehre von der secundären Degeneration im Rückenmarke des Menchen nebst Bemerkungen über die Anatomie des Tabes. Arch. f. Psychiat., Berl., 1883, Bd. xiv, S. 359-390.

Gombault et Philippe. Contribution a l'etude des lésions systématisées dans les cordons blancs de la moelle épinière. Arch. de méd. expér. et d'anat path., Par., 1894, t. vi, pp. 365-424.

Lenhossék, M. v. Der feinere Bau des Nervensystems im Lichte neuester Forschungen. Berl., 1893.

Hoche, A. Ueber Verlauf und Endingungsweise der Fasern des ovalen Hinterstrangsfeldes im Lendenmarke. Neurol. Centralbl., Leipz., 1896, Bd. xv, S. 154-156.

—— Also, Ueber secundäre Degeneration, speciell des Gowers'-chen Bündels, nebst Bemerkungen über das Verhalten der Reflexe bei Compression des Rückenmarkes. Arch. f. Psychiat., Berl., 1896, Bd. xxviii, S. 510-543.

Zappert, J. Beiträge zur absteigenden Hinterstrangsdegeneration. Neurol. Centralbl., Leipz., 1898, Bd. xvii, S. 103-107.

Müller, L. R. Ueber einen Fall von Tuberculose des oberen Lendenmarkes mit besonderer Berücksichtigung der secundären Degeneration. Deutsche Ztschr. f. Nervenh., Leipz., 1896-7, Bd. x, S. 273-291.

Campbell, A. W. On the Tracts in the Spinal Cord and their Degenerations. Brain, Lond., 1897, vol. xx, pp. 488–535.

Spiller, W. G. A Microscopical Study of the Spinal Cord in two Cases of Pott's Disease. Johns Hopkins Hospital Bulletin, Balt., June, 1898.

remain next to it for their entire course. He was able to trace fibres for a short distance into the gray matter, but they were soon lost owing probably to a change in direction.

The septal degeneration which runs but one segment below the lesion is rather unusual. Hoche figured it somewhat as seen in the present case. Spiller, in a case of compression of the cord at the level of the first thoracic segment, found a diffuse degeneration of the ventral portion of the dorsal funiculi, which extended 3½ cm. below the place of compression. Müller also described an intense degeneration of the ventral half of the dorsal funiculi, which extended for several segments below the compression, which was due to a solitary tubercle of the spinal cord, extending between the first and second lumbar nerves.

Fasciculus Cerebellospinalis.—Of the views relating to the origin of the axones of this path, that most generally accepted is that they arise from the nerve cells of the nucleus dorsalis. Tooth* however concludes from his experimental work done on monkeys, that in the cervical region and possibly also in the upper thoracic region, fibres from the dorsal roots of the spinal nerves enter largely into the composition of this tract. Tooth admits that lower down the fibres do not come by way of the dorsal roots. If this view of Tooth is correct, it will possibly explain the different pictures of this path, in the present case, given by the methods of Marchi and Weigert.

The nucleus dorsalis, which then, everyone admits gives rise to the bulk of this fasciculus, extends from the seventh cervical to the third lumbar segment of the spinal cord. The lowest limit of the transverse lesion in this case, being at the level of the third thoracic segment, one would expect an extensive involvement of this tract. The degeneration of this tract is found to occupy in its lower part, the usual area ascribed to it, but it is not very intense. The interesting point in connection with it is the variation in the picture given by the method of Marchi from that revealed by the method of Weigert.

Up to the third cervical segment, as seen by both methods, the degenerated area occupies its usual position, extending ventralwards from the tip of the dorsal gray horn and outside the region of the fasciculus cerebrospinalis lateralis. At the level of the third cervical segment the field degenerated becomes more evident in the Marchi specimens. It will be remembered that the third cervical dorsal roots on both sides are degenerated. The view of Tooth, that the cervical dorsal roots take part in the formation of this fasciculus, would explain this tract becoming more evident here. If Tooth be correct, however, it is curious that such a host of observations as those recorded, have been constantly negative as regards this point. On the other hand, in the Weigert specimen, the intensity of the degeneration remains the same, and there appears a band of sounder fibres which lies on the periphery of the cord next to the tip of the dorsal gray horn. The third cervical roots as seen in the Weigert specimen also contain degenerated fibres. At the level of the first cervical segment the area of degeneration is very faint in the Weigert specimens, and is separated from the periphery of the cord by a bundle of sound fibres. On the other hand, in the specimens prepared by the method of Marchi, the degeneration is very well marked. It is readily seen with a magnification of ten diameters. The first and second cervical dorsal roots are found degenerated by both methods. The shape of the degeneration, also, is somewhat different at the level of the first cervical segment in the Marchi specimens. Next to the tip of the dorsal gray horn it is very broad, occupying the peripheral third of the lateral column. In passing ventralwards it diminishes in breadth.

The shape of this tract as seen in the Marchi specimens corresponds to that in the new edition of Quain* in a case of hemi-section at the level of the twelfth thoracic nerve. Hoche's† pictures of this tract at the level of the first cervical segment do not correspond with that seen in the present case. His cases were instances of compression myelitis at the level of the first thoracic and between the fourth and fifth thoracic segments. He represents the fasciculus cerebellospinalis as starting in a point at the tip of the dorsal gray horn and increasing in width on going ventralwards to join Gowers' tract. In his cases the cord was examined from four to six weeks after the onset of compression.

Fasciculus Ventrolateralis Superficialis (*Gowersi*).—This tract is not so well understood as is the direct cerebellar. Its origin is not definitely known. Schäfer in Quain's Anatomy states that it probably comes from cells in the dorsal horn in the lumbar region. Campbell‡ believes that the axones probably arise from cells in the gray matter of the lumbar cord, possibly in the "middle cell-column" of Waldeyer. Lenhossék§ says it arises partly from cells in the ventral horns and partly from cells in the middle zone of the gray matter.

One would therefore expect in this case to find considerable degeneration of this tract. This is not especially indicated in either the Weigert or Marchi specimens. In the latter only scattered degenerated fibres are found in the tract as far up as it was traced. The Weigert method revealed more alterations, and with it the degeneration seemed to be more intense at the higher levels of the cord. It was not, as mentioned by Schäfer, most intense immediately adjacent to the fasciculus cerebrospinalis lateralis (lateral pyramidal tract), but a little ventral to this, opposite the gray horn. This appearance comes out best at the first cervical segment, where a sounder band of fibres is interposed between the degenerated Gowers' tract and the direct cerebellar tract.

The position of Gowers' tract in the figures of Hoche agrees fairly well with the present case as far as the first cervical seg-

*Tooth. Quoted from A. W. Campbell, Brain, 1897, op. cit. p. 8.

*Quain (J.) The Elements of Anatomy. Edited by E. A. Schäfer and G. D. Thane. 10 ed. The Spinal Cord and Brain, 1893.

†Hoche, A. Ueber secundäre Degeneration, speciell des Gowerschen Bündels, nebst Bemerkungen über das Verhalten der Reflexe bei Compression des Rückenmarkes. Arch. f. Psychiat., Berl., 1896, Bd. xxviii, S. 510-543.

‡Campbell, A. W. On the Tracts in the Spinal Cord and their Degenerations. Brain, Lond., 1897, vol. xx, pp. 488-535.

§Lenhossék, M. v. Der feinere Bau des Nervensystems im Lichte neuester Forschungen, Berl., 1893.

ment, the difference of methods being taken into consideration. Farther up the degeneration cannot be followed in the Weigert preparations, nor is it indicated in the Marchi specimens. It is generally conceded that the bulk of Gowers' tract is ascending, so the fact that the degeneration of the direct cerebellar comes out well, and that of Gowers poorly or not at all, by Marchi's method, would seem to indicate that Gowers' tract degenerated sooner in this case than the direct cerebellar.

Rapidity of Degeneration.—It may be worth while here to say a word concerning the results given by the Weigert and Marchi methods. Schaffer* noted certain differences between the results of the two methods in a case of transverse lesion of the spinal cord. He employed both the Marchi and Weigert methods, and obtained results which differed from previous observations. He concluded from his work that after a transverse lesion of the cord, the fasciculus gracilis degenerates most quickly, the fasciculus cerebrospinalis lateralis next, while the descending degeneration in the dorsal funiculi, the ascending degeneration of the fasciculus cuneatus, the fasciculus ventrolateralis superficialis and the fasciculus cerebellospinalis follows later.

Whether all of Schaffer's conclusions are true or not remains to be seen, but the case here recorded lends support to some of his statements. The fasciculus gracilis is the most sclerosed of all the tracts, as is beautifully revealed by Weigert's method. Homén† states that after section of the spinal cord in dogs, the first degenerative changes are seen three or four days after the operation in the dorsal funiculi above the place of operation. The fasciculus cerebrospinalis lateralis shows on the whole slightly more degeneration by Weigert's method than either the fasciculus cerebellospinalis or the fasciculus ventrolateralis superficialis, although the latter shows well marked degeneration at the highest levels of the cord. The Marchi method which reveals degeneration in actual progress, shows least of all in Gowers' tract throughout its entire course. The degenerated field in the dorsal funiculi corresponds in area to that in the Weigert specimens, but is of less intensity. An interesting point with regard to the fasciculus cerebellospinalis is the fact that different fields of degeneration are revealed by the two methods at the highest levels of the cord. Concerning the descending degeneration, the most striking feature is that the degeneration in the dorsal funiculi extends but one segment below the lesion. In the lateral pyramidal tracts, the black dots representing degenerated fibres, can be followed as far down as the lumbar cord, but here they are only sparsely scattered. The degeneration is however well marked at this level in the Weigert preparations.

The fact that the oval field of Flechsig (the descending septo-marginal tract of Bruce and Muir‡) was not indicated by the Marchi specimen would go to indicate that this tract also degenerates rapidly. In fact, the recent cases of Hoche, Bruce and Muir, and Scarpatetti,* in which this tract and the comma of Schultze were thoroughly degenerated, were instances in which death ensued within a month or two after the onset of compression. Thus the individual fibres were caught in the first period of degeneration by the Marchi method, whereas they would not have been shown by other methods. By the Weigert method, these paths in the dorsal funiculi are shown only where the fibres are massed together and there has been considerable sclerosis, as found by Gombault and Philippe, who thus discovered their median triangle. In the present case there was some lightening of these areas in the Weigert preparations.

LEGENDS FOR FIGURES.

The lettering for the tracts is the same throughout. Each of the drawings of the spinal cord represents a magnification of five diameters.

F. cs. l.— Fasciculus cerebrospinalis lateralis (lateral pyramidal tract).
F. vl. G.—Fasciculus ventrolateralis superficialis (Gowersi).
F. cls.—Fasciculus cerebellospinalis.
F. c.— " cuneatus (Burdachi).
F. g.— " gracilis (Golli).
F.L.—Lissauer's fasciculus.
F. s.—Septal fasciculus.
Comma.—Schultze's comma fasciculus.
F. p. l.—Fasciculus proprius lateralis.

FIG. I. Level of the first cervical segment. Weigert-Pal preparation.

The degeneration of the tracts is indicated in this and the other Weigert preparations by a lightening in color.

FIG. II. Level of the first cervical segment. Marchi specimen.

FIG. III. Level of the second cervical segment. Weigert-Pal specimen.

FIG. IV. Level of the second cervical segment. Marchi specimen.

FIG. V. Level of the third cervical segment. Weigert-Pal specimen.

FIG VI. Level of the third cervical segment. Marchi specimen.

FIG. VII. Level of the fifth cervical segment. Weigert-Pal specimen.

FIG. VIII. Level of the seventh cervical segment. Weigert-Pal specimen.

FIG. IX. Level of the fourth thoracic segment. Weigert-Pal specimen.

FIG. X. Level of the fifth thoracic segment. Weigert-Pal specimen.

FIG. XI. Level of the sixth thoracic segment. Weigert-Pal preparation.

FIG. XII. Lumbar region of the cord. Weigert-Pal specimen.

FIG. XIII. Specimen from the region of compression. Stained by Van Gieson's method. Leitz objective $\frac{1}{12}$ (oil immersion), eye piece 3.

N.—Swollen irregular shaped nerve fibres, containing swollen deeply staining axones.

N.'—Nerve fibres containing vacuolic areas.

* Schaffer, Karl. Beitrag zur Histologie der secundären Degeneration. Arch. f. mikr. Anat., Bonn, 1894, Bd. xliii, S. 252-266.

† Homén, E. A. Atlas d. path. Histol. d. Nervensyst., Berl., 1896, Lfg. vi, S. 5-19.

‡ Bruce, A. and Muir R. On a Descending Degeneration in the Posterior Columns in the Lumbo-sacral Region of the Spinal Cord. Brain, Lond., 1896, vol. xix, pp. 333-345.

* Scarpatetti, J. von. Befund von Compression und Tuberkel im Rückenmark. Jahrb. f. Psychiat., Leipz. u. Wien, 1896-7, Bd. xv, S. 310-329.

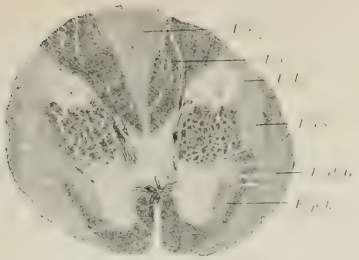

FIG. I.

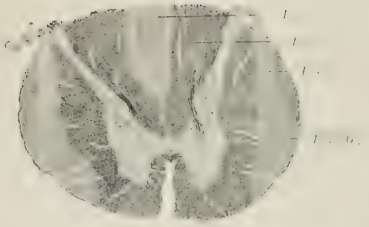

FIG. V.

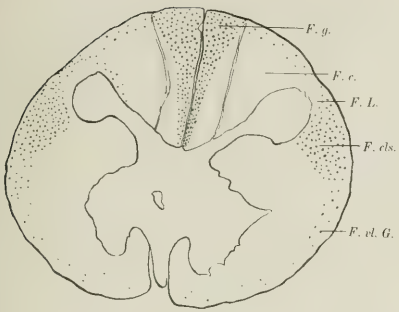

FIG. II.

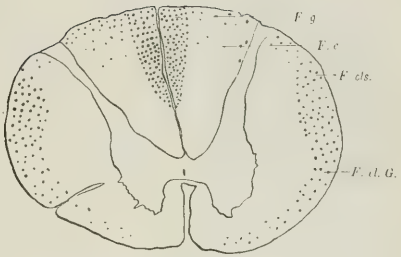

FIG. VI.

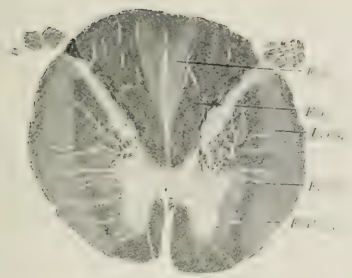

FIG. III.

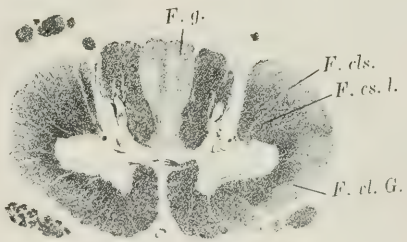

FIG. VII.

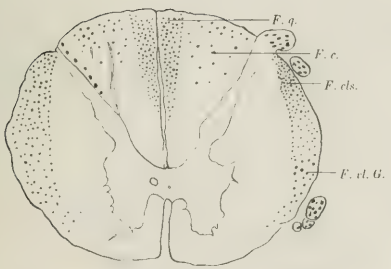

FIG. IV.

Schmidt and Ruschkamp del.

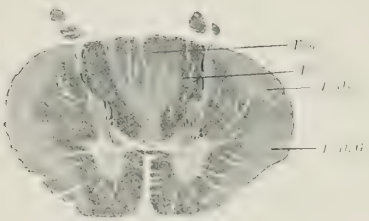

FIG. VIII

Fig. IX.

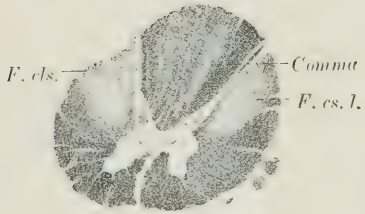

Fig. X.

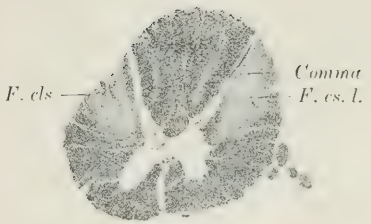

Fig. XI.

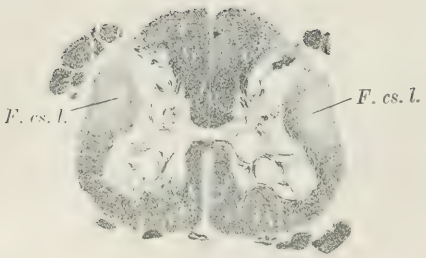

Fig. XII.

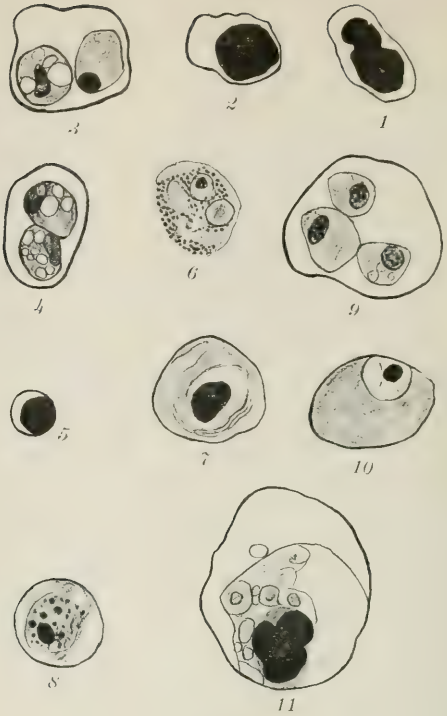

Fig. XIV.

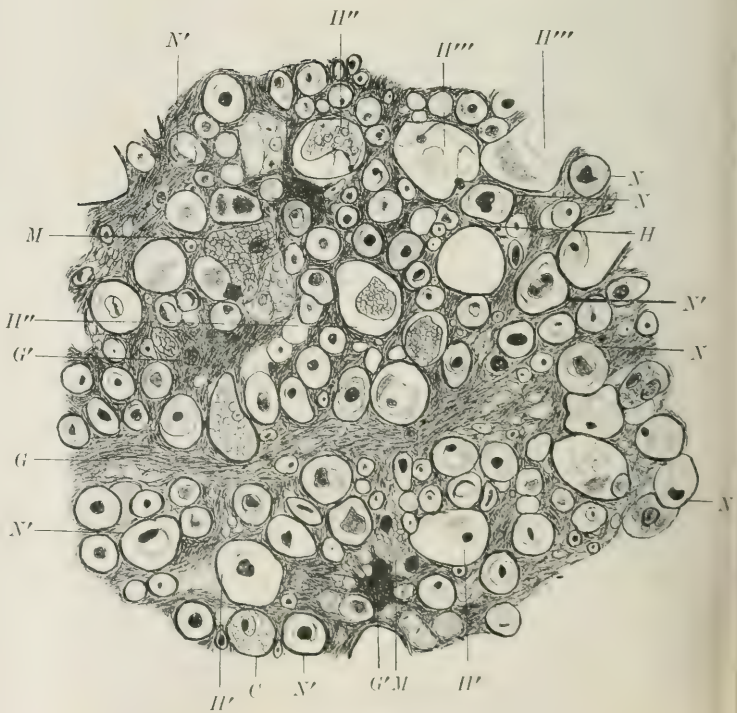

Fig. XIII.

G.—Neuroglia, greatly increased in amount.

G.' Nuclei of neuroglia cells.

M.—Masses of globular material imbedded in the neuroglia, staining a pinkish color.

H.—Empty hole.

H.'—Hole containing a disintegrating nerve fibre.

H.''—Holes containing masses of more or less globular appearance, staining a pinkish color. They are probably modified compound granular corpuscles.

H.'''—Holes containing material taking on a yellowish and pinkish coloration. Probably broken down nerve fibres.

C.—Compound granular corpuscle.

FIG. XIV. From various parts of the region of compression. Leitz objective $\frac{1}{12}$ (oil immersion), eye piece 3.

1 and 2. Corpora amylacea—Van Gieson's stains.

3 and 4. Eighth cervical segment. Two large irregular holes, containing cells, the nuclei of which stain a deep red color. The protoplasm contains vacuoles, and in parts looks as if it were made up of small globules. These are probably modified compound granular corpuscles Upson's carmine.

5. Second thoracic segment. Hole containing one of the corpora amylacea, which are very numerous at this level. It stains a pink color. Marchi's fluid and Upson's carmine.

6. Same section as 5. Shows several degenerating fibres. In one the axone stains a faint pink color; in another the axone is barely outlined. Numerous black globules of myelin are seen. The rest of the myelin has a faint yellowish color.

7. A nerve fibre is shown here, with a vacuolar area around the axis-cylinder.

8. Marchi specimen counter-stained in Upson's carmine. Hole containing a degenerating nerve fibre. The axone stains a fairly good pink color. The myelin sheath is represented partly by black granules, partly by a yellowish staining mass.

9. Haematoxylin and eosin. Hole containing three compound granular corpuscles. The nuclei stain black and are granular.

10. Eighth cervical segment. Van Gieson's stain. Swollen ganglion-cell. The protoplasm stains a homogeneous pink color. The nucleus is almost colorless; the nucleolus stains a deep pink color.

11. Weigert-Pal specimen counter-stained in Upson's carmine. Large hole containing several large black masses, surrounded by ball-like masses, which are outlined by darkly staining rings.

THE TREATMENT OF OTOMYCOSIS BY THE INSUFFLATION OF BORACIC ACID AND OXIDE OF ZINC.*

BY SAMUEL THEOBALD, M. D., *Clinical Professor of Ophthalmology and Otology, Johns Hopkins University.*

Seventeen years ago, in an article published in the American Journal of Otology,† I called attention to the value of a powder containing equal parts of boracic acid and oxide of zinc in the treatment of otomycosis aspergillina. In this article objection was urged to the use of alcohol, the agent most commonly employed for the destruction of aural fungi, on the ground that it not infrequently causes considerable pain when instilled into the auditory canal and tends to aggravate the inflammation of the canal walls and tympanic membrane usually present in otomycosis. A distinct gain, it was pointed out, would be made if a remedy could be found which would effectually destroy the parasite and at the same time exert a beneficial influence upon the inflammation excited by its presence; and such a remedy, it was claimed, had been found in the boracic acid and oxide of zinc powder.

Experiments were described which showed the specific action of boracic acid in destroying aspergillus and other fungi, and the drying effect of the oxide of zinc was held to render more effectual the germicidal action of the acid. At the same time, there was abundant evidence to show that the combination of the two, used as suggested (by insufflation), was one of the most efficacious remedies that we possess in overcoming diffuse inflammation of the external ear.

Although in the interval that has elapsed since the publication of this paper, I have used this remedy in all the cases of otomycosis that I have met with, and have never known it fail to destroy effectually the parasite—a single application often accomplishing this result, and more than two applications being seldom needed—I should not feel warranted in bringing the subject again to the attention of otologists but for the fact that the majority of them, to judge by the text-books, still seem to adhere to the practice, which, I think, should long since have become obsolete, of treating these cases by alcohol instillations.*

That alcohol is a suitable agent to pour into a diffusely inflamed and painful auditory canal will hardly be maintained by any one; while its relative inefficiency in destroying aspergillus seems to be shown by the statement of Politzer, that the instillations should be kept up for "a year" to prevent a return of the growth,† and that of Hovell, who says they should be repeated "two or three times a day" until the parasite is gotten rid of, and continued at intervals of a week for "several months" in order to guard against a relapse.‡ As opposed to this, we have the one, two or, at most, three applications of the zinc and boracic acid powder, at intervals of 24 or 48 hours, immediately and effectually eradicating the parasite, and at the same time, almost invariably, greatly benefiting the attendant inflammation.

The addition of bichloride of mercury or boracic acid to alcohol, as has been recommended, probably increases its parasiticidal effect, but certainly does not lessen its irritant action. Boracic acid and iodoform, mentioned among other agents by Gleason, ought to be efficacious, but, for the sake of our patients and their friends, iodoform should not be used if a less objectionable remedy will accomplish the same purpose. Chinoline salicylate and boracic acid, 1 part to 8 or 1 to 16, recommended by C. H. Burnett,§ is highly extolled by Robert Barclay.‖ I cannot speak of the value of this remedy from

* Read before the American Otological Society, July 18, 1898.

† Vol. III, No. 2, p. 119.

* Compare Politzer, Dench, McBride, Hovell, Gleason.

† Diseases of the Ear, p. 187.

‡ Diseases of the Ear and Naso-pharynx, p. 195.

§ Medical & Surg. Reporter, Phila., Vol. LXI, p. 539.

‖ Burnett's System of Diseases of the Ear, Nose and Throat.

personal experience, but I am prepared to believe that it must yield favorable results from the large proportion of boracic acid which it contains.

The boracic acid and oxide of zinc powder is open to the single objection that it is a somewhat insoluble compound, but this is not a serious objection, especially if it be blown into the ear, as it should be, only in sufficient quantity to cover lightly the walls of the meatus and the tympanic membrane. The parasite destroyed and the inflammation subdued, the removal of that portion of the powder which may have adhered to the membrane and canal walls may be safely left to nature, which, through the outgrowth of the epidermis, will accomplish this completely within the course of a few weeks.

A brief description of a single typical case, recently under observation, will suffice to illustrate the action of this remedy and the manner of its employment.

Mr. X, of Baltimore, consulted me in the latter part of May last, because of an uncomfortable "full feeling," attended by slight pain, in the left ear. The history of the case indicated that there had been a slight dermatitis in each auditory canal for a considerable time. The symptoms complained of in the left ear were found to be due to the presence of aspergillus nigricans, which had excited a well-marked diffuse inflammation of the deeper portion of the canal walls and the tympanic membrane.

By the aid of the syringe, probe and forceps the aspergillus was removed as completely as possible and the meatus was freed of a considerable quantity of exfoliated epithelium. The ear was then dried and the boracic acid and zinc powder blown in lightly. On the following day, although the unpleasant symptoms were entirely relieved, the treatment was repeated as a matter of precaution. This completed the cure, which a lapse of three weeks has shown to be radical.

BOOKS RECEIVED.

Atlas and Abstract of the Diseases of the Larynx. By Dr. L. Grünwald, of Munich. Authorized Translation from the German. Edited by Charles P. Grayson, M. D. 1898. 12mo. With 107 Colored Figures on 44 Plates. 103 pages. W. B. Saunders, Philadelphia.

On Cardiac Failure and its Treatment, with Especial Reference to the Use of Baths and Exercises. By Alexander Morison, M. D., F. R. C. P 1897. 8vo, 256 pages. The Rebman Publishing Co., London.

Hay Fever and its Successful Treatment. By W. C. Hollopeter, A. M., M. D. 1898. 12mo, 137 pages. P. Blakiston's Son & Co., Philadelphia.

A Report on Vaccination and its Results, Based on the Evidence Taken by the Royal Commission during the Years 1889–1897. Vol. I. The Text of the Commission Report. 1898. 8vo, 493 pages. New Sydenham Society, London.

A Text-Book upon the Pathogenic Bacteria. For students of medicine, and physicians. By Joseph McFarland, M. D. Second edition, revised and enlarged. 1898. 8vo, 497 pp. W. B. Saunders, Phila.

An American Text-Book of the Diseases of Children. By American teachers. Edited by Louis Starr, M. D., assisted by T. S. Westcott, M. D. Second edition, revised. 1898. 4to, 1244 pp. W. B. Saunders, Philadelphia.

The Diseases of the Stomach. By William W. Van Valzah, A. M., M. D., and J. Douglas Nisbet, A. B., M. D. 1898. 8vo, 674 pp. W. B. Saunders, Philadelphia.

Twelfth Annual Report of the State Board of Health of the State of Ohio, for the year ending October 31, 1897. 8vo, 308 pp. 1898. The Laning Printing Co., Norwalk, Ohio.

Preliminary Report of an Investigation of Rivers and Deep Ground Waters of Ohio, as Sources of Public Water Supplies. By the State Board of Health. 1897-98. 8vo, 259 pp. J. B. Savage Press, Cleveland.

Second Catalogue of the Library of the Peabody Institute of the City of Baltimore, including the additions made since 1882. Part III, E-G. 1898. 4to, 2006 pp. Baltimore.

An American Text-Book of Gynecology, Medical and Surgical, for practitioners and students. By H. T. Byford, M. D., *et al.* Edited by J. M. Baldy, M. D. Second edition, revised. 1898. 4to, 718 pp. W. B. Saunders, Philadelphia.

A Text-Book of Materia Medica, Therapeutics and Pharmacology. By G. F. Butler, Ph. G., M. D. Second edition, revised. 1898. 8vo, 860 pp. W. B. Saunders, Philadelphia.

King's College Hospital Reports; being the annual report of King's College and the medical department of King's College. Edited by N. Tirard, M. D., F. R. C. P., *et al.* Vol. IV. (Oct. 1st, 1896–Sept. 30th, 1897). 1898. 8vo, 358 pp. Adlard and Son, London.

The Office Treatment of Hemorrhoids, Fistula, etc., without operation. By Charles B. Kelsey, A. M., M. D. 1898. 12mo, 68 pp. E. R. Pelton, New York.

Twentieth Century Practice. An International encyclopedia of modern medical science by leading authorities of Europe and America. Ed. by Thos. L. Stedman, M. D. Vol. XV. Infectious Diseases. 1898. 8vo, 658 pp. Wm. Wood & Co., New York.

The Principles and Practice of Medicine. By William Osler, M. D. Third Edition. 1898. 8vo, 1181 pp. D. Appleton & Co., New York.

The Mineral Waters and Health Resorts of Europe. Treatment of chronic diseases by spas and climates with hints as to the simultaneous employment of various physical and dietetic methods. Being a revised and enlarged edition of "The spas and mineral waters of Europe." By H. Weber, M. D., F. R. C. P., and F. P. Weber, M. D., F. R. C. P. 1898. 8vo, 524 pp. Smith, Elder & Co., London.

A Clinical Text-Book of Medical Diagnosis for Physicians and Students. By Oswald Vierordt, M. D. Authorized translation with additions by F. H. Stuart, A. M., M. D. Fourth American edition, from the fifth German, revised and enlarged. 1898. 8vo, 603 pp. W. B. Saunders, Philadelphia.

WALTER S. DAVIS, M. D.

At a meeting held at 4.30 o'clock Wednesday afternoon, on the twenty-eighth of September, in the office of the superintendent of Johns Hopkins Hospital, presided over by Dr. H. M. Hurd, the following resolutions were adopted:

Whereas, we have lost our beloved comrade and fellow-worker, Walter S. Davis;

Be it Resolved, That we, the Medical Faculty of the Johns Hopkins University and the staff of the Johns Hopkins Hospital do express to his family our most heartfelt sympathy in their great bereavement.

His enthusiasm in the profession was unbounded and always a stimulus to his co-workers; but we shall remember him particularly for his sterling character, his ever cheerful disposition, and his fidelity as a friend, and,

Be it further Resolved, That a copy of these resolutions be conveyed to his family and published in the Bulletin of the Johns Hopkins Hospital.

THOMAS S. CULLEN,
JAMES F. MITCHELL,
GUY L. HUNNER.
Committee.

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BULLETIN

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CONTENTS.

THE DIAGNOSIS OF THE CONDITION OF EACH KIDNEY BY INOCULATION OF THE SEPARATED SEDIMENTS INTO GUINEA-PIGS IN SUSPECTED RENAL TUBERCULOSIS.

By Edward Reynolds, M. D., *Boston, Mass.*

The direct inspection of the air-distended bladder which we owe to Kelly, with its sequelæ of easy exploration of the ureters, has already led to great advances towards an accurate knowledge of the urinary diseases of women, and at the present moment, when so much is opening up before us, any new step towards exactness of diagnosis seems worth reporting.

Little is yet known of the natural history of renal tuberculosis; indeed, it is for comparatively few years that we have known that tuberculosis can be primary in the kidney, and the great mass of the profession has not yet realized that this disease is often localized for many years in one kidney before invading the rest of the urinary tract; but in the last three years we have been accumulating a considerable amount of clinical evidence in support of these views, namely, that though renal tuberculosis does in the end kill when untreated, it is often nevertheless so strictly localized in one kidney that the patient may be restored to perfect health after this is removed by nephrectomy. Among the many cases of this nature which we now have may be cited a remarkable one by Vineburg* and three by Kelly.† I am myself able to add three unpublished cases, two of my own and one very remarkable case which I saw in consultation after a nephrectomy by another surgeon. Those who have ever seen how these patients are transformed in nutrition and general health, by the removal of the offending kidney, will be slow to listen to arguments against the operation for cases in which the disease is unilateral, but it is of course justifiable only in such cases, and our success must therefore rest on our power of diagnosing the disease while it is limited to one kidney, and thus confining the operation to cases which are capable of cure by nephrectomy. For this purpose we must not only be able to establish the diagnosis of renal tuberculosis, in advance of the constitutional breakdown of the patient, but must also be able to satisfy ourselves with some positiveness of the health of the other kidney; and striking testimony to the advances which have been made in this subject during the last few years is to be obtained by inspection of the most recent text-books on medical diagnosis. Thus one, which shall be nameless, in the course of three pages devoted to renal tuberculosis, gives under diagnosis only these three clues: the presence in the sediment of the urine of little, yellow, cheesy masses of degenerated tuberculous material; the presence of pus and other signs of chronic pyelitis from no assignable cause other than tubercle, and, lastly, the presence of tuberculosis in other organs. Even the latest edition of Osler, in which the section on this subject

* Medical Record, Feb. 6th, 1898.

† Johns Hopkins Hospital Bulletin, Feb.-Mar., 1896.

has been considerably rewritten and evidently brought up to date, may be summarized as saying that there is but little chance of making a diagnosis unless we are put upon the track by finding tuberculosis in other organs, though this acute writer does mention the special methods of examination employed by gynecologists and the hope for the future which they afford.

It is apparent that these medical descriptions refer to what we from a surgical standpoint should call advanced disease. Our surgical specialty has already led us to the possibility of establishing the diagnosis at a very much earlier stage than this.

Though such a diagnosis can be made only by physical examination, a suspicion of tubercular or other renal disease will often be excited by the symptomatology, and this must therefore be briefly reviewed. The early symptoms of the disease will vary greatly both in character and in intensity in different cases, and from time to time in the same case, but will consist typically of pain and tenderness over the abdomen on the affected side, frequency of urination, and sometimes hæmaturia. These symptoms are, however, equally characteristic of simple pyelitis, renal calculus and new growth in the pelvis of the kidney. There are, indeed, no differences of kind in the symptomatology of these diseases in their early stages, though there are differences in the degree in which the several symptoms are likely to be present.

All these diseases are characterized by dull pains over the kidney and along the course of the ureter on the affected side. The pain is often bearing-down in character, and therefore a uterine origin is usually assigned to it; is usually increased by standing; and is always more or less associated with frequency of micturition, occurring at night as well as in the day-time. In all of them the call to micturate is a very urgent one; the pain on micturition is usually referred to the meatus; and all are liable to more or less tenesmus at the end of micturition. In all the pain may be increased by jarring or jolting (as in driving over rough roads).

This whole group of symptoms is, however, in reality symptomatic of the amount of inflammation present, and therefore varies with this subsidiary feature of the case. They are often though not always more marked in renal stone than in the other diseases.

All the diseases enumerated may be accompanied by hæmaturia, but this is rare in simple pyelitis; it is more likely to be profuse in tuberculosis or a new growth than in stone.

In all, the patients are almost equally liable to attacks of mild renal colic, due usually to inflammatory obstruction in the ureter. They differ from the pains excited by the passage of a calculus in being less severe and not followed by the appearance of the stone. These attacks are perhaps less common in new growths than in the other diseases under consideration. Not infrequently, at intervals in the course of these chronic renal diseases (and especially in tuberculosis and simple pyelitis), the inflammatory symptoms will be found to be most marked on the sound side. This is probably because each exacerbation of the disease in the affected side leads to an increased elimination of toxic materials from the functionally more active kidney; and this excites a transitory and somewhat acute inflammation in the mucous membrane of the urinary apparatus on the sound side.

This transposition of symptoms I have seen so frequently (I may say almost constantly) that I am sure it must always be guarded against. The side on which the patient tells us that the symptoms were first noticed is usually the diseased side.

The inquiry into the history should be followed by palpation, both abdominal and bimanual. In all these lesions we find, on palpation, a tenderness which may extend from top to bottom of the urinary tract on the affected, and even on both sides, but which is usually most marked at one or more of three points: namely, over the kidney; at the spot where the ureter crosses the brim of the pelvis, in which case it is often limited to a spot the size of the finger-tip, midway between the umbilicus and the anterior superior spine of the ilium (McBurney's point or its fellow); and, finally, over the vesical end of the ureter at the side of the cervix, which examination may even detect an enlargement or induration of the ureter. These tender points are again symptomatic of the amount of inflammation present, and therefore usually vary with the amount of pain.

A study of the history and the results of the gynecological examination usually enables us, then, to suspect, and sometimes permits us to postulate, a diagnosis of some renal disease of a surgical nature, but it does not enable us to say what, nor always on which side it is. The special examination now steps in and the real diagnosis begins here.

If a visual examination of the bladder shows that the vesical mucous membrane is substantially normal except in the interureteral region, and that a strongly localized inflammation is present there, the source of that inflammation is probably to be found in the passage of a vicious urine from one or the other ureter. If one ureteral orifice is abnormal in appearance, this probably marks the diseased side. The next and most important step is the catheterization of the ureters and a microscopical and chemical examination of the urine secreted by each kidney. But here the results must be interpreted with the greatest care, as recent advances have made it certain that most of our past opinions on the results of urinalysis must be revised in the light of the new knowledge. This is especially true of renal tuberculosis; the large amounts of degenerated pus and bits of necrotic material which are commonly described as characteristic of the disease being, in fact, found only in locally advanced cases, while the urinary signs of early tuberculosis are usually limited to the detection of pus and the bacilli by the microscope.

In the more advanced of the class of cases which are still quite operable we are indeed almost sure to find more or less degenerated pus, but the amount of it varies greatly from time to time, and is not infrequently insignificant. The detection of tubercle bacilli in the sediment of the urine is of some positive value (it is absolute if its confusion with the smegma bacillus is sufficiently carefully excluded; and it should therefore be absolute in the sediment of the urine obtained by ureteral catheterization). Its absence is of no diagnostic value whatever; *e. g.* I have had a highly trained expert make repeated negative reports on the urine from a

bladder in which tubercular ulcerations were actually visible and in which a subsequent report was positive.

It is probable that the discharge of the bacilli with the urine is not uniform, and no man can expect to search a sediment so thoroughly as to detect the bacillus with certainty if only a few are present; but it is held that if a fresh sediment is injected into the peritoneum of a guinea-pig, the presence of only one or two bacilli will be enough to cause infection in this very sensitive animal. The generally accepted opinion that this is the most delicate test for tuberculosis known, and the great surgical importance of using the most delicate test possible for the determination of the condition of each kidney separately in suspected renal tuberculosis, has then been my reason for injecting the sediments obtained from the kidneys by ureteral catheterization into separate guinea-pigs in each of three cases of suspected renal tuerculosis.

If this test is to be of real surgical value two points must be determined with regard to it: 1. Will it give us positive evidence in the early stages of the disease? 2. How absolute is the negative evidence obtained by the negative results from the other kidney in the same case? But neither of these questions can be answered by anything but an extended experience.

One case was positive as regards one kidney only, both the others were wholly negative, though each woman showed evidence of surgical disease in one of her kidneys. I have put off the publication of this report for several months in the hope of reporting the ultimate results in the equally important negative cases, but as both patients are still deferring operation* I am publishing the one positive result in the hope of inducing others to try this very delicate test, and also because the individual case is of itself of much interest from the slight development of the disease in the kidney which was removed, and from the very satisfactory improvement in the patient's condition since operation, which certainly so far supports the negative result obtained from the examination of her remaining kidney.

On March 21, 1898, I saw, with Dr. Percy C. Proctor, of Gloucester, Mass., Mrs. P., thirty-one years old, ten years married, multipara, of tuberculous family history, but with good personal history until the beginning of the present illness.

Eight years ago, after suffering for some months from backache and bearing-down pain, she suddenly began to pass bloody urine, which gradually returned to the normal after a duration of some weeks. Though partially relieved of her backache after the attack, she has been a semi-invalid ever since. Four years later, in October of 1894, she had a second, similar attack, and on the 17th of February, 1898, a third attack, the hæmaturia beginning with equally little warning. The pain has always been relieved during the attacks, but has always returned after their cessation, and has never been affected by the act of urination. During these attacks she has passed urine about every half hour during the day, but only once or not at all during the night. In the intervals between the attacks she has had no frequency or other abnormalities of urination, *i. e.* the symptomatology was indistinctive.

On palpation no tenderness could be detected. On examination under ether her genital organs were essentially normal, and a careful visual inspection of the bladder showed no abnormality whatsoever, except that a stream of thin blood trickled steadily downward from the right ureteral orifice, while from the left spouted intermittently a normal looking urine.

The ureters were catheterized and the specimens were submitted to Dr. J. B. Ogden, Assistant in Chemistry in the Harvard Medical School, whose reports of the examination of the urine and of the inoculations which he made at my request are here appended:

"On March 22, 1898, two specimens of urine from the right and left ureters—case Mrs. P.—were submitted to me by Dr. Edw. Reynolds, for examination.

Urine from Right Ureter.—Amount received 10 cc.; color, bloody; reaction, alkaline; specific gravity could not be taken as quantity of urine was not sufficient; urea, 1.01 per cent.; albumin, between ¼ and ½ of 1 per cent. The sediment, which was abundant, consisted chiefly of normal blood. After the blood had been destroyed by means of distilled water, which had been acidulated with acetic acid numerous leucocytes, a few small round and caudate cells (probably ureteral) and rarely a brown granular cast were found. No crystalline elements detected.

Urine from Left Ureter.—Amount received 3 cc.; color, pale, slightly turbid; reaction, acid; specific gravity could not be taken; urea, 0.95 per cent.; albumin, a trace. The sediment contained frequent normal and abnormal blood globules and few leucocytes, many medium and small round cells, and numerous small caudate cells as from the ureter. An occasional granular and brown granular cast, and uric acid crystal.

The clinical examination of these specimens did not reveal much toward deciding as to the most probable cause of the clinical symptoms. The uric acid crystals suggested a possible cause of the trouble, but as it was several hours after the urines had been collected before a microscopical examination could be made, they were probably secondary (formed and deposited after the collection of the urine).

The considerable quantity of normal blood in the urine from the *right* ureter was apparently of traumatic origin, and was the probable cause of the alkalinity of the urine. The presence of numerous leucocytes in the sediment led to the question: Are there more leucocytes than can be accounted for by the amount of blood present? This I was unable to fully decide, although they appeared to be present in somewhat larger numbers than would be expected in that quantity of blood.

The tubular disturbance shown by the presence of casts, although slight, appeared to be more marked in the left kidney than in the right.

Since the question of a tuberculosis of the urinary tract had been raised as a possible cause of the symptoms in this case, it was considered advisable to make as thorough and complete an examination of the urine for tubercle bacilli as was possible, and at the same time, if a tuberculosis existed, to determine whether one or both kidneys were diseased. Accordingly the sediments of both specimens were washed twice, by decantation, with distilled water, in order to free them from albumin and other soluble urinary constituents, a centrifuge being used to settle the sediments after each addition of water. Each sediment was then divided into two portions; one portion was injected into a guinea-pig, and the other was reserved for microscopical examination for tubercle bacilli.

* While the paper was in press both negative cases came to operation, and both proved to have non-tubercular disease. Both will be published in detail later.

The injections into the guinea-pigs were made as follows: The barrel and needle of a small Koch syringe were thoroughly sterilized by dry heat; the abdominal wall of a guinea-pig was thoroughly cleansed and then ½ cc. of the sediment of the urine from the *right* ureter was injected into the abdominal cavity. The barrel and needle of the syringe were cleansed and again sterilized. The abdominal wall of another guinea-pig was cleansed, after which ½ cc. of the sediment of the urine from the *left* ureter was injected into the abdominal cavity.

The pigs, following the injections, showed only slight disturbance, from which they recovered in a few days, and were apparently quite well for the eight weeks they were under observation. An examination of the pigs between the fifth and sixth weeks showed that the one which had been inoculated with the sediment of the urine from the right kidney had, in both groins, enlarged glands, which were hard and quite nodular. The one injected with the sediment of the urine from the left kidney showed no enlarged glands and was apparently in a healthy condition. Both animals were then placed under the care of Dr. W. F. Whitney.

On the same day that the inoculations were made the portion of sediment which had been reserved for microscopical examination was centrifugalized, and the sediment placed on cover-glasses was carefully dried, stained and examined. No tubercle bacilli could be found in the limited number of preparations at hand. The amount of sediment furnished by these small specimens was originally comparatively slight, and since some of the sediment had been used for the inoculation experiments, too little remained for as *thorough* a microscopical examination as is often necessary for the detection of tubercle bacilli in the urine."

The patient was kept absolutely in bed on a non-stimulating diet, but the hæmaturia continued until the latter part of April, when the bleeding ceased and the pain in the back returned. As I thought it advisable to give her some weeks in which to regain condition, the pigs were left undisturbed till some weeks later, when I received the following letters from Dr. W. F. Whitney, curator of the Warren Anatomical Museum and Pathologist to the Massachusetts General Hospital.

"May 26, 1898. The guinea-pig inoculated with the urine from the right kidney of Mrs. P. was killed to-day, and showed cheesy abscesses in the glands of both groins, in the pus from which a few scattered tubercle bacilli were found. There were also characteristic miliary cheesy nodules in the spleen, as well as a few scattered areas in the liver. The condition is perfectly characteristic of inoculated tuberculosis."

"June 13, 1898. The guinea-pig inoculated with the urine from the left kidney of Mrs. P. on March 22, 1898, was killed June 9, 1898, and found to be perfectly normal."

As I always think it a pity to disturb the ureter of the sound side by catheterization immediately before an operation, in renal cases, I made no further ureteral examination, but the urine secreted in 24 hours was now collected and submitted to Dr. Ogden, whose report upon it follows:

"On June 10th an examination of the *twenty-four hour* urine showed the following:—Twenty-four hour quantity, 1150 cc.; color, pale, turbid; reaction, acid; sp. gr., 1013; urea, 1.13 per cent. or 12.99 grammes in 24 hours; albumin, a slight trace; bile and sugar absent. The sediment consisted chiefly of pus which was free and in clumps. Considerable squamous and scaly epithelium and a few blood globules; a few small round cells. An occasional hyaline and granular cast with renal cells and little blood adherent.

The greater part of the pus seemed to come from the same source as the squamous and scaly epithelium, in other words, probably from the vagina. I could not be certain that some of the pus did not come from the bladder or from the diseased kidney. There was still evidence of a tubular disturbance (shown by the casts) which had more the appearance of a mild renal congestion than any primary disease of the kidneys.

The sediment of this twenty-four hour urine was thoroughly examined for tubercle bacilli, but with a negative result."

June 24th I removed the right kidney by lumbar nephrectomy. The kidney was brought to the surface with great ease and rapidity and was so wholly normal in appearance that nothing but the absolute certainty which I thought myself to possess of its diseased condition would have induced me to remove it. The ureter was thoroughly normal in appearance, was cut some two inches below the kidney, closed in by catgut sutures, and dropped into the wound. On splitting the kidney after its removal the tubercular disease was at once evident, in the shape of numerous miliary tubercles on the mucous membrane of the pelvis.

The very beautiful painting which is here reproduced was made for me by Miss Florence Byrnes, artist to the Harvard Medical School.

Dr. Whitney kindly examined the kidney, and his report and the letter which he sent me are inserted below:

"The kidney was of normal size. The capsule stripped off easily, showing the surface marked by numerous small, superficial cicatricial depressions. The cortical part was slightly narrow and pale. In the papillary region were a few scattered minute opaque dots, and the pelvis was quite thickly covered with them, and markedly injected. Microscopic examination: The epithelium of the cortical tubules was low and irregular, and the cicatricial depressions were marked by a round-cell infiltration and disappearance of the tubules at that point. The opaque dots were composed of small round and epithelioid cells with an occasional giant cell. The centres were cheesy degenerated. The diagnosis is a miliary tuberculosis of the pelvis and kidney."

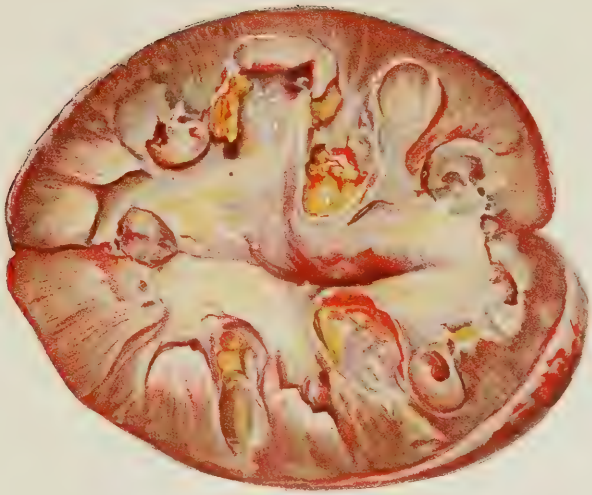
MARBLEHEAD, Mass., *August* 13, 1898.

Dear Dr. Reynolds:—I enclose the report of the kidney which you desired. The case is certainly favorable, as the local lesions are comparatively slight, and it is interesting that, with so little ulceration and loss of substance, a positive result should have been obtained from the inoculation with the urine.

Yours sincerely,
W. F. WHITNEY.

The patient's convalescence from the operation was rapid and satisfactory. She passed from thirty to forty ounces of urine uninterruptedly and never had a bad symptom. I have not seen her since, but a letter from Dr. Proctor, dated October 10, 1898, informs me that she is now passing forty ounces of normal urine with no evidence of renal irritation in the sediment. She has gained in flesh and color and is greatly improved in general condition.

The negative results of two examinations of the sediment for tuberculosis, made by an expert at widely separate times, and the positive result of the inoculation of a guinea-pig by one of these same sediments, with the confirmation of this positive result by inspection of the kidney in question, and the improvement of the patient's health after the operation, form certainly a picture of considerable clinical interest, more



Miliary Tuberculosis of Kidney.

To face p. 250.

especially, as this is, so far as I am aware, the first case in which this test has been used for the examination of each kidney separately.

As so little is known of frequency of unilateral and primary renal tuberculosis I had hoped that an examination of the records of a large number of autopsies, performed upon subjects who died from other diseases than tuberculosis, might yield something of interest, and accordingly requested Dr. John T. Bottomley to examine the pathological records of the Boston City Hospital for some years past. He looked over 3300 reports which were consecutive except for the omission of deaths from tubercular disease in other organs of the body, but found only two cases of primary renal tuberculosis, both unilateral, one of which died from fracture of the spine, the other of uremia.

His abstracts of the cases are as follows:

Case I. Surg. Rec. C., Vol. 23, Page 248. Male, 48 years. No venereal diseases, case of scalp wound, alcoholism, and fractured spine.

Autopsy Rec., Vol. 16, Page 56. Autopsy showed that right kidney was about normal size; upper third replaced by several sacs, each corresponding to a pyramid and its accompanying cortex; each sac had a thin, firm capsule which was filled with opaque, white, cheesy or putty-like material, a little gritty to the touch. In one of the lower pyramids was a similar sac; no evidence of any inflammation; microscopic examination negative; pelvis and ureter normal. Bladder and appendages were normal except a few small calcified nodules in prostate.

Anatomical diagnosis. Stenosis of aortic valve. Chronic passive congestion of spleen and kidneys. Chronic tuberculosis of right kidney. Fracture of spine.

Case II. Med. Rec., Vol. 175, Page 249. Female, 45 years, married. Always well till three months before; all symptoms pointed to disease of the kidney.

Autopsy Rec., Vol. 3, Page 125. Autopsy. No truly normal tissue remained of left kidney. The entire wall was composed of abscesses of varying sizes, containing a thick almost cheesy pus. Peri-nephritic fat adherent to the wall, also to diaphragm; nothing important in other organs.

[The second case could probably have been saved by nephrectomy had the diagnosis been made a few months before. She, however, entered the hospital in the year 1880 and in a dying condition.]

LAPAROTOMY FOR INTESTINAL PERFORATION IN TYPHOID FEVER.

A REPORT OF FOUR CASES, WITH A DISCUSSION OF THE DIAGNOSTIC SIGNS OF PERFORATION.

By Harvey W. Cushing, M. D., *Resident Surgeon, The Johns Hopkins Hospital.*

The present communication is based upon four recent cases of laparotomy for perforating typhoid ulcer, in one of which the abdominal cavity was opened on three successive occasions with recovery.

The fact that surgical intervention offers practically the only hope in these cases seems to be studiously overlooked, if we are to judge by the paucity of occasions in which laparotomy has been performed for this condition.

On a recent visit to the military hospital at Fort McPherson, the writer was told that of thirty autopsies held upon fatal cases of typhoid which had occurred there, perforation was found to have been the cause of death in six instances, one being of the appendicular variety. This would attribute to perforation alone 20 per cent. of the fatalities, a percentage which corresponds with that of Hare of Brisbane, and is almost twice that of Murchison (11.38 per cent.), and three times the figures given by Dr. Fitz (6.58 per cent. in 4680 cases). In none of these cases had operative intervention been advised, nor do I know of a single instance of operation for the relief of typhoid perforation on any of the possible 2000 cases which have died from typhoid in the field hospitals and elsewhere during the late war.

If the recent statistics of Gesselewitsch and Wanach (Centralblatt für die Grenzgebieten der Medizin und Chirurgie, Bd. I, No. 6, p. 382, 1898) are to be relied upon, namely, that 10 per cent. of the entire number of fatalities in typhoid are due to perforative peritonitis, we may credit 200 of these deaths to this cause alone. According to the statistics from Fort McPherson and those of Hare, 400, or double the number, would be accounted for in this way.

In a recent communication Dr. Nicholas Senn writes: "Strange as it may seem, having seen hundreds of cases of typhoid fever during the war, I was called upon only once to operate for perforation. In that instance the patient was moribund, and I refused to operate. I have reason to believe that this complication was frequently overlooked."

We have four widely different but quite characteristic histories to report:

In Case I an early diagnosis and immediate operation, before peritonitis set in, led to recovery.

In Case II general purulent peritonitis with three perforations was present, and it should be considered that the relief of the general peritonitis, and not typhoid perforation which had taken place many hours before, was the objective point of operation.

In Case III what may be considered as pre-perforative symptoms of peritonitis were present and were neglected. Perforation subsequently occurred with, unfortunately, a virulent streptococcus infection, which proved fatal despite early laparotomy.

Case IV illustrates one of the strange attacks which closely simulate perforation. No lesion was found at the operation, and the exploration had no appreciable effect upon the subsequent course of the fever.

Case I. Surgical No. 8009. *Typhoid perforation at end of second week. Laparotomy. Suture of perforation. Drainage. Fæcal fistula after 3 days from second perforation. Spontaneous closure of fistula. Seven days later symptoms of perforation. Laparotomy. No perforation found. Obstruction over-*

looked. Two days later laparotomy for acute intestinal obstruction with closure of second perforation. Recovery.

Herbert H., aged 9, was brought into the medical wards of the Hospital on the 8th of August with the history of having been ill since the first of the month with "pain in his head and stomach." His mother and one brother were also in the hospital, and one brother had just died of "typhoid" at home. On entrance, the temperature was 104.2°, the pulse rapid, the spleen enlarged and the general appearance typhoidal. There was some tenderness noted in the lower right quadrant of the abdomen. There was no Widal reaction obtainable at this time, nor had there been in the case of his brother and mother, who had had a very mild type of fever. The patient was put on the usual bath treatment. August 9th, leucocytes 8400.

Dr. Thayer's note on August 11th says: "Abdomen is a little full. Patient does not flinch on pressure."

There is no further note of unusual interest. The boy was dull, and seemed to be having a rather severe attack. He complained much of pain in his abdomen on being given his tubs.

On the morning of August 13th (five days after admission) the patient was found to be complaining of abdominal pain. He had vomited twice and his pulse rate had increased. The leucocytes were 9600.

He was seen, in consultation with Dr. Thayer, at 1 P. M. At this time his respirations were 34; his pulse 165, rather thready and of poor quality; temperature 105°. He was crying out and complaining of general colicky abdominal pain. He was very restless; his expression pinched; his color quite cyanotic, with lips blue and extremities blue and cold. The abdomen was quite soft and there was no muscle spasm. There was considerable general tenderness, which seemed more marked on the right side. Pressure per rectum in the recto-vesical cul-de-sac seemed to cause especial pain, but no more marked on one side than the other. There was some apparent increase of dulness in the flanks, but no shifting dulness. There was no obliteration of liver dulness. The leucocytes were 16,000. The patient was immediately transferred to the operating-room.

Before the administration of anæsthesia the temperature was 105° (there had been no fall up to this time) and the pulse 170.

Operation I.—August 13th, 1898, 1.30 P. M., four hours after first symptoms, under primary chloroform anæsthesia.

Median laparotomy. Partial evisceration. Closure of perforation. Toilet of peritoneum with salt solution irrigation. Drainage.

An incision was made in the median line below the umbilicus. On opening the peritoneal cavity a considerable amount (perhaps 200 cc.) of sero-purulent fluid escaped, coming chiefly from the pelvis. Cultures were taken from this fluid and it was also immediately examined in cover-slip preparations. It contained a great number of polymorphonuclear leucocytes, but no micro-organisms could be found. The serosa of the intestine was everywhere greatly congested, but evidently the greatest reaction was in the right iliac fossa, where the loops of the ileum were especially injected and covered with a slight fibrinous deposit. The general cavity to the left was walled off with gauze and the loops of the ileum drawn from the wound. The last foot of the small intestine showed several greatly thinned areas corresponding to Peyer's patches. In the centre of one of these areas, the surroundings of which were quite bluish in color, was a small perforation about two millimetres in diameter, from which fluid fæces were flowing. It was about 25 cm. from the cæcum and situated in the free surface of the bowel. A few centimetres beyond this were two more patches, which seemed very thin and practically covered by little more than serosa. A few fine, filmy adhesions held the omentum to this part of the bowel.

The perforation was closed by a circular suture of fine silk taken about the edge of the thinned area, which was fortunately small, measuring about one centimetre in diameter. A similar inversion of the two thin neighboring patches would have been attempted, but the patient's condition at this time demanded immediate attention and the idea was abandoned. His pulse was almost imperceptible and his respirations were very shallow. Hypodermic injections of strychnia were given and an infusion of a litre of salt solution in the pectoral region. The exposed coils of intestine were irrigated and the abdominal cavity was flushed out with salt solution. A strip of bismuth gauze was left in for drainage, leading down to the site of the suture, and another to the two thinned Peyer's patches. The omentum was pulled down over the gauze. The abdominal wound was then partly closed. The operation lasted but twenty minutes from the beginning of anæsthesia till the final closure.

The cultures taken from the fluid found free in the peritoneal cavity remained sterile. No cultures were taken from the material flowing from the perforation.

The patient rallied well from the operation, and in eight hours the pulse had fallen to 112, and the temperature to normal. There was no vomiting, and he slept most of the time for the next twenty-four hours, taking liquid nourishment (albumen water) well, during his waking intervals. Three hundred cubic centimetres of salt solution were given *per rectum* every four hours for thirst. On the following day the temperature again became elevated; the day after the leucocytosis disappeared, and for the following ten days the clinical picture was that of an ordinary typhoid in the third week. A fæcal fistula developed on the second day, discharging typical pea-soup fæces. It was impossible to tell, at that time, whether this discharge came from the broken down suture or from one of the neighboring thinned Peyer's patches, to which the drain led. (It was subsequently proved to come from the latter.)

The boy complained a good deal of abdominal pain at times, and of pain on micturition, but there was no abdominal rigidity or other symptoms of peritoneal inflammation. He was given regular ice sponges, after which he would sleep for long intervals. The fæcal fistula ceased to discharge after a few days. There was considerable diarrhœa at this time (cf. Clinical chart).

August 18th. (*6 days after operation I.*) A positive Widal reaction was obtained by Dr. Schenck for the first time (in ten minutes in a dilution of 1 to 40). Cultures from the rectum, taken through a high rectal tube, showed only the bacillus coli communis. The patient had a pinched look and was very peevish. The pulse was weak and dicrotic. A crop of rose spots was present on the abdomen.

August 25th. (*13 days after operation I.*) On the evening of this date, after a very good day, the patient became suddenly much worse and vomited several times. At 9 P. M., when seen in consultation with Dr. Thayer, he was quite

collapsed and very restless. His abdomen was slightly distended. He was hiccoughing and complaining of abdominal pain. He looked pinched and the extremities were cold and sweating. His leucocytes were only 4000.

A definite diagnosis of perforation was made and steps taken for immediate operation. An hour later the temperature had fallen four degrees to 98.6°, and the leucocytes had increased to 13,000.

Operation II, August 25, 1898, 10.30 P. M.; two hours after first symptoms; under chloroform anæsthesia. *Median laparotomy. No cause for symptoms demonstrable. Closure with drainage.*

The abdomen was opened beside the first incision, avoiding the site of the fistula. There was no free fluid. The bowels were not injected except to a slight degree in a few places, corresponding to some of Peyer's patches. No evidence whatever of a perforation could be found. There were no adhesions except about the loop of ileum which led to the old sinus and which was surrounded by quite firm omental adhesions. These were not broken up. There was no particular distension of one coil more than another. (There was nothing to suggest the thought of obstruction, and I must confess it did not occur to me. I supposed that I had overlooked a perforation somewhere, but the patient's condition precluded further search.) The wound was closed, with a small drain leading to the omental adhesions.

The operation lasted thirty-five minutes from the beginning of anæsthetization. Cultures taken from the site of the adhesions remained sterile.

The patient's condition did not seem to be materially affected by the operation. The collapse, with cold sweating extremities, the sudden onset of abdominal symptoms, with hiccough, vomiting and pain, the drop of temperature without signs of hæmorrhage and the rapid rise in the leucocytes made operative intervention imperative.

During the following twenty-four hours the condition became progressively worse. All attempts at feeding were followed by immediate vomiting, and enemata were but partially retained. The patient had voided no urine for 18 hours. The lips were parched; the tongue dry and coated. By the early morning of August 27th (30 hours after operation II) the distension had become more pronounced, and on close inspection, with a candle placed beside the exposed abdomen, a slight visible peristalsis was to be made out, which first demonstrated that obstruction, and not peritonitis, (despite the leucocytosis at this time of 20,000) was responsible for the symptoms, and it was learned that the irrigations, preceding the enemata, since the time of collapse, had not been stained with fæcal matter as had previously been the rule.

The child's condition, however, seemed to forbid operative intervention. He was vomiting without effort, restless and in collapse more pronounced than at any time previous. The radial pulse could not be counted. He was given small doses of morphia and strychnia and hot compresses over his abdomen, which quieted him considerably, and four hours later an operation was determined upon.

Operation III, August 27th, 8.30 A. M. (34 hours after operation II), under chloroform anæsthesia.

Median laparotomy. Acute intestinal obstruction due to adhesions about a second perforation. Obstruction relieved. Perforation sutured. Closure with drainage.

The recent wound was re-opened. There was no sign whatever of peritonitis. The small intestine, which was greatly distended, was turned out of the abdomen together with that loop of ileum and its surrounding omentum, which had become adherent to the anterior parietes, as a consequence of the drainage at the first operation. In this omental mass was an acute kink of the bowel, about ten centimetres proximal from the old suture, the distal part of the bowel and the colon beyond being completely collapsed. The original suture was intact. At the exact situation of the kink, and covered by the omentum which caused the obstruction, was a second perforation, apparently corresponding to the thin Peyer's patch seen at the first operation.

On freeing the obstructing omentum, gas and fæces in great amount escaped from this perforation, greatly diminishing the distension. The perforation was about 1 cm. in diameter, with rounded edges, showing everted mucous membrane, so that evidently the whole floor of the ulcer had given way. It was closed easily by a single purse-string suture of fine silk. The bowels after irrigation with salt solution were replaced. A small drain of bismuth gauze was inserted down to the wad of omentum, from which cultures had previously been taken. (In these cultures Dr. Clopton found an abundant growth of the bacillus coli communis, of proteus vulgaris, bacillus lactis aërogenes and an organism culturally closely akin to the bacillus typhosus.) The abdominal wound was partially closed.

The operation lasted twenty-five minutes from the beginning of anæsthetization. The patient's pulse could not be counted. He was given 500 cc. of salt solution in each pectoral region and also *per rectum*.

Throughout the day the child's condition remained most serious. Distension was pronounced with active, visible and painful peristaltic cramps. He was given small doses of morphia, and large hot bichloride fomentations, for which he seemed very grateful, were at short intervals placed over the whole abdomen. He vomited only twice after returning to the ward, and soon began to retain his nourishment. Twelve hours after the operation, flatus first began to pass from the lower bowel. On the following day, though considerable meteorism remained, the bowels moved three times, and considerable diarrhœa persisted for the four or five succeeding days. As the clinical chart shows, the patient, though greatly emaciated and very feeble, returned to his typical typhoidal condition which ran its course in the next ten days.

Convalescence was very tedious. The child had a series of superficial indolent staphylococcus albus abscesses over the back and shoulders which had to be opened, and a protracted bloody mucous diarrhœa set in which kept him thin and weak. The abdominal incision broke down after the third operation, and was slow in healing. He has, however, made a complete recovery.

In Case I, therefore, we have what is most unusual, a child with early perforation. The symptoms at onset were typical, and the condition was readily diagnosed. The early vomiting was a great help, while the prostration, abdominal pain, tenderness and the leucocytosis made the picture complete before the onset of peritonitis.

The history of preceding abdominal pain for some days before the actual occurrence of perforation is interesting and, in the light of the subsequent cases, important, in that it most probably was associated with a slight local peritonitis due to the near approach of an ulcer to the general peritoneal surface. From what will be said later it seems possible that clinical symptoms arising from this condition are not uncommon and that they may be utilized in foretelling a perforation, or at all events in putting the attendant on his guard so that the patient may be kept more than ordinarily quiet and tubs omitted, especially if they are disagreeable and resisted.

Among other points of unusual interest is the fact that so prompt intervention was rendered possible, owing to the discernment of Dr. MacCallum, who had charge of the ward, and that the perforation was closed before there was any evidence of peritoneal infection, the cultures from the free fluid remaining sterile.

The subsequent perforation of a neighboring ulcer showed that it would have been desirable at the first operation to have turned in by a suture those patches which seemed thin, and threatened perforation, as was done by Sifton* in his case with recovery, and also by W. Hill.† In view of the fact, however, that there were several of these areas, and that it did not seem justifiable to further prolong the operation, a strip of gauze was placed leading to the two worst looking patches. Whether the trauma of the gauze was itself responsible for the subsequent perforation, or, whether by forming adhesions, it saved the general cavity from the escape of intestinal contents through a perforation, which would have occurred in any case, must remain undetermined.

The leucocytosis which at the first operation afforded an apparently certain indication was completely misleading at the second. Here, although in two separate counts the leucocytes were 20,000 there was found no inflammatory reaction to account for the increase. I do not know whether obstruction is usually associated with leucocytosis or not.‡

It is also noteworthy that the perforation was not associated with an early drop in temperature, contrary to the supposed rule, whereas one of the first symptoms of the obstruction was a fall of four degrees. The importance of immediate intervention was evidenced at the first operation. Practically the same symptoms appeared twelve days later without perforation. As was found subsequently these symptoms were due to an acute obstruction, and at the second operation, which was performed immediately after the onset of symptoms, the real condition was overlooked because at this early period distension of the proximal bowel which would naturally have suggested obstruction had not yet taken place. The question of justifiability of such an immediate intervention on the first symptoms of perforation will be considered later, as well as the difficulty of distinguishing between acute obstruction and perforation in their early stages.

It was learned from this case that a median incision was a bad one as the lesions occur in the right iliac fossa almost as naturally as do appendicular ones. It is also apparent that the mere performance of laparotomy in the course of typhoid fever, provided it is made before the occurrence of septic extravasation, is in itself attended with little more risk than a similar procedure in febrile states, the only apparent drawback to it being the necessary omission of any bath treatment during the subsequent progress of the fever.

I have found in the literature only one instance in which more than one laparotomy has been performed in an attempt to combat intestinal perforation and its sequelæ. In Bogart's* interesting case a perforation in the ileum, which was closed by the tip of the appendix, occurred in a third attack of fever. Death resulted three days later from obstruction at the hepatic flexure of the colon, an operation for the relief of which was abandoned. Of this case Keen† says: "I can scarcely think that we would ever be justified in re-opening the abdomen in such a case. Possibly a very exceptional case might justify such a procedure, but a typhoid patient rarely escapes with his life even after one operation and could not be expected to survive a second. The same remark would apply to any new perforation which might occur. Such cases must unfortunately be left to their fate; but if the surgeon has been careful to search for and suture any impending perforation he has done much to prevent such a disaster."

Dr. Keen's last remark holds true, but it is hard to agree with the statement that a patient should be left to his fate, no matter how desperate the condition, provided surgical intervention offers any chance of relief, forlorn though it may be. The great vitality of some of these patients is illustrated as well by this case as by the remarkable one of Dr. Finney's in which after two relapses, an otitis media, a pleurisy, and phlebitis subsequent to the operation, there was eventually a complete recovery.

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*Sifton, H. A.: Chicago Clinical Review, Vol. IV, p. 368, 1894-5.

†Reported by Keen: Surgical Complications and Sequels of Typhoid Fever, 1898, p. 238, Case 40.

‡In a condition of obstruction at the hepatic flexure, following a recent operation for acute appendicitis the patient had a leucocytosis of 44,000 without peritonitis, whereas during the acute stage of his appendicitis the leucocytes had been only 23,000. A differential diagnosis between peritonitis and obstruction is most difficult. Bogart's case was similar to this one, an obstruction simulating general peritonitis. Damner Harrison (Brit. Med. Jour., Oct. 20, 1894, p. 865) operated on a typhoid case for perforation, and found an obstruction. Barbe (Étude clinique sur certaines formes des perforations de l'intestin grêle: Importance du diagnostic précoce. Thèse de Paris, 1895) calls attention to similar cases. No record of the number of leucocytes is given by these writers. The high degree of leucocytosis, such as was present in the writer's two cases, may possibly be of some diagnostic value in differentiating between these conditions, though in a manner entirely opposed to the usual interpretation.

*Bogart, J. Bion: Laparotomy for Perforating Typhoid Ulcer of the Ileum, etc. Annals of Surgery, Vol. 1, 1896, p. 596.

†Keen, W. W.: Surgical Complications and Sequelae of Typhoid Fever, p. 232, 1898.

Case II. General No. 23,970.—*Typhoid perforation in the fifth week. Laparotomy under cocaine anæsthesia. General peritonitis. Suture of three perforations in ileum. Death four hours after operation.*

September 3, 1898. William N., aged 18, was brought to the medical wards of the hospital with the history of a febrile attack of three weeks' duration. The patient's mother and sister died at home during his stay in the hospital of "malignant typhoid."

The patient was dull and stupid, and presented a typical typhoidal appearance. The medical note on the abdomen at entrance is as follows: "*Abdomen.* Peculiarly mottled, especially in inguinal regions, a bluish discoloration, taches bleuâtres. Walls somewhat tense; grooves obliterated; everywhere tympanitic. Slight tenderness across upper abdomen in umbilical and epigastric regions. Spleen enlarged, edge readily palpable. *Liver.* Relative dulness at upper border of 6th rib; absolute in 6th space and extending to costal margin; towards left extending 3 cm. below xyphoid; edge palpable."

Sept. 5th. The abdomen was noted by Dr. McCrae as being natural.

Sept. 10th. The patient has well-marked diarrhœa with colicky pains.

Sept. 11th. Widal reaction positive in dilution of 1 to 100.

Sept. 12th. Dr. McCrae. "Patient has been complaining of abdominal pain. Abdomen is slightly distended, tense. Rose spots present. Liver dulness present. No abdominal tenderness on palpation. Leucocytes 7500 at 10 A. M." 4 P. M. Patient vomited twice in early afternoon after nourishment. Leucocytes 8400 at 8 P. M.

Sept. 13th. "Patient has been very ill for 48 hours. Eyes are sunken. He has somewhat the look of collapse. Abdomen is somewhat full with respiratory movements present. The walls are very tense and tender on palpation. Liver dulness absent in mammary line, present in mid-axillary line."

The patient vomited after nourishment at 10 and 12 o'clock last night.

The leucocytes on this date were as follows:

Leucocytes at	9	A. M.	6000	
"	" 10	"	7200	
"	" 11	"	8800	
"	" 12.15	P. M.	6400	
"	" 1.30	"	6000	operation performed.
"	" 2 00	"	7000	

At 1 P. M. a note by Dr. Thayer is as follows: "Patient lying on back. Tongue beefy, eyes sunken and wide open. Respirations short and shallow. Patient has a peritonitic facies. Green vomitus in sputum cup. Pulse small, 152. Abdomen tense, full and tympanitic. With patient on his back there is no hepatic flatness in the mammary line and none till one almost reaches the axillary line. There is dulness in either flank which disappears when the patient lies on the opposite side. Frequent vomiting during the examination. There is a well-marked friction throughout the right axilla which is heard all the way down to the costal margin. With patient lying on his left side there is no hepatic flatness anywhere.

The patient was immediately taken to the operating-room.

Operation at 1.30 P. M. under cocaine anæsthesia. *Closure of three perforations in ileum. Irrigation and drainage for general septic peritonitis.*

A linear infiltration of the skin with Schleich's solution was made in the right linea semilunaris. On opening the abdominal cavity there was an explosion of gas followed by the escape of a large amount of stinking material looking like pea-soup stools. The bowels were of a dark bluish color, distended, covered by a thick plastic lymph and everywhere bathed in the fœcal extravasation.

The cæcum was located, and the first loop of ileum when drawn out showed three large ragged holes about 1½ cm. in diameter and with fine bridges across them made by threads of submucosa.* They were closed with Halsted mattress sutures. The appendix and colon were free from perforations. The patient was given a few whiffs of chloroform; the bowels were turned out, and the abdominal cavity cleaned as thoroughly as possible and irrigated with salt solution. Drainage was left in to the bottom of the pelvis and to the site of the suture.

The operation lasted 20 minutes.

Needless to say his condition was desperate with a pulse of 160 and respiration 60.

The patient rallied somewhat after the operation under stimulants and salt infusion, but remained in a state of euthanasia, often seen in severe septic infections, and died four hours later. Unfortunately no post-mortem examination could be made.

The cover-slip preparations taken from the general cavity at operation showed a great diversity of organisms, some cocci, but mostly bacilli of various shapes and sizes, and a great number of pus cells. No streptococci were seen. Nothing was grown out on culture but the bacillus coli communis.

This case well illustrates the practical hopelessness of operation when perforation, at its onset, has been overlooked, and the operation delayed until the stereotyped symptoms of extensive extravasation, such as obliteration of liver dulness and evidences of shifting free fluid, have appeared. It is such cases as this which render the operative statistics for perforation so uniformly bad. Abbe's† case, however, makes recovery seem never impossible after operation.

The complete absence of abdominal tenderness and of leucocytosis unfortunately was misleading, but the preceding diarrhœa, abdominal pain and vomiting under ordinary circumstances would have led to early exploration had it not been for the fact that so many of the house cases this fall have complained of adominal pain and tenderness associated with diarrhœa. This point will be referred to later.

The importance of making cover-slip preparations as well as immediate plate cultures from the abdominal contents in cases of peritonitis is well shown by the fact that the bacillus coli communis overgrew all other organisms in what the cover-slips had shown to be a polyinfection. Careful investigations, such as those of Flexner‡, show what a variety of organisms may be present. Undoubtedly the colon bacillus being more in evidence is frequently held responsible for peritoneal infection due to more virulent but culturally less vigorous organisms. In one of Flexner's cases (Case IV) there was obtained from the peritoneal cavity the bacillus typhi abdominalis, bacillus coli communis, proteus vulgaris,

*Such as are shown in Keen, op. cit., Plate V, Fig. I.

† Abbe, Robert: Perforating Typhoid Ulcer. Peritonitis. Operation. Recovery. Medical Record, Vol. XLVII, p. 1, January 5, 1895.

‡ Flexner, Simon: Certain Forms of Infection in Typhoid Fever. Johns Hopkins Hopital Reports, Vol. V, 1895.

staphylococcus aureus and the streptococcus pyogenes. I know of no other case in which the bacillus typhosus has been obtained in culture from a general peritonitis following perforation. The organism in our Case I, though akin to it, was not positively identified. Körte* isolated the bacillus from a general peritonitis which originated however from a ruptured suppurating mesenteric gland. Klein also is said to have obtained it, but from a localized peritonitis.

CASE III. Surgical No. 8131.—*Typhoid perforation at end of fourth week after prolonged abdominal symptoms. General streptococcus peritonitis. Laparotomy. Suture of perforation. Death after eight hours.*

Sept. 5, 1898, Peter B., colored, aged 31, was admitted to the medical wards complaining of having had "pain in his head and stomach and general weakness" since August 23rd. He had had some diarrhœa and abdominal pain during this time, but had not taken to his bed.

The note on the abdomen at entrance is as follows: "*Abdomen* looks natural; no distension; costal and iliac grooves are well marked; respiratory movements are present. Some tenderness on palpation, especially in right inguinal and iliac region. Liver dulness begins at the sixth rib and extends to costal margin. Spleen is just palpable." *Blood count.* Red corpuscles 4,820,000. White corpuscles 5,600.

The Widal reaction was positive in dilution of 1 to 100. The patient was very ill and delirious at times, and on the night after admission jumped ten feet out of the ward window without, however, injuring himself. A slight leucocytosis was found a few days after admission which, coupled with his abdominal pain, occasioned suspicion, and he was watched very closely.

On several occasions the writer saw him in consultation with Dr. McCrae, but the complete absence of objective abdominal symptoms and the fact that there were several patients in the wards with similar subjective symptoms made us hesitate about operative intervention. For ten days he pursued a usual typhoid course, though the leucocytosis at one time reaching 15,200 persisted (cf. Clinical chart) and abdominal pain was constantly complained of. There was no diarrhœa. He was given the usual bath treatment.

Dr. McCrae's note the morning of the 17th inst. states: "General condition good. There is no delirium. Tongue is still coated. Patient frequently lies with knees drawn up. He states that he has very slight abdominal pain this morning. Abdomen is flat, soft on gentle palpation. Patient complains of severe pain when pressure is applied. Muscles at times are rigid, at others soft.

I am inclined to believe that his perforation took place the following night coincident with the drop in temperature (cf. Clinical chart). His pulse at midnight was recorded at 120 and his respirations at 36. By a strange misfortune during rounds the next day at noon he seemed very much better. His pulse was 76 and respirations 22, possibly as a result of the recent tub, and there seemed to be no change in his abdominal condition.

He was quite delirious during the day. There was no nausea or vomiting His leucocytosis had disappeared. At midnight of this day Dr. McCrae found him in considerable pain, lying on his back with his knees drawn up. He was dull and answered questions slowly and unintelligently. Respirations 44. Pulse 120. There was some vomitus on the floor beside the patient's bed. This was the first vomiting that had been noted.

Respiratory movements were absent from the abdomen. There was no fulness but general tenderness on palpation, especially in the right iliac fossa. There was distinct dulness, which was movable, in the right flank. The liver dulness began at the 7th interspace and extended to the costal margin. His leucocytes were 4300.

September 19th. *Operation* at 1 A. M. *Ether anæsthesia. Laparotomy. General peritonitis. Suture of perforation in ileum. Irrigation. Gauze drainage.*

The incision was made through the right rectus sheath, and the muscle drawn toward the median line. On opening the abdominal cavity bubbles of gas and sero-purulent fluid escaped. Cover-slips from this fluid were immediately examined and found to be full of streptococci with an abundance of other pleomorphic organisms.

The ileum was quite distended. For about two feet from the cæcum, as it was withdrawn, it appeared injected and pretty extensively covered with a delicate, fibrino-plastic lymph which could be readily peeled off in sheets. This pellicle was in many places glistening and quite transparent. There were no adhesions. About 10 cm. above the cæcum in the centre of a dark bluish area measuring about 1½ cm. in diameter was a small perforation which was partially occluded by a pouting nubbin of red mucous membrane and from which there seemed to be escaping very little of the intestinal contents at this time. The perforation and thin patch were turned in with Halsted sutures. There was not a great amount of extravasation or free fluid present, certainly not enough to have given shifting dulness.

The eventrated bowel was irrigated and the fibrin wiped off with wet salt sponges. The general cavity was wiped dry with salt sponges. Drainage was inserted to the bottom of the pelvis and to the site of suture and a neighboring thin Peyer's patch.

The patient stood the operation, which lasted 30 minutes, fairly well. There was no vomiting during or after the anæsthesia.

Death supervened 8 hours after the operation. The temperature remained high. There was no vomiting and nourishment was taken frequently. Nutritive and stimulant enemata were given and retained. The clinical picture was one of acute general toxæmia, such as streptococcus infection sometimes produces.

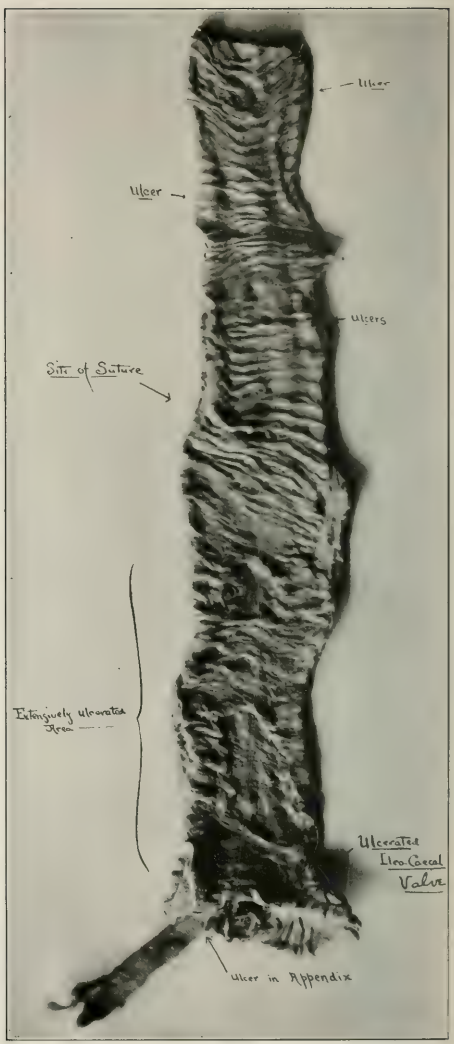
From the peritoneal fluid at operation Dr. Clopton obtained in cultures an abundant growth of the streptococcus pyogenes, the bacillus coli communis, the bac. lactis aërogenes and a yeast fungus.

Autopsy. Eleven hours after death. Dr. Nichols.

Anatomical diagnosis. Typhoid fever. Perforation. General fibrino-purulent peritonitis. Operation. Healing ulcers in ileum, cæcum and appendix. Slight ileo-colitis. Suppurating peritoneal gland. Acute splenic tumor. Cloudy swelling of kidneys, etc., etc.

The protocol need not be given here in full. The lesions in the organs were typical of typhoid infection. The peritoneal surfaces were quite generally involved in an inflammatory process with thin adhesions and without the production of much fibrin or pus. The free fluid had a sero-purulent character. There was a second threatening perforation a short

* Körte, W.: Erfahrungen über die chirurgische Behandlung der allgemeinen, eitrigen Bauchfellentzündung. Verhandlungen der deutsch. Gesellschaft für Chirurgie, 21ter Congress, p. 164, 1892.



PHOTOGRAPH OF THE ILEUM OF CASE III.

distance above the ileo-cæcal valve. The mesenteric glands were all swollen, soft, and one showed an area of suppuration the size of a pea. There were two or three small round healing ulcers in the cæcum and appendix. The following description is taken directly from the protocol:

The Ileum presents a remarkable appearance. The very edge of the ileo-cæcal valve has preserved its mucous membrane. Above this the mucous membrane has been completely destroyed over a large surface by single, confluent, often suspicious looking ulcers. One has reached the size of 7 cm. in length by 4 cm. in breadth. (This is well shown in the photograph.) The central part of this has a small clot adherent to it, and corresponds to a hæmorrhagic area on the serosa, looking like an imminent perforation situated 4 cm. above the ileo-cæcal valve. These ulcers have the same general characteristics, their edges are raised, seem opaque, congested and partly hæmorrhagic. Their base is clean and apparently extends down to the transverse musculature. It is of bright red color, and transverse striae can be plainly seen. About the edges and often running in small strands across the base is a pink, delicate, new growth of epithelium. The general direction of these ulcers is longitudinal. This extensively ulcerated area does not extend much further than 11 cm. from the valve. Fourteen centimetres above the valve is a similar ulcer, puckered and inverted by the silk sutures where the perforation had occurred. This ulcer was not larger than a five-cent piece.

There are about five small, similar ulcers at various distances apart above this. The whole mucous surface is somewhat congested and there are small sub-mucous ecchymoses. Peyer's patches and the solitary follicles are not swollen to any appreciable extent.

Bacteriological Report—Dr. Harris.—Cultures from the abdominal cavity gave the streptococcus pyogenes. From the spleen and gall-bladder was obtained an actively motile bacillus, which decolorized by Gram, and in cultural characteristics corresponded to the bacillus typhosus. From the liver, kidney and peritoneal gland an organism was obtained which was identified as the bacillus coli communis. Also from the pelvic exudate, lung and peritoneal gland was obtained a bacillus corresponding to the bacillus lactis ærogenes.

This case would appear to be of special importance in that it exemplifies the existence of a definite recognizable condition spoken of above as the pre-perforative stage of ulceration. It seems not unnatural to suppose that, owing to the extreme degree of ulceration of the ileum or possibly of the appendix, some inflammation of the serosa, limited by adhesions, may have taken place. This would account for the abdominal pain, tenderness and leucocytosis of several days duration and the disappearance of the latter after perforation had actually occurred. Doubtless it would have been better to have operated early, and have sutured or drained from any suspicious patch.

These preliminary abdominal symptoms undoubtedly somewhat disguised those of perforation with extravasation when it subsequently actually occurred, and the abdomen unfortunately was not opened until after evidences of general peritonitis had begun to appear.

How often a streptococcus peritonitis has been the cause of death in the fatal operative cases cannot be told, and it is a matter of regret that bacteriological reports showing the variety of peritonitis present in these cases are not more often noted. Keen* says: "There is but a single instance, so far as I know, of a bacteriological examination of the contents of the peritoneum in typhoid perforation." Undoubtedly peritonitides of this nature are very fatal, and the abundance of long streptococcus chains, found in cover-slip preparations during the operation, gave immediately a bad prognosis to what seemed otherwise a favorable case.

The extent of peritonitis macroscopically was one such as is not infrequently recovered from in those more fortunate cases in which streptococci are not the paramount infective agent. As Durham † has emphasized, "the more virulent the infection the less marked are the local signs of peritonitis."

A streptococcus infection in typhoid is undoubtedly a very severe complication and Vincent ‡ believes that it carries with it an extremely grave prognosis. Doubtless, considering its frequency in autopsy records of perforation, it has been present in many of the fatal cases which have succumbed after operation. Reports by Flexner,§ Fraenkel‖ and others show how frequently streptococci are obtained from the peritoneal exudate at post-mortem examinations after typhoid perforations. Tavel and Lanz¶ in their extensive report on peritonitis, recognize the frequency and importance of streptococcus infections, but they seem to have encountered no cases of typhoid perforation at the surgical clinic in Bern, nor has Körte** in his recent paper added any to his two previously published cases.

It is strange with the degree of ulceration found and the abundance of streptococci present, that there was no diarrhoea in this case. The steady drop in the leucocytes, after the perforation and with the onset of general peritonitis, is a most interesting feature and recalls the condition in Case II, where with the purulent peritonitis no leucocytosis was present, though it will be observed that no count was made in the latter case at the time of probable perforation or just before it. It is quite well recognized that in appendicitis the leucocytosis, which may be high (20,000 to 30,000) before, drops after perforation, and

* Op. cit., p. 220.

† Durham: On the Clinical Bearing of Some Experiments on Peritoneal Infections. Med. Chir. Trans., London, Vol. LXXX, p. 191, 1897.

‡ Vincent, M. H.: Étude sur les résultats de l' association du streptocoque et du bacille typhique. Annales de l' Institute Pasteur, Vol. VII, p. 141, 1893.

§ Flexner, Simon: Certain Forms of Infection in Typhoid Fever. Johns Hopkins Hospital Reports, Vol. V, 1895.

‖ Fraenkel, Eug.: Zur Aetiologie der Peritonitis. Münchener med. Wochenschrift, Bd. XXXVII, s. 23, 1890.

¶ Tavel, E. und Otto Lanz: Ueber die Aetiologie der Peritonitis. Mitteilungen aus Kliniken und medicinischen Instituten der Schweiz, 1898.

** Körte, W.: Weiterer Bericht über die chirurgische Behandlung der diffusen eiterigen Bauchfellentzündung. Mitteilungen aus den Grenzgebieten der Medizin und der Chirurgie, Bd. II, 1897, p. 145.

with the onset of general peritonitis often disappears completely.

I am inclined to believe that in these suspicious cases the tubs should be discontinued. The late appearance of vomiting and its single occurrence shows the unreliability of this symptom for the diagnosis of perforation.

CASE IV. Surgical No. 8154.—*Typhoid fever in fourth week during relapse. Supposed perforation. Exploratory laparotomy negative. Recovery.*

Maggie P., aged 15, was admitted to the medical wards, August 8, 1898, in the first week of typhoid fever. The fever pursued a typical course (cf. Clinical chart) without abdominal symptoms, with no leucocytosis and with a positive Widal reaction. A moderately severe phlebitis of the left leg appeared unassociated with leucocytosis on the 33rd day. There was considerable swelling of the leg, and tenderness over the femoral vessels. The temperature reached 104°, but in a few days dropped to normal, and remained down twelve days. The patient was up in a wheel-chair, and without symptoms.

On September 22nd (the 52nd day after onset) a relapse of the fever came on abruptly, the temperature rising suddenly to 103° and on the following day to 105°. There was some nausea and vomiting, without abdominal tenderness or pain, but associated with a leucocytosis of 16,000. This condition persisted for the succeeding 48 hours, and the right iliac fossa was noted as being slightly resistant. Some tenderness was noticed in the right calf.

On September 24th, the child began to complain of abdominal pain. She was seen in the evening in consultation with Dr. McCrae, but there were no objective abdominal symptoms at that time. The condition was much as on the preceding day. There was some tenderness in both calves on pressure.

September 25th, 1.30 A. M., the child awoke crying out with a sudden sharp pain in the abdomen "unlike anything she had previously had." Some nausea and slight vomiting followed. Leucocytosis 11,000. Two hours later, 3.30 A. M., the patient was again seen by the writer. She was complaining of colicky pain in the abdomen. Her thighs were kept flexed. There was some slight distension present. The liver dulness did not reach the costal margin by a finger's breadth. The walls were somewhat tense, and with moderately deep pressure in the right iliac region muscle spasm was elicited and the patient would cry out with pain. The chief rigidity, however, was above the level of the umbilicus. Her leucocytes had dropped to 8200. She vomited about 20 cc. of nourishment given her just before.

Operation September 25th, 6 A. M., four and one-half hours after the first appearance of symptoms.

Exploratory laparotomy. Negative findings. Closure without drainage.

An incision was made in the right iliac region. There was no free fluid in the general cavity; no injection of the peritoneum. The appendix, ileum and ascending colon appeared normal and without adhesions. The Peyer's patches in the ileum were swollen and hard, being felt like buttons through the bowel. The gall-bladder was not distended or inflamed. The pelvic viscera were negative. No thrombi could be palpated in the internal iliac veins. There were no suppurating glands felt in the mesentery. The abdominal wound was closed. The operation lasted only fifteen minutes.

The patient showed no ill effects from the operation. There was no subsequent nausea or vomiting; her leucocytosis disappeared, and she passed through an uneventful relapse of fever (cf. Clinical chart).

In the light of our previous experience with Cases II and III and with such symptoms as sudden acute abdominal pain, nausea and vomiting with increasing distension, some rigidity and tenderness and leucocytosis (especially a falling leucocytosis), the writer did not dare take the responsibility of withholding operative intervention even though there was some doubt as to the diagnosis. The possibility of an extension of the phlebitis to the internal iliac veins, thus causing some abdominal pain and tenderness, was thought of, but with the preceding phlebitis of September 22nd there had been no leucocytosis, pain or vomiting. The fact that the chief rigidity was above the level of the umbilicus suggested a gall-bladder complication, which in itself would have demanded exploration. The general appearance of the child was not that of collapse following perforation. There was no marked change in pulse, temperature or respiration with the above-mentioned symptoms. Nevertheless, I believed much less responsibility to be associated with an exploratory laparotomy than with running the risk of neglecting a perforation until signs of peritonitis should occur.

The precise cause of the patient's symptoms remains undecided. She was a very nervous child, and there had been some children with acute abdominal affections in the ward during her previous period of convalescence.

Similar cases have been reported. Herrington and Bowlby* report an operation on a young girl convalescing from typhoid who had even more marked symptoms of perforation with collapse than those related above. There is no mention of a leucocyte count. A laparotomy revealed no peritoneal lesion. Convalescence was uninterrupted.

General Considerations on Operation for Typhoid Perforation.—In recent years several tables have appeared in which are included all of the supposed authentic cases of operation for this particular complication in typhoid, notably those of Finney, Keen and Monad and Vanverts.

Statistics, however, always misleading, are especially so when they concern a question involving so many considerations as are included under the one head of "Results of Operation for Typhoid Perforation."

In the first place two distinct varieties of perforation may be recognized in which the operative prognosis is widely different. In one, the appendicular form, the process takes place in a quiet corner of the abdomen usually remaining localized, owing to the formation of adhesions, for perhaps a long time. In these cases some pre-existing chronic appendicular trouble may predispose toward perforation in the same way as does an ulcer of typhoidal origin in this situation. The condition, then, is practically one of acute perforative appendicitis occurring in the course of typhoid, and has the same prognosis and surgical features as similar conditions unassociated with

*Herrington, W. C., and Bowlby, A. A.: Typhoid Fever Convalescence; Symptoms of Perforation, Laparotomy; no Lesion found; Recovery. Med. Chir. Transactions, London, Vol. LXXX, 1897, p. 127.

typhoid which give a certain percentage of recovery in unoperated cases.

In the other variety the perforation almost always occurs in the freely moving bowel, usually in the lower foot of the ileum.

I believe that Dr. Fitz* first clearly distinguished between these two varieties of perforation in typhoid, emphasizing the fact that many cases would be called appendicitis which, when occurring during typhoid fever, are classed as perforations. Undoubtedly the appendicular cases are much more common than has been ordinarily supposed. Fitz finds, however, only 3 per cent. in 167 cases. Of the 20 cases of perforation in the pathological records of the Johns Hopkins Hospital there have been 2 appendicular perforations which, grouped with a single case out of the nine of which I am personally cognizant, makes 9.6 per cent. which have occurred in the appendix.

To further quote from Dr. Fitz's paper: "The probability of its occurrence (perforative appendicitis) furnishes the best solution to the prognosis of intestinal perforation in the latter disease (typhoid fever). Most cases of recovery from symptoms of perforation of the bowel in typhoid fever are those in which an attack of appendicitis is most closely simulated, while the fatal cases of perforation of the bowel in typhoid fever are, in the great majority of instances, those in which other parts of the bowel than the appendix are the seat of of perforation."

It is of course important to recognize the fact that either of these conditions may be present, but a differential diagnosis can hardly be made, and were such possible, operative interference is as surely indicated as in any acute appendicitis. The prognosis in the appendicular varieties, for the reasons given above, is naturally more favorable, but in all cases the earlier surgical intervention is sought the better for the patient. This applies especially to the variety in which the perforation is in the free bowel. Here, also, adhesions presumably form as the ulcer approaches the serosa, but inasmuch as they are attached to a movable part of the bowel they cannot be relied upon to hold, and extravasation usually soon takes place. It is with perforation of the ileum that we are chiefly concerned, and in looking for information upon this subject we are hampered because we find commingled in the statistician's tables, two very different and widely separate conditions, one, the results of operation for typhoid perforation, the other, the results of operation for general peritonitis following typhoid perforation.

The mortality following operation for general septic peritonitis, due to extravasation of intestinal contents, is necessarily high. Could these cases be excluded from the tables we should find that operative interference in typhoid perforation is associated with a moderately low mortality.

A consideration of our cases, and of some heretofore reported, emphasizes the necessity of early operation upon the first symptoms of perforation, or possibly upon recognizable pre-perforative symptoms, without waiting for the usual signs of peritonitis. It is far better to operate early, needlessly if it so eventuate, rather than to wait until symptoms of peritonitis appear and actually demonstrate a perforation by its dread and practically inoperable sequel of general septic infection of the peritoneal cavity.

Any abdominal symptoms occurring in the course of the fever are as urgent indications for a surgical consultation as is the appearance of pain and tenderness in the right iliac fossa under all occasions, and only when this is fully realized will the mortality of these cases approach the low percentage reached in operations for acute perforative appendicitis or perforating gunshot wounds of the abdomen. Delay in these two latter conditions is no longer thought of, and equally prompt intervention on the first abdominal symptoms in the course of typhoid, without waiting for actual evidence of peritonitis, will similarly reduce its high death-rate. It is hard to understand Dr. Keen's advocating delay until symptoms of shock have passed away and his preference of the second twelve hours for operating, when one appreciates that extravasation, perhaps of virulent organisms, is with all probability continually taking place while we are waiting.

There are of course certain cases, of which Dr. Osler* makes mention, in which perforation gives rise to no signs whatever as the patients are desperately ill and the local features are masked by the severity of the toxæmia. The diagnosis is usually made at such times on the autopsy table. Hospital cases, however, are usually carefully watched and some symptoms almost invariably should give warning of the complication, if not before, certainly at the time of perforation.

The figures, however, as they are given, including cases of all descriptions, even those condemned before they reach the operating room, present a comparatively low mortality.

Westfall's statistics (1898) given by Keen† are the most recent, and show 19.36 per cent. of recoveries in 83 collected cases. Those of Finney‡ (1897) include forty-five fairly authentic cases, with eleven recoveries, making his statistics somewhat better with 26.22 per cent. of recoveries. Monad and Vanverts§ consider the mortality to be much greater, namely 88 per cent., contrasted with a supposed 95 per cent. of deaths in unoperated perforations. With this small margin, however, they strongly recommend operation.

It is probable that the last figures more nearly represent the truth, as there are presumably many cases lost from tardy operations, which are never reported, and in the more favorable statistics given above there are doubtless some cases included which are of questionable typhoid origin.

Only in recent years has it become possible by bacteriological examination and by the serum reaction to conclusively demonstrate the nature of certain fevers. The writer recently operated on a perforated appendix associated with a general fibrino-purulent peritonitis due to a colon infection in a patient who subsequently had for three weeks a typical typhoid

* Fitz, R. H.: Intestinal Perforation in Typhoid Fever: Its Progress and Treatment. Trans. of the Assoc. of Am. Phys., Vol. VI, p. 200, 1891.

* Osler: Practice of Medicine, 3d edition, 1898, p. 26.

† Surgical Complications and Sequels of Typhoid Fever, 1898, p. 234.

‡ Finney, J. M. T.: The Surgical Treatment of Perforating Typhoid Ulcer. The Annals of Surgery, March, 1897.

§ Monad, Ch. et J. Vanverts: Du traitement chirurgical des péritonites par perforation dans la fièvre typhoide. Revue de Chirurgie. T. XVII, 1897, p 169.

chart and a general typhoidal appearance without leucocytosis, and with no abdominal symptoms. This would undoubtably in former years have been considered an appendicular typhoid perforation. Only after persistent negative results with the Widal reaction could we believe the case to be non-typhoidal.*

Another case, which would certainly have been considered a perforation in an ambulatory typhoid had not careful microscopical and bacteriological study been made of the tissues, is as follows:

The patient, Fred. H., aged 26, having been discharged from the work-house the day previously, entered the hospital January 25, 1897, after 12 hours of acute abdominal distress. He had all the symptoms of general peritonitis, and at operation a single perforation was found in the ileum the size of a five-cent piece and about ten inches above the ileo-cæcal valve. He died 6 hours later, and the necropsy revealed an acute splenic tumor, parenchymatous degeneration of the liver and kidneys, but no other intestinal lesions characteristic of typhoid. There were no focal necroses in the liver, and the bacillus typhosus was nowhere obtained in cultures.

This case of perforation of the ileum, evidently not typhoid, presents such similarity to the notable one of Miculicz, which is usually admitted to have been of typhoid origin, that I cannot but believe the latter also was due to a perforation not resulting from typhoid fever, though its exact nature must remain uncertain. Doubtless many others of the tabulated perforation cases would likewise be discarded as "not typhoid" could they be scrutinized in the light of more recent and positive methods of diagnosis.

Diagnosis.—The question of early diagnosis of typhoid perforation is unfortunately but little touched upon in the recent monographs upon the subject, which give little more than a stereotyped picture of pain, collapse, vomiting and abdominal tenderness, a symptom complex which is enough of course in ordinary cases to assure one of the condition. We have seen illustrated by the above cases, however, that this picture is but rarely complete, and the difficulties in the way of the recognition of perforation are frequently so great that it may be overlooked entirely. Two of them also show that other conditions may give the characteristics typical of perforation when this complication has not occurred.

The complete symptomatology is usually given as follows. During the course of the fever, usually in the third week of a severe attack, most often in male adults there appears, with sudden onset, abdominal pain usually in the right side, associated with more or less tenderness and rigidity. Vomiting follows with more or less irregularity. The onset may be associated with a chill and pyrexia, or with cold extremities, collapse and a drop in temperature often of several degrees. The pulse becomes small and wiry. Leucocytosis is supposed to make its appearance, and soon more or less abdominal distension sets in with increase of vomiting, shifting dulness in the flanks, obliteration of liver dulness, a gradual return of pyrexia if there has been a fall, with rapid feeble pulse, restlessness and thirst, all indicative of general peritonitis, with death supervening in 24 to 48 hours.

Of these symptoms, especially those associated with the onset, a few remarks will be made.

Abdominal pain and tenderness.—It is a well-recognized fact that the character of the symptoms in typhoid fever seems to vary in different years within considerable limits. An unusually large number of the cases which have been treated in our medical wards this fall have had abdominal pain and tenderness which have frequently been associated with diarrhœa. This has been so pronounced a feature that several cases have been seen in surgical consultation for symptoms which have subsequently disappeared. A sudden acute onset of increased abdominal pain is an all important symptom which unfortunately may be absent, or owing to a patient's stupor be overlooked. Any complaint of pain, however, of less abrupt onset, associated with tenderness, must arouse the greatest suspicion on the part of the attendant. I cannot but believe that the condition which has been spoken of above as a pre-perforative stage of ulceration often exists. A little localized inflammation of the serosa, with or without the passage of microorganisms and leading to a slight adhesive peritonitis, usually of omentum, can give rise to these symptoms and produce an associated slight leucocytosis. This is precisely analogous to what occurs in the pre-perforative stage of appendicitis which, however, is of less urgent nature because in the case of the appendix which is fixed and does not move about freely in the general cavity, as do the coils of ileum, the adhesions are less likely to be dislocated and a general peritonitis, which would result from this separation, is avoided. This is as true of appendicular perforations in typhoid as of those occurring at other times. I believe that this pre-perforative stage may be frequently recognized as in Case III reported above. Doubtless in some of the successful cases of operation for perforative peritonitis such a pre-perforative stage has been met with. This was notably so in Dr. J. B. Murphy's case,* where no perforation was found, but merely a local inflammatory reaction about one threatening ulcer. Several of the other successful cases illustrate a pre-extravasation stage where adhesions had reinforced the serosa before it gave way entirely and had temporarily prevented extravasation. Among such cases may be mentioned Watson's,† Bogart's‡ and our first case at the third operation.

Under rare conditions when the adhesions are firm, which, for the reasons mentioned above, is more likely to occur when the appendix is the seat of threatened perforation, the base of the ulcer may completely penetrate the bowel and yet the general cavity be protected. A local abscess may result, or the adhesions may floor the ulcer and subsequent healing take place over them so that recovery follows without operative intervention.

This is the usual explanation of recovery following symptoms of perforation, in cases which have not been subjected to operation. In the case of Buhl,§ quoted by Fitz, at an autopsy

* This case subsequently came to autopsy and a tuberculous enteritis was found. The appendicular perforation was probably through a tuberculous ulcer.

* Westcott's table, Case No. 41. Keen.

† Watson: Boston Med. and Surg. Journ., Vol. CXXXIV, 1896.

‡ Bogart: Op. cit.

§ Zeitschr. f. rat. Med., 1857, N. F. VIII, S. 12.

following death from hæmorrhage, a pre-existing perforation was found to have been closed by omentum. This was twenty-three days after the occurrence of symptoms of perforation. Dr. Hare* of Brisbane, says: "At present it is an open question whether the treatment should be medical or surgical; whether indeed laparotomy is justifiable." He reports an interesting case in which symptoms of perforation had occurred. The patient subsequently died, some time later, with dysenteric symptoms, and the ileum was found surrounded by adhesions, which were especially dense at the point corresponding to a supposed perforation. I do not think, however, that this case is at all conclusive. A threatened perforation with perhaps the escape of some organisms through an intact serosa, which Dr. Welch has proved to be possible, would have accounted for the localized peritonitis. Had the perforation been complete, doubtless the adhesions would not have long sufficed to confine the extravasation. In his second case of supposed recovery after perforation an operation, had it been offered in the first hours of symptoms, would with greater probability have insured success. Mr. Gairdner's† interesting cases also would show that a fatal peritonitis without an absolutely complete perforation may take place. He reports five such instances.

The protection by adhesions in this way is too precarious a thing to be relied upon, and that they should hold for any length of time is something which can never be anticipated. The recognition of this pre-perforative stage I would emphasize as all important.‡

This is the period in which, if possible, an operation should be performed, and as it may endure but a short time, the opportunity should be immediately seized. Such a condition existed in Bogart's case§ in which he found a perforation of the ileum closed and the ulcer floored by the adherent tip of the appendix. He speaks of the presence of sero-purulent fluid in the general cavity which doubtless was free from organisms as it was in our Case I, which was operated upon before extravasation of intestinal contents had taken place. An opportunity of operating in this stage was unhappily neglected in Case III.

An analogous pre-perforative stage was recognizable in the following case, one of dysentery, upon which the writer recently operated, though too late. The patient had been in the medical wards for some days with a severe amœbic dysentery. He developed considerable abdominal pain, tenderness and leucocytosis, with some rigidity of the parietes. Several days later, while having a rectal irrigation, sudden evidence of perforation and extravasation occurred with acute pain and collapse. At the operation, three hours later, his abdomen was full of fæces, which were pouring from a large opening in the sigmoid flexure. The autopsy revealed an extraordinary degree of ulceration of the colon with a complete loss of substance in the bowel in several places, but all of these ulcerated areas, except the one found at the operation, were completely floored by protecting omental adhesions.

As in the three typhoid cases reported above, here too was a distinctly recognizable pre-perforation or pre-extravasation stage of intestinal ulceration which demanded operative relief before final signs of perforation with extravasation had rendered the chances of giving it most desperate.

Undoubtedly, signs exist which are often considered trivial, but which may aid us in anticipating a final perforation by indicating early laparotomy.

Temperature and Pulse.—A pronounced drop in temperature is a not infrequent symptom, associated with the onset of the perforation. It must, however, be clearly distinguished from the great fall in surface temperature, which is often pronounced and gives rise to the cold and clammy extremities so characteristic of the collapse of onset. This latter condition, however, may be associated with a rise of central temperature. In some of the cases cited by Fitz this collapse was the only symptom indicative of perforation.

The sudden fall of the central temperature, when it occurs, is such a pronounced feature that more importance has been ascribed to it than it deserves. Dieulafoy* considered it an almost infallible sign. He says: "La perforation intestinale, au cours de la fièvre typhoïde se traduit dans la très grande majorité des cas, par une *chute brusque de la température.*" He thinks the appendicular attacks occurring in the course of the fever show, on the contrary, a rise in temperature, and may thus be distinguished. Lereboullet,† however, takes exception to this statement in a thorough discussion, and believes it to be exceptional. Gesselewitsch and Wanach‡ also emphatically assert that many cases are accompanied by a rise in temperature. One can merely state that when present it is a characteristic symptom, but that it may be absent. It also, of course, frequently occurs in other conditions such as hæmorrhage, and our Case I further illustrates its unreliability as there was no drop with the perforation, but a pronounced fall with the obstruction and after each operation. It may possibly be a means of distinguishing, as Dieulafoy suggested, between a perforation with extravasation into the free cavity and one protected by adhesions giving merely a local inflammatory reaction.

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* The Cold Bath Treatment of Typhoid Fever, 1898, p. 178.

† Gairdner: Peritonitis in Enteric Fever. The Glasgow Med. Journal, Vol. XLVI, p. 114, Feby., 1897.

‡ Under "pre-perforative stage" let it be understood that the whole period is included between the first involvement of the serosa with the customary formation of adhesions at that point, until these adhesions, which may for a time constitute the floor of the ulcer after the serosa has given way, have themselves become broken down and general extravasation has taken place. This period as in perforating appendicitis may last a longer or shorter time and is associated with pain and tenderness and a possible rise in leucocytosis owing to the localized peritonitis.

§ Bogart, J. Bion: loc. cit.

* Dieulafoy: De l'intervention chirurgicale dans les péritonites de la fièvre typhoïde. Bull. de l'Académie de Médicine. Oct. 27, 1896.

† Lereboullet: Sur le diagnostic et le traitement des perforations intestinales dans la fièvre typhoïde. Bull. de l'Acad. de Méd. Nov. 3, 1896.

‡ Gesselewitsch and Wanach: Die Perforations Peritonitis beim Abdominal Typhus und ihre operative Behandlung. Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie, Bd. I, H. 1 und 2, 1898.

The disparity between pulse and temperature may be a marked feature, the former being small and rapid during the drop in temperature. The respiration likewise is apt to be more rapid and shallow with less marked abdominal movements.

Of symtoms other than those associated with a *threatening* perforation or with its immediate occurrence little need be said. A chill sometimes occurs, but more often with the circumscribed and appendicular varieties, when, too, the temperature is more apt to rise. Vomiting is an important symptom when present, but its frequent absence makes it an unreliable one. The acoustic phenomenon of Levaschoff, a sound caused by the passage of gas through the perforation with each descent of the diaphragm, has not been generally confirmed. Later signs, such as shifting dulness from free fluid, distension, obliteration of liver dulness and other indications of abundant extravasation of gas and fæces, such as were present in Case II, make the diagnosis of a long standing perforation as easy as its prognosis is unfavorable. Even many of these stereotyped indications of general peritonitis may be misleading. In Case III shifting dulness was a marked feature, and yet but little free fluid was present. Similarly a distended colon may cause partial obliteration of liver dulness, but even with perforation and extravasation too small an amount of gas may escape to produce it.

Leucocytosis.—Of great interest and of great diagnostic importance in these cases would seem to be the presence or absence of leucocytosis.

The final interpretation, however, to be given to this symptom is far from being made. Dr. Finney says: "Of all the so-called diagnostic signs of perforating typhoid ulcer most reliance is to be placed upon the development of an attack of severe, continued abdominal pain, coupled with nausea and vomiting, and at the same time a marked increase in the number of white blood corpuscles." We have seen, however, in some of our cases a fall and not an increase in leucocytes, which must receive consideration.

The fact that "there is not only no increase in the proportion of colorless corpuscles during the fever, but that on the contrary there is rather a tendency toward a diminution in number at the height of the disease," was emphasized by Thayer* in 1892. The occurrence of leucocytosis therefore is quite properly in most cases supposed to be coincident with the presence of some septic complication other than the surface ulcerations of the intestinal tract. Cabot† is inclined to the belief that in all the cases in which leucocytosis exists constantly, some complication really *is* present though it may be unrecognized. He cites two cases with a leucocytosis of 24,000 and 18,000 respectively, occurring at the time of perforation. He further states: "It occasionally happens in very exhausted patients that complications fail to produce any leucocytosis, the patient (as in some cases of pneumonia or purulent peritonitis) being unable to react against the infection" (p. 170). This statement, I think, needs some qualification.

* Thayer, W. S.: Two cases of Post Typhoid Anaemia. With Remarks on the Value of Examinations of the Blood in Typhoid Fever. Johns Hopkins Hospital Reports, Vol. IV, No. 1, p. 88.

† Cabot, R. C.: Clinical Examination of the Blood, p. 168, 1897.

Using the cases above reported, in all of which careful leucocyte counts were made, we are confronted by quite a different picture. In Case II the complete absence of leucocytosis was the unfortunate cause of a deferred operation. I doubt not, however, that a leucocytosis, which subsequently disappeared, was present at the onset of the peritonitis.

In Case I there was an early and recognized leucocytosis appearing, however, before any signs of general peritonitis had developed; and in the peritoneal fluid comparatively few white cells were present and no micro-organisms.

In Case III, a preceding leucocytosis associated with abdominal pain and tenderness, which, as has been stated, was probably indicative of a mild local peritonitis about the extensively ulcerated bowel, was completely wiped out concomitant with the occurrence of general peritonitis and the appearance of great numbers of leucocytes in the extravasated peritoneal fluid.

In the case of dysenteric perforation, mentioned above, the leucocytosis had previously been constantly high. A few days before the perforation it was 47,000. At the time of perforation it was 41,000. An hour later it had fallen to 30,000 and at the time of operation it was 27,000, a drop of 20,000 in three hours. At the operation the lower bowel was matted together with adherent omentum, this local inflammatory process doubtless being the cause of the preceding leucocytosis. The general cavity was full of fæcal and purulent fluid, in which were great numbers of polymorphonuclear leucocytes, eosinophiles and mononuclears in about the proportions found in the blood. Many of these cells were crowded with organisms and disintegrating. There is but one natural conclusion to be made from this sudden diminution of the number of white cells in the peripheral circulation coupled with their appearance in the peritoneal exudate.

Similarly in appendicitis the writer has frequently seen, after a high percentage of leucocytes present during the acute stage, a drop in their number occurring in association with the onset of peritonitis, as characteristic as that which occurs with the subsidence of the acute attack and recovery.

In Cabot's table XXI of counts made in general peritonitis, there are 4 without leucocytosis, the numbers varying between 4600 and 6000. Of those with leucocytosis, as well as in his cited dysenteric case with 24,000 leucocytes there is no recognition of a possible fall in number such as occurred in the cases cited above after the onset of general peritonitis.

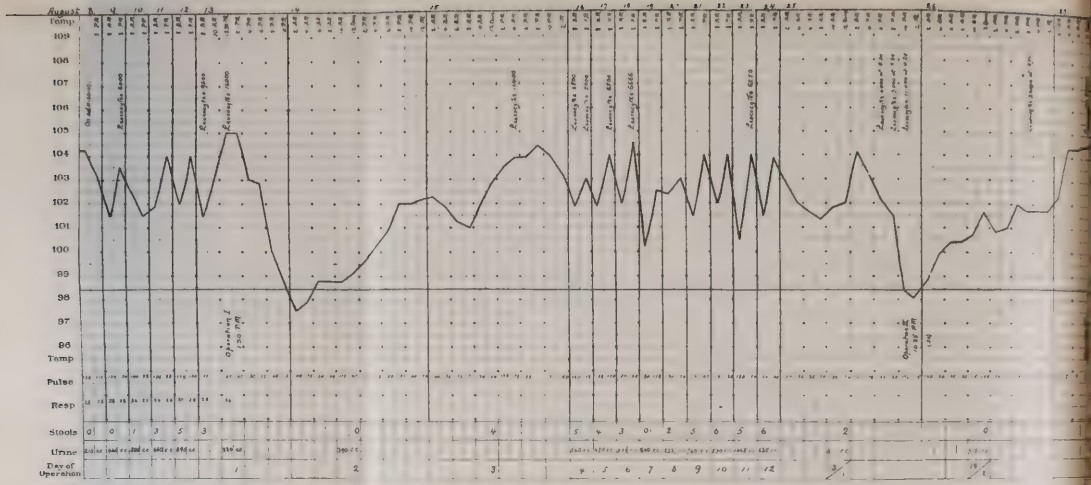
Cabot* says: "A steadily increasing leucocytosis is always a bad sign and should never be disregarded even when other bad symptoms are absent." I would add that a decreasing leucocytosis may be a much worse sign, and should never be disregarded. This is especially of importance in those typhoid cases in which the "other bad symptoms" are difficult to estimate on account of the dull condition of the patient.

From these data on leucocytosis the following conclusions may be drawn:

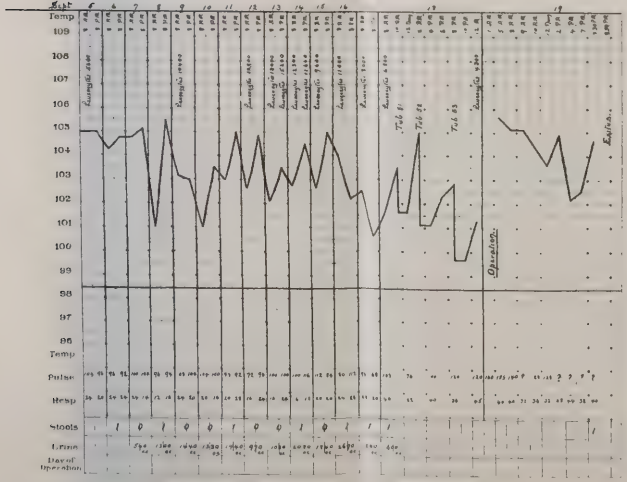
1. The appearance of leucocytosis in the course of typhoid fever points toward some inflammatory complications in its early stage.

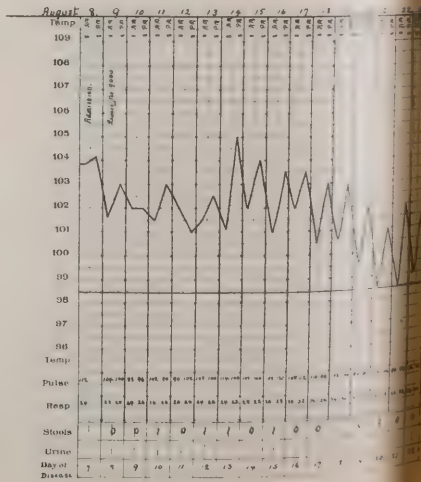
* Op. cit., p. 197.

CASE I.

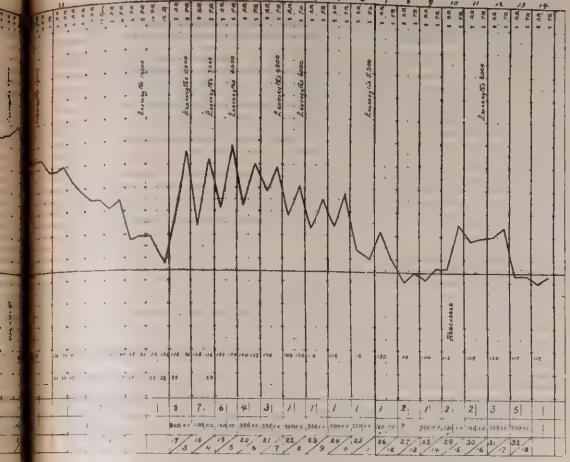


CASE III.

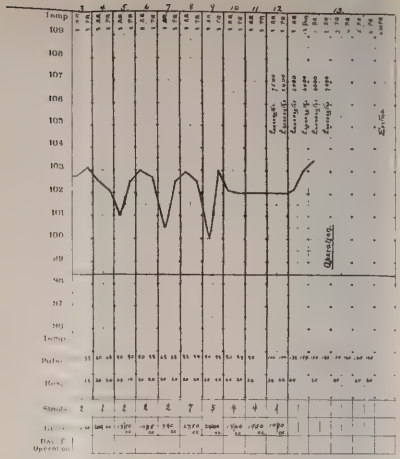




The complete chart showing the tubs is only given on the 18th inst.

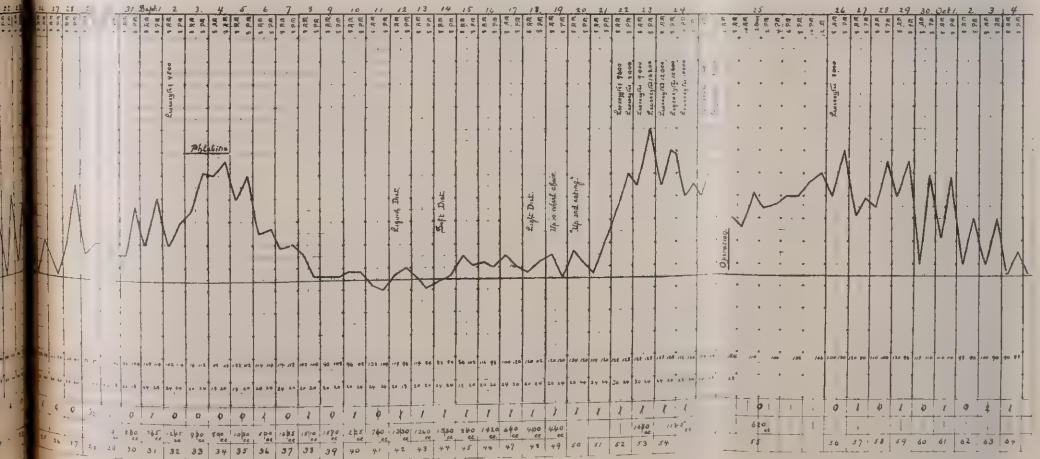


CASE II.



This chart does not show the effect of the tubs.

CASE IV.



2. If this complication be a peritonitis and remain localized, associated possibly with a pre-perforative stage of ulceration (cf. Case III) or with a circumscribed slowly-forming peritonitis after perforation, it may be and usually is signalized by an increase of leucocytes in the peripheral circulation.

3. If, however, a general septic peritonitis follow, the leucocytosis may be but transitory and overlooked, as it disappears concomitantly with the great outpouring of leucocytes into the general cavity.

The various forms of operative procedure advocated in these cases it is not the object of this paper to discuss. They are fully set forth in the recent monographs on the subject by Finney, Gesselewitsch, McCosh, Keen, and Farrar Cobb.*

CONCLUSIONS.

The diagnosis of intestinal perforation in typhoid fever may present many difficulties. No abdominal symptoms either subjective or objective occurring in the course of the fever should be regarded as trivial, and a sudden change of any sort in the patient's condition should lead first of all to the suspicion of this most serious complication. A distinction should be drawn between the two varieties of perforation, the appendicular and those occurring in the free bowel, as their symptoms, course and prognosis vary considerably. Many cases, however, even those of perforation from the free bowel, present what may be recognized as a pre-perforative stage which in some cases calls for a laparotomy in anticipation of a complete perforation with extravasation. The presence of leucocytosis is not an infallible sign of perforation as it may disappear with the onset of general peritonitis. It is most valuable in this anticipatory stage.

When the diagnosis is made operation is indicated, whatever the condition of the patient. As Abbe's case exemplifies, no case may be too late. A precocious exploration from an error in diagnosis is not followed by untoward consequences such as must invariably be expected after a neglected and tardy one.

Our present knowledge amply corroborates the statement of Miculicz made at Madgeburg in 1884: "If suspicious of a perforation one should not wait for an exact diagnosis and for peritonitis to reach a pronounced degree, but on the contrary one should immediately proceed to an exploratory operation, which in any case is free from danger."

Discussion.

Dr. Finney.—There are a number of points in Dr. Cushing's most interesting paper to which I should like to call attention. Some of the points he has made are new, and I think a distinct addition to our knowledge of the subject. This is a subject in which I have been, personally, very much interested and have recently had occasion to go over the literature of the operation pretty thoroughly. I have myself operated upon four cases with one recovery; the other three were practically moribund at the time of operation. They were forlorn hopes, but as Dr. Abbey's case recovered, and since we have nothing to lose by operating in such cases, we may occasionally gain something. Next to Dr. Cushing's case, which must take the palm for having recovered under the greatest difficulties, I think my case a good second. Dr. Cushing's patient had three successive laparotomies, and subsequently recovered. My case had but one operation, but he had almost every complication that a typhoid patient can have.

In regard to the question of leucocytosis, we expressed the hope a year or two ago (the suggestion being first made by Dr. Thayer) for much of diagnostic value in the blood count of these doubtful cases. It has been of some value, but just how much remains to be seen. Dr. Cushing mentions the fact that in one case the increased number of leucocytes suggested perforation, and in another the rapid decrease in leucocytes was suggestive, if not of perforation, at least of a critical condition of the patient. The question of the value then of the blood count and its diagnostic significance remains to be determined.

In Dr. Cushing's third case I find the only one, in about a hundred which I have collected, occurring in a negro, and he died.

The question of a pre-perforative stage, as Dr. Cushing has called it, is very interesting and important if it can be really differentiated. It is a point which will be further investigated with a great deal of interest. As to statistics, it depends entirely upon how many doubtful cases one admits into one's series. In our previous report we found 26.2 per cent. of recoveries. Then Dr. Keene's very exhaustive work appeared in which he reduced the percentage to 19.6 per cent., but since then there have been a number of cases that will, I am glad to say, bring up the percentage somewhat. I have not a complete history of some of these cases as yet, but I think it will average between 20 per cent. and 25 per cent. The distinction which Dr. Cushing has drawn between operating for the relief of a perforating typhoid ulcer, and a general septic peritonitis following such a perforation, is a very good one.

After all, early operation is the main point in this as in many other operations. If we can get these cases early enough we shall have a much larger percentage of cures, and there, as Dr. Osler has suggested, the physician and surgeon must work together and try in every way to increase our diagnostic ability. So far as the technique of the operation is concerned, I believe there is not much to be gained, and we have reached the point in dealing with these cases where we haven't much to hope for in that direction, but must turn in the direction of an earlier diagnosis for any marked improvement in our statistics.

Dr. Osler.—I think Dr. Cushing is to be congratulated upon his excellent results. Certainly to save one case in three of perforation is much more than we can do on the medical side, for they all die with us, except a few cases of appendical perforation.

Dr. Cushing has pointed to the difficulty of diagnosis, and I do not know of any more difficult problem than to determine in some cases the existence of perforative peritonitis. The local symptoms may predominate, and I would ask whether in the case of the young girl the general symptoms of collapse, change in countenance, pulse, etc., were present or not?

There are many other points in connection with this question that I would like to discuss, but the programme is a long one and there will probably be other speakers. I would, however, refer to one point mentioned, the great importance, when the autumnal crop of typhoid cases is in hospital, that the house surgeon and house physicians should often make rounds together.

*Farrar Cobb: Septic Peritonitis and its Surgical Treatment. Boston Medical and Surgical Journal, Sept. 8, 1898.

SPONTANEOUS HÆMORRHAGIC SEPTICÆMIA IN A GUINEA-PIG, CAUSED BY A BACILLUS.

By George H. Weaver, M. D., *Chicago.*

(*From the Pathological Laboratory of Rush Medical College.*)

The bacillus here described was obtained from a large female guinea-pig, which died suddenly without apparent cause in the animal room attached to the pathological laboratory of Rush Medical College.

Upon examining the body, the condition of the uterus first attracted attention. The right cornu was swollen to a diameter of 1 to 1.5 cm. for 5 cm. of its length. The covering of peritoneum exhibited marked vascular injection, but no exudate. The opposite cornu was of the normal size and appearance of the unimpregnated uterus. On opening the uterus from in front the cavity was found empty. The mucous membrane of the right cornu presented numerous scattered hæmorrhagic areas, which became confluent in front. On the posterior surface, about midway between the bifurcation and apex of the horn, was an area 1½ x 2 mm. in diameter, slightly elevated, firm, and of a dirty blackish-brown color.

The spleen was enlarged and soft; the kidneys and liver pale. The heart was distended with blood. The lower lobe of one lung was firm, airless, and of a dark red color. In the opposite lung was a smaller area of firm consistence, of a deep red color, slightly depressed below the surface. On section the solidified portions were yellowish in color, and airless.

Cultures upon agar-agar, from the uterine wall, spleen, kidneys, heart-blood, and pneumonic area gave an abundant growth of the bacillus to be described below. Portions of the organs, hardened in alcohol, and stained with hæmatoxylin and eosin, and with Loeffler's methylene-blue, were examined with the following results:

Uterus.—The mucous tissue is largely destroyed in the right cornu at the site of the necrotic area. The superficial layer consists of necrotic cells, some with fragmented nuclei, some containing blood-pigment. In some places are areas of hæmorrhage with well-preserved blood-cells, the infiltrated tissue staining poorly. The tissues beneath the serosa are much swollen, and the capillaries here much dilated. The muscular coat is much thickened from enlargement of the fibres and separation of them by fluid exudate. There is no round-cell infiltration in any part of the organ. Sections stained with methylene-blue show abundant bacilli, corresponding to those obtained in cultures, in the necrotic uterine lining. They have penetrated but a short distance into the tissues and are not found in the deeper layers of the mucosa, nor in the muscular or serous layers.

Lungs.—The lesions in the lungs are those of a hæmorrhagic pneumonia. The exudate is in part made up of small round cells (multinuclear). In other parts it is almost entirely hæmorrhagic, containing few or no leucocytes. In these latter areas the blood is, for the most part, well preserved, and some round cells contain pigment. When stained with methylene-blue and eosin, numerous bacilli are found in the hæmorrhagic areas. In places they are so numerous as to be easily recognized in mass with the low power. In the areas where the exudate consists of small round cells, few bacilli are to be found.

Liver.—Extensive fatty degeneration of the liver cells extends throughout the lobules.

Kidney.—The epithelium of the convoluted tubules is swollen and cloudy. The glomeruli are distended with blood, in some escaped blood being seen free in the capsules. There are a few small areas of hæmorrhage in the cortex.

Spleen.—There is a hyperplasia of the cells, and many large cells containing pigment.

DESCRIPTION OF ORGANISM.

Cultural Peculiarities.—In gelatine plates at room temperature, after 48 hours, the deep colonies appear to the naked eye as pin-point sized, white growths, and with a No. 3 Leitz objective, as round or slightly oval, pale yellowish, with an even outline and finely granular. After the same length of time the superficial colonies appear to the naked eye as about 1 mm. in diameter, glistening white, slightly elevated, with even or finely serrated edges. With the No. 3 Leitz objective they are translucent, with finely serrated edges, and uniformly and finely granular.

On agar-agar after 48 hours at 37° C. the superficial colonies were quite characteristic. The colony consisted of three zones. The centre was transparent or translucent white. About this was a zone of opaque white, while a third peripheral zone was transparent like the centre. The edges were finely irregular, and the colonies about $\frac{3}{16}$ inch in diameter.

The growth upon an agar-agar slant was abundant, white and porcelain-like.

On gelatine there was a fine granular growth along the line of puncture, and at the surface a fine growth which did not spread over the surface, nor become elevated.

On Loeffler's blood-serum mixture there was an abundant creamy, white growth, with gas production in the water of condensation. In glucose-agar there was abundant gas production. Bouillon was rendered diffusely cloudy. On potato there was a yellowish-white growth, elevated and with an irregular surface, which after a few days tended to extend over the surface beyond the site of inoculation.

Litmus-milk was turned faintly pink in 24 hours at 37° C., and in a week had lost some color, but there was no coagulation. There is no odor to the cultures, and no production of indol or phenol.

The growth is not so luxuriant when oxygen is excluded.

Growth is rapid at a temperature of 37° C., less so at 20° C. Slow growth occurs at as low as 7° C.

Morphology and Staining Properties.—The bacilli from cultures upon agar-agar, and blood serum, are non-motile. They stain readily with the aniline dyes. With carbol-fuchsin there is often a more intense staining at the poles, which is not present in specimens stained with Loeffler's methylene-blue. The bacilli are short, two to four times as long as thick, with rounded ends. They resemble the bacilli of chicken-cholera. They occur singly, often in pairs, but never in long strings. They are decolorized by Gram's method. No spore formation was observed.

Effects upon Animals.—Guinea-pigs and mice (house and white) died in from 15 to 36 hours after subcutaneous inoculations. The fatal dose of a 24-hour bouillon culture, at 37° C., was 0.5 cc. in guinea-pigs, and from 15 to 45 drops in mice.

In guinea-pigs, at the autopsy, there was found a reddish,

gelatinous exudate extending into the tissues to some distance from the point of inoculation. The adjacent lymph glands were swollen and very red. The serous cavities usually contained a blood-stained fluid exudate. The viscera of the abdomen and thorax did not show much macroscopic change except a swelling of the spleen, and perhaps an increased amount of blood in the lungs. Cultures from the blood in the heart, the various viscera, and serous cavities, always showed large numbers of bacilli everywhere. Sections of the various organs after hardening in alcohol allowed the bacilli to be demonstrated in the smaller vessels and capillaries. The tissue changes were not marked. There was fatty degeneration of the liver cells; distention of the capillaries in the glomerular loop in the kidney, with hæmorrhage into the capsule; areas of hæmorrhage in the spleen, and areas of hæmorrhagic pneumonia.

In mice there was at times some œdematous infiltration at the point of inoculation, but usually none. The internal organs were macroscopically little changed, except an enlargement of the spleen and a reddish mottling of the lungs. Smear preparations and cultures showed the bacilli to be present in all the organs and in the blood in the heart. In sections stained with Loeffler's methylene-blue the smaller vessels and capillaries of the various organs contained numerous bacilli. The tissue changes consisted in an increased amount of blood in the spleen, and fine areas of hæmorrhagic pneumonia in the lungs. In the pneumonic areas the bacilli were numerous.

Rabbits are almost entirely immune. After subcutaneous inoculations a local reaction occurs, but recovery follows. One young rabbit died after an injection of a very large quantity, probably from intoxication rather than from infection.

White rats and pigeons were entirely refractory.

This bacillus is an example of the bacteria classified by Hueppe as the cause of true hæmorrhagic septicæmia. They are usually short bacilli, which appear as diplococci because of the deeper end-staining. They do not spread over the surface of the gelatine, and usually do not grow on potato. They cause a true septicæmia, and invading the general vascular system cause a hæmorrhagic diathesis. A sharp line cannot be drawn between these and bacteria, which also cause multiple necrosis by growth in certain small areas.

This organism resembles some of those already described, but varies in its effects upon animals, and in other vital properties.

ANTITOXIC RELATION BETWEEN BEE POISON AND HONEY (?).

By G. H. Stover, M. D., *Denver, Colo.*

Miss M., aged 35, single, consulted me on September 9, 1895, on account of the rather unusual swelling of her right cheek following a bee-sting received some days before; the whole right side of the face was considerably swollen and she felt some constitutional symptoms.

After treatment for five days she recovered, and on her final visit made the interesting statement that, while in the past she had never been able to eat honey, indeed, was nauseated by the smell of it, even, since being stung she had developed a craving for it, and found that she could eat it with complete satisfaction and with no ill results.

Will some of the immunization experimenters throw light on this occurrence?

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Broadbent's Sign.—Dr. Camac.

It is with regret that I announce that the patient with adherent pericardium, who exhibited very strikingly the Broadbent Sign, is unable to be here to-night. As the phenomenon has been demonstrated to this Society at a former meeting I trust it will not be amiss to have reference to the sign without showing the case.

Broadbent* describes this sign of adherent pericardium as follows: ". . . Marked systolic retraction of some of the lower ribs on the lateral or posterior aspect of the thorax *may sometimes be seen.* This phenomenon is best seen when the patient is sitting up in a good light and the movements of the chest are carefully observed from a short distance off, first from the front and then from the lateral aspect. When a pulsatile movement is seen over the lowest part of the left side of the chest posteriorly, it may at first sight appear to be expansile. On a more careful scrutiny it will be found that there is a tug on the false ribs during the cardiac systole and a sharp rebound during diastole, which can be felt as well as seen when the hand is laid flat upon the chest-wall at the spot; *it is more marked when a deep inspiration is made;* it may be seen occasionally, not only on the left side, but also on the right, especially if the patient leans over to the left. Here, it is not possible that the heart can be directly fixed to the chest-wall at the points of retraction by pericardial adhesions, as the lung tissue intervenes; but the explanation seems to be the following: The heart is, by means of the pericardium, adherent not only to the central tendon of the diaphragm but probably also to a large area of the fleshy or muscular portion of the diaphragm, and, it may be, to the anterior thoracic wall as well; as it contracts it drags upwards and inwards the less resistant

*Adherent Pericardium. John F. H. Broadbent, M. D., M. R. C. P.

fleshy part of the diaphragm towards the central tendon or anterior chest-wall; hence the points of attachment of the digitations of the diaphragm to the lower ribs and costal cartilages are dragged inwards and downwards. It will always be found in such cases that the retracted positions of the chest-wall correspond to the floating ribs or costal cartilages of the lower ribs at the points of attachment of the diaphragm. (Systolic recession of the left subcostal angle and epigastrium does not necessarily imply the presence of pericardial adhesions.)"

"The above is a most important diagnostic sign of adherent pericardium *when present*, and is quite distinct from recession of the lower ribs in inspiration."

Twice in the course of the description Broadbent infers that this is not a constant sign of adherent pericardium. He says at the beginning of the description that the sign "may sometimes be seen," and again at the conclusion that it is a most important sign "when present." It is to the explanation of this inconstancy that one's attention is drawn.

I have been unable to find in any work upon anatomy an accurate description as to the extent of pericardial attachment to the diaphragm. The general arrangement of the pericardium would suggest a hammock in which the heart is slung, attached above to the cervical fascia and below to the diaphragm, the diaphragmatic attachment involving largely the central tendon.

McClellan* gives the following description: The pericardium "is *intimately adherent* to the middle leaflet of the tendon about the opening for the inferior vena cava, and *more loosely connected* to the muscular part on the left side". . . . "These connections" (together with those of the deep cervical fascia already mentioned) "of the pericardium are of great interest, for *if the entire diaphragm descends* in respiration it must draw with it the heart sac, and therefore exert more or less strain upon the vessels at the base of the heart. The author inclines to the belief that *the central portion* or *tendon of the diaphragm does not descend, although the lateral muscular portions do.* On one occasion, after the excision of the sixth, seventh and eighth ribs on the right side, he was able to examine the upper surface of the diaphragm during the forced efforts of inspiration under ether, and on another, after the evacuation of the contents of an enormous abscess, involving the left lobe of the liver, he could easily introduce his hand into the abscess cavity and detect *the lateral upheaving of the diaphragm* and the rapid pulsation of the heart. In the latter case, during the straining of the patient in the act of vomiting, it was observed that the diaphragm descended and ascended with spasmodic contractions, *but only upon the sides*, there being apparently little if any change in the relations of its central tendon."

These observations would lead to the conclusion that the action of the diaphragm is like that of a flying bird, the central tendon being the motionless body, while the muscular portions would suggest the flapping wings.

Here, too, would seem to be the explanation of why, in extensively adherent pericardia, this sign may be absent. For if the pericarditis have involved that portion of the pericardium attached to the muscular diaphragm, which is constantly engaged in respiratory acts and attached to the false ribs, the tug on these ribs will be more pronounced than had it involved that portion attached to the central tendon, which is stationary and not engaged in respiratory acts. This explanation is further borne out by Broadbent's observation that the sign "is more marked when deep inspiration is made," the diaphragm being thus rendered more tense and consequently better suited to allow the heart to tug upon the ribs.

May we then say that those cases of adherent pericardium, in which Broadbent's Sign is absent, are such as have the least extent of involvement of that portion of the pericardium attached to the muscular diaphragm?

While this may appear anatomically correct it can only be conclusively proven by careful measurement of the diaphragmatic attachment of the pericardium in both healthy and adherent pericardia.

* Regional Anatomy. Vol. I, pp. 272-273, George McClellan, M. D.

Aortic Aneurysm.—Dr. Brown.

This case came to the hospital about a month ago complaining of pain in both sides of the back, especially the left, and the epigastrium. He came from healthy stock that did not indulge in alcohol to any extent, but his own personal history was different, as he had indulged largely in alcohol and had been exposed many times to venereal disease though he denied lues. He had been a hard worker. The present attack commenced nine months ago with a definite pain in the lower part of the back, at first rather slight and not enough to prevent the performance of his usual duties. Later it increased and at last became so intense that work was impossible; by this time the pain had radiated to the right side occasionally. He had no marked cough and very few other symptoms except the pain, but that was so great that sleep was difficult and it was necessary to maintain firm pressure to secure relief. He obtained this by standing up and pressing the epigastrium or the lumbar region against the edge of the table.

When he came into the hospital the physical examination showed a systolic and a diastolic murmur with marked pulsation in the left side of the chest which lifted up the sternum and was well marked in the axillary line. There was no point of expansile pulsation in this area. In examination of this area no tumor was seen, but one of the examiners described a tumor felt by ballottement, though all others were unable to feel it. Over the pulsating area both sounds of the heart were heard, but there was no diastolic shock. An examination of the arteries showed very marked sclerosis, and pulsation of the abdominal aorta was obtained with difficulty. The pain has lessened markedly since he came into the hospital.

Perhaps it will be of interest in connection with this case to say something of the etiology of the trouble. When we consider the etiology of aneurysm we have mainly to discuss the question of arterio-sclerosis. In this there are many factors, one of the most important being that of heredity. In this case that point applies but very slightly. Next comes the diffusion of certain poisons throughout the system, among which the most important are alcohol, and the poisons of gout, rheumatism and

syphilis. Exactly how these poisons act it is impossible to say definitely, but probably some at least act upon the adventitia of the arteries, and cause changes there which are finally compensated by hyperplasia of the intima. We simply have to take the etiology of arterio-sclerosis to work out the anatomical etiology of aneurysm. Given a man with weak arteries, and let him live a quiet life with little strain, he probably will not develop an aneurysm, but allow that man to do very hard work in which the strain upon the arterial system is very great and you have a great possibility of producing the disease.

In the question of diagnosis of aneurysm of the aorta there are various signs and symptoms according to the different portions affected. The aneurysms of the aorta may be divided into those of the ascending thoracic branch, of the arch, of the descending thoracic branch and of the abdominal aorta. In the first we have more signs than in any of the others. There is very marked pulsation, sometimes a tumor, though often few pressure symptoms, while, in the case of the transverse arch, the pressure symptoms are more marked, but the physical signs are less so. As we go into the descending portion of the thoracic aorta we may have more of the pressure symptoms, while as we proceed to the lower thoracic and upper portion of the abdominal aorta the symptoms become less because the chances of pressure are diminished. An aneurysm can be simulated by so many other conditions in the abdomen that Dr. Osler has said in his work that without the discovery of an expansile tumor, which can be grasped, a definite diagnosis cannot be made in many cases.

As regards the treatment, it is indeed multiform. Diet of a very dry character with rest in bed is given with the hope of diminishing the pulsation and increasing the formation of fibrinous elements in the blood. Various operative treatments, such as wiring of the sac and electrolysis, have been performed with the object of coagulating the fluid contents of the sac, with slight success, however, in most cases.

We attempted to clear up the diagnosis in this case by means of an X-ray photograph, but it was not much of a success. In looking up the subject of the application of X-ray photography to aneurysmal cases, however, I find that many have given it up, as better results are secured by use of the fluoroscope, carefully watching for a pulsating tumor. Whether the pulsating tumor will be shown by the fluoroscope in this case it is difficult to say, as fluoroscopic and radiographic work in the chest and abdomen are very difficult, but the signs and symptoms in this case are strongly in favor of its being a case of aneurysm, probably of the lower portion of the thoracic aorta.

Discussion of Mr. MacCallum's Paper on Pathology of Heart Muscle.—[See BULLETIN for Aug., p. 194.]

DR. FLEXNER: Mr. MacCallum's acquaintance with the embryology and histogenesis of the heart muscle made the pathology of the same muscle a peculiarly suitable subject of study. One must admire the technical method which resolves the muscle fibres into structures almost as complex as organs. Of much interest is the part played by these elementary constituents in the pathology of the fibre. In addition to the demonstration of the minuter changes in the fibres, the light shed on the nature of fragmentation of the heart muscle—whether due to irregularities in contraction or degeneration—is considerable. The necessary conclusion from these studies is that there is at least one form of fragmentation which cannot be regarded as agonal in origin—the one preceded by what Mr. MacCallun denominates sarcolytic degeneration. Whether in the light of this study we are to agree with the French writers who would make of this condition a disease *per se* is another question and one still to be answered.

The study of fibrous myocarditis must interest those who pay attention to histogenesis. The facts elicited are, to say the least, unexpected, and an explanation of the order of the degeneration does not seem apparent.

Epidemic Cerebro-Spinal Meningitis—Exhibition of Specimens.—DR. LIVINGOOD.

The present case is of interest as being one of several cases of epidemic spinal meningitis occurring in Baltimore which has come to autopsy. Some of you here present witnessed the autopsy. I do not think it necessary to go into minute details of the lesions generally met with in epidemic meningitis, as they have just been given in detail in Councilman, Mallory and Wright's monograph, which is accessible to you. I shall therefore confine my remarks to the case under consideration.

The patient was a boy aged 13 years. He was moderately well nourished; there was no external eruption; the skull-cap was of average thickness; the external (hard) meninges were injected; the vessels of the cortical pia were also injected, but there was no excess of fluid or any exudate in the cortical moderated. The exudate covered the basal portion of the brain, and existed in the form of a thick, adherent, creamy membrane, extending over pons, medulla and throughout the spinal canal. The ventricles were dilated, especially the lateral ventricles, and in the most dependent parts contained a turbid fluid. The walls of the ventricles were softened and somewhat macerated. The only other organs of interest besides the brain are the lungs. The right lung was free from adhesions; no pleurisy. The lower lobe was deeply congested, and contained four or five small areas of consolidation each the size of a marble. On section these were coarsely granular and variegated, pale or red, in color. The upper lobe contained about its mid-portion and near the pleura a consolidated focus the size of an orange. The pleura was congested over it and covered with a fibrinous membrane. The contained bronchi were dilated and contained purulent contents. On section it also was coarsely granular and variegated in appearance.

The bacteriological examination consisted in the study of cover-slips from the exudate in brain and cord and the consolidated foci in the lungs, and the examination of cultures from these several sources. The films made from the meningeal exudate showed only doubtful organisms; those made from the lungs showed many bacteria, chiefly within cells, which were in the form of diplococci, in many ways resembling the gonococcus, except for the absence of the buscuit-like flattening. In other cells the forms resembled more the lanceolate coccus. Tested by Gram's method most of the cocci gave up the dye; only those presenting lancet shapes seemed to retain it.

The cultures were interesting. Lumbar puncture made during life gave a positive result in that films and cultures

showed diplococci agreeing with the meningococcus intracellularis of Weichselbaum and Jaeger. At the autopsy cultures from the heart's blood, lungs, (consolidation) spleen, kidney, liver, brain and spinal meninges were made. Positive results were obtained only from the lung and meningeal exudate. The plate from the exudate over the medulla contained very few colonies of the meningococcus. The organisms isolated from the lung proved to be the micrococcus lanceolatus.

The meningococcus as obtained from the exudate presented the usual characteristics as given by Weichselbaum, Jaeger and Councilman, and did not retain the dye when treated by Gram's method. The culture from the lung failed in so far as the meningococcus was concerned, which was believed to be present there from the study of films, and which was shown by Councilman to be capable of setting up pneumonic conditions. As the subject of the nature and classification of these organisms has so recently been reviewed in the BULLETIN (J. H. H. BULLETIN No. 83), I shall not take up your time in restating the present views concerning them.

NOTES ON NEW BOOKS.

The Psychology of Suggestion. By BORIS SIDIS, M. A., Ph.D., Associate in Psychology at the Pathological Institute of the New York State Hospitals. With an Introduction by Prof. WILLIAM JAMES, of Harvard University. (*D. Appleton & Co., New York*, 1898.)

Dr. Sidis, after devoting a chapter to the discussion of the meaning of the term "suggestion," all previous definitions of which he finds unsatisfactory, submits the following:

"By suggestion is meant the intrusion into the mind of an idea; met with more or less opposition by the person; accepted uncritically at last; and realized unreflectively, almost automatically."

Thus, if I ask a friend to lend me five dollars, it is a suggestion only in case he is reluctant to do so, and, nevertheless, finally gives me the money without thinking of his prospects of reimbursement. If he lends it to me willingly, or with the expectation of getting it back, or if he declines to let me have it at all, it is not a suggestion. This seems like a pretty arbitrary limitation, and it would be easy to show, by citations, that Dr. Sidis, in practice, dispenses with every one of the limitations which he imposes on the intruding idea.

It does not follow, because a writer fails in the definition of his subject that he may not have something of interest to say about it. Dr. Sidis has made many interesting observations, and presents the facts in regard to hypnotism and allied conditions, with which, naturally, the book is largely occupied, clearly and temperately. But, as might perhaps be expected from such a beginning, his inferences are not always warranted by the facts on which they are based.

The book is divided into three parts, the first treating of suggestibility, normal and abnormal, the second of the self, or personality, the third of the relations of suggestion to social phenomena.

In the first part the author undertakes to determine the laws of normal and abnormal suggestibility. The former he concludes to be as follows:

"Normal suggestibility varies as indirect suggestion, and inversely as direct suggestion."

In ordinary language, this means that if you want a normal person to do something, the surest way to do it is to conceal your wishes from him, while insinuating the idea of the action into his mind. So stated, it is evident at once that it is not a universal or even a general law. Dr. Sidis must be more unfortunate than most people in his acquaintances if their knowledge that he would like them to do so and so would not be some inducement to them to do it even uncritically and somewhat against their inclinations.

The law of abnormal suggestibility he formulates as follows:

"Abnormal suggestibility varies as direct suggestion, and inversely as indirect suggestion."

That is, in dealing with an abnormally suggestible person, the more explicit and emphatic the commands are made, the more likely they are to be executed. Dr. Sidis evidently has the hypnotic condition in mind, but it is by no means true that persons in this state are always insusceptible to indirect suggestion. As Dr. Sidis himself points out, the fallacy in the accounts given by Bernheim, Charcot and others of the various stages of the hypnotic state is due to the fact that the symptoms had been indirectly and unconsciously suggested to the patients by the operator. But hypnotism is not the only condition of abnormal suggestibility. In "negativism," or "contrariness," the patients may be led to do anything desired by telling them to do just the opposite.

The fact is, that in a normal condition, every suggestion, direct or indirect, tends to be carried out, but, on the other hand, it is apt to suggest, indirectly, conflicting ideas, which may inhibit it. In the hypnotic state, on the contrary, the conflicting considerations would seem to be largely or completely in abeyance.

In the second part, on "The Self," Dr. Sidis considers the nature of personality and the relations of what he calls the subconscious subwaking or secondary self, as manifested in such conditions as hypnotism, double consciousness and hysteria, to the primary or waking self. This is much the most interesting portion of the work. The account of the case of Rev. Thomas C. Hanna, who suffered complete loss of memory as the result of an accident, and of the means and steps by which the lost connection was recovered, is of remarkable interest, and the more detailed account which is promised will be most welcome to all readers of the book who are students of such subjects.

Perhaps the most original contribution of facts to be found in the book is the account of experiments tending to show that some degree of the abnormal acuteness of the senses which is a well-known phenomenon in many cases of hypnotism and hysteria is subconsciously present, to a certain extent in the normal condition. Thus, the author found that when words, letters or figures were shown at such a distance that they appeared as a mere confused blur, if the subjects of the experiments were required to guess what was shown them, their guesses were correct in a much larger proportion of cases than could be accounted for by chance. If his results in this direction are confirmed by subsequent investigators, they would seem to constitute a distinct advance in this department of psychology.

Although the tendency of the book is to show the subconscious presence, in normal conditions, of mental phenomena which are usually thought of as peculiar to abnormal states, Dr. Sidis does not seem fully to appreciate the fact that there is really no sharp distinction between our conscious and subconscious selves, but that they are constantly passing into and out of each other. Without attempting to criticise his discussion of the essential nature of personality, it may be said that our conception of our own personality in any given case is made up of our present sensations and feelings and our memories of the past. Only a small portion of all our experiences occupy our attention at any given moment; many can be readily called up; many more are lost beyond the possibility of recollection. We have entirely forgotten how we first learned to walk and to talk, for instance, although the knowledge then gained still abides with us. In the states of abnormal consciousness which the author has in mind, great blocks of the knowledge which is ordinarily at our command may be, for the time being, as much out of

reach as the recollection of the events of infancy. And just as we accept the account of others as to the events of times which have passed from memory, and incorporate them in our conception of our personality, so the hypnotic subject may accept the statements of the operator as to who and what he is, and govern himself accordingly.

As a physical basis for the phenomena of association and dissociation of states of consciousness, the author assumes the truth of the theory of contractility of the neuron. However convinced he may personally be of its correctness, it is hardly fair to his non-professional readers to give no hint of the fact that it is, thus far, a mere hypothesis, without, as far as at present appears, even the possibility of experimental verification, and open to very grave theoretical objections.

In the chapter on "Subconsciousness and Insanity," Dr. Sidis brings out clearly the analogy between post hypnotic suggestion and morbid impulses and imperative conception. Paranoia is much less satisfactorily treated.

In the third part of the book, treating of the psychology of crowds and mobs, and of "crazes" of various sorts, the mistake is made of confounding quite distinct phenomena. The influence exerted on susceptible persons by the presence of a multitude filled with a common emotion may very probably be, in some respects, analogous to the hypnotic condition, but there would, doubtless, have been a stampede for the Klondike if every one of those who went had supposed he had private and exclusive information of the riches to be gained there.

On the whole, the book, while containing much of interest, is valuable rather for its facts than its reasonings.

The Diseases of the Stomach. By William W. Van Valzah, A. M., M. D., and J. Douglas Nisbet, A. B., M. D. Illustrated. (*Philadelphia: W. B. Saunders*, 1898.)

The stomach is a very important viscus, notwithstanding the fact that recent surgical successes have shown that under certain special conditions it can be dispensed with in the economy. Its importance is sufficiently in evidence when valuable text-books on its ailments follow each other with the rapidity which they have within the last two or three years. The present volume, while not supplanting the valuable treatises that have preceded it, has merits of its own, and is apparently well suited for a text-book on its subject.

The authors' plan of their work is a simple one, giving first the general methods of diagnosis and the general medications, then following this successively by sections on the dynamic affections of the stomach, including under this head all the symptomatic disorders that present, so far as known, no characteristic pathological anatomy, on the anatomical diseases which are, on the other hand, thus characterized, and finally ending with a section on the "vicous circles of the stomach," on the action of gastric disorders in producing or in being produced by disease elsewhere. This classification may be open to some criticism, but, on the whole, it seems fairly well adapted to afford a general view of the morbid conditions in which the stomach plays a chief or principal part. It is not especially original in its contents, and will hardly displace the recently published and excellent work of Hemmeter as a favorite with the American physician, but, as already said, it has its merits, and is well worthy of being an addition to any medical library.

Public Health Reports. (Formerly abstract of Sanitary Reports.) Issued by the Supervising Surgeon-General of the Marine Hospital Service. Vol. XII, Nos. 1–53. (*Washington: Government Printing Office*, 1898.)

This volume contains the reports of sanitary inspectors, United States consuls, and others on health conditions in foreign parts, translations from foreign languages of papers on special epidemics, and statistics of municipal health authorities here and abroad, of commissioners of emigration, etc., etc.; altogether a vast amount of valuable information upon sanitary matters. The work is a very useful one for reference in regard to these subjects, and the series of three volumes must form a very valuable record of sanitary statistics throughout the world, while the monthly publication of the parts that compose them is a useful current record.

The Archives of the Roentgen Rays. (Formerly Archives of Skiagraphy.) The only journal in which the transactions of the Roentgen Society of London are officially reported. Edited by W. S. Hedley, M. D., and Sidney Rowland, M. A. (*London: The Rebman Publishing Co.*, 1898.)

The title of this journal sufficiently indicates its nature and scope. It is elegantly printed and illustrated, and should be well received by those who use the Roentgen rays in physical or medical research. The only thing one can say against it is, that with the widening range of utility of Roentgen's discovery in surgery and medicine, a less expensive journal issued more frequently would be still more welcome to the medical profession. An actinoscopic adjunct is becoming almost essential to a surgeon's outfit, or at least such must be available to him, and there is every reason to believe that new utilities will be found, as time passes, for this method.

BOOKS RECEIVED.

Tenth Report of the State Board of Health of the State of Maine for the Two Years Ending Dec. 31, 1897. 395 pages. 8vo. 1898. Kennebec Journal Print, Augusta.

Practical Urinalysis and Urinary Diagnosis. A manual for the use of physicians, surgeons, and students. By Charles W. Purdy, M. D , LL. D. Fourth revised edition. 8vo. 1898. 365 pages. The F. A. Davis Co., Phila.

Essentials of Materia Medica, Therapeutics and Prescription Writing. Arranged in the form of questions and answers. Prepared especially for Students of Medicine. (Saunders' Question-Compends, No. 7.) By Henry Morris, M. D. 12mo. 1898. 288 pages. W. B. Saunders, Phila.

A Primer of Psychology and Mental Disease. For use in training-schools, for attendants and nurses and in medical classes. By C. B. Burr, M. D. Second edition, thoroughly revised. 12mo. 1898. 116 pages. The F. A. Davis Co., Phila.

The Care of the Baby. A manual for mothers and nurses, containing practical directions for the management of infancy and childhood in health and in disease. By J. P. Crozer Griffith, M. D. Second edition, revised. 8vo. 1898. 404 pages. W. B. Saunders, Phila.

Transactions of the Association of American Physicians. Thirteenth Session. Held at Washington, D. C., May 3, 4 and 5, 1898. Vol. XIII. 1898. 8vo, 484 pp. Printed for the Association. Phila.

Operative Gynecology. By Howard A. Kelly, A. B., M. D. Vol. II. 1898. 4to, 557 pp. D. Appleton & Co., New York.

Lehrbuch der Allgemeinen Pathologie und der pathologischen Anatomie. Von Dr. E. Ziegler. Zwei Bände. Neunte neu bearbeitete Auflage. Zweiter Band. Specielle pathologische Anatomie. 1898. 8vo, 1024 pp. Gustav Fischer, Jena.

The Pocket Formulary for the Treatment of Disease in Children. By Ludwig Freyberger, M. D., Vienna. 16 mo. 1898. 208 pages. The Rebman Publishing Co., Limited, London.

Transactions of the Michigan State Medical Society for the Year 1898. Volume XXII. 8vo. 1898. 450 pages. Published by the Society, Grand Rapids.

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The Medical Department of the Johns Hopkins University was opened for the instruction of students October, 1893. This School of Medicine is an integral and coördinate part of the Johns Hopkins University, and it also derives great advantages from its close affiliation with the Johns Hopkins Hospital.

The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter.

Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have acquaintance with Latin and a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry, and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory coursee, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the
REGISTRAR OF THE JOHNS HOPKINS MEDICAL SCHOOL, BALTIMORE.

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BULLETIN

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CONTENTS.

MEDICINE IN THE NINETEENTH CENTURY.

By T. Clifford Allbutt, M. D., *Regius Professor of Physic, Cambridge University.*

(*Delivered before the Johns Hopkins University, Oct.* 17, 1898.)

Were we asked to describe in a phrase the tendency which distinguishes our age it might be replied that it is the study of origins. In the later thirteenth and early fourteenth centuries, for example, men's minds were fixed for the most part on the validity of dialectic, were bent rather upon securing mental surefootedness and sharp and true weapons of thought than upon the verification of premises. For instance, Albertus Magnus, with the utmost fairness, marshalled from the writings of his adversaries thirty arguments in favor of the doctrine of the oneness of the soul; so that on the death of the individual his share is merged again in the whole, and loses whatsoever personality it may seem for a time to have assumed; on the other hand for the doctrine of the persistence of individual souls after death he found thirty-six valid reasons; thus the essential multiplicity of the soul was proved. Again Raymond Martini found eighteen reasons for the eternity of the world, and eighteen against it; the doctrine hung anxiously in the balance until he discovered seven other reasons which fortified it; he scrupulously admitted indeed that the last seven were not altogether apodeictic, but "with the reinforcement of faith" they sufficed to sustain it. Thus again for these disputants Aristotle and Galen were not so much chosen as received as guides, and their scriptures accepted as bibles. Now although it is not fair to press this character as a conspicuous feature of the greatest minds of the latter half of the thirteenth century, for Thomas of Aquino, for example, regarded Aristotle as a pagan sage to be treated with no more than respect, and it is still less true of Roger Bacon, the greatest of them all; still it was the fashion of that time to look rather to agility and sureness of logical fence than to genesis and verification. To one of our own time who turns to their pages, or of John Henry Newman in our own time, the quickness and subtility of their arguments, the keenness and variety of the language which they elaborated by incessant exercise in such dialectic, make a most interesting study. Therein indeed the reader may find cause to regret that in modern times we have too often allowed these instruments of close and strong logic to fall into rust and neglect, though in our own time again we shall not thus speak of our greatest minds; to confine ourselves to our own race, argument more sure and penetrating than that of Newton, of Faraday, or of Darwin, for example, is not to be found in any century. Still the common mind of our time is set rather towards the investigation of premises—of origins; we look less to the closeness of our web of arguments, and take less heed to every logical stitch than our forerunners, who took their causes for granted and thought only how to fight for them. Yet although we may escape too cheaply in respect of logical processes on one way, we must travel at least as warily, namely, on the

method of experiment. Generally speaking, facts are now preferred to arguments, and as facts so far from being the fixed and flinty things they are supposed to be, are shifty and protean, we require from those prospectors who proclaim the discovery of facts a minute demonstration of their methods, and we do not allow any agility in verbal fence to put us off this prime demand. Show us your clews, take us over the tracks you say you have surveyed, bring us into the ambush of nature which you think you have discovered; for howsoever finely you may talk about them we shall not believe you until we in our turn have followed you on the path. This at any rate is the attitude of those who pursue the exact sciences, and it is with the sciences, whether of experiment or observation, that not we only but also our fathers of the thirteenth and fourteenth centuries were concerned.

It may be urged that surely these sciences are the labor of our times, not of earlier times when sages spent their time in sophistry! Yet such an assertion is scarcely justified. Such is the essential kinship of man in all ages that by whatsoever names he calls them, or by whatsoever methods he pursues them, his search is after the ends of science; I mean his argumentative search, for I am not at present speaking of artistic creation. When we turn to the speculations whether of the Greeks, or, after them, of Western nations, we find that they concerned themselves with the same subjects as those of the modern thinker; they argued of cosmogonies, of the elements of nature, of ethics, of law, of the virtues latent in natural objects, and so forth. The antagonism between the conceptions of creation and of development is not, as too often we think, a division of our own time only; in cruder forms, but still in full distinction, these opposing theories were familiar to philosophers of the fourth century before Christ as well as of the thirteenth century after Christ. The explanations given in such days as those differed widely from ours, but they were explanations, and were discredited only because they turned out to explain too little. Even to-day the experimental method can only be applied to the exact sciences; to the moral sciences and to medicine, for example, dialectic must still be largely applicable. In the study of medicine the experimental method has but a narrow field; observation takes a higher place in its pursuit, but dialectic has also no inconsiderable part, and we shall do wrong if we allow instruments fashioned under other conceptions of method to fall from our hands under the attraction of the richer results of the modern methods of the exact sciences. While ethics and politics must largely depend on dialectic and mechanics, let us say but little on it—though mathematics is indeed in itself a sublimated dialectic; medicine, occupying a middle position, must keep both weapons furbished. For instance, a true conception of causation is largely a matter of dialectic, and however ingenious our experiment and observation we cannot afford to be ignorant of the laws of causation and of thought, and of the language in which these abstract ideas are to be expressed. For this language, I repeat, we are indebted to our forefathers of the thirteenth and fourteenth centuries as well as to Hume and to Mill. I have hinted that we are too prone to think, indeed to vociferate, that a fact is a fact, forgetting that inference is of the essence of every proposition; inference sticks to fact as closely as shadow to substance. A statement of the plainest facts implies a cement of inference, and he who has learnt to handle ideas will thus far have a great advantage in every research. Looseness in words and lack of lucid and orderly expression of ideas in the records of modern medicine is lamented by Dr. Da Costa in his address to the Association of American Physicians and Surgeons, May 4, 1897, and in a recent leading article the London *Times* laments the same defects in English lawyers of the day and urges the need of a more formal education in this great accomplishment. Those who decry dialectic decry also what they are pleased to call "theory." That such and such a teacher is too "theoretical" is a stone thrown in many a classroom, and often no doubt it hits the mark. It is true that to pursue philosophy as a study in itself has been a source of mischief or of bewilderment in many schools, as in Germany and in Scotland. Nevertheless we are now beginning to find that long practice in theoretical, that is in abstract, thought has given both Germans and Scotchmen a strength in dealing with modern and more fertile problems which Englishmen at any rate somewhat jealously and somewhat impotently admire. In England we are apt to retort that we are saved by our adhesion to the inductive method. If such an one—and now I may pass beyond my own land—be asked what he means by induction it turns out that he means, or thinks he means, a mosaic of concrete observations. Not only does he fail to realize that even these are bound together, as I have said, by a cement of inference, but perceiving, as he unconsciously must, that such short links do not carry him far in explaining things, he takes refuge in assertions which indeed are broad enough but have taken on appearance of solidity from their established currency. Mrs. Grundy is not unknown even in the sphere of abstract propositions; use and convention may make the hollowest surmises respectable and their acceptance comfortable. It is by no means true that the ordinary man hates abstract propositions; he loves many of them, as for instance that the weather depends on the phases of the moon; that most bodily discomforts arise from disorders of the liver, and so forth. There is no proposition, however wide and abstract, which he will not swallow with avidity if it be brought from the pages of an old almanac; nay, easy as knowledge outgrows such outworn opinions he will yet strive to extract some truth from their arid sources—to prove that there is "something in them after all." What the ordinary man hates is not the abstract proposition but the making of abstract propositions. He inherits any ready-made theory gladly, but he resents being called upon to make one himself, or even to adapt his mind to such novelties; he has never been practised in this gymnastic and it jades him. He dislikes it as we dislike any unaccustomed exercise, as we love an old coat or an old pair of shoes.

I need not occupy your time, gentlemen, by pointing out that the inductive method consists of two processes at least—in observation and imagination; in imagining again and again from a short series of facts the probable course of a longer series; and then in testing the truth of all or any such notions until the right one is hit off. Such surmising requires an alert imaginative or theorizing faculty. To pursue the study of philosophy for itself alone has only a gymnastic value, and leads, as I have said, to routine and sterility; but I repeat

also that past exercise in this faculty, barren as it seemed for awhile, turns out, when carried into more fertile fields of research, to have given to such students a suppleness and sureness of argument which we may well envy. The Anglo-Saxon brain contains, as its literature has shown, the sanest and strongest imagination of any in the world; but thus far in the world's history it has been rather a pioneering brain, a fighting brain, whether with man or Nature; and immediate material results have been prized to the disadvantage of the more prophetic powers. The Anglo-Saxon has fought rather for bread to-day than for cake to-morrow; nevertheless, the future will be for those who can combine the practical spirit with a mind exercised in the arms of theoretical and dialectical precision.

What we have learned, then, is that speculation in former times has been valuable as exercise rather than as achievement; that, although the deductive side of our method of thought is better adapted to exposition, the inductive bias is for most men the safer way in research. In the words of Klebs (Allgem. Pathologie, vol. i, p. 4), we must learn not that the construction of hypotheses is bad, but that "Diese Hypothesenbildung nicht das Spielzeug einer weitschweifenden Phantasie sein soll, sondern das Werkzeug ernster wissenschaftlicher Arbeit."

Among the lessons of this kind which we have painfully learned during the last two thousand years two stand out perhaps as the chief; these are, first, the barrenness of all conceptions based upon causal entities; secondly, the constraining need of verification. First, concerning causal entities, there has been a tendency of late to bring back into physiology the notion of "vitalism" or "vital force," and to scoff at those who would apply the word "mechanical" to the processes of life. It may well be that the connotations of the word mechanical embarrass us in the use of it to signify the complex phenomena of life; on the other hand, we are on safe ground so long as we endeavor from the simpler phenomena of physics to rise continuously to conceptions of the more complex phenomena of life; at any rate, we must not desert this track so far as it goes, and within these limits there is plenty to discover. But, under whatsoever name, to import an occult principle as a cause is to return to the most sterile rhetoric of the middle ages. Unable to shake themselves wholly free from the personification of natural objects, a personification which had gradually been removed from the objects themselves to their supposed causes, the ancients assumed such a principle to govern the movements of the celestial bodies; and even to this day we are apt to speak of force as something or entity acting on matter. That physical forces acting as simple molecules can account for the complex phenomena of life no one wishes to assert; no one will assert that they can account for the phenomena of chemistry in which the molecules, though less complex than the living, are far more complex than those studied in physics. But if we are to assume a vital principle in the animal cell assimilating food, then what need is there of a study of any other forces? The fact is, we are too impatient to await the unravelling of the manifold composition of forces in a highly compound molecule, an investigation which is only possible by long and unwearied series of experiment. No one attributes the virtues of chemical molecules to "chemism"; nor the vastly more complex functions of societies to a principle of socialism. Products differ from factors as sugar differs from a mixture of carbon, hydrogen and oxygen, and as an organism differs from the unrelated activities of an aggregate of nucleated cells. The phenomena of life are wholly conditioned by the peculiar complexity of its molecule, and with the size and complexity of the molecule the synthesis of forces increases in a multiple ratio.

We may speak, then, of a molecule as a highly elaborate construction of matter, or we may regard it as a highly elaborate system of forces, and this view of life, which brings its phenomena into line with the subject-matter of other sciences, is one, at least, of the achievements of our own time which we shall do well to preserve.

Another conception which now rules our thoughts far more profoundly than ever before in the history of mankind is that of law in the course of Nature. Far indeed from a new idea—for that Nature works by fixed laws, first conceived by the sages of Ionia, had penetrated the minds of thinkers of the fifth century before Christ, and moulded the thoughts of Hippocrates. This great conception, by means of which alone a knowledge of Nature and an empire over her become possible, was afterwards obscured for many centuries; it was left, indeed, for our own day to grasp the idea in its full meaning. The Ionians were not free from a tendency to personify these laws, and even to-day we may hear the Laws of Nature spoken of as agencies by which Nature is compelled, rather than as our formulas for invariable sequences. Yet it is no exaggeration to say that, even in its ontological form, a true conception of natural law was a greater achievement of the mind and more important in the advance of knowledge than the doctrine of the conservation of energy or the conception of evolution—ideas which we are wont to regard, and rightly to regard, as consummate achievements of modern philosophic theory. Again, the perception that activity of thought can only be true and just in the best sense when it is in vital and incessant connection with the activities of the phenomena on which it is engaged, is an invaluable quality of modern thought.

An accomplished Oxford tutor, lately taken from us, said of another department of knowledge: "One always comes back to the feeling that the truth in the ultimate problems is not got by thinking (in the ordinary sense), but by living." What Nettleship experienced in the study of ultimate problems is no less true of proximate problems.

It was for lack of this touch of nature that the older universities of Europe fell out of line with life. Whether for the analysis or for the harmony of knowledge, we cannot keep before us the quality, depth, complexity and manifold interaction of natural processes without incessant converse with them in their flow. We cannot retain a conception, nay, not even an apprehension, of the infinite vastness and variety of the work of the eternal loom by taking thought alone, by discussing them as if we were gods. Our minds can only be edified with Nature's bricks; beside her work the worlds we build out of our own heads are but doll's houses. Philosophy,

as a mere literature, ends, as I have said, in conjectural systematizing, in speculation upon speculation, in a visionary gymnastic. Oxford scorned the "base and mechanical pursuits" of Boyle, and the wiseacres who so spoke of that great man are dead and forgotten. Medicine in Germany was almost grotesque until the day of Rokitansky and Müller. Moreover, ideas thus engendered are not only hollow and arid, but they have all the rigidity and inertia of inanimate things; they become as shells which happily may be sloughed off but never have part in new development, and meanwhile are strangling the very germs of it. Ardent enquirers in touch with nature are thwarted or extinguished, and Nature, indifferent as ever to man's self-sufficient conceits, goes her own way like a wild dam eating up her own offspring. Not only are notions engendered without the seed of Nature contrary to the truth; they are also antagonistic to the discovery of the truth. As Dr. Daremberg says, "Les idées sont plus entétées que les faits." Is it not one of the marks of our own age that man is not only now freed from the bondage of authority, not only is he now free of the kingdom of pure thought, but he is also brought into touch with Nature; now Nature is to be his inspiration, not his destruction.

Even in my young days the first chapter of Genesis was generally held in its literal meaning as a string of affirmative propositions; and for many previous generations the advance of true conceptions of biology had been continually thwarted thereby. In medicine as well as in natural history we are dependent on true biological conceptions, for without them we are apt to lie content with empiricism.

Again, with evolution has arisen a living conception of progress; mankind, no longer dreaming about a golden age in the past, is set with its face to the future; the golden age is in the future, not in the past, and the happiness of the human race is to be won by reading the secrets of natural law, and by strenuous effort. Yet this dream of a lapsed golden age, like all such myths, held some truth in it; a truth which, in the revolution of the standpoint from past to present and future, fell into neglect. The study of the past is now returning in a new spirit, in that *study of origins* which, as I have said, is a feature of our generation; and the neglected lesson that we cannot afford to forget the travail of any age is seen in a new light. Tradition is recognized as the mould into which our activities have run as an embodiment of human experience; and we are learning the humble lesson that modern man is perhaps no greater in faculty than his forefathers; that if we have entered into new and more fertile fields it is by means of our inheritance rather than by means of greater faculties. If the average modern man be as highly endowed as the greater ancients some few of them, such as Archimedes or Aristotle for example, were perhaps richer in mental gifts than the greatest of modern men. If this be so it will appear that *tradition* is a larger part of progress than we are disposed to admit. If the transmission of acquired faculties by inheritance be not altogether disproved, it is proved at any rate that such inheritance is a much smaller factor in progress than we had assumed. It seems certain indeed that its sphere is at best a very small one; and that we stand at the apex of the pyramid not by virtue of better building but because we were born with the pyramid below us. To contemn or to subvert the ideas of our fathers is then to cut the ground from below our own feet; to destroy that accumulation of the results of former labors which in commerce we call capital, and which in things of the mind we call tradition. There is no evidence that we are greater even by virtue of a more highly organized brain; there is no evidence that we are a new and more gifted variety of man; we are greater because we are born richer in circumstance, richer in the gifts and endowments whether handed down to us in material shapes or as learning from past ages. If in certain ages of the world tradition has held too large a place in the admiration of men, and has laid too heavy a hand on freedom and originality of thought, we may yet appreciate the due value of tradition in our own advance, and our duty to our descendants in preserving for them all that seems good in our own time, while our minds play freely nevertheless, and are not smothered by its weight. For as Plato says in the Ion: "There is a stone which Euripides calls a magnet, but which is commonly known as the stone of Heraclea. This stone not only attracts iron rings, but also imparts to them a similar power of attracting other rings; and sometimes you may see a number of pieces of iron and rings suspended from one another so as to form a long chain, and all of them derive their power of suspension from the original stone. In like manner the Muse first of all inspires men herself; and from these inspired persons a chain of other persons is suspended, who take the inspiration." May we not accept this beautiful figure which Plato imagines of poetry to signify all tradition by which man is enriched and advanced. "Through all these," he says, "the God sways the souls of men in any direction which he pleases, and makes one man hang down from another." It is in our great seats of learning, such as this in which I am now speaking, that men forge and hand down to their children the cosmos of inherited experience in which we dwell and about which we breathe an atmosphere which forms and inspires without our being conscious of its presence. If we may counsel that our minds shall come to Nature "disencumbered, clear and plastic," this counsel has regard to the accidents of mental occupation, not to the edification which began in the cradle and ends only as the faculties of assimilation in each of us are outworn. You will thus be prepared to know that our great ancestors among the ancients, however vast their mental endowments, could not have built up true doctrines. The empirical method is the necessary porch of entrance into science; and there can be no true generalizations till facts have accumulated in quantity sufficient for the foundation of them.

To Hippocrates little was possible beyond superficial clinical observation; anatomy and pathology were slowly to be built up by harassed and painful men in many a broken century to come. But Hippocrates, thus confined to clinical observation, could describe such general movements as fever calculate, and the phases of disease in time—as acute and chronic, as subject to crises, and so on; and again, on this chemical basis he formed the great conception of diathetic diseases, so that thenceforth many diseases were no longer regarded as isolated events, but as terms in series. While we admire the breadth of these conceptions we admire also the genius which all attain to them when

no other kind of enquiry was then open; for it was not until the time of the school of Alexandria that anatomy and pathology could be said even to begin. Nosological detail, as we daily study it, was out of his reach. The method of experiment was not even formulated, though Littré has reminded us that Hippocrates made the profound observation that no study of the brain could have led us to foresee that wine would produce so peculiar a disturbance of its functions. It was left to Galen to bring empiricism, clinical observation, normal and morbid anatomy, and even experimental methods together in one coordinate study, soon however to be eclipsed in the darkness of the middle ages. Even to this day physicians have not assimilated the lesson that disease is not an entity but a particular state of the body and has no more of a separate or objective existence than, let us say, the constellations of the Great Bear or Charles's Wain.

I need not at this day remind you that progress in any one science depends on what may be called the accident of progress in ancillary sciences and arts. I have always thought it a remarkable instance in this sense that the stupendous advance of modern surgery waited upon two main conditions, namely, on the discovery of anæsthetics and on those researches of Pasteur which laid the foundation of modern bacteriology. When I was a boy surgeons operating upon the quick were pitted one against the other like runners on time. He was the best surgeon, both for patient and onlooker, who broke the three-minutes record in an amputation or a lithotomy. What place could there be in record-breaking operations for the fiddle-faddle of antiseptic precautions? The obvious boon of immunity from pain, precious as it was, when we look beyond the individual, was less than the boon of time. With anæsthetics ended slapdash surgery; anæsthesia gave time for the theories of Pasteur and Lister to be adopted to practice. It is within the memories of some of us how the great performing surgeons scoffed at Lister's first essays—happily this great man has lived himself to see his own splendid vindication. How the improvement of the microscope lifted physiology and pathology into new realms of discovery is a familiar story, but one perhaps not fully comprehended by those who have not learned how the want of this instrument arrested the work of Harvey in his labors on the problem of generation, as well as on the circulation of the blood; or, on the other hand, how its use by forwarding the work of Bichat founded modern physiology afresh; how by the microscopic discovery of the human egg the mystery of generation was unveiled by v. Baer in 1827; how by forwarding the work of Schleiden and Schwann the realm of the cellular pathology was opened out, afterwards to be cultivated so successfully by Virchow.

Illuminated by such cross-lights new fields of clinical medicine, which on the old method of Hippocratic observation Sydenham had carried perhaps to its extreme limits, stood revealed by the labors of the great French school of Laennec and Magendie, of Louis, Andral, Cruveilhier, Trousseau and Charcot. Laennec gives me the impression of being one of the greatest physicians in history; one who deserves to stand by the side of Hippocrates and Galen, Harvey and Sydenham. But without the advances of pathology Laennec's work could not have been done; it was a revelation of the morbid anatomy of the internal organs during the life of the patient.

It were too long a task for us now to turn to other fields to note how the discoveries of the great chemists of the last two generations threw light upon pathogeny; how those of the biologists gave a new meaning to the study of human morphology. You know already how natural knowledge advancing from many quarters was extended, and especially in the realm of medicine which we are now contemplating. Each great branch of natural knowledge has its own *Hinterland* which it surveys for the common good. Nor shall we forget that a like activity in other departments of human intellectual enterprise has enlarged the conceptions of physicians even where the facts stood aloof from their ordinary conversation. As Locke and Hume told for medicine in the eighteenth century, if indirectly yet none the less enormously, so in our own century Lyell, Darwin, Spencer and others, by profoundly modifying the whole attitude of our minds towards Nature, have given to physicians a new standpoint from which to survey their particular world.

It would now seem that even in medicine the experimental method, which seemed forbidden to her, is making its way after all. If pathology never can become a science of direct experiment in the sense that physiology is so, it makes use of it as a second line of advance. If we cannot produce a pneumonia we can study the results of cutting a nerve. In physiology the number of variables is embarrassing, yet in medicine it is far greater. No two cases of a disease are alike—temperament, race, season, circumstances, all variables, conspire to modify cases and inferences. It will always, indeed, be impossible in any branch of the biological sciences to isolate conditions and to repeat them as in chemistry and physics. Yet, as I have said, an approximation to such means is manifested in the bacteriological laboratory where pure cultures are separated, their toxines tested in proportion to body weight, antitoxins calculated, and immunities predicted.

It would seem to be, in the study of immunities, that the physician will first attain the reward of scientific research in prediction. A science which cannot predict quantitatively is in an inchoate stage. Multiplication of corpuscles, like the increase of cell growths in a hypertrophied heart or kidney, is but a case of compensation—a measure of resistance to disturbance.

Whether we regard it from the static or the dynamic point of view, the conception of the vis medicatrix naturæ gains newer force every day. Our blood and other corpuscles are microbes, their serums are factors in natural processes, and are regarded as healthy or unhealthy as they happen to be convenient or inconvenient at the moment of observation. Glands, such as the liver and kidney, are aggregations of microbes specialized for particular functions, and generate juices which are factors of nutrition, and not only of negative, but, as we have learned so well in respect of the thyroid, of positive influence in the balance of its manifold processes.

From experiment and observation we find that this reserve energy of the body in its various parts is enormous. How large is the view of the province of therapeutics thus presented to us we may see in the rapid advance of what I may call physiological remedies. As hygiene is to the state of health, so is physiological medicine to that of disease. By

physiological medicine I mean the use of the ordinary functions of the body in counteraction of contingent or inherent perils.

It is a common but I think a shallow reproach to modern medicine, that, with all the advance of our knowledge of pathology, therapeutics stands where it did in the time of our fathers, or has even fallen back, in so far as a certain sceptical distrust of empirical remedies has discouraged the continued use of remedies which the wisdom of our fathers had discovered by practice and observation. It is said that we will not use the most respectable of traditional remedies unless we have some notion of its mode of operation. It is possible that the invaluable work which a scientific scepticism has done for us, not in therapeutics only, has been attended by some destructive effects which are to be regretted. I think, however, it would be difficult to bring forward many instances of the kind in our own case; while, on the other hand, the pruning and clarifying which our practice has undergone far outweigh any such temporary disablements. The truth is that the cry itself is a shallow one. I will not stay to assert that modern surgery, the brilliant progress of which is in all our mouths, is progress in therapeutics, the division between surgery and medicine being a division of convenience, a division to which a mere practical and temporary usefulness only is to be attributed. Are we to forget, for instance, how the prognosis of peritonitis, of obstruction of the bowels, of pleuritic effusions, of encephalic tumors, of perityphlitis, of pelvic diseases, of ovarian ascites, and so forth—a prognosis in troops of cases turned from sadness to hope—is not to be called progress in therapeutics because not infrequently the method is carried out by the skill of another hand? It might as well be asserted that the modern scheme of feeding in fevers, because it is carried out by trained nurses, is no therapeutical progress. Nor will I admit, even in the sphere of drug therapeutics, that our progress is contemptible.

When we regard the additions made to our hypnotics, the discovery of the value of the nitrites, of the bromides, of arsenic in pernicious anemia, of the salicylates, of the antipyretic, hypnotic and antalgesic group, of the antiseptic treatment of diseases of the skin, of the antitoxic treatment of diphtheria, of the thyroid treatment of myxœdema; when, again, we realize the greater precision of our use of the older empirical remedies, as of digitalis, in the preciser administration of remedies in syphilis, in the injection of alcohol and ether, of apomorphine, of ergotine of strychnine, of hyoscine, of cyanide of mercury; when, once again, we think how much more accurately we discriminate our means in the treatment of phthisis, of dyspepsia, of fevers, of palsies, central or peripheral, we may confidently take encouragement and meet those adversaries in the gate who say that therapeutics has made no considerable progress. At the same time, we may well take to heart the lesson which such criticism may teach us. While we have learned that empirical knowledge, although a power against ignorance, is of less avail against the more ordered and living knowledge of a maturer science, on the other hand, for this very reason, we are now, perhaps, apt to despise unduly the traditional remedies which rest their claims to usefulness more on empirical than on reasonable grounds. For in the use and practice of all methods we must remember that medicine is an art, that it is something more than an applied science.

Our art has always been, and probably long must be, in advance of scientific direction and explanation. Moreover, as in all arts, more than knowledge is needed, namely, common sense, rapid and firm decision, and resourcefulness—faculties by no means resting upon intellectual conceptions, but on a certain virility of character not to be got from books. It is no uncommon experience to see physicians of high intellectual subtlety, of great learning and of a pretty wit, lose themselves in the practice and even in the exposition of their profession, because in them the critical faculty exceeds the practical. Indiscriminate doubt, however valuable an attitude of mind in the laboratory, is mischievous in the field of action, where a keen determination to make the best of imperfect instruments, to use any accredited means rather than none should be the dominating impulses—impulses which enlist also on the side of the physician the hope and animal spirits of the patient; for, after all, the practice of medicine contains no small element of "suggestion." Furthermore, the fastidious spirit, which I have endeavored to indicate, is, on the whole, opposed to progress, as, even in thought, it lends itself too readily to irresolution, and irresolution is the quick way to indolence. On the other hand, I need not warn you that practice without continual scientific re-edification soon degenerates into stereotyped and sterile routine.

Once more, when we are twitted with the discovery of manifold new diseases, without the discovery of any means of dealing with them, we may reply that not only are we discovering the course and ends of these destructions, not only are we discriminating between this series of symptoms of dissolution and that, but we are engaged, as I will remind you again, in the study of origins. We are no longer satisfied to contemplate the wreckage of disease, but we are earnestly hunting out the processes in which such and such deviations from health took their being.

The study of origins, then, is not only the new method of modern criticism, of modern history, of modern anthropology, of our reading of the evolution of the universe itself from elements which even themselves are falling under the same analytic inquiry, but the study of origins is leading to a revolution in our conception of therapeutics, as of all these other studies; a revolution which as yet we have not fully understood. This revolutionary conception is that death is not to be driven away by the apothecary, not by any cunning compilation of drugs, but is to be prevented by the subtler strategy which consists in knowing all the moves of the game. Few and simple are the diseases which can be expelled by leechcraft, as we expel a worm. The medicine of the future will consist in setting our wits to nature, in recognizing that when evils have befallen us there is no counsel, and that in the simple beginnings of things are the time and place to detect where stealthy nature, atom by atom, builds and unbuilds, feeds us or poisons us. To disentangle the clue we shall not pull at it anyhow; we shall anxiously seek the beginning of it, thence to unravel its windings.

There is an old saw that Nature takes as much trouble to

make a beggar as a king. She does not make diseases to sit so loosely that they can be expelled by violence or bound by a charm Much of curative medicine, in the vulgar sense, will thus be swallowed up in preventive medicine. We shall not wait till we are half dead before we take in hand our disorders; abnormal processes, not their results only, will be our fruitful study.

Another feature of modern therapeutics is the use of Nature against herself. We learn, as I have said, to play the game; we are not content to sleep at our posts till we must fight desperately, against a checkmate, but we keep in touch with the enemy all through, and use the same means. Thus, by the side of preventive medicine, we learn that hygiene, in its largest sense, is also to be our guide. Instead of trusting to prescriptions for alleged specifics, which have no little kinship with magic and antidotes, we ally ourselves with Nature's own forces. For example, if we cannot prevent infantile palsy, which soon, perhaps, we may do, we shall attempt its cure, not by idle drugs, but by strengthening the physiological factors of life; by the use of massage, electricity, warmth, and so forth. As we further discover the physiological factors of life, we learn to supplement the failing juices of a gland from other sources in the economy; by learning the distribution of heat in the body, we find that fever can be controlled by conductions of heat by cold baths and otherwise; by a better knowledge of the mechanics of the circulation, we arm ourselves with means for regulating its currents by baths and gymnastics and the like. Even in the sphere of drugs themselves we are, year by year, deposing this drug and that from the place of specifics, as in the case of quinine, and putting them in the ranks of preventive agents, and, with respect to others, we are carrying our study of origins into their qualities, as well as into the healthy or morbid processes over which they have power. The relation of atomic weight to physiological effect, the experiments by which, on slight substitution of one molecule for another, we convert compounds from one kind into another and widely diverse kind, from convulsants, for example, into narcotic or paralyzing agents, we throw light not only on their own properties but also on the secret processes of the animal body itself. I will not stay to illustrate in the same way the parallels between the members of different series, nor the advances, of late the least active, by the way, of physiological chemistry, and of chemotaxis, and of the study of the behavior of serums and the like within the more comprehensible range of the test tube. Such considerations impress us again and again with the importance of the union of practical and laboratory or theoretical work in the same person and in the same schools. No scientific observer who has not made medicine more or less a practical study can be as well equipped as otherwise he would be to investigate such subjects as these.

The modern hospital must be the modern laboratory of medicine. As in the sixteenth century the great laboratories of anatomy sprang into existence, in the seventeenth the laboratories of physics, in the nineteenth the chemical (Liebig), the physiological (Ludwig), the chemico-physiological (Hoppe-Seyler), the pathological (Virchow), the hygienic (Pettenkofer), so the clinical laboratories initiated but the other day in Germany by v. Ziemssen, Curschmann, and in the United States by Pepper, are the factories out of which the new medicine is to come—the medicine which, penetrating into the intimate processes of Nature, learns to turn Nature to her own correction. The clinical laboratory is to be the scene of the study of the origins of disease.

What are the aids and dangers of "specialism" in these advances? Against this tendency in modern studies and practice an outcry has been raised which, if a little unintelligent in its way of expression, has not been without justification. In advancing civilization the applications of thought, as well as those of labor, must be divided and subdivided. The activities of the mind are at least as multiform as those of the traveler in the world, and it is impossible for all explorers to follow each other over all ways. As pioneers increase in number and in adventure the more are they divided from each other, the more difficult is it for each to make himself master, even by report, of the work of all. This general law is as true for medical inquiry and for medical practice as for electricians or naval engineers. Not only so, but we may say that, in the sciences, men are not traveling over one world only, but over many. If within each world of mathematics, physics, chemistry, and so forth, explorers separate and travel out of sight of each other, what shall be said of the remoteness of explorers in these several worlds? Yet these several worlds of the sciences are not as Mars to us, but as the various kingdoms of the earth. What goes on in each is of the utmost importance to all, and as civilization advances becomes not of less importance, but of more and more. Herein lies the justification of what I have called the outcry against specialism. The protestants have perceived this inter-relation of all knowledge, and they have foreseen both the narrowness of spirit and the lameness of practice which must come of such a disintegration of parts of such an isolation of efforts. Nay, they may not improperly conceive that a less amount of knowledge, duly systematized, may be of more value in affairs and in philosophy than more knowledge in scattered parcels. If the outcry has been somewhat unintelligent, this has been not in the perception of the kind of injury to learning. This is to be credited to them as a virtue. But in the want of perception that some division of labor is inevitable, the protestants have seemed to care less for the advance than for the system of learning, and, indeed, to have set practice in some antagonism to learning.

We shall henceforth perceive, I trust, that this new movement comes from the deeps; that it is not by withstanding the very conditions of modern progress that we shall secure its balance, its concert and its sanity. Happily, evolution will be found still to consist not in differentiation only, but also in integration. As labor is divided, an organization of knowledge must proceed step by step with the division. Specialism will have its disadvantages, as all exclusive aspects of things have them. In practice, specialism will have its charlatanry, as omniscience has had it. It is only by the increase of discernment and education in society at large that the genuine and humble children of Nature will be known, and it is by progress in its best sense that such discernment and education are to be extended. I do not hesitate to say that even within

my own lifetime these qualities in the relation of society towards our profession have not only increased, but have waxed abundantly, and thus is a medium formed in which the remoteness and alienation of specialized workers finds a corrective. The worker in all subjects, even in the larger operations of ordinary trade, learns that he, too, must think of the whole as well as of parts and details. Even money cannot everywhere be broken up into small change; commerce can no longer be a piecemeal affair. In the tradesman, indeed, is engendered a mind in favor of breadth of view, and even in the man in the street is begotten a hazy notion that there cannot be, as in ancient Egypt, a physician for every part of the body. There is no mean in Nature but Nature makes that mean; if these qualities of intellectual concert, of scientific formation of mind, of breadth and sagacity are needed, they will be found, and the way to them will be found also. Indeed, such conceptions of education are gaining apace on the general mind, though their full bearing is not yet understood. It is this very breadth of mind which is aimed at by educational reformers, by those who prize education before mere acquisition, who assert that, with the greater complexity and definiteness of knowledge, associations of workers and certain harmonies in their results must be brought about.

Those, then, who resent the specialization of science, as of other fields of human work, although they are wrong in their way of opposition, have hold, nevertheless, of an important truth, and they agree with the Thracian King Zamolxis, who was also a god. Zamolxis observed that "as you ought not to attempt to cure the body without the head, or the head without the body, so neither ought you to attempt to cure the body without the soul, and this," he said, "is the reason why the cure of many diseases is unknown to the physicians of Hellas, because they are ignorant of the whole, which ought to be studied also, for the part can never be well unless the whole be well." (Charmides.) Although then we cannot hope that every physician shall be a man of science, we may secure that he shall have the scientific habit of mind, for thus, as we have seen, he will be habituated to lay out his knowledge systematically, to trace phenomena to their sources, and to see his own facts in their due relation to other facts. This is the philosophic temper which cannot be learned from books and rarely without tradition and converse with gifted men.

Some disciples are more apt to receive this grace than others; some men, many learned specialists, are incapable of wise scientific judgment; no examination can test it; no memory can secure it; it is in part a product of time, which accepts what is good and rejects that which is transitory. It is to be assimilated from organs of knowledge, such as universities, and not from mere polytechnic institutions. It is the highest reward of the teaching from a living source, for, as Professor Butcher says, "the test of life is to impart life."

Too many students pass through their schools without an awakening of their minds. They believe their superficial knowledge to be exhaustive, and they become the mouthpieces of ready-made opinions.

I should be an ill bird were I to say anything to-day in depreciation of the value of lectures, of my own wares. In bygone times I have said much in depreciation of them, urging that they are survivals of a time when books were scarce and dear, and when knowledge was looked upon as spoonmeat. I have helped forward the cry that the laboratory must be the future living source of knowledge and of inspiration. While men were blind to this new truth it was necessary to urge it to the hindrance of other needs which men were not likely to forget. Now that the battle is won, and the laboratory is everywhere with us, we may turn again to consider what there is in older methods which we would not willingly lose. In lectures we may still find the virtues which flow from living converse with thoughtful men who have been over the field of our studies before us, who can show us how their minds worked, how they systematized their knowledge, how they came to see it in the light of other researches, how they inspired it with human interest. For such ends as this we must have no mere retail dealer in knowledge for our lecturer. In all universities it is now recognized that, except for tutorial work, the lecturer to beginners must be the leader in his faculty. He it is who can give the true first set to the thoughts of young men who are entering into the subject of their lives; older men and advanced work may well be undertaken by demonstrators.

Thus far I have considered specialism and breadth in respect of the education in our profession, but a larger problem lies before us, namely, that wider culture which lies beyond the confines of all professions. One of the difficult conditions of our own generation is the urgent pressure on young men and boys by reformers and anxious parents who desire, not unreasonably, to mold their sons into money-making machines at as early a date as possible. When I took my degree at Cambridge our course was, in the first place, to take an arts' degree, at that time only to be had in the arts. Thereafter came the natural-science studies, with their tripos, and after that again the clinical studies proper to our professional life. This course occupied us up to the age of twenty-five, at least, and in some respects it was a far better education than we now bestow. Now, from the first hour of the medical student's arrival in Cambridge he is too often turned at once into the narrower channel of his special calling, and he even tries to pick up a precarious instruction in clinical work while he is ostensibly at work on the preliminary sciences. Nay, such is the pressure of the times, parents and teachers are getting impatient even with this rate of speed, and are insisting that even at school time is wasted in classical and other broader studies which might be utilized for science, and that men should come up to the university ready to "specialize" farther still. Among other strong arguments in favor of this reform is this: That whoso means to practice surgery should acquire manual dexterity, and that this advantage cannot be acquired by the ordinary man unless he begin to educate his plastic fingers in early youth. This argument I will dismiss in a word by saying that, in my opinion, every man should be educated in a handicraft or mechanical art of some kind during his early youth. The importance of this element of education is curiously forgotten even by such a mechanical race as the English and American. So much for surgery; the boy who has learned to use a lathe or to make a chest of drawers will have fingers apt enough for surgery.

There is, moreover, another means of education most useful in early life, namely, that of measurement. At every national school youths of both sexes should learn to measure accurately to thousandths of an inch and to hundredths of a grain; thus the eye is taught with the hand, and, what is of more importance, the mind is trained to know what accuracy means. These occupations, invaluable in training of character and skill as they are, would add nothing to the burden on a growing brain.

Of the sciences, those of memory and observation only should have a place. The mind of youth is in a stage when the imagination, rather than abstract thought, should be cultivated. To collect natural objects, and thus to be drawn into the haunts of animals, into the habitations of plants, and to see the structure of the earth, excites and enlarges the imagination and strengthens the memory at a time when these faculties are ripe for culture. I have never happened to meet a young man, educated in abstract science at school, who seemed to me to have used his time to the best advantage. If, for the present, it has led to success in the narrowest sense, I think we are entering even now into a generation when success must be based on a larger education than this—on an education in letters and in the humanities, as well as in the laws of the material universe. Rousseau well said we should not teach children the sciences, but give them the taste for science.

We are apt to forget that even in these days of science, advancing by leaps and bounds, that still the greater part of man's life is spent in the expression of his thoughts and in converse with mankind. He should, therefore, have learned to handle the ideas which concern himself and his fellows, not only in their *material* conflict with Nature, but also in those higher spheres of history, ethics, politics and social aspiration for which alone man can be said properly to live. If we regard the mastery of modern man over Nature in any other light than as clearing for us a larger base for a reconstruction of societies which shall be more wise, more humane, more beautiful in spirit than in the past, there would be nothing but sadness in the contemplation of modern life, with its "gay afflictions, golden toil." No doubt we must rebuild our material home, but we ourselves also must be born again. (Newman).

The uses of learning Latin and Greek lie in this—that in these studies, more than in any others, the ideas which concern man in his highest endowments of mental, spiritual and social life are manifest, and not only so, but are manifested in languages the most virile and beautiful the world has known. Latin and Greek are called dead languages. If so, the Hermes of Praxiteles and the Venus of Milo are corpses. Latin and Greek contain in perfection of form not modern science, but that for which modern science exists—the best that man has lived and thought. It would be a narrow pedagogy which should assert that strong and penetrating thought, and noble and chastened imagination are to be found only in Latin and Greek; we may be thankful, indeed, that the English language is or has been as noble an instrument, and enshrines at least as fine a literature. Yet it has been said long before our time that to know one literature only is to wander in the sphere of letters without a scale of relative dimensions—to lose the faculty of comparison for lack of standards of comparison. To learn to speak a language like a parrot is but to train a mechanical memory. Latin and Greek, however, although they contain the finest records of human thought and action, are, as I have said, not the only shrines of letters, and the noble literatures of France, Germany or Italy may take the place of either of them, and carry the additional advantage of common usefulness.

But do not let us forget that our calling derives its honor not from its power of repairing the carnal body; were this its only title to respect it would take a low place in the hierarchy of professions. Those professions which deal with the ends which alone make life worth preserving—such as that of the law of religion, philosophy and of the fine arts—would in such case regard our occupation but as a higher kind of farriery. The glory of our profession, from the hour when Hippocrates, in that oath wherewith like a trumpet, the notes of which reverberate still through the ages, summoned us to take our place in the forefront of the fight, has been that we are concerned not only for mankind, but for men. The ideal side of a physician's life is that he brings healing or solace to his human fellow. The Greek philosopher, like the modern socialist, would sacrifice man to the State; the priest would sacrifice man to the Church; the scientific evolutionist would sacrifice man to the race. Yet, while all these elements of co-operation and of aspiration work together for good, we thankfully see that, after all, the tendency of civil evolution, as of Christian ethics, is to use society as a means for man himself, as a means to purify and to elevate the individual soul. The physician, then, is more than a naturalist; he is the minister not only of humanity at large but of man himself. Thus it is that the humblest of us, and he who labors in the darkest and most thankless parts of our cities, is never a drudge; in the sight of the angels he is illustrious by the light of his service to men and women. The man of science can tell us delightful things about birds, flowers and wild life, for all life is various and touching; he can tell us queer and uncomfortable things about our insides, amazingly useful things about steam and electricity, but at bottom, when the marvel is over or the material gain is won, all this grows stale. Ideas concerning the harmony of the spheres, concerning cosmic evolution, concerning the inhabitants of Mars, are prodigious; they may uplift us sometimes with a sense of the greatness of man's inheritance, but alone they are cold and unsatisfying. The child of his age feels that a sonnet of Wordsworth, a flash of Browning's lamp into man's heart, an idyll of Tennyson give us thoughts worth more than all the billions of whirling stones in the universe. In strengthening and cherishing this inner life of his brother and sister, happily, the physician has many fellows, but the physician alone among them all holds sacred the lamp of the personal life for its own individual sake; he alone forgets Church, State, nay, even the human race itself, in his tender care for the suffering man and for the suffering woman who come to him for help.

ON REFRACTORY SUBCUTANEOUS ABSCESSES CAUSED BY A FUNGUS POSSIBLY RELATED TO THE SPOROTRICHA.

By B. R. Schenck, M. D.

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On November 30, 1896, A. W. presented himself at the surgical clinic of the Johns Hopkins Hospital with an infection of the right hand and arm of an unusual nature. The primary point of infection was on the index finger, whence it extended up the radial side of the arm, following the lymph channels, and giving rise to several circumscribed indurations, which were in part broken down and ulcerated.

One of these indurated areas was incised, and deep in the tissues a thimble full of gelatinous, puriform material was found. A culture from this fluid was made on gelatin. At the end of four days there was a growth of the staphylococcus epidermidis albus, besides which several other distinct, white colonies, raised from the surface of the medium appeared. Cultures made on agar from the latter colonies showed after three days in the thermostat, an abundant growth of an organism, not resembling the bacteria and evidently present in pure culture.

On December 7, under aseptic precautions, an indurated area just above the elbow was incised, and a small piece of tissue removed for microscopical examination. Two cultures were taken on slant agar from the puriform contents of this nodule. In three days both tubes showed a growth in pure culture of the peculiar organism previously obtained.

On December 14, Dr. Finney made the following note: "Ulcerated area, size of finger nail, over dorsal surface of second joint of index finger—right hand. Edges much undermined. Sero-purulent, gelatinous discharge on surface. A second, similar ulceration between second and third metacarpal-phalangeal joints. An indurated line, 1 to 1.5 cm. in diameter, follows along dorsum of hand and forearm, with here and there ulceration.

On the arm there are two indurated points, which have been excised, the highest one being in the middle of the arm. At the junction of the upper and middle thirds of the forearm there is an indurated spot, the size of a bean, situated to the outer side of the main line.

Epitrochlear gland not involved. Axillary glands palpable, but not especially enlarged."

Dr. Finney then removed with aseptic precautions a second, larger piece of tissue for microscopical examination.

The patient gave the following history: Age 36. Marked family history of tuberculosis. Patient has suffered from phthisis for past twelve years.

During the latter part of August, 1896 (3 months before visit to the Johns Hopkins Hospital Dispensary), while working at the iron worker's trade in St. Louis, the patient scratched the index finger of right hand, on a nail, while reaching into a red lead keg. Shortly after this a small abscess formed which was opened with a pin. A slight amount of watery fluid escaped, which patient thinks did not look like pus. In about three weeks the ulcer between the second and third metacarpal-phalangeal joints appeared. This was treated at the St. Mary's Dispensary (St. Louis). The inflammation traveled up the arm, and in about seven weeks after the infection seven similar abscesses had formed. These were opened, and a watery discharge escaped. About this time a "waxen kernel," size of a walnut, appeared in the axilla. It was not especially tender and disappeared in two days. While in St. Louis the arm was bandaged daily with bichloride and carbolic dressings. The patient thinks that he had no fever, and says the pain was very moderate. Being unable to work he returned to his home in Baltimore late in November.

Physical examination on entrance showed evidences of advanced tuberculosis of the lungs, and the sputum contained numerous tubercle bacilli.

The infection involving the hand and arm proved very refractory to treatment, the last lesion, at point of primary infection, not granulating until late in February, 1897.

The organism which was assumed to be in etiological relationship to the above-described lesions was obtained in three cultures from two different foci of the disease: Once from one of the lesions in the forearm, admixed with the skin coccus, and twice from one of the lesions in the arm, in pure culture.

Cultural Characteristics.—Cultures were made on all our common media, including plain, glycerine and sugar agars, plain and sugar bouillon, plain and acid gelatin, milk and potato. With the exception of the milk all the cultures developed luxuriantly.

Agar.—At 37° C. the growth is first apparent at the end of 48 hours, when the tract of the needle is marked by a faint line, slightly opaque, which under a low magnifying power is seen to be made up of minute colonies, with feathery outline, resembling somewhat minute snowflakes. At the end of 72 hours, the line of inoculation is sharply marked by an opaque, white, moist growth, having well-defined edges, raised from the surface of the media. Here and there at the periphery are isolated colonies. As the age of the culture increases—about five days—the growth extends very much in thickness and but little peripherally. The surface is corrugated, the edges lobulated and sharply defined (Plate I, Fig. b).

In cultures of ten days and older the growth is very thick; the surface is rough, corrugated, and stained a dark brown color, the shade at the periphery being deeper than in the centre. The medium also becomes stained.

Colonies of three days appear to the naked eye as round, raised, moist dots, 0.5 to 1 mm. in diameter. Under the low power they appear to be made up of a feltwork of minute fibrillæ, dense in the centre, lighter at the periphery, with a feathery outline. Scattered through this meshwork are many minute dots, consisting of the conidia.

Colonies of ten days are characteristic. They are round, sharply circumscribed, and elevated from the surface of the medium. The surface of the colony is brownish, and marked

by radiating lines proceeding from centre to periphery, evidently caused by the drying and shrinking of the growth (Plate I, Fig. a).

By a comparison of the development on glucose, lactose and saccharose agars, little difference is to be made out during the first two weeks. In cultures older than 14 days, however, the growth continues longer and becomes heavier on glucose than on plain agar, and in all the sugar media there is more discoloration both of the growth and of the substratum.

Gelatin.—The growth in stab cultures develops slowly. It is much more abundant in the upper part and spreads laterally over the surface, while the development in the depth is feeble, being scarcely perceptible in the lower third. At the end of six days there is slight liquefaction of the medium. The organism grows somewhat more luxuriantly in acid gelatin, and the liquefaction is greater.

Bouillon.—Growth in bouillon is fairly abundant in three days, and appears as little, cottony tufts which settle to the bottom of the tube, leaving the supernatant fluid perfectly clear. As growth proceeds, it tends to spread up the side of the tube. The reaction of the bouillon is not altered.

Potato.—At the end of 48 hours the growth is abundant. It is elevated, the surface is moist and the edges lobulated. After several days the surface of the growth becomes rough and wrinkled, the edges discolored and the potato darkened.

Milk.—There is no change produced in the tint of litmus milk at the end of seven days, and no coagulation takes place. The organism does not seem to thrive in this medium, film preparations showing only very small numbers.

Fermentation Tests.—Stab cultures in glucose, lactose and saccharose agars show no gas bubbles. Glucose, lactose and saccharose media, made from sugar-free bouillon, prepared according to the method of Theobald Smith, placed in fermentation tubes, give an abundant growth in the aërobic bulb, the anaërobic tube remaining clear. There is no gas formation.

Relation to Oxygen.—No growth develops in culture placed in the Buchner jar.

Vitality.—Growth which has remained on potato for eleven months again develops when placed in sterile bouillon. Agar cultures retain their vitality for at least nine months. To test the resistance to low temperatures, portions of growth from bouillon were placed in sterile water and allowed to remain in cold storage, at a temperature of 28° F., for ten weeks, after which they proved to be alive. In these cases actual congelation did not take place. When frozen for this length of time, however, they lose their vitality.

The vitality of cultures is destroyed by exposure to a temperature of 60° C. for five minutes.

The optimum temperature for development is between 20° and 37° C.

Morphology and Development.—For many of the points relating to the morphology and development of the organism, I am indebted to Dr. Erwin F. Smith, of the United States Department of Agriculture, Washington, who has given much time to the working out of the more difficult and obscure points pertaining to its life history and classification. I take this opportunity of acknowledging the great value of his help and advice, and of expressing my appreciation of his kindness.

Cover-glass preparations made in the ordinary way, from agar and bouillon cultures, show two forms: (1) a thread-like, branching form, or mycelium, and (2) oval, spore-like forms, or conidia. In an unstained specimen the mycelium is seen to be made up of a doubly contoured thread, branching irregularly, but not very profusely, and never dichotomously. The protoplasm appears granular. The diameter of the threads presents considerable differences, with an average of 1.5 to 2 microns. The conidia are elliptical or ovate, many of the latter forms being distinctly apiculate. They are also doubly contoured and granular. The spores from the solid media are rounder and smaller than those developing in bouillon. They vary in length from 3 to 5 microns.

The organism stains well in all the basic dyes, and is not decolorized by the Gram method. Stained preparations show marked irregularities in the coloring, especially of the mycelium. The conidia frequently show a small unstained area near the smaller pole of the spore.

In smears made from agar or bouillon it is not possible to determine the relation which the conidia bear to the mycelium. Occasionally, however, one or two spores are seemingly attached by the smaller end to the side or end of the mycelium. This relation can be much more clearly brought out by observing their development in hanging-drop cultures, the description of which I quote from Dr. Smith's report of April 13th. The drawings are also reproduced from Dr. Smith's sketches. "When a little of the bouillon containing the colorless, elliptical or cylindrical conidia was inoculated into hanging drops of alkaline beef broth, and set away under a moist bell jar for forty-eight hours, there was an abundant growth of the fungus, the spore-bearing branches of which, being undisturbed, retained their spores in the normal condition, and the appearance of the fungus under such conditions is shown in the sketches (Figs. 1 to 3). Here from three to six or more spores were to be found, quite commonly clustered at the tips of the spore-bearing branches. Naturally, if the fungus had been disturbed by shaking or lifting out into a drop of water, most of these spores would have been readily washed away, leaving only one or two, that is, leaving such appearances as are shown on the drawings made directly from the bouillon cultures" (Figs. 4 and 5).

The life history of the organism was studied from bouillon cultures and from hanging drops. The conidia germinate by sending out one or more straight, unbranched germ tubes, sometimes from the end, again from the side. These germ tubes give off spores of the same character, the attachment being either terminal or lateral, by means of short pedicles or sterigmata (Figs. 6 and 7). Other seemingly similar spores push out into the branched mycelial forms, which in turn produce a new generation of conidia.

The existing classification of the fungi is a purely artificial one and is incomplete in many particulars. On this account it is often very difficult to determine where an organism is to be classed. Dr. Smith has kindly gone over the points in

regard to the classification of this organism, and his conclusions are as follows:

"It is a conidial fructification only, and on this account it is impossible to give more than a guess as to its position in the natural system of classification. To determine this the perfect spore form would have to be obtained. It can only be put into a form genus, in other words, into some artificial system of classification, until the natural one is known. It seems to me that it might be classified in either of these genera, according to the system given in Saccardo's *Sylloge Fungorum*, which is the commonly accepted standard of the artificial classification.

(1) It is not unlike the *Botrytis bassiana*, the muscardine, or calicino disease of silk-worms, and might therefore be regarded as a Botrytis. Against this classification, however, it is the fact that the spore-bearing branches are not erect, which is a rather trifling distinction. It might also be classed as (2) *Sporotrichum*, but inasmuch as it becomes dusky when it is old it might also be classed as (3) *Trichosporium*. Saccardo separated out the dusky forms of Sporotrichum into a separate genus under this name. The mere difference in color, as we know from cultures of many fungi, is often a very trifling matter, the early stages of a fungus often being white and the later stages dusky or even brown. On this ground I think that his distinction is of no value, and I think that we may throw out the genus Trichosporium altogether. As regards the other two, my own judgment would be that it fits best into *Sporotrichum*. In his *Sylloge Fungorum* Saccardo describes more than one hundred species of *Sporotrichum*, but most of them are described very imperfectly, and I cannot identify this fungus as belonging to any one of them."

The tissues removed for microscopical examination present the characteristics of a chronic abscess, consisting of inflammatory and cicatricial tissues. On the inside is a layer of necrotic material, next a zone of leucocytes, and outside newly-formed connective tissue, in which are several minute secondary abscesses.

Numerous sections stained by the Weigert and Gram methods failed to reveal any micro-organisms whatever. Sections stained for the tubercle bacillus by the carbol-fuchsin method were also negative.

Animal Experiments.—4 dogs, 6 guinea-pigs, 1 rabbit, 1 wild mouse and 2 white mice were employed. The results were as follows:

Dog I. The external jugular vein was opened, and 1 cc. of a suspension in salt solution of the organism was introduced. The dog remained well, and was killed on the 30th day. Nothing unusual was made out at the autopsy. All cultures were negative. The microscopical examination of the organs revealed nothing abnormal.

Dog II. Inoculated subcutaneously on the abdomen with 2 cc. of a 36-hour plain bouillon culture. On the next day there was an induration at the point of inoculation, followed in 24 hours by the formation of a tumor about 3 cm. in diameter, which on palpation gave evidences of fluctuation and tenderness. This remained practically unaltered for ten days, and then gradually became smaller and firmer to the touch. The dog remained apparently well, but was killed on the 28th day. Nothing was made out in the internal organs, and cultures from these were all negative. The tissues around the point of inoculation were excised and found to consist of firm scar tissue, in the centre of which was a small cavity containing a few drops of a gelatinous fluid. Agar tubes, inoculated with several loops scraped from the walls of the cavity, showed on one six colonies and on the other eight colonies of the organism. Bouillon cultures were also positive. However, no organisms could be demonstrated in cover-slips.

Microscopical sections through the wall of the cavity showed advanced cicatricial tissue. Numerous sections, stained according to the Gram and Weigert methods, failed to reveal the organism.

Dog III. Inoculated subcutaneously over the abdomen in a manner similar to Dog II. A second series of injections was made over the thigh in order to ascertain whether or not enlargement of the inguinal lymphatic glands would follow. Induration developed at the points inoculated, followed in two days by fluctuation and tenderness, the process increasing until the end of the first week, when the tumors became firmer and smaller. At no time were the inguinal glands palpable. Dog killed on the 21st day. The internal organs appeared normal; cultures from them remained sterile. Microscopical examination of the organs negative. At the local lesions nodules of fibrous tissue, containing small cavities similar to those in Dog II, were found. These little pockets contained a scanty amount of gelatinous material.

Smears from the cavities were negative.

Cultures from both lesions were positive, the organisms being rather few in number. They were, however, more abundant than in cultures from Dog II.

Microscopical examination of the fibrous tissue revealed the same condition as already mentioned and micro-organisms could not be demonstrated.

Dog IV. Inoculated subcutaneously in a similar manner, the induration and swelling took place as before, and on the fourth day, when the process seemed to have reached its height, the lesion was excised. The nodule was larger and less firm than the preceding ones, the cavity was greater and was completely filled by a thick, yellowish-red, gelatinous material, smears from which showed fibrin and red-blood corpuscles in small amounts, large numbers of polymorphonuclear leucocytes and a few objects similar in size and shape to the conidia characteristic of the organism introduced. None of these bodies were seen in leucocytes, all being extracellular.

Cultures from the walls of the cavity showed a very abundant characteristic growth of the organism.

Microscopical examination of the excised tissue shows the lesion to be a focus of inflammation. The walls are made up of the subcutaneous areolar tissue, forming a loose meshwork, the spaces of which are filled with coagulated albuminous material and leucocytes. The pus cells also infiltrate the connective-tissue stroma. At the edges of the cavity the connective tissue is denser and the infiltration of the leucocytes more marked. The cavity is lined by a mass of coagulated serum and necrotic pus cells. In specimens stained with hæmatoxylin and eosin, it is not possible to make out the organisms; but sections

stained by the Weigert method reveal them in large numbers, situated principally between the inner layer of cell detritus and the adjoining zone of infiltrated connective tissue which forms the wall of the cavity. For the most part they are associated in clumps of from six to thirty elements, but many occur singly and in groups of two or three. They occur mainly close to the edge of the cavity, but now and then may be situated singly or in clumps in the connective tissue stroma.

The organisms are of irregular shapes and sizes. In form they are round, oval and club-shaped, the last predominating. The smallest round forms are from one to two microns in diameter, while the long, club-shaped forms vary from two to four microns in length. These club forms are of irregular diameter, swollen at one end and tapering at the other; the staining is slightly irregular, there being often a small area near the centre taking the stain less intensely. The oval and round appearing forms correspond in size to the varying diameter of the club forms, and give one the impression of being cross-sections of the latter. These organisms are frequently seen within the bodies of both leucocytes and large connective-tissue cells. Many, however, are extracellular (Plate II, Figs. 1, 2, 3).

In the dog then, the inoculation of fluid cultures, either intravenously or subcutaneously, produces no evident constitutional symptoms and no internal pathological changes. When introduced subcutaneously there is a local lesion at the point of inoculation, consisting of a circumscribed inflammation and abscess formation. When allowed to remain for from three to four weeks absorption of the contents of the abscess takes place, and a mass of scar tissue containing a small cavity alone remains. In the cavity organisms are present probably in very small numbers as is shown by the failure of cover-slip preparations and the small number of colonies developing in cultures.

If, however, the nodule is excised at the height of the process, signs of active inflammation are obtained—an exudation of serum and white-blood corpuscles having taken place, as well as an infiltration of the adjacent connective tissue with leucocytes. The micro-organisms are abundantly present, being seen in cover-slips, and developing luxuriantly upon cultures, while sections from the lesions stained by the Weigert method reveal them in large numbers.

Rabbit.—One rabbit was inoculated intravenously with 1 cc. of a 36-hour plain bouillon culture. The animal developed no evident symptoms and remained apparently well for five months.

Guinea-pigs.—Six guinea-pigs were inoculated without result. In three the organisms were introduced subcutaneously. No induration followed at the point of inoculation. In three the inoculation was into the peritoneal cavity. No appreciable symptoms resulted. Five of these six animals died at periods ranging from six days to seven weeks after the inoculations, but in none was anything to be seen at autopsy, and all cultures from the organs were negative. At the time of these experiments numerous guinea-pigs kept at the pathological laboratory died of some unknown cause, and apparently the death of these animals was not due in any way to the organisms introduced.

Mice.—White Mouse I. Inoculated subcutaneously with 0.3 cc. of a suspension made in sterile bouillon, from agar growth. On the second day the mouse appeared ill, sat in the corner of the cage, refused to eat and scarcely moved when the cage was shaken. Death took place on the sixth day. At the point of inoculation there was an area 0.5 cm. in diameter, raised, soft, and gelatinous in consistency, and paler than the surrounding tissues. This involved the subcutaneous tissue and muscle. On section the intestines were hæmorrhagic and the spleen enlarged. The other organs appeared normal.

Smear preparations from the point of inoculation showed abundant oval and long forms of the micro-organisms, the latter varying from two to four microns in length. These stain irregularly, having usually a more or less clear area at one end. The same forms were present in smears from the lungs and liver, but in much smaller numbers. Those from the peritoneal cavity, spleen and heart's blood were negative.

Cultures from the local lesion, lung and liver showed the micro-organism in pure culture. The culture from the spleen was contaminated, while those from the kidney and heart's blood remained sterile.

Microscopical examination of the tissues.—Point of inoculation. The subcutaneous connective tissue is infiltrated with large numbers of the organisms situated in clumps, some around the blood-vessels, and others having no apparent relation to the blood-supply. The leucocytes are fairly abundant, and often contain several organisms within their protoplasm. Numerous larger phagocytic cells appear. Deeper down in the tissues the organisms are very abundant, and lie in large masses between the muscle bundles. The organisms do not invade the muscle, and there is no apparent increase in the muscle nuclei. Sections stained in hæmatoxylin and eosin show hyaline degeneration of the muscle fibres.

Liver.—In the liver many organisms appear in the larger blood-vessels and capillaries. Throughout the organ are minute focal necroses and degenerated liver cells, the organisms being in the capillaries of the diseased area and occasionally within the necrosed liver cells, and in leucocytes. The organisms have the same characteristics as those above described.

Sections of the lung and spleen appear normal except for the presence of the organisms in small numbers both within and without cells. They appear for the most part in small clumps containing numerous elements, but also occur here and there singly.

No pathological changes were made out in the kidney sections and no organisms could be demonstrated.

Lymphatic glands.—The lymphatic structures throughout the body showed the most striking and characteristic appearances. The organisms were readily demonstrable in the peribronchial, perinephritic and peritoneal glands, which contained immense numbers of them. They presented the same characteristics as before, and occurred for the most part outside of and between the lymphatic cells, although at times they are seen within the cells (Plate II, Fig. 4).

White Mouse II. Inoculated in a manner similar to Mouse I. Death occurred on the 10th day. The autopsy revealed

the same soft, semi-caseous area at the point of inoculation and a similar hæmorrhagic condition of the intestines.

The microscopical findings were the same as in the previous experiment.

Mouse III. A wild mouse was inoculated with 0.3 cc. of a 36-hour bouillon culture. Animal appeared to be unaffected until the fourth week, when it became less active and refused to eat. Died on the 38th day. Around the point of inoculation there was a very extensive induration, the tissues being hard, shrunken and dry. This sclerosed condition involved the whole posterior third of the back extending down the thighs and to the root of the tail. Internally the intestines were adherent and the testicles involved in the cicatrix.

Cover-slips and cultures were negative.

Microscopical examination of the tissues removed from the local lesion showed exceedingly dense scar tissue. No organisms were demonstrated. Examination of the organs was negative.

SUMMARY.

The condition in the human subject reported here seems sufficiently unusual to warrant publication.

It is further of interest in view of the evidence given, which would indicate that the skin abscesses and indurated lymphatic glands were due to infection with a micro-organism, differing markedly from the bacteria, but agreeing with certain of the fungi.

The cultural characteristics of the organism are similar to those of many fungi and yeasts, and the imperfect life history which could be determined renders it not improbable that it may belong to the genus *sporotricha*. But for the present the exact classification of the parasite must be left undecided.

The experiments upon the dog and the mice prove the pathogenicity of the organism, and indicate that, under different circumstances, it may remain local in its development and effects (dog), or it may invade the internal organs and produce a sort of pyæmia (mouse).

The etiology and pathology of many fungoid affections in man and animals receive a new interest in the light of the more recent studies of the pathogenic yeasts and their possible relation to tumor formations. It may be mentioned that the pathological conditions met with did not in any instance suggest any other than a simple inflammatory process.

I take pleasure in acknowledging my indebtedness to Dr. Flexner for advice and assistance in the course of the study recorded here.

EXPLANATION OF FIGURES.

Plate I.

Fig. a. Colonies of 10 days. Glucose agar. From lung of white mouse I.

Fig. b. Growth on glucose agar. 3 days. Photograph by Dr. J. F. Mitchell.

Fig. c. Cover-glass preparation from glucose agar. × 1000. Photograph by A. H. Eggers.

Figs. 1 and 2. Growth in hanging drop of bouillon. 60 hours.

Fig. 3. Same. 4 days. Reproduced from camera sketches by Dr. E. F. Smith.

Figs. 4 and 5. Cover-glass preparations from bouillon.

Fig. 6. Swollen and germinating conidia, from hanging drop of bouillon. 30 hours.

Fig. 7. Germ tubes with conidia attached, from hanging drop of bouillon. 3 days.

Plate II.

Figs. 1, 2 and 3. Sections of wall of abscess in subcutaneous tissue dog. Leitz obj. $\frac{1}{8}$ (Fig. 1), $\frac{1}{6}$ (Fig. 2), and $\frac{1}{12}$ (Fig. 3).

Fig. 4. Peribronchial lymph glands of white mouse. Carmine and Weigert's stain. Leitz obj. $\frac{1}{8}$ inch.

ŒDEMATOUS CHANGES IN THE EPITHELIUM OF THE CORNEA IN A CASE OF UVEITIS FOLLOWING GONORRHŒAL OPHTHALMIA.

Edward Stieren, M. D, *Pittsburgh, Penna.*

Oedema of the corneal epithelium with various changes and distortions of the epithelial cells due to pressure of fluid in the intercellular spaces, has been observed by many workers in the pathology of the eye, and has been described and depicted more or less thoroughly since Arlt's[1] original observations in 1855. He described the œdematous changes taking place in the corneæ of eyes affected with choroiditis accompanied by increased intraocular tension.

Fuchs,[7&8] Fridenberg,[6] Birnbacher and Czermak,[5] Klebs[12] and other observers have seen these changes occurring in glaucomatous and staphylomatous eyes.

Some experimental work has been done; Leber, Gutmann, and others have produced artificial œdema in the corneal epithelium. Leber[13] succeeded by injecting oil of turpentine under the anterior epithelium in producing, without any roughening of the surface, a corneal opacity which closely resembled the haze of glaucoma. On microscopical examination he found numerous vacuoles in different layers of the epithelium with a pronounced dilatation of the intercellular spaces. More recently, Gutmann[3] by injections of a solution of asphalt in chloroform, demonstrated a communication between the lymph spaces of the corneal matrix and the finer system of channels in the anterior epithelium, and produced a condition similar to that found by Leber.*

The corneal œdema of glaucomatous eyes (causing haziness and the appearance of rainbow colors around a flame at night)

*Bizzozero,[4] in his excellent article, first demonstrated the presence of a series of intercellular spaces or clefts forming a system of minute channels for transporting nutritive fluids to the individual cells and containing a small amount of viscid cement substance. Pfluger[14] and Gruber[10] have also described the nutrition of the corneal epithelium through these channels.

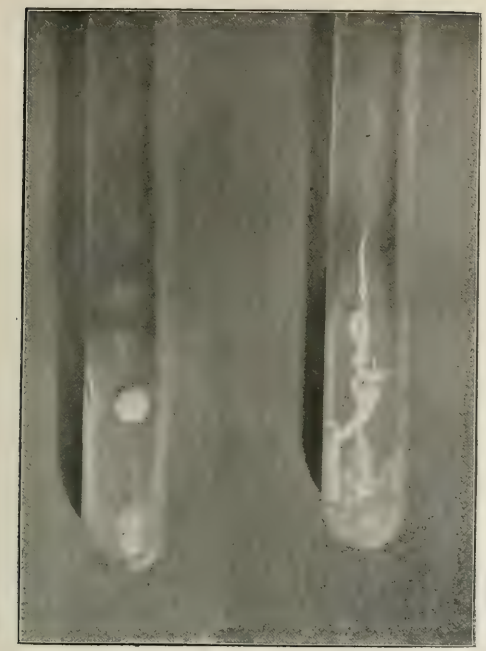

FIG. a. FIG. b.

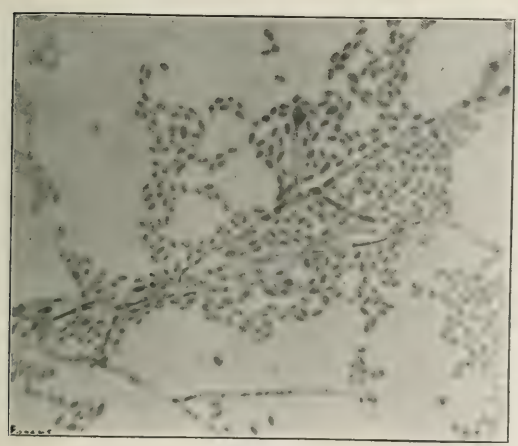

FIG. c.

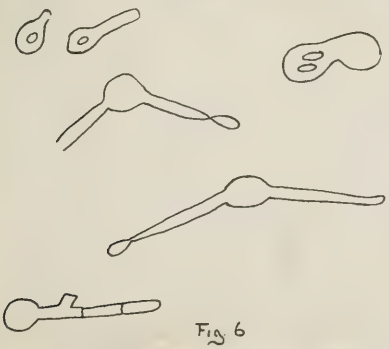

Fig 6

Fig 1

Fig 2

Fig 3

Fig 4

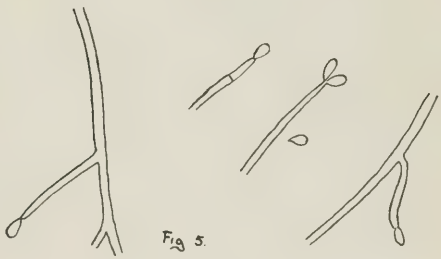

Fig 5.

Fig 7

FIG. 1.

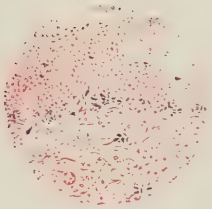

FIG. 2.

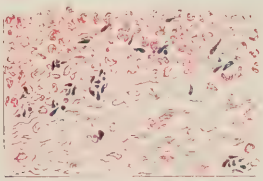

FIG. 3.

Sections from local lesion.—Dog.

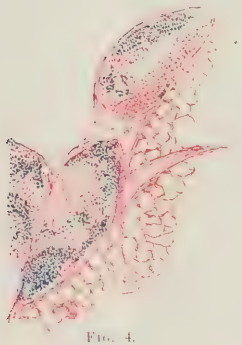

FIG. 4.

Peribronchial lymph glands.—Mouse.

PLATE II.—To face p. 290.

is due to the increase in intra-ocular pressure, the tension of the tunics being suddenly or gradually raised, while the centrifugal flow of fluids is impeded or entirely shut off, resulting in an accumulation of fluid in these intercellular spaces. These are now transformed from mere channels into dilated lacunæ. This at least seems the most plausible theory, although Fuchs[8] thinks it possible that the œdema can be caused by pressure osmosis, the aqueous humor being forced by the intra-ocular pressure through Descemet's membrane (especially as this is often broken down in inflammatory glaucoma) into the corneal substance proper and thence through the lymph channels in the nerve sheaths and of the corneal matrix into the epithelial interce lular spaces.

In the case I wish to describe there is present an œdema causing marked changes in the epithelium which cannot be ascribed to increased intra-ocular pressure, since this was never present. Before entering into the microscopical appearance of the sections, a clinical history of the case is of decided importance, and is as follows:

John A., æt. 25 years. American; occupation, commission merchant, was first seen in June, 1894, confined to bed with gonorrhœal rheumatism and gonorrhœal ophthalmia of both eyes. The right eye was the worse of the two, the central part of the cornea at this time breaking down in an ulcer; the ulcerative process went on to perforation, allowing the aqueous humor to escape and the iris to come in contact with the cornea, when the ulcer finally healed over and left a central opacity, adherent to the iris and about 4 mm. in diameter. The treatment consisted in the application of 2 per cent sol. argenti nitratis, atropin, cold compresses to eyes continually, with the internal administration of salicylates. The disease in the left eye ran the usual course and made a good recovery without any corneal involvement. The patient was seen from time to time after this, and in March, 1896, he made his appearance with the right eye painful, and the left eye a little sensitive to light; inspection showed considerable ciliary injection of the right eye, the globe was tender to touch; an ophthalmoscopic examination was impossible on account of the adherent iris and corneal opacity. Enucleation was advised as sympathetic ophthalmia was feared, the inflammation extending, without doubt, along the entire uveal tract. The eye was removed shortly afterwards, that is about two years after the contraction of gonorrhœal ophthalmia.

MICROSCOPICAL EXAMINATION.

Sections through the limbus, cornea, iris and ciliary body show evidence of a marked inflammation involving all these structures. In addition to the changes in the corneal epithelium, which will be described below, the corneal matrix shows marked sclerotic changes, and numerous large blood-vessels coursing through it. The iris shows an acute inflammation as well as sclerosis, but in the sections examined it is nowhere adherent to the cornea. Between the iris and cornea there is considerable inflammatory exudate. The ciliary body shows marked sclerotic changes. The inflammatory processes, chronic and acute, are much more marked in one side of the eye than in the other.

The epithelial layer of the cornea is markedly thickened, the thickening being most pronounced at the limbus on the less involved side. For a distance of about 4 mm. from this point towards the other side the epithelium tapers down gradually and almost uniformly to the thickness of normal corneal epithelium. Although there is a slight hyperplasia present in all this area, the cells are larger than normal and there exists a certain dimness of outline in the individual cells, while their nuclei are swollen.

Beyond this point the cells begin to lose their characteristic appearance. At first this is most marked in the basement cells; their approximation is not so perfect, the intercellular spaces are dilated, the length of the cell is increased; the nucleus is pushed towards the top of the cell, while its base retains its normal attachment to Bowman's membrane. Here the more superficial layers are not much disturbed, except that the cells and their nuclei are slightly enlarged and the cell outline is not so sharply defined.

As we proceed across the field the above changes in the basement row become more exaggerated; the cells are drawn out longer and become narrower, while the position they formerly occupied is encroached upon by the dilating intercellular spaces. Their protoplasm stains lighter than normal. The more superficial cells are pushed forward. These changes become more marked toward the left (the more involved) side of the section, apparently due to persistent pressure of fluid. Round and oval vacuoles occupy in places the former sites of cells, now broken down. In some instances they contain broken down cell debris and degenerating nuclei.

These spaces occur for the most part in the basal layers ("Fusszellen" of Rollet and Lott), but are also present in the more superficial ones, a most interesting factor, however, being the manner in which the most superficial layer of cells remains intact under these circumstances. In several instances a vacuole extends from Bowman's membrane below to this superficial layer above, and this latter appears to be reinforced by a mass of broken down cell substance forced against its posterior border. Polymorphonuclear leucocytes appear in considerable numbers in the intercellular spaces in the more affected regions of the epithelium. When these spaces or vacuoles are not present the basal row of cells has the appearance of a uniform row of "palisades,"* while the cells above them and lying horizontally appear as rows of "arcades."*

Fuchs[8] observed that in glaucomatous eyes the vacuoles were most numerous at the points of nerve channel entrance into the basal row of cells. This cannot be demonstrated in the present case.

In the *substantia cornea propria* evidences of a most active inflammation are present. Round-cell infiltration is marked, with the formation of new blood-vessels in every field. Descemet's membrane for the greater part is intact though most of the cells are flatter than normal. Where it has broken down the sites are marked by the presence of numerous polymorphonuclear leucocytes.

The anterior chamber is filled with the coagulated remains of a thick fluid inflammatory exudate, dotted with mononuclear and polymorphonuclear leucocytes. The iris is generally infiltrated with round cells and polymorphonuclear leucocytes,

* Apt terms used by Klebs.[4]

and in areas there are vast accumulations of them. The blood-vessels are enlarged. The tissue elements are considerably broken down and contain much free pigment.

As we approach the ciliary attachment of the iris the round cells become more numerous and there is much thickening, due to new fibrous tissue. Schlemm's canal is much reduced in calibre by an inflammatory deposit on its interior, and surrounding it are numerous mononuclear and polymorphonuclear leucocytes. Between the fibres of the ciliary muscle and of the corneal matrix in this region there are deposits of fibrous tissue. These secondary inflammatory alterations are much more marked on the side in which the œdema of the cornea is found. To these alterations the œdema is probably due.

It seems not improbable that the lymph spaces conducting from the cornea into Schlemm's canal have been occluded either by the sclerotic changes in the tissues, by the accumulation of inflammatory exudate, or by mechanical pressure.

At any rate the absorption of corneal fluids has been checked in this region. A stasis in this locality would cause accumulation of fluid in the intercellular spaces of the epithelium.

In addition to the occlusion of the channels of absorption it is not improbable that another factor in causing the œdema has been the severe acute inflammation attacking the cornea and neighboring structures, and thus tending to cause an increased outflow of fluid from the blood-vessels. There is nothing to indicate, however, that the intra-ocular tension was at any time much increased.

In conclusion, I wish to express my gratitude to Dr. C. R. Bardeen for his timely assistance in preparing this article, and to Dr. R. L. Randolph for his careful review of the same. To Dr. Heckel of Pittsburgh, I am indebted for the clinical history of the case and for the specimen from which the sections were prepared.

DESCRIPTION OF PLATE.

FIG. 1. Zeiss, ocular 4, objective AA, 65 diameters.

Alcohol fixation, celloidin section, hæmatoxylin and eosin stain. The section passes through the cornea, sclera and iris near the corneal margin. In the corneal epithelium, represented at the right above, may be seen the œdematous spaces described in the text. The many blood-vessels passing through the substantia propria show the severe alteration which the main body of the cornea has undergone. The anterior chamber is filled with an inflammatory exudate. Inflammatory changes in the iris are obvious.

FIG. 2. Zeiss, ocular 4, objective DD, 370 diameters.

Alcohol fixation, celloidin section, stained with Bende's iron hæmatoxylin and with congo red. A vertical section passing through the corneal epithelium, from a region slightly nearer the centre of the cornea than that shown in Fig. 1. The marked alterations in the epithelial cells, described at some length in the text, are here clearly shown. A few leucocytes appear among the epithelial cells.

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PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Meeting of November 7, 1898.

Primary Focal Hæmatomyelia from Traumatism. — Dr. PEARCE BAILEY, New York.

The definition was self-explanatory with the exception of the word *primary*, which was used by the author as indicating that the hæmorrhage was the result of force exerted directly upon the spinal cord without the intervention of a fracture or dislocation of the spine. Primary traumatic hæmatomyelia is thus differentiated from the hæmorrhages which complicate crushes of the cord brought about by compression. After a brief historical introduction, and after expressing the belief that this affection was more frequent than is generally recognized, the questions of causation, pathological anatomy, symptoms, diagnosis and prognosis were severally considered. With the exception of pistol-shot wounds, sudden flexions and extensions of the neck were the best established causes. The author believed the lesion was produced by an actual stretching of the cord, with resulting laceration of blood-vessels and to a certain extent of centrally situated nerve fibres; he rejected the explanation proposed by Thorbun that a momentary displacement of a vertebra was the immediate causative agent. The pathological anatomy of the condition consists in a focal hæmorrhage confined chiefly to the gray matter always in the cervical or upper thoracic region; the blood sometimes burrows for considerable distances up and down the cord. The extravasa-

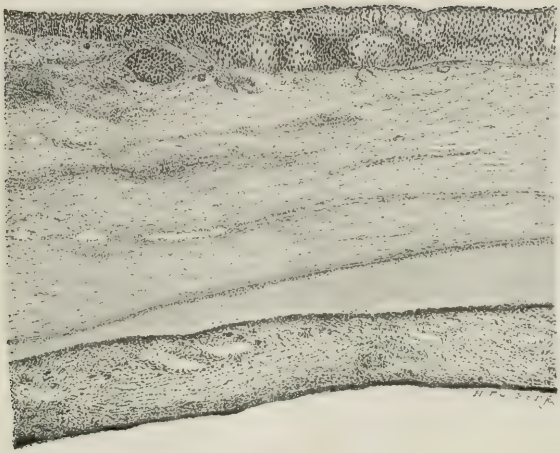

FIG. 1.

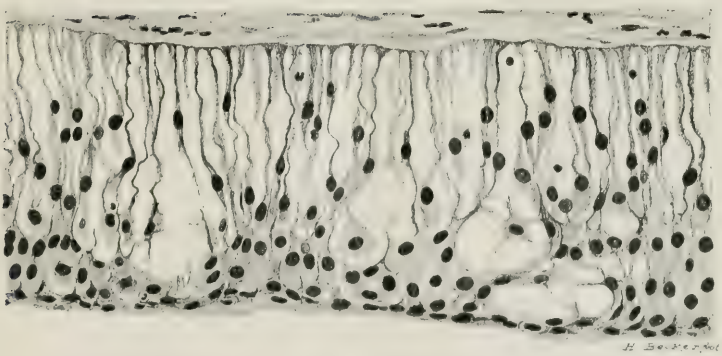

FIG. 2.

To face p. 292.

tion on its absorption leaves a cavity which may remain patent or be filled up by new tissue. Secondary degenerations are usually not pronounced. The symptoms are in general those of other spinal cord traumatisms, though usually less severe and less numerous; but the motor and sensory symptoms have distinguishing characters. The distribution of the motor symptoms depends upon the extent and situation of the clot. There may thus be spinal hemiplegia, or monoplegia, or (probably) brachial diplegia, or paralysis of the legs, or paralysis of both arms and legs. The paralysis at first, unless the lesion is very small, is flaccid in all its characters; later it assumes the central neurone type in the legs with places in the arms of peripheral neurone type. The sensory symptoms consist, in addition to pain in the neck, of a dissociated anæsthesia, that is, anæsthesia for temperature or for pain or for both, with perfect preservation of tactile sensibility. A case was reported in which this peculiar clinical condition was absolutely distinct, but in which, as shown by subsequent microscopical examination, the blood had exceeded to a certain extent the confines of the central gray matter of the cord. The sensory anomalies of primary focal hæmatomyelia from traumatism are usually transitory, unless the case is exceptionally severe. In reported cases the analgesia has disappeared before the thermoanæsthesia.

In the author's cases thermoanæsthesia was the only sensory anomaly present.

Diagnosis depends chiefly upon this dissociated anæsthesia; light is further thrown upon it by the transitory paralysis of most muscles and by the general rapid improvement of the patient.

The prognosis is better than for any other form of injury to the cervical region of the spinal cord. Several cases were cited from literature to show how rapid recovery may be. Two personally observed cases were also reported. In one, after complete paralysis of arms and legs, with loss of power of the sphincters, resulting from a diving accident, the patient could use his hands, and walk unassisted up four pairs of stairs, in less than two months; in the other, a man who, as the result of a fall of thirty feet, was completely paralyzed in the legs, with retention of urine, was able to go to work (night-watchman) in two months.

The treatment is the same as for other varieties of spinal cord injuries, except that any operative measures are strongly contraindicated.

Dr. Preston.—I have been very much interested in Dr. Bailey's clear presentation of this subject. It is an extremely suggestive paper. As he was reading the paper I could not help wishing I had had this particular knowledge many years ago. It has been my fortune or misfortune to see quite a large number of these cases of spinal injury, for the City Hospital is located in the centre of our city, and many cases of sudden injury are brought in there.

One of the most puzzling questions connected with these cases is that referring to the advisability of surgical interference. I have been always of the opinion that where we can be sure that there is direct injury to the column there should be prompt interference. I can recall now, however, a certain number of cases in which I advocated operation and where the after results proved that it would have been better not to have opened the column. Again I can recall cases that I am sure would have been benefited by an operation. We had no definite symptoms to decide the question as to whether there was simply this focal injury or whether we had an injury which involved the bones and portions of the spinal cord, particularly the white columns. The hopes that were raised a dozen years ago by surgical exploration of the brain have not been borne out. We have had to limit the sphere of surgical interference, but I think neurologists are now looking strongly to some sort of surgical interference in injuries of the spinal cord. I think, perhaps, there may be some slight predisposing cause here in Baltimore to hæmorrhagic myelitis. At any rate we see a large number of such cases. Dr. Osler has just whispered the suggestion that it is due to the smooth pavements of Baltimore.

We can now, after what Dr. Bailey has told us, differentiate clearly between cases of focal hæmatomyelia and cases in which the cord has been injured. The loss of pain and temperature sense and the preservation of tactile sensibility are two valuable points in the diagnosis. He has also given the neurologists help in enabling them to give a favorable prognosis in these cases, which is a boon to men practicing upon a class of cases where few die and none get well.

Dr. Barker.—I am grateful to have had the opportunity of listening to a paper so rich in personally studied matter and first-hand experience.

The difference in the etiology of spinal hæmorrhages and of cerebral hæmorrhages is obvious from what Dr. Bailey has said. While nearly all spinal hæmorrhages are due to trauma, relatively few cerebral hæmorrhages are thus produced, the majority of the latter being dependent upon chronic arterial disease. A spinal hæmorrhage due to vascular disease is one of the rarest of pathological findings.

If I understood Dr. Bailey correctly he referred in one part of his paper to the possibility of occurrence of an anæsthetic area in which no painful sensations resulted on the application of heat, though pain could be elicited by ordinary methods of stimulation. I have been convinced myself in the study of sensations that "heat-pain" is due to the stimulation of pain nerves and not to the stimulation of "temperature nerves," *i. e.* the warm-points or cold-points. In areas on the circumscribed area of elective sensory paralysis on my own left arm where pain sensations are the only ones which can be elicited by any method of stimulation, a test-tube heated above a certain temperature, after a certain latent period, will always cause pain not preceded or accompanied by any temperature sensation. The studies of von Frey demonstrate conclusively the existence of points in the skin which when stimulated give rise to painful sensations, but not to thermal or tactile sensations. In the case I have studied all the warm-points, cold-points and pressure- or tactile-points in certain areas are thrown out of function and the pain-points alone yield a response. Ice and heat applied to these areas cause painful sensations, but no feeling of cold or warmth. One interesting feature of the heat-pain and cold-pain as studied upon surfaces supplied only with

pain nerves is the latent period of the pain. When one carefully applies a piece of ice or a hot test-tube to such an area he has no sensation at all at first; only after the lapse of some seconds does any sensation result. There is first disagreeableness which soon goes over into distinct pain. Ordinarily when a hot test-tube is applied to normal skin the part is jerked away quickly. This is due to the fact that there is such violent stimulation of the heat-points that we are warned that if we do not remove the arm pain will result. We say that it hurts, but as a matter of fact we are not hurt but only warned that we shall feel pain unless the heat be removed. The same is the case in applying a piece of ice. If the ice remains in contact long enough we have "cold-pain," but the first effect on normal skin is a violent stimulation of the cold-points with a startling sensation of cold. I have wondered if heat-pain and cold-pain are ever really absent in areas where pain-sensations can be elicited by the application of ordinarily painful stimuli, such as pricking with a needle. I am of the opinion that the prolonged contact of ice or hot water would give rise always in such cases to the sensation of pain. May it not be that the existence of heat-pain and cold-pain is often overlooked in cases in which the cold-points and warm-points are thrown out of function. Many, of course, still hold that heat-pain and cold-pain are due to over stimulation of temperature nerves and not due to the stimulation of specific pain nerve, but this view is irreconcilable with our present physiological and pathological knowledge.

I would add a few words with reference to the relation of hæmatomyelia to syringomyelia and central glioma. Since the investigations of Minor, early in this decade, the attention of all neuro-pathologists has been directed towards this dissociation of sensation or elective sensory paralysis in cases of central hæmatomyelia. As Dr. Bailey has said there can be but little doubt in most cases with regard to differential diagnosis, for the symptoms follow so directly upon the trauma that one can scarcely make a mistake. The pathology of these cases, however, is somewhat more puzzling than their clinical history. A number of cases have been studied in which in addition to hæmorrhage, or the signs of old hæmorrhage, cavity formation with gliosis (or gliomatosis) in the periphery of the cavities has been observed. Some pathologists assert that after hæmatomyelia not only may partial obliteration of the hæmorrhagic cavities by glia tissue occur, but these cavities may become lined later by glia cells and thus give rise to syringomyelia or even be the starting point of a central gliomatosis. Minor goes so far as to suggest that such cavities secondary to hæmorrhage may possibly at once or later become connected with the canalis centralis, receive an ependymal lining from this and so give rise to the appearance of a malformation of the cord. One cannot help being somewhat skeptical with regard to such a point. It is certainly not to be forgotten that in so-called gliomata in which the main constituents are cells of the ependymal type multiple cavities are frequently found, and there seems to be a special tendency to hæmorrhage in such cases. In a case of this kind where such multiple cavities exist with surrounding gliosis or ependymal tumor formation a slight trauma might produce a hæmorrhage, and the symptoms would be those of hæmatomyelia. Clinically this might present the typical picture of primary hæmatomyelia, but pathologically it would have to be considered as hæmatomyelia secondary to the new growth.

I would also like to ask Dr. Bailey if he has, in his experience, met with any case of bilateral gummata giving rise to dissociation of sensation of the syringomyelic type.

Dr. Bailey.—Replying to an inquiry from Dr. Osler I would say that I think undoubtedly many of the cases once called concussion of the spine were cases of intra spinal hæmorrhage.

In regard to Dr. Barker's inquiries I have never personally seen analgesia in these cases except for thermal stimuli, but I did not examine to see whether after a certain time of application of heat the patient complained of pain. We held the water on for a few seconds only.

As to the ependymal lining of the gliosis that occurs after cavity formation I have only had the opportunity of seeing one case in which I could trace the whole process. The man was an active man and healthy in every other way. In his case there was a large growth in the central part of the spinal cord, but it was in no way connected with the central canal. The central canal is the part of the gray matter that seems to escape most frequently in hæmatomyelia, and in the case to which I made reference this canal was normal and there were no ependymal cells lining the cavity.

As to bilateral gummata, I have no doubt they could give rise to dissociated anæsthesia as many other processes do, such as pachymeningitis.

In the cases I have examined the knee-jerk has been absent for two or three weeks, but entirely returned at the end of two months. As to the cause of the absence of knee-jerk I am sure I do not know.

Two Cases of Pylorectomy.—Dr. Finney.

The first case is that of a man about 50 years of age who presented himself at the Hospital on July 15, '98, complaining of distension of the stomach, daily vomiting, and constipation. His family history was negative. For about one year he had noticed a pain in the stomach, accompanied by a full feeling, and had lost weight, falling from 126 pounds to 95 pounds in the course of the year. He began to vomit after eating his meals, and has vomited twice daily about a quart, more or less, of light brown, sour material. He says that he has vomited material which he had eaten the day before, or even two days previously. The day before entering the hospital he vomited a little bright red blood.

On examination he appeared rather emaciated, had a temperature of 99.4°, pulse of 52, with a volume full and firm, pupils equal, skin moist and mucous membranes of good color. There was considerable arterio-sclerosis. His heart sounds were regular, and there was no murmur. His abdomen was soft and not distended. Waves of peristalsis were seen moving from left to right. To the right and just above the umbilicus a hard mass could be felt, about the size of one's thumb, which moved up and down with respiration. Examination of the contents of the stomach showed no free hydrochloric acid, and microscopically no tumor cells.

The diagnosis of carcinoma of the pylorus was made, and an

operation advised. He was operated upon July 20th. The stomach was irrigated daily, for a day or two beforehand, and rectal feeding only, for 24 hours previously. A small incision was made under cocaine anæsthesia, as I had promised him I would make an exploratory incision first, to find out what the trouble really was before giving him a general anæsthetic. Under cocaine then, I made an incision about 4 inches long in the median line, exposed the tumor so that I could see and feel distinctly its outlines, also an enlargement of some of the mesenteric glands, and thus confirmed our previous diagnosis. Ether was then administered and the operation proceeded with. The median incision was enlarged, and also a lateral one was made through the right rectus. We found a hard, scirrhous mass about the pylorus, which was a little larger than it had appeared through the abdominal wall. This was removed without any particular difficulty except that the duodenum was very adherent to the head of the pancreas, and we had some difficulty in arresting hæmorrhage after its separation. By dividing through the duodenum the growth was removed with a portion, perhaps one-third, of the stomach, which I have here. Several enlarged mesenteric glands were also removed. The stomach was sutured in the usual manner, grafting the duodenum into the stomach after partially closing the cut end. There was no difficulty in doing this. I used the mattress suture of Dr. Halsted, and closed the abdomen without drainage. He made an uninterrupted recovery.

The patient is present to-night, having kindly come from Pennsylvania to attend this meeting. He has gained 30 pounds in weight since July 15th. You may be interested in seeing the man and examining the condition of the wound at present (exhibiting the patient). You will see that the scar is very firm, and there is no weakening of the abdominal walls due to the section of the rectus.

CASE II. Case II is that of a man 56 years of age who came to the Hospital on October 12, '98, and was operated upon in the clinic. His family history is also negative. About 4 months ago pain began in the epigastric region, starting first in the left hypochondrium, beginning about one-half hour before meals, and relieved after eating. He never suffered with it directly after eating. It was not much worse when he came to the Hospital than at the time he first noticed it, and now it passed over the whole upper portion of the abdomen. There had been some nausea and vomiting, with rapidly increasing weakness for the past few months. He had lost in weight he thought about fifteen pounds. He looked as if he had lost more than that, as he was rather emaciated. Nothing was made out on physical examination except that in the abdomen to the right of the median line, in the upper umbilical region, there was a slight tumefaction. On turning to the right in the recumbent position this mass moved to the right about 1 cm., and when turning to the left it moved to the left 3 cm. Here is a drawing showing the location of the mass and the relative position before and after dilatation of the stomach.

Analysis of the stomach contents showed no free hydrochloric acid, and a faint trace of lactic acid. This case was also diagnosed as cancer of the stomach, probably of the pyloric end, and involving a portion of the stomach. He was operated upon October 21st under ether. Incision was made in the median line, the stomach was delivered and packed about with gauze. The adhesions were not so marked as in the other case, although the omentum bothered us considerably by being adherent below, and the larger portion of it had to be ligated and divided. Some glands felt to be enlarged, below the stomach in the omental fold, were removed, I think about four in all. There was no particular difficulty about the operation, the same procedure being employed here as in the other case, with this exception, in the second operation I removed much more of the stomach, taking out at least two-thirds, and sutured the duodenum to what was left of the stomach. The growth in this case extended much more along the lesser curvature of the stomach than along the greater, so that I took out an additional V-shaped piece here, and thus facilitated the subsequent suture very much. The procedure is an old one, having been suggested first by Billroth. After suturing the cut edges where the V-shaped piece had been removed, the opening in the stomach was found to match the lumen of the duodenum exactly, and I then had a simple circular suture of the intestine, and made use, in performing it, of the dilatable rubber bags of Dr. Halsted.

The first case made an uninterrupted recovery. He complained of nothing after the operation save hunger, and so bitterly did he complain of this that we gave him some milk thirty hours after the operation. The second was one of those unfortunate cases that happen now and then, in which the operation was a great success, but the patient died. The operation was very satisfactory, the enlarged glands we had felt were removed without difficulty, and, as it proved subsequently at autopsy, all the enlarged glands were removed. The case did well surgically, there were no symptoms of peritonitis and no pain, but he rapidly developed a typical pneumonia in the right lung, which extended to the left, and on the fifth day he died. The autopsy showed an extensive double lobar pneumonia.

Cover-slips from the abdomen were negative. There was not a single adhesion between the abdominal wound and the site of operation, and the peritoneal cavity was perfectly dry. It was unfortunate that this man should have developed a pneumonia, as apparently all the growth had been removed.

Dr. CUSHING.—One of the most striking features of Dr. Finney's report lies in the closure of the abdominal wound without drainage after a long operation necessarily associated with more or less soiling of the peritoneal cavity. Of course the peritoneum will take care of a certain number of micro-organisms provided no non-absorbable material such as a bit of necrotic tissue or fæcal matter is left behind. In these operations high up in the intestinal tract, however, another most important and encouraging factor must be taken into consideration, namely, the organisms or better, lack of organisms, which the peritoneum has to take care of. In Dr. Finney's first case unfortunately no cultures were taken from either duodenum or stomach. In the last case in which the healing was so perfect and clean, cultures taken from the duodenum at the time of operation remained sterile and cover-slip preparations were negative. It is astonishing to consider that the duode-

num should be free from micro-organisms especially in a case of this sort where there has existed a condition of chronic disease. My attention was first attracted to this subject a year ago after operating upon a case of perforating gunshot wound of the abdomen in which, though twenty-seven hours after the accident, but a slight degree of peritonitis was present. There were four perforations present in the upper part of the jejunum. On looking over the cases of gunshot wound with intestinal perforation which had previously been operated upon in the hospital, I found, strangely enough, that the only ones which had recovered were those of jejunal perforations. Since that time we have been observing very carefully indeed the bacteriology of all cases in which the upper part of the alimentary canal is opened on the operating table and have found the duodenum sterile on several occasions. This I think is an all-important prognostic feature of these cases, and I do not know that it has ever been emphasized before. In conjunction with Dr. Livingood I spent several weeks last spring upon some experimental work with animals which gave us very much the same results as we had observed clinically. It apparently is possible in some instances to render the greater part of the intestinal tract surgically clean before operation, that is, free from pathogenic micro-organisms. I hope soon to publish the results of our observations.

Dr. Cone.—As Dr. Flexner is not here to speak of the pathology of Dr. Finney's cases I might say a word. Most of us have been over the pathology of the last case. It showed only in a few areas the invasive character of the epithelium, but the glands were typically invaded with adeno-carcinoma. The gross appearance of the specimen from the second case was that of scirrhus carcinoma involving nearly the entire circumference of the stomach, showing no ulceration, but the mucosa had been worn off. Frozen sections showed masses of spindle cells and round cells which made us think of sarcoma although it is one of the rarest tumors of the stomach. There were tumors of very few epithelial cells in teased sections.

These tumors of the stomach may be classified as follows: medullary, scirrhus, colloid and diffuse carcinoma. The last case was most interesting because it shows how the stomach may be invaded by a growth that cannot be determined microscopically from an examination of the tumor itself, but one must go further and look at the glands which show typical adeno-carcinoma.

Dr. Finney.—I would like to say a word as to the anæsthetic used in these cases. In the last case the patient impressed us as being a poor subject for a long, depressing operation. The operation varies in length from one to three hours, depending upon the difficulties with which one meets, and the rapidity of the operator. A patient who is under an anæsthetic for two hours must of necessity be affected to some extent. It has been proven, first by Dr. Halsted in his breast operations for cancer, that hæmorrhage is the prime factor in shock in most cases. That rule holds good in most instances except in operations in the peritoneal cavity. In the latter instance the element of time certainly plays an important part, and so if we have a long, depressing operation upon a patient who has lost many pounds in weight, we have a patient already pulled down, and in a condition to stand very poorly any marked strain. The question of choosing an anæsthetic then becomes a very serious one. If one could do these operations satisfactorily under cocaine it would be a great gain, but when it comes to an operation of this sort where you have to handle the stomach so much, and do so much violence to the solar plexus, so to speak, you must use a general anæsthetic. I debated in my own mind the relative advantages and disadvantages of chloroform and ether, and decided in favor of the latter. I believe that the ether played a very important part in the production of this patient's pneumonia. We need a new anæsthetic for cases of this sort. Neither ether nor chloroform is an ideal anæthetic, particularly for cases of this kind.

The Non-Medical Treatment of Epilepsy.—Dr. Hurd.

Within a few years past a new departure has been made in the treatment of epilepsy. The former treatment by medicine alone has been unsatisfactory, and remedy after remedy has been used and discarded. Surgical operations also have been performed, in some instances with good results, but in a great majority of instances with little benefit.

In epilepsy we do not deal with the epileptic paroxysm alone but with a complexus of symptoms, among which the epileptic convulsion may be regarded as the last of a series of morbid processes.

The majority of epileptics possess an extremely weak nervous system, perhaps inherited, and the individual patient is always unduly susceptible to disturbing influences. It has been known for a long time that the causes of epilepsy varied. In many instances epilepsy has been thought to be due wholly to disturbances of digestion, but it is now pretty evident that we have to deal with a more serious trouble. It is not primary digestion alone but often secondary digestion which is at fault. There is some defect in metabolism as a result of which the system becomes poisoned. The neurotic organization to which I have referred being unduly responsive to the action of this poison is overwhelmed by it and we have an epileptic paroxysm. It was formerly thought that if some remedy could be found to control the paroxysm, epilepsy was cured, but now we know that remedies which merely control the paroxysm do very little to cure the disease. It is like tying the hands of a maniac to cure his excitement. The general effect of the bromides and of similar remedies has not been to prevent the generation of the poison in the system, but merely to restrain its manifestation in an epileptic attack. Such restraint may be effective for a time, but finally the poison becomes so overwhelming that a paroxysm can no longer be restrained, and a furious convulsion follows which probably equals in force the sum of the minor paroxysms which had been prevented by the remedy. It has been found by experience that the condition of such a patient is worse than if he had more frequent but milder convulsions.

It has been found in institutions for the insane that the effect of large doses of bromide upon insane epileptics has been to deaden their sensibilities, to increase their growing dementia and to render them more furious and dangerous; and the

majority of physicians who have to deal with this class of patients long ago concluded that it was unwise to attempt to cure these patients by remedies which were given to check convulsive seizures.

Recent observations have indicated the character of the poisonous substances which enter the circulation and produce the epileptic seizure. They are probably leucomaines, but their exact relations to the disease have not been fully worked out and much remains to be done to determine the means of preventing the formation of these poisons in the system. There has however grown out of these investigations a system of providing for epileptics which promises much for the future. In this system it is not intended to substitute hygienic and moral influences for medical treatment or to decry medical treatment, but rather to relinquish the idea of depending upon drugs alone in the treatment of epilepsy.

Within the past few years provision has been made in many States for the care of epileptics in large colonies. The epileptic is not a pleasant member of the home circle whether he is sane or insane, and he seldom does well if treated at home in the family, being difficult to control and unable to co-operate in curative measures. In New York, Ohio and to some extent in other States institutions for their special treatment have been started. In the majority of instances this treatment consists in giving the epileptic the largest possible amount of open-air life and in controlling his diet so that the amount of nitrogenous food may be carefully regulated. It is equally essential that the growing epileptic shall have something to do. It has been found that patients fed upon drugs with nothing to do have frequent epileptic seizures, while, if kept employed in the open air the seizures are less frequent. An attempt is now made to give them useful labor every day under medical control with the theory that a physician should in every case prescribe the kind and amount of labor and the time of day it should be performed. Many epileptic patients are prone to seizures immediately after meals, especially if allowed to fall asleep. It is necessary therefore in all matters which relate to the labor of the patient that the medical man shall say when and how the patient shall exercise.

As the result of such treatment patients who have been subject to daily or weekly seizures often without any medicine, go a month, sometimes a year, or longer without a convulsion.

From our present knowledge the best treatment for an epileptic is an open-air life, carefully selected food and a judicious amount of labor.

NOTES ON NEW BOOKS.

Atlas of Legal Medicine. By Dr. E. von HOFMANN. Translated by FREDERICK PETERSON, M. D., and ALOYSIUS O. J. KELLY, M. D. 56 plates in colors and 193 illustrations in black. (*W. B. Saunders, Philadelphia*, 1898.)

The previous volumes of the present series of Atlases have been reviewed in these pages as they have appeared. The series is a very valuable one, and well illustrates the importance of colored drawings in representing natural objects in the domain of medicine. To pathologists, and especially to coroners' physicians, the present volume will be found of service. It is manifestly quite impossible to do more than draw attention to the salient features of the work, for to do it justice in a review a record of the various medico-legal conditions described would be necessary. The object of the Atlas is to show the appearances met with in organs and the body in general in case of death from violence or unexplained causes, which come under the jurisdiction of coroners or their physicians. As in this country we do not have a specially trained set of legal physicians, the opportunity to become familiar with many of the objects treated of in the volume is open to few; and therefore as a work of reference in doubtful instances, or as affording an opportunity to study the effects of poisons, etc., upon the organs, the Atlas will fulfil a useful purpose.

Annual and Analytical Cyclopædia of Practical Medicine. By CHARLES E. DE M. SAJOUS, M. D., and one hundred Associate Editors. Volume I. (*The F. A. Davis Co., Publishers, Philadelphia*, 1898.)

The Annual of the Universal Medical Sciences comes to us now in a new form, that of an Analytical Cyclopædia of Medicine. The change is explained by the editor, and would seem to better fit it for the use of the practitioner of medicine to whom the original "Annual" often failed to give the desired information. The general appearance of the pages is somewhat novel, as the newer literature upon etiology, treatment, etc., is interpolated at irregular intervals in the general text, occupying a smaller sized type. Thus each subject is treated in a complete fashion as in any modern textbook, and may be read as such by confining the attention to the large type only, while the recent additions to the subject may be obtained in the course of this reading, or separately by consulting the matter in small type. It is expected that the entire domain of medical subjects will be embraced in six volumes. The present volume covers the subjects from "Abdominal Injuries to Bright's Disease." The list of associate editors embraces some of the best known names in this land and foreign countries.

The Methodist Episcopal Hospital Reports, Vol. I, 1887–1897. Edited by LEWIS STEPHEN PILCHER, M. D., and GLENTWORTH REEVE BUTLER, M. D., (*New York: Published by the Hospital*, 1898.)

This handsome volume contains a history of the Hospital from its beginning, together with the usual scientific medical reports from the officers of its medical staff. The longest of these contributions are those on the several diseases of the female genital organs and on operative methods, by Dr. L. S. Pilcher, on the injuries of the cranium and spine and on appendicitis, by Dr. George R. Fowler, on fracture by Dr. J. P. Mathews; and there are besides a number of minor reports, all of interest and value. It appears that from the first the surgical side of the Hospital has received the largest patronage—over two-thirds of the total number of patients suffering from diseases requiring surgical relief; hence the predominance of surgical papers in this volume. The medical side is, however, also well represented by valuable reports by Drs. Butler, Mathews, Shaw and others.

The volume is beautifully printed, and the illustrations are especially good, and even the half-tones are intelligible and useful, which is not always the case in works of this kind. In these as well as in other respects the authorities of the Methodist Episcopal Hospital have set a high standard for their future reports.

The Anatomy and Functions of the Muscles of the Hand and of the Extensor Tendons of the Thumb. By J. FRANCIS WALSH, M. D. Essay awarded the Boylston Prize for 1897, Department of Anatomy and Physiology, by the Boylston Medical Committee, Boston, Mass. (*Philadelphia: Charles H. Welch*, 1897.)

The merits of this careful and thorough study of the anatomy of the human hand are directly evidenced by the fact that it is the

Boylston Prize Essay of last year. It is a thorough critical study of the gross anatomy of a very important region which can hardly fail to have some practical bearing on some of the surgical questions that may from time to time arise on the musculature of the hand. The theoretical value of such studies is of course beyond question.

Medical and Surgical Reports of the Boston City Hospital. Ninth Series. Edited by CHARLES F. FOLSOM, M. D., W. T. COUNCILMAN, M. D., and HERBERT L. BURRELL, M. D. (*Boston: Published by the Trustees*, 1898.)

About half this volume is taken up with the discussion of diphtheria in some of its aspects, and the papers are of decided value and interest. In Dr. Jenks' study of the nervous system in this disease, the microscopic examinations were largely confined to the pneumogastric nerve, though the spinal cord was also examined in some cases and the brain in one or two. It is to be desired that a more thorough investigation of the higher nerve centres should be made in this disease than seems to have been done so far.

The other papers in this volume, are all apparently meritorious, as might be assumed from the names of the editors. Those on formaldehyde as a disinfectant, and on the anæsthetics used in the eye, are among the longest and are of considerable practical interest.

In the surgical abstract accounts are given of several cases of foreign bodies in the digestive tract, that are of interest in connection with some occasional hospital experiences, and as showing how such bodies are liable to behave under certain conditions. In one case a plate with three false teeth was passed safely in the natural way; in another a similar plate and teeth lodged in an enlargement of the œsophagus, and was only detected there by the dangerous hemorrage it produced. In still another case a fish bone ulcerated through the peritoneum, causing an extensive abscess between it and the abdominal wall.

The volume is a worthy addition to a valuable series.

Epidemic Cerebro-Spinal Meningitis and its Relations to Other Forms of Meningitis. A Report of the State Board of Health of Massachusetts. (*Boston: Wright & Potter Printing Co., State Printers*, 1898.)

This report, by Professor Councilman and Doctors Mallory and Wright, will take rank with the best scientific literature and become an authority upon this disease. It gives a historical sketch of the disorder, and full reports of over one hundred cases; its bacteriology, symptoms and complications; its diagnosis and relations to other forms of meningeal affections. Altogether, the report is one of the best monographs of its kind and compass on a single disease.

The relations of cerebro-spinal meningitis to mental disorders are only very briefly touched upon. Considering the fact that meningitis figures amongst the alleged causes of insanity so frequently, this is a little noteworthy here; the more so since the authors elsewhere express the opinion that "all infections of the meninges other than by the diplococcus intracellularis are fatal." There are many who will hardly accept this conclusion, but those who do can not avoid admitting that cerebro-spinal meningitis, due to the infection of the diplococcus intracellularis, is one of the more potent and frequent causes of insanity.

The report has a lengthy bibliography attached, but it "contains some omissions," to use a Hibernicism, some of which, it would appear, might have been included, the references certainly being noteworthy enough to have been included in the literature. As, however, the list given only contains those works and articles mentioned in the text, and is not represented to be a complete bibliography of the more important memoirs on the subject, this hardly calls for criticism. The report itself will most certainly be often quoted in the future and take a most honorable position in the literature of its special theme.

Doctor and Patient: Hints to Both. By Dr. ROBERT GARSUNG, Vienna. Translated, with the permission of the author, by A. S. LEVETUS, with a preface by D. J. LEECH, M. D., F. R. C. P., etc. (*Bristol: J. Wright & Co.*, 1898.)

This is a work of a class that has had several representatives in this country, but it has a special value as showing how nearly alike the professional conditions are in all countries. The Vienna professor might have written his book for an English-speaking public in the first place, and hit nowhere amiss. The fact is, the doctor and patient stand in the same relations to each other over the whole civilized world, and the same ethical questions, troubles and trials exist in one place as well as in another. Here we have in our cities the dispensary evil, and in our country generally too large a freedom of medical education and practice, which are only partly peculiar to us; in the older countries also we hear of the overcrowding of the profession, and the medical proletariat spoken of by Dr. v. Ziemssen in a recent address is an evil in Germany as well as here. There they have, moreover, the socialistic unions, cheapening medical practice, as in England. The "Battle of the Clubs" is an apparently perennial question for discussion in the medical journals. Another custom of medical practice which is generally reckoned with us as hardly commendable or profitable to the physician appears, judging from this little work, to be common enough in Austria as to be accepted as perfectly normal, viz. the regular season contract with patients and their families. If this is the usual or even common practice it is rather to our European confrères' disadvantage.

The ethical tone of the work is, as might be expected, the very best, and it is one that will be profitable for occasional reference by the old practitioner as well as valuable to the beginner in the medical profession.

A Text-book upon the Pathogenic Bacteria for Students of Medicine and Physicians. By JOSEPH MCFARLAND, M. D. Second Edition. 1898. 497 pages. 8vo. (*W. A. Saunders, Philadelphia.*)

We had occasion to review the first edition of this work in August, 1896. In this edition parts have been rewritten and new chapters have been added, which have much enhanced the value of the work. In the light of our present knowledge the omission of cerebro-spinal meningitis under the section on acute inflammatory processes is much to be regretted. In the chapters dealing with general technique, the author at times recommends measures which are now somewhat obsolete, and some procedures are faultily described. We do not think that the majority of bacteriologists would coincide in Dr. McFarland's remarks concerning the action of light upon bacterial growth, and to many they would seem quite erroneous upon the whole. Contrary to the statement in the book we have invariably found the house-mouse highly susceptible to anthrax; also the growth of staphylococcus pyogenes aureus is by no means most typical upon nutrient agar-agar, but upon potato, when grown at room temperature. The statement regarding the streptococcus pyogenes and the diplococcus pneumoniæ having *no* growth upon potato, we believe to be exceptionally the case and not the rule. The author's view that the pseudo-diphtheria bacillus is but an attenuated variety of the true bacillus diphtheriæ is now considered untenable. Several of these errors were pointed out in a review of the first edition. Until they are corrected the book cannot be entitled to the praise it otherwise might readily command. The arrangement of the book as a whole is good, and the matter of its various subjects is commendably planned and dealt with, while its photographic reproductions and general make-up are of a high order of excellence. N. MACL. H.

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ILLUSTRATIONS.

PUBLICATIONS OF THE JOHNS HOPKINS HOSPITAL.

THE JOHNS HOPKINS HOSPITAL REPORTS.

VOLUME I. 423 pages, 99 plates.

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The Vessels and Walls of the Dog's Stomach; A Study of the Intestinal Contraction; Healing of Intestinal Sutures; Reversal of the Intestine; The Contraction of the Vena Portae and its Influence upon the Circulation. By F. P. MALL, M. D.
A Contribution to the Pathology of the Gelatinous Type of Cerebellar Sclerosis (Atrophy). By HENRY J. BERKLEY, M. D.
Reticulated Tissue and its Relation to the Connective Tissue Fibrils. By F. P. MALL, M. D.

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The required period of study for the degree of Doctor of Medicine is four years. The academic year begins on the first of October and ends the middle of June, with short recesses at Christmas and Easter.

Men and women are admitted upon the same terms.

In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

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As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have acquaintance with Latin and a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry, and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

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Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

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