pally based on the subjective symptoms, and I believe that that is thoroughly correct, because so far as concerns the objective symptoms, the palpation of the thrombosed pelvic veins, I agree with Dr. Vineberg that it is very difficult; it is only in exceptional instances that we can palpate those veins. The best way is by rectovaginal palpation and even by that method the diagnosis is not easy. I believe that the condition of the blood is not a good guide at all. The mere presence of microorganisms in the blood is not a criterion as to the prognosis. Microorganisms may be circulating in the blood of a patient who recovers without treatment. I have seen a number of such instances and have watched them carefully. Again, there may be other instances in which we may not be able to establish the presence of microorganisms in the blood and those patients will die, undoubtedly of a septic infection. I believe that while the examination of the blood is important in establishing the presence or the absence of a bacteremia, it does not give us an exact prognosis. I believe that when we have such instances as Dr. Vineberg has reported, multiple abscess in the uterus complicating the condition of thrombophlebitis, there is only one course, that mentioned by him, extirpating the uterus at the same time. On the whole, I believe that in this subject we are still in doubt. We cannot come to a definite conclusion until we have made further research, until we have gained further information from the laboratory. On the matter of vaccines I am at a loss to give an explanation. We have instances in which we have treated our septic patients with vaccines and some recover. By continuing with the work which has been laid out for us, with the surgical intervention wherever we can make our diagnosis, and give heed to what the laboratory may tell us in regard to vaccines, in the course of time we may be able to give a more definite opinion as to our treatment in this condition.

Dr. C. O. THIENHAUS, Milwaukee, Wis.: Agreeing fully with the views taken by Dr. Huggins I would like to add to the literature of the subject reports of two cases which happened in my own practice. In the first case, which I saw eight days after confinement, the woman had had four chills on the sixth day and five chills on the seventh day. Being certain that the physician who called me into consultation could not have overlooked remnants of placenta left within the uterus, I advised immediate laparotomy. I found thrombophlebitis present, and not only ligated the veins but removed the uterus in the wall of which I found numerous small abscesses. The woman recovered. I believe that in such acute cases as this the best procedure is not only to ligate the veins, but to remove at the same time the locus primæ formations of infection, that is, the uterus. The second patient I operated on six weeks after confinement, the woman suffering from chills irregularly every second or third day since the fifth day following confinement. During examination I found the uterus freely movable, the right ovary slightly enlarged and very painful to touch, but also freely movable. On opening the abdomen I found thrombophlebitis and an ovarium on the right side. I ligated the veins and removed the right ovary. The chills, however, continued and the patient died fourteen days after the operation. It is interesting to know that a pyovarium may be freely movable.

Dr. T. J. WATKINS, Chicago: A feature of this subject that has not been considered is the question of the estimate of results. The operation for phlebitis as done by the aurist is always done in connection with the mastoid operation. Consequently, it is extremely difficult to estimate how much value is obtained from the mastoid operation and how much value is obtained from the ligation of the veins. In thrombophlebitis affecting the leg, one never thinks of operating. What is accomplished by ligating the vein in thrombophlebitis? Does the ligature prevent the extension of the bacteria or of the toxins, or limit the extent of the blood-clot? It would seem not to accomplish any of these results. The injury to the intima of the vein and the strangulation of some tissue in the ligatures would seem to do more harm than good. Those who are advocating ligation for thrombophlebitis should give us some accurate information as to what the operation accomplishes.

Dr. R. R. HUGGINS, Pittsburgh: I have tried to emphasize the importance of the clinical symptoms in the diagnosis of thrombophlebitis: the presence of high temperature, falling in a few hours to normal or below; the recurrence of chills, not necessarily present, however; the falling of the pulse with the lowered temperature; the improvement in the general appearance of the patient with the change of the above symptoms. In septicemia the pulse runs much higher than the temperature and there is not the disposition to periods of improvement. There are but two points to consider in the discussion; the first is diagnosis and the second indication for operation. There is no doubt that many patients with mild attacks recover and certainly many of those with severe attacks die. The first case to which I have called attention is that of a woman admitted to the hospital after an eight days' illness, with a temperature ranging between 99 and 104.5, with frequent recurrence of chills; she was studied carefully. Blood-cultures were negative; there was no evidence indicating a localized infection in the pelvis. Clinically it was not a case of septicemia; there was slight tenderness at the outer margin of the right broad ligament, extending upward along the inner side of the anterior superior spine. In view of the doubt, an exploratory laparotomy was done which revealed a thrombosis of the right ovarian vein. Because it was feared that there might be some infection outside of the vein, the midline incision was closed and an extraperitoneal incision made. The second case is one in which cesarean section was done for a ruptured uterus. The temperature remained up for several days following the operation, blood-cultures were negative, and there were no pain or other local symptoms. After the second chill, operation was done and thrombosis of the right ovarian vein was found. If Dr. Watkins had been present at the operation and witnessed the pus and filth within the vein, he could understand why placing a ligature above the point of infection was a rational procedure.

TUBERCULOUS MENINGITIS

A PATHOLOGIC REPORT OF NINE CASES *

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I recently had the opportunity of examining histologically nine cases of meningitis, seven (Cases 1, 2, 3, 4, 5, 6 and 7) of which had been diagnosed clinically and pathologically as tuberculous meningitis. Case 8 had been diagnosed as one of tuberculous meningitis from which the patient recovered only to succumb a month later to an attack of pneumonia.

The findings are interesting as showing the histologic features in a recovered case of meningitis.

Case 9 was diagnosed clinically and pathologically as pneumococcus meningitis and is of interest in comparison with the findings in the tuberculous cases.

As far as possible the material was taken from those regions of the cortex where the tubercles were not found. While all the sections were stained for the tubercle bacillus, none was discovered in any case after careful search. It should be mentioned that some of the specimens were hardened in Kaiserling, which may have affected its staining properties for the tubercle bacillus. The results were interesting and instructive and, though they do not permit the drawing of any positive conclusions, they suggested some ideas which are worthy of mention.

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It seemed possible that the lesion which was fairly uniform in its histologic character was caused not alone by the tubercle bacillus, for reasons which will be developed later on in this paper. It further seemed possible that the meningitis was due to a mixed infection. If this could be proved it would seem but a step further to obtain a vaccine which might operate against such a process. If this could be successfully combated, there then would remain the tuberculous process alone, which in itself may be looked on as less fatal than the mixed infection, and within the possibility of cure.

Experiments are now on foot, in conjunction with Dr. Herbert Fox, with this end in view and a report will be made later, embodying the results of these experimentations.

I am indebted to Dr. J. Crozer Griffith, Dr. J. C. Gittings and Dr. Alfred Hand, for the privilege of reporting some of these cases, and Dr. C. Y. White for the pathologic material from these cases from the Children's Hospital.

CASE 1.—Patient.—A. P., aged 12, was admitted to the Children's Hospital, Sept. 14, 1905. The family and personal histories were negative. The symptoms dated from the day before admission and consisted of fever, delirium, persistent vomiting, headache, drowsiness and slight stiffness of the neck. On admission the abdomen was distended and there was obstinate constipation. Examination of the lungs was negative and also of the heart except that it was rapid. The pupils were dilated and equal. Kernig's sign was present. The head was retracted and *tache cérébrale* was demonstrated. Numerous dark-brown spots scattered over the body were seen. Later the legs became rigid, the face was drawn to the right, and deafness ensued. Examination of the eyes, by Dr. William Campbell Posey, was negative, except that the pupils were dilated.

An irregular temperature marked the course of the disease ranging from subnormal to 104 3/5. The patient was most of the time in a semistuporous state, and died November 26.

Autopsy.—The dura was opaque and thickened. The pia-arachnoid was also opaque and thickened, and areas of exudate were observed on the base, the convexity and along the sylvian fissure. A few miliary tubercles were observed. No tuberculous process was seen elsewhere.

Microscopic Study.—The pia was the seat of a round cell infiltration, the cells being mainly of connective-tissue type, though there were some mononuclear round cells. Connective-tissue formation enclosing blood-pigment and numerous blood-cells was also observed. The connective-tissue cells showed in places vacuolization and some contained blood-pigment. The intima of the arteries and veins was thickened and showed proliferation of the connective-tissue cells. The pia of the medulla was the seat of a marked round cell infiltration, the cells consisting of small mononuclear cells and large polynuclear cells. In the cortex there was a marked degree of perivascular dilatation but the cortical cells stained well.

This case was of the mixed type, the proliferative type predominating in the pia of the cerebral cortex, and the exudative type in the pia of the medulla. This case was clinically one of tuberculous meningitis and while no tubercle bacillus was found in this or, indeed, in any of the cases of this series, microscopically it coincided with the usual histologic characteristics of this disease.

CASE 2.—Patient.—M. H., aged 13 months, was admitted to the Children's Hospital March 16, 1906. Histories, family and personal, were negative. The patient died March 25, seven weeks after the onset of the disease, though the nervous symptoms preceded death but three weeks. The first symptom consisted of diarrhea with green stools. A month later the child was seized with convulsions affecting the left side of the face, arm and leg. The eyes were turned toward the right and later the right side of the face, the right hand and foot were convulsed. The movements were more or less continuous and there

was some general rigidity which later became very marked, the legs and arms being held in extension. Kernig's sign was not clearly demonstrated. The knee-jerks were not increased. Lumbar puncture was done without effect on the symptoms. The heart was rapid and there was some dyspnea. There were no spots on the body and examination in other respects was negative. The temperature ranged from 99.2 to 104.4.

Autopsy.—There was found general tuberculosis involving the lungs, epicardium, peritoneum, kidneys, stomach, intestines and lymph-glands.

Microscopic Examination.—The infiltration of the pia consisted mainly of cells of the connective-tissue type. Many plasma cells, however, were present. Numerous red blood-cells were found in the thickened pia. The veins were slightly thickened, the intima showing a marked proliferation of the connective-tissue cells. There was a slight perivascular distention and slight perivascular infiltration of the cortex.

In this case in which the nervous symptoms manifested themselves for three weeks only before death, there is evidence clinically of an acute process. The type of cellular infiltration is strikingly proliferative. The presence of blood in the process is worthy of mention as being present in both the exudative and proliferative forms of tuberculous meningitis.

CASE 3.—Patient.—R. S., aged 6½ years, was admitted Nov. 14, 1906, to the Children's Hospital and died November 28. The family and personal histories were negative. Duration of the disease was twenty-two days and began with loss of appetite, headache, slight enlargement of the tonsils and fever. On admission the examination of the lungs and heart, abdomen and spleen was negative. There was marked *tache cérébrale*. The patient was irritable and lay curled up on one side. There developed then rigidity of the neck, dysphagia and general convulsions. Kernig's sign was present on the sixth day. The patellar reflexes were irregular, being sluggish on the right. Paralysis of the left external rectus was present associated with nystagmus. Babinski phenomenon was present and finally Cheyne-Stokes respiration.

Autopsy.—A diagnosis of tuberculous meningitis was made, though no note of any tubercles was made at the time of the necropsy.

Microscopic Examination.—The pia showed the presence of a dense infiltration which contained many mononuclear and polynuclear leukocytes. In other places the cellular infiltration consisted largely of endothelial cells which was very marked around the blood-vessels. Red blood-cells were numerous and a number of plasma cells were observed. Where the tissue was loose the cellular infiltration was composed largely of lymphocytes and leukocytes, but where the tissue was denser the connective-tissue cells predominated. The blood-vessels showed some thickening of the walls, and in places accumulation of round cells beneath the intima was pronounced.

In the cortex there was perivascular distention and slight round cell infiltration around the blood-vessels. Marked encephalitis was observed, the leukocytes predominating in the exudate.

This case illustrates the mixed form, showing the presence of both the exudative and proliferative type of tuberculous meningitis.

CASE 4.—Patient.—M. E., aged 19 months, was admitted to the Children's Hospital April 24, 1906, and died two days after admission. Her mother had died of tuberculosis four months previously, but otherwise the family history was negative. The patient had suffered from a cough and general irritability for four months previously.

Two days before admission she became first dull, then unconscious. She was able to move the left side of the face only and the eyes twitched at times. There was general rigidity, more on the right side. The left eyeball was drawn inward and there was also palsy of the right external rectus. Kernig's sign was not definite.

In the lungs coarse moist and fine dry rales were audible. The spleen was palpable and the liver enlarged. Examination.

of the heart was negative. The temperature ranged from 98 to 102.8.

Autopsy.—A diagnosis of general tuberculosis was made, involving the lungs, liver, spleen, kidneys, intestines and meninges. The exudate over the meninges occupied the posterior and superior surface of the cortex posterior to the middle line. The base of the brain was also the seat of infiltration.

Microscopic Examination.—In the pia the infiltration was made up of leukocytes and lymphocytes mainly. In places there was present in the pia large quantities of red blood-cells. The process was mainly of an exudative type. The cortex was invaded in places, the cells in the subcortical layers being of the mononuclear type and containing darkly-staining nuclei, but polynuclear cells and some plasma cells were also observed. Perivascular distention of the cortex and round cell infiltration around the vessels were present. Obliteration of the small vessels with some slight proliferation of the intima in others was noted.

This is an example of the purely exudate type of meningitis. The case was a rapid one, the evidence of meningeal implication lasting but four days.

CASE 5.—Patient.—H. P., aged 2 years, was admitted to the Children's Hospital March 25, 1906, and died March 31. The family and previous histories were negative except that one sister died in spasms. There was no history of tuberculosis. The child had been sick for two weeks before admission, making the duration of the disease eighty-one days. The disease was ushered in with vomiting, constipation, slight cough and somnolence.

On admission the child was unconscious, the eyes were open, the pupils large, reacting sluggishly, strabismus was present and there was rigidity of the neck and extremities. The knee-jerks could not be developed, though ankle-clonus and the Babinski phenomenon were present. Kernig's sign was positive. The temperature ranged from 98 to 100 until just before death when it rose to 105.2.

Autopsy.—A diagnosis of tuberculous meningitis was made and miliary tuberculosis of the lungs, liver, kidneys, spleen, intestines and bronchial glands was present. There was an exudate over the motor region on the right side and also at the base.

Microscopic Study.—The pia was thickened, this being due to fibrous tissue containing many connective-tissue cells and a few round cells. Some red blood-cells were found in the thickened pia. The veins were surrounded by many connective-tissue nuclei, but the blood-vessels themselves were not implicated.

The cortex was invaded by the process. There was some perivascular dilatation and the blood-vessels were distended and showed slight proliferation of the intima.

The proliferative type of tuberculous meningitis predominated in this case. The process was not extensive or very intense, and was evidently, as the clinical story would indicate, a chronic process.

CASE 6.—Patient.—B. P., aged 3½ years, was admitted to the Howard Hospital Jan. 12, 1908, and died January 13. The family and previous histories were not obtainable. Patient on admission showed paralysis of the right side of the face, right arm and leg. The right arm was flexed and was distinctly spastic. The left arm and leg was kept in constant motion. Movements of the head were painful and disclosed stiffness of the neck muscles. The right biceps-jerk was increased but the left could not be elicited. Both knee-jerks were increased and equally so. Babinski phenomenon was present on both sides but ankle-clonus was absent. The pupils reacted normally. Temperature ranged from 102 to 105.

Autopsy.—This revealed the presence of tuberculous meningitis and hydrocephalus. Miliary tuberculosis of the kidney and peritoneum was observed.

Microscopic Study.—The pia from the paracentral region was the seat of a dense process which implicated both the pia and the superficial cortical layers. Connective-tissue cells predominated, though there were some trifol cells but these were mainly perivascular and were present where the infiltrative lesion was less dense. The connective-tissue cells were found

in various states of degeneration many of them showing vacuolization. In the superficial layers of the diseased pia the loose connective tissue was infiltrated with mononuclear and polynuclear cells, and a few plasma cells, and was also the seat of extensive extravasation of blood.

In the frontal region the same condition obtained. In this region the blood-vessels were diseased, the outer walls being the seat of cellular accumulations. The cortex had been invaded slightly in places, the tissue being loose and the seat of some space formation. Just below the pia there was present cellular infiltration, some cells being mononuclear round cells, some being pale and granular without a demonstrable nucleus, some elongated cells, some cells with two nuclei, some trifol cells and some large cells with many nuclear fragments tending to undergo vacuolization. Phagocytosis was also observed in the subcortical layers.

The cortex of the cerebellum was the seat of a marked encephalitis. The pia of the cord was the seat of a mononuclear round cell infiltration of moderate intensity and the posterior roots were infiltrated with cells of similar nature. The anterior roots were similarly affected, but to a less degree.

This case belonged to the proliferative type of tuberculous meningitis, but the characteristics of the exudate type of the disease was also present to a marked extent, and it therefore more properly comes under the head of the mixed type.

CASE 7.—Patient.—V. S., aged 2 years, was admitted to the Howard Hospital Nov. 4, 1907, and died November 8. The family and previous histories were unobtainable. The child was admitted with tumor of the abdomen which proved to be a distended bladder.

Examination.—The patient was semicomatose on admission. The pupils did not react to light and the eyeballs were moved from side to side constantly there being a tendency to left conjugate deviation, with transient weakness of the left internal rectus. The scalp and the nape of the neck were tender to pressure and the head was retracted. There was general rigidity of the limbs and from time to time a clonic spasm of both arms. *Tache cérébrale* was present. The knee-jerks could not be elicited, probably due to the rigidity, and the Babinski phenomenon was observed on both sides. The examination of the eye-grounds, by Dr. William Campbell Posey, was negative.

Autopsy.—General tuberculosis was found of the lungs, liver, mesenteric glands and also the meninges, though microscopically no tubercles could be observed in the process in the meninges.

Microscopic Study.—The pia was much thickened and contained leukocytes and connective-tissue cells. The cells were mainly of the connective-tissue type, though many plasma cells were present and some red blood-corpuscles. The blood-vessels showed marked cellular proliferation of the walls. Around the blood-vessels there was marked cellular accumulation of connective-tissue cells. The cortex was the seat of encephalitis in places and there was perivascular distention, the cortex being in places rarified.

This case belongs to the proliferative type of tuberculous meningitis.

CASE 8.—Patient.—J. R., aged 6, was admitted to the Children's Hospital Jan. 27, 1906, and died January 30. The family and previous histories were entirely negative. She had previously been treated at the Children's Hospital for an attack of meningitis, which lasted from Dec. 1, 1905, to December 28, when she was discharged as cured, save for paralysis of the external rectus muscle of the left eye.

At that time she had suffered with rigidity of the cervical muscles and of the legs which were held in extension. Kernig's sign was present and there was paralysis of the external rectus of the left eye, which remained paralysed. The knee-jerks were absent and there was no ankle-clonus or Babinski phenomenon present. The pulse was irregular and intermittent. The temperature was not characteristic and ranged from 97 to 104. Examination of the fluid obtained by lumbar puncture showed the presence of intercellular diplococcus and an excess of polymorphonuclear cells. A month after her dis-

charge she returned with symptoms of lobar pneumonia from which she died in a few days.

Autopsy.—The pathologic diagnosis was double lobar pneumonia and acute fibrinous pleurisy. The lung showed some cavity formation and pulmonary tuberculosis was probably present, including some miliary tubercles. Arachnoid was congested except over the frontal lobes.

Microscopic Examination.—The infiltration in the pia was not intensely cellular. There were some leukocytes in small quantities, numerous round cells, numerous connective-tissue cells and some large round mononuclear cells. Many red blood-cells were seen. Some of the connective-tissue cells showed advanced vacuolization and some contained blood-pigment. Other cells stained deeply and contained dark round nuclei. The vessels of the cortex were filled with red blood-cells, the walls were thickened, showing hyaline degeneration and some of the vessels were obliterated. There was perivascular round-cell infiltration of the cortex which was rarified. Fresh hemorrhages were found in the subcortical layers which was also the seat of a slight cellular infiltration.

In this case a diagnosis of tuberculous meningitis had been made, from which the patient made a recovery, having been discharged as cured. It may have been, and probably was, a diplococcus meningitis, though the presence of cavity formation in the lungs leaves some doubt as to whether or not it was not actually a case of tuberculous meningitis after all. This case is interesting as illustrating the alleged cures of tuberculous meningitis, about the exact nature of which, however, it seems to me there is some doubt.

The microscopic findings were similar to those found in tuberculous meningitis of a proliferative type but less marked. Added to this there was evidence of an old process in the fibrous nature of the process and in the presence of degenerated cells.

The cortical lesion was of two kinds, an old process, represented by the rarification of the cortex and degenerated blood-vessels, and a recent process characterized by fresh hemorrhages and some round cell infiltration, perivascular in type.

The older process, I take it, was the remains of the diseased condition from which the child recovered, apparently, a month prior to the onset of the fatal pneumonia. The more recent process could be explained by a meningeal extension of the pneumococcus invasion.

CASE 9.—Patient.—J. S., aged 1 year, admitted to the Children's Hospital September 26, 1907, died October 21. The family and previous histories were entirely negative. The child was breast-fed from birth. The duration of illness was thirty days and began with high fever and vomiting. Shortly after the onset the patient was comatose, the neck became stiff, the pupils were dilated, reacting sluggishly to light, and the reflexes became increased. Except for two vesicles which were found on the cheeks, no eruption was observed.

Later there developed internal strabismus, tremor of the head and body, spasm of the hamstring muscles and Cheyne-Stokes breathing.

On several occasions lumbar puncture was made; the fluid contained, besides pneumococci, many polymuclear cells, leukocytes and red blood-cells. The temperature ranged from 98.2 to 105, rising finally to 107.2 before death.

Autopsy.—Cerebrospinal meningitis was diagnosed. None of the other organs showed any tuberculous involvement. There was marked distention of the fourth ventricle.

Microscopic Examination.—The pia was fibrous and sparsely dotted with cells, mononuclear in type. The nuclei stained poorly in the outer layers of the thickened pia and in some the protoplasm was granular while in others there were two nuclei present. In the inner layers there were many deeply staining, small and irregular nuclei. A few plasma cells were observed. Around the blood-vessels the cellular accumulation was marked, composed mainly of the connective-tissue type of cell. There was also a slight proliferation of the intima of the

small veins. In the cortex capillary hemorrhages were observed and there was some perivascular distention. In some of the cells four nuclei were observed, suggesting karyokinesis.

This case was diagnosed as pneumococcus meningitis, the pneumococcus having been found in the cerebrospinal fluid. It is of the mixed type showing proliferative and exudative characteristics, and it is to be noted that microscopically it differed in no way from the usual picture of tuberculous meningitis.

SUMMARY

Of these cases only one (Case 4) properly belongs to the purely exudative type of tuberculous meningitis. Three (Nos. 2, 5 and 7) are proliferative cases and three (Nos. 1, 3 and 6) are of the mixed type. Blood or blood pigment was found in eight (Nos. 1, 2, 3, 4, 5, 6, 7 and 8) of the cases. Plasma cells were found in six of the cases (Nos. 2, 3, 4, 6, 7 and 9).

Blood-vessel changes to a more or less degree were present in all the cases. Cortical changes were present in all the cases, in three of which marked evidence of encephalitis was observed. The duration of the disease seems to have little if any bearing on the character of the exudate. The duration of the disease in the exudative type was four days; in the proliferative type three weeks, twenty-seven days, eighty-one days and one of short duration; in the mixed type seventy-four days; thirty days, twenty-two days and one of short duration.

In this study an effort was made to investigate the histologic characteristics of the process at those places removed from the tubercles themselves. The lesion in all cases was more or less similar, except in the one case showing a purely exudative type and this was, beyond doubt, one of typical tuberculous meningitis.

Cases 8 and 9 are doubtful cases of tuberculous meningitis but the histologic findings are identical to those found in the other cases.

This brings up the question as to the nature of so-called tuberculous meningitis. I believe that it is possible, if not probable, that the meningeal exudate in these cases is due to a mixed infection and not alone, or at all, to the toxins of the tubercle bacillus.

The rapidity of the course of the disease in these cases, which from its inception till the death of the patient is often but a very few days, is unlike the slow chronic process characteristic of tuberculosis in other organs. Moreover, in cases of tuberculosis of the meninges of patients who succumb to this disease in other organs, the histologic picture is not the usual one found in the tuberculous meningitis of children.

The process in tuberculous meningitis, I believe, does not necessarily originate solely from the tubercle bacillus or its toxins. The absence of the bacillus of Koch, which is not unusual, speaks against it. Moreover, the histologic picture of the lesion removed from the tubercle is of a round cell infiltration which, I believe, cannot be said to be pathognomonic of a tuberculous process.

Non-specific or simple inflammatory reactions in tuberculous meningitis have been already described by Villaret and Tixier,¹ Peron,² Hayen,³ Chantemesse⁴ and others.

Diffuse leukocytic infiltration without tuberculous granulations and without definite tubercles and giant cells has also been observed by Siredey and Tinel.⁵

1. Villaret and Tixier: *Compt. rend. Soc. de biol.*, 1905, p. 600.

2. Peron: *Arch. gén. de méd.*, 1898, p. 413.

3. Hayen: In Josué and Salomon (Note 16).

4. Chantemesse: In Josué and Salomon (Note 14).

5. Siredey and Tinel: *Lancet*, London, April, 1907, p. 1033.

That it may be a mixed infection is well illustrated in the observations of Perrin,⁶ who found the diplococci in the cerebrospinal fluid; of Kneass, Hendrickson and Sailer,⁷ who isolated the *Micrococcus tetragenus* in the spinal fluid, as well as the tubercle bacilli in the smears from the tubercles in the meninges; of Griffon and Abrami,⁸ in whose case the cerebrospinal fluid was invaded by the *B. coli*; of Marotte,⁹ who described a case of septicemia of tetragenous origin coincident with tuberculous meningitis; and of Poisseau and Tixier,¹⁰ in whose case were found diplococci not taking the Gram stain.

In two cases in my series, moreover, the diplococcus was found in the cerebrospinal fluid. In this connection, however, should be mentioned the contention of Sicard,¹¹ that the exudate in the pia is not the result of polymicrobial infection and that the bacillus of Koch and its toxins are capable in themselves of creating these granulations.

The experimental evidence is somewhat conflicting. Hektoen¹² failed to produce typical meningitis by injecting tubercles into the carotids of rabbits, though miliary tubercles were observed in the meninges.

On the other hand, Sicard produced experimentally a diffuse process consisting of a leukocytic infiltration and other lesions similar to the diffuse meningeal changes found in man. There is no evidence in these experiments to exclude, however, the existence of a mixed infection.

At the same time the experiments of Martin and Vandremmer,¹³ and Peron,¹⁴ show, according to these observers, that the toxins of tuberculosis play an important rôle in the development of tuberculous meningitis.

CELLULAR CHANGES

The cellular changes have been studied by Diamond,¹⁵ Josué and Salomon,¹⁶ Poisseau and Tixier,¹⁰ Higgs¹⁷ and Siredey and Tinel.⁵

Diamond¹⁵ found that the plasma cells, lymphoid cells, and phagocytic cells formed the principal cell-content of the infiltration of vascular leptomeningitis. He claims to have been the first to have described the presence of the plasma cell in acute tuberculous inflammation. The phagocytes were looked on as transmitting the tubercles from one area to another.

Lymphocytes and polymuclear cells predominated in the cases of tuberculous meningitis in adults studied by Josué and Salomon.¹⁶

In the case cited by Poisseau and Tixier¹⁰ the cellular infiltration was composed of mononuclear lymphocytes and endothelial cells without giant cells and finally, in the case of Siredey and Tinel,⁵ the examination showed a diffuse leukocytic infiltration without tuberculous granulations or giant cells.

The exudate in Higgs' case consisted of fibrin and round cells, mainly large and small lymphocytes, but some polymorphonuclear leukocytes.

The cellular changes of the exudate of tuberculous meningitis are not absolutely characteristic, somewhat similar changes having been described by Spielmeyer,¹⁸ as existing in trypanosomiasis and paresis (Gehry¹⁹), though Gehry concludes that the miliary foci in the pia give the process a typical appearance. While this is true, I think it still may be contended that the cellular makeup of the process remote from the tubercle is not typical of a tuberculous process.

VASCULAR CHANGES

The blood-vessels exhibited, in my cases, more or less change in seven of the nine cases studied. These changes consisted of thickening of the walls of the arterioles and some veins, which in one case went on to obliteration of the lumen of the small vessels. Perivascular round-cell infiltration was observed quite commonly. In some instances the coats of the veins were thickened and in others there was cellular proliferation of the intima. In one case an accumulation of round cells beneath the intima was observed; in another case cellular proliferation of the outer coat was demonstrated; and finally, in still another case the walls of the capillaries, in which the outer coat showed cellular proliferation, had undergone hyaline degeneration.

The vascular changes described by Hektoen¹² which were present in all of his nine cases, consisting of a primary endarteritis and a phlebitis causing thrombosis and obliteration, were not uniformly present in my cases.

Hektoen believes that this primary endarteritis is due to the implantation of the tubercle bacilli on the intima. He describes, (1) a diffuse form in which proliferation of the epithelioid cells occurs between the elastic lamina and the endothelium; (2) isolated miliary tubercle on the intima either singly or in conjunction with diffuse endarteritis, and (3) diffuse changes which proceed from periarterial foci.

He quotes the works of Huguenin, Huttenbrener, Cornil and Hirschberg, who observed tuberculous endarteritis which was looked on as primary and due to the implantation of the tubercle on the intima.

Rindfleisch, Ziegler, Birch-Hirschfeld, Lancereau, Baumgarten, and Guernieri and others believed that the bacilli were localized in the adventitia, and Guernieri and Baumgarten described an endarteritis which they regarded as secondary (Hektoen¹²).

Blood-vessel changes have been described by Raymond,²⁰ who found in the majority of the vessels of the pia an infiltration of the sheaths. Vascular changes have also been described by Diamond¹⁵ and Lartat-Jacob and Sabareanu.²¹ In Dreher's case²² proliferation of the intima went on to obliteration of the lumen, and there was also perivascular infiltration.

Ettinger,²³ on the contrary, said that the absence of obliterating arteritis was striking and that the walls, and especially the external and middle coat, are a little thickened but uniformly so, and that the infiltration of the round cells is regular.

ENCEPHALITIS

A slight diffuse encephalitis is always present in these cases, according to Oppenheim.²⁴

6. Perrin: Rev. méd. de l'est., 1902, No. 34, p. 677.
7. Kneass, Hendrickson and Sailer: Jour. Nerv. and Ment. Dis., 1903, p. 431.
8. Griffon and Abrami: Bull. et mém. Soc. méd. d. hôp. de Paris, 1906, xxiii, 613.
9. Marotte: Bull. méd., 1909, p. 259.
10. Poisseau and Tixier: Gaz. d. hôp., 1909, p. 979.
11. Sicard: Presse méd., 1900, p. 67.
12. Hektoen: Tr. Chicago Path. Soc., 1894-5, 1, 69.
13. Martin and Vandremmer: Compt. rend. Soc. de biol., 1898, p. 273.
14. Peron: Arch. gén. de méd., 1898, II, 412.
15. Diamond: Am. Jour. Med. Sc., New Series, 1903, cxxvi, 147.
16. Josué and Salomon: Bull. et mém. Soc. méd. d. hôp. de Paris, 1903, xx, 1183.
17. Higgs: Brit. Med. Jour., 1909, p. 1170.

18. Spielmeyer: Die Trypanosomenkrankheiten, 1908.
19. Gehry: Arch. f. Psychiat., 1909, p. 59.
20. Raymond: Rev. de Med., 1886, p. 230.
21. Lartat-Jacob and Sabareanu: Bull. et mém. Soc. anat. de Paris, 1904, p. 161.
22. Dreher: Deutsch. Ztschr. f. Nervenhe., 1899, p. 58.
23. Ettinger: Compt. rend. Soc. de biol., 1896, p. 23.
24. Oppenheim: Lehrbuch der Nervenheilkunde, 1905, p. 776.

Distention of the perivascular spaces was noted in seven of the cases under discussion. In three cases there was marked round cell infiltration of the superficial layer of the cortex and in another capillary hemorrhage was found. The cortex was rarified in two cases and the cerebellum was the seat of a marked encephalitis in one case.

In this connection the work of Lhermitte²⁵ is interesting. He described tuberculous meningo-encephalitis and believed it impossible to decide, in a great many cases based on the histologic findings, whether the condition was one of tuberculous encephalitis or a simple (banale) inflammatory reaction. He found in these cases that the plasma cell was present in the cortex.

PLASMA CELL

Studies of the plasma cell in tuberculous meningitis have not been made to any extent until within the last ten years. Wolf believed that they were regularly present in tuberculous meningitis and believed, furthermore, that degenerated plasma cells were found in all cases, though in varying amount, and raised the question whether these did not have some connection with regressive metamorphosis. Gehry¹⁹ believed that the plasma cell played an important rôle in the regressive changes in the nerve-elements.

The rôle of the plasma cell in vascular tuberculous meningitis was described at length by Diamond,¹⁶ who found them present in chronic and acute cases of tuberculous meningitis.

They were not found in all of the cases reported in this paper. In six cases, however, they were present to a greater or less extent.

As to the origin or significance of the plasma cell, this paper does not strictly pertain. Suffice to say that much has been written on the subject and whether the plasma cell originates from the lymphocyte, as Krompecher,²⁷ Marschalko,²⁸ Justi,²⁹ Joannovics,³⁰ Porcile,³¹ Councilman,³² Herbert,³³ Jadassohn³⁴ and Schottlander³⁵ claim, or from the endothelial cell, as is believed by Unna,³⁶ Ehrlich³⁷ and others, is still a matter of dispute.

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CHANGED PERSONALITY DUE TO HEAD INJURY

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Cases of lost personality are by no means rare, but they are always intensely interesting. As a rule, the personality is lost for a single period of time, either long or short. In the case I wish to report, this mental lapse seems to have persisted for about fourteen years, and since it has received considerable publicity, a full report of the medical aspect cannot fail to be of value.

S. C. R. was brought to me late in the evening of Oct. 13, 1911, with the following incomplete history: He had been working in the saw-mill at Port Blakely, one of the near-by

towns, for a period of six months. Nine weeks before his entry to the hospital he had been married. Nothing was known of his previous history, but it was supposed that he had served a number of years in the navy. As far as anyone knew he had been a perfectly normal man. His habits had been exemplary. Tuesday, October 11, while at work, he complained of not feeling well; left work and returned to his home about 10 a. m.; changed his clothes; ate his mid-day meal; and asked his wife what he might order for her from the store. He went to the store, left his order and was not seen again until about 9 p. m. Thursday, when a person living near the outskirts of the village, attracted by the unusual actions of a collie dog, took a lantern and followed the dog into the brush to investigate. The patient was discovered naked, moving around on his hands and toes. Assistance was called; he was seized, handcuffed and taken to the hospital, where he snapped at the attendants and gnawed at his chains until his teeth crumbled and broke. The next morning he was taken before an insanity commission, which decided that he was not insane and sent him to Seattle for treatment.

I saw him first at 10 p. m. Friday. He was in good physical condition; his body showed many scratches, especially over the knees and legs; he did not articulate, but pointed to his ear and then to his mouth, apparently suggesting that he could hear but not speak. Pupils were equal and dilated; they did not react. Head, neck, chest and abdomen were negative. Cremasteric and knee-reflexes were much exaggerated, but equal; on stroking the foot the toes flexed sharply and as sharply extended and spread widely. The pulse was full and slow, with tension much increased—a typical pulse of increased intracranial pressure; temperature and respiration were normal.

A tentative diagnosis of probable uremia being made, suitable treatment was instituted, even though a catheterized specimen of urine showed no albumin.

The next morning his condition was considerably improved; the pulse-rate was between 70 and 80, and the tension but slightly above normal. He was able to enunciate a word which sounded like "clothes," pointing the while to his naked body. I saw him again in the late afternoon. There had been a return of his cerebral symptoms. His pulse had dropped to 50 and was of very high tension. I noted for the first time that he was probably unable to see, since his eyes never focused on any point.

The next morning, his condition being unchanged, Dr. George Swift was asked to make a fundus examination, which he did shortly after noon. He reported a progressing choked disk in both eyes, but more marked in the right. At this time a white-cell count showed 16,000, and the differential count 40 per cent. small mononuclears, with a corresponding decrease in the polynuclears. An immediate decompression was decided on.

Under ether an osteoplastic flap, 3½ inches square, was removed. The dura, which bulged tensely, was opened, disclosing a typical "wet brain," which oozed fluid so rapidly that it trickled in a fine stream from the dependent portion of the wound. The dura was only partly closed, and the scalp wound was closed with drainage. The patient was removed to his room in good condition.

The morning of October 16 the pulse was still somewhat slow; the temperature was normal; and the patient seemed quite normal, except that there was some hernia of the brain. He complained much of headache and was decidedly aphasic, asking with much difficulty—apparently being unable to find the correct words—some few questions regarding himself. When his wife came in to see him he did not recognize her and denied that he was married.

He slept much of the day and when I saw him the following morning he was much improved, there being but a slight aphasia and a lessened hernia of the brain. He evinced much interest in the dressing of his wound, and related to me that a woman calling herself his wife had been in to see him. He said: "Maybe she is, if she says she is, but I have never seen her before this." Dr. Robert Percy Smith, who examined him at this time, reported that "Kelly," as we then called him, was in a condition of "mental confusion." When the patient was questioned he said that his name was not Kelly, but that he could not remember his right name. That evening, for the first time, he said that his name was S. C. R., and that he lived with his "granny" and sister.

The day following—the 18th—he objected to being called Kelly, and denied being married. That afternoon he stated that he must have been unconscious when he was brought to the hospital, as he recollected nothing beyond the evening before, and that he thought he had been in there about two

25. Lhermitte: *Rev. Neurol.*, 1910, p. 49.
27. Krompecher: *Beitr. z. path. Anat. u. z. allg. Path.* (Ziegler's), 1898, xxiv, 104.
28. Marschalko: *Centralbl. f. allg. Path.*, 1899, p. 851.
29. Justi: *Virchow's Arch. f. path. Anat.*, 1897, cl, 197.
30. Joannovics: *Ztschr. f. Heilk.*, 1899, p. 159.
31. Porcile: *Beitr. z. path. Anat. u. z. allg. Path.* (Ziegler's), 1904, p. 276.
32. Councilman: *Jour. Exper. Med.*, 1898, p. 393.
33. Herbert: *Jour. Path. and Bacteriol.*, 1901, vii.
34. Jadassohn: In Krompecher (Note 27).
35. Schottlander: *Ueber Ekerstocks Tubercul.*, 1897, p. 81.
36. Unna: In Krompecher (Note 27).
37. Ehrlich: *Virchow's Arch. f. path. Anat.*, 1904, clxxv, 198.