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CHRONIC EPIDEMIC ENCEPHALITIS

REPORT OF A CASE: CLINICAL RECORD, COMPLETE NECROPSY AND DETAILED HISTOLOGIC STUDY OF THE CENTRAL NERVOUS SYSTEM *

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The following report of a case of epidemic encephalitis representing both clinical and anatomic examinations is of particular interest because of the persisting inflammatory brain changes after fourteen months, and also because complaints of abdominal pain, muscle spasm and gastric distress thought to be due to local causes ultimately led to an exploratory laparotomy. This exploration revealed no pathologic condition to account satisfactorily for the abdominal symptoms, and the final analysis of the case explained these symptoms as being due to brain lesions.

CLINICAL REPORT BY DR. SCHALLER

History.—K. G., dispensary number 91724, aged 42, an American laborer (harvest hand), was admitted to the clinical ward of Lane Hospital on Jan. 3, 1921. He complained principally of abdominal pain, but other complaints were: headache, burning pain in the back and legs, soreness over the lower part of the chest, numbness and weakness of the right arm, hoarseness and difficulty in swallowing, tinnitus and nervousness. The abdominal pain was described as gnawing in character, relieved for a short time by soda or by eating. Three or four times a day he had a severe jerking pain like stomachache, generally on the left side of the abdomen under the ribs, but also on the right side. He had been nauseated only once, about two months ago, but had never vomited. Occasionally he suffered with a sour stomach and burning regurgitation after eating. This had occurred more frequently of late. There was a tendency to constipation.

In September, 1920, he was in a hospital in Berkeley, Calif., for two weeks, where a diagnosis of gastric ulcer was made. He was not benefited by a special diet. He said that he weighed 125 pounds (56 kg.), his normal weight being 165 pounds (74 kg.).

The patient attributed his trouble to an illness he had had while in Nebraska in November, 1919, which began with roaring in the ears, sharp occipital headache and alternating chilly and feverish sensations. He thought he had grip. Following this onset he felt run down, and when he attempted to work he felt worse. He had constant dull headaches. One month after the beginning of

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his illness he was seized with convulsions which lasted about forty-eight hours, coming on one after another. They were intensely painful causing him to double up as with colic. These convulsions were described as a general spasm without loss of consciousness, and a part of the spasm seemed to be inside his abdomen. These spasms of pain terminated suddenly, leaving him weak, trembling and scarcely able to talk. He was removed to a hospital a day later where a diagnosis of ptomaine poisoning was made. Here he remained for four months, and he was said to have been delirious for two months. After regaining consciousness he was drowsy, resembling he thought, a patient in a neighboring bed whose case was diagnosed as lethargic encephalitis. The headaches persisted, and about a week after leaving the hospital a churning pain began in the stomach, his voice became hoarse, and a twitching in both arms and shoulders developed so that he could hardly use either. At times his muscles would contract involuntarily so as to jerk him violently one way or another. He improved until the latter part of 1920, difficulty of speech disappearing, and his left arm becoming normal. During the last few months, however, his condition had become aggravated gradually reaching the stage in which he had difficulty with speech and swallowing, and could use his right arm very little; his stomach trouble also increased.

He had acute inflammatory rheumatism when 7 years old, lasting three years, from which he recovered without complications, and the usual children's diseases, including diphtheria. "Chancres" eight years ago were treated locally Gonorrhea was denied. He had smallpox several years ago.

The family history was unimportant.

Examination.—The patient was first examined in the medical service of Dr. A. W. Hewlett. The chest was well developed but asymmetrical due to thoracic scoliosis. The left side moved less posteriorly than the right. No abnormalities were found in the lungs. The heart impulse was not seen or felt, and the cardiac dimensions were of normal size. The heart sounds were clear. The heart rate was accelerated; the blood pressure was: systolic, 150; diastolic, 100. The abdomen was on a level with the ribs. The right side was quite rigid, particularly above; the left side moderately so. Repeated later examinations of the abdomen continued to show marked rigidity and muscle spasms, especially in the upper half and on the right side (upper right quadrant). The patient continued to complain of pain just beneath the ensiform.

Report of Eye Clinic (Albert B. McKee).—The fields and pupils were normal. Vision in the right eye was 20/100; with plus 2 hypermetropic astigmatism correction, vision was 20/40; vision in the left eye was 20/30-20/20; no glass. The backgrounds were normal. Diagnosis: Anisometropia (right hypermetropic astigmatism); double dacrocystitis.

Roentgen-Ray Examination.—The gastro-intestinal tract was normal. The chest was normal except for old pleural scars.

Report from the Ear, Nose and Throat Clinic (E. C. Sewall).—Pointing tests with the right arm were influenced by interference with movements caused by impaired muscular action. The left arm showed a slight spontaneous past pointing to the right. Past pointing after turning was in the proper direction but hypo-active. All canals responded properly to stimuli, except the left vertical canal, which showed a slightly perverted nystagmus after caloric stimulation of five minutes.

Ears: The ear drums were fibrous and retracted; poor light reflex.

Hearing of watch-tick was diminished in the right ear so that a watch-tick normally heard at a distance of 40 inches (101 cm.) could only be heard at 3 inches (7.6 cm.). In the left ear it could only be heard on contact. In the tuning-fork tests air conduction was good in both ears, but bone conduction was only fair. The Rinné test was positive. In the Weber test the vibrations were lateralized toward the right.

Neurologic Examination (Feb. 9, 1921).—General Survey: The patient was poorly nourished and weighed 125 pounds (56 kg.). He was nervous and trembling, and sweated profusely at the time of examination. A fine muscular tremor was present on both sides of the face and neck, most marked on the left side. The thyroid cartilage was drawn somewhat to the right. The Romberg sign was negative, and the gait was normal.

Coordination: A slight ataxia was present in the finger to nose test, with marked intention tremor. The heel to knee test was normal. The spread fingers showed a coarse tremor. An intention tremor was present when the patient attempted coordinate movements (reaching for a glass) under observation.

Neuromuscular: Twitchings (tremor) of facial and platysma muscles were present; there was a slight atrophy of the right platysma. The muscles of mastication seemed weak as a whole; there was marked atrophy of the left masseter and temporal muscles. The left pterygoids were involved (inability to move the jaw laterally to the right as far as to the left). The grip of the teeth was weak; the grip was weak in both hands, more marked in the right.

Reflexes: The tendon reflexes were hyperactive throughout. There were no pathologic pyramidal reflexes: the Babinski, Oppenheim and Gordon signs were negative.

Sensibility: Somatic sensation was unaffected by the usual tests for superficial and deep sensation.

Cranial Nerves: The first nerve was normal. Second Nerve: The fields and fundi were normal. (See special eye examination.) Third, Fourth and Sixth Nerves: The pupillary reactions and the eye movements were normal. A slight nystagmus was present to the left when looking to the left. There was no diplopia. Fifth Nerve: Taste on the anterior two thirds of the tongue was normal. The corneal reflex was present bilaterally. The muscles of mastication were weak, especially on the left side, as noted. Seventh Nerve: Tremor was present in the facial muscles, especially on the left and in the platysma. On emotional expression the face was less wrinkled on the right side than on the left. Eighth Nerve: See special ear examination. Ninth, Tenth and Eleventh Nerves: Some difficulty was experienced in swallowing, marked at times. Taste was normal on the posterior third of the tongue. The trapezius muscle was slightly atrophic on the right. Twelfth Nerve: There was slight deviation of the tongue to the left. There was some difficulty of protrusion of the tongue, but no tremors.

Laboratory Examination.—On Jan. 31, 1921, the urine was clear, yellow-amber, acid, 1.025; no abnormalities were found. Blood analysis on Feb. 1, 1921, showed 4,600,000 red cells, hemoglobin 85 per cent. (Talquist), white cells 6,050, polymorphonuclears 74 per cent., lymphocytes 20 per cent., large mononuclears 5 per cent., transitionals 1 per cent. A repetition of the white count on February 14 showed 7,350 cells. The sputum was examined on Feb. 1, 1921; it was whitish with a musty odor and in consistency was watery streaked with bright red blood. There was no tubercle bacilli, but streptococci were

abundant; there were also many staphylococci. A feces examination on Jan. 31, 1921, revealed a soft formed dark brown material with a few vegetable fibers and cells, and a few small particles of fat; the examination was otherwise negative. A cerebrospinal fluid examination was made on Feb. 5, 1921. Approximately 15 c.c. of fluid were withdrawn; the pressure was 90 mm. The fluid was clear in appearance and contained 1.2 leukocytes per cubic millimeter. The Nonne and Noguchi tests for globulin were negative, but the Pandy was faintly positive. The Wassermann reaction was negative in amounts as high as 1 c.c., cholesterinized beef heart antigen being used. The blood Wassermann test under date of Feb. 1, 1921, was negative with three different antigens—cholesterinized beef heart antigen, acetone insoluble antigen and guinea-pig heart antigen. Repeated tests of the stomach contents (five in all) from February 1 to February 13, inclusive, after the ingestion of an Ewald test meal, showed a total acidity ranging from 95 to 32. The free hydrochloric acid ranged between 74 and 25. There was no free blood found, and apparently digestion was fair.

Nurse's Record.—The temperature on admission was 99 F., but dropped to normal the next day. Several early morning temperatures of 97 were recorded in the following days. Rectal temperatures as high as 100-100.4 F., were noted on January 7, 9, 10, 11 and 12. The pulse on one occasion (February 11) was registered at 100, but averaged between 80 and 90. The respirations averaged 20.

A note on Feb. 16, 1921, stated that the patient had been on a Sippy diet for nine days and felt more comfortable, and that the muscle spasm was somewhat lessened, but the result was not striking. On Feb. 18, 1921, the patient was transferred to the surgical clinic for an exploratory abdominal operation.

Operation.—Feb. 19, 1921, an exploratory laparotomy appendectomy was performed. The operators were Dr. John F. Cowan, assisted by Dr. Frances Ford and Dr. Lloyd Reynolds. A high right rectus incision was made; the exploration revealed a normal stomach, gallbladder, liver, spleen and pancreas. Both kidneys were normal in size and position. The bladder and prostate appeared normal. There was no evidence of tubercles in the peritoneum, nor any enlargement of the retroperitoneal lymph glands. The appendix was atrophic and was removed in the usual manner. Nothing was found in the abdomen to account for the patient's symptoms. On Feb. 20, 1921, the patient vomited a considerable amount of dark coffee-ground material, which gave a positive benzidin test for blood. On February 22 there was great difficulty in swallowing, and fluids were regurgitated through the nose; a considerable heavy sputum apparently came from the throat. At 5 a. m. on February 23 the patient died.

Summary.—An American laborer, aged 42, developed symptoms in November, 1919, which were suggestive of a severe attack of epidemic encephalitis. Improvement was noted for a year, but at the end of this period there seemed to be a mild recurrence of certain of his former complaints, notably difficulty of speech and of swallowing, headache, generalized burning pains and nervousness. Added to these were more distressing local complaints of abdominal pain, muscle spasm and gastric distress, which finally led to an exploratory operation. Except for an atrophic appendix, which showed on removal microscopic evidence of a chronic obliterative process, no gross lesions were found. The patient died four days after the operation from bulbar paralysis.

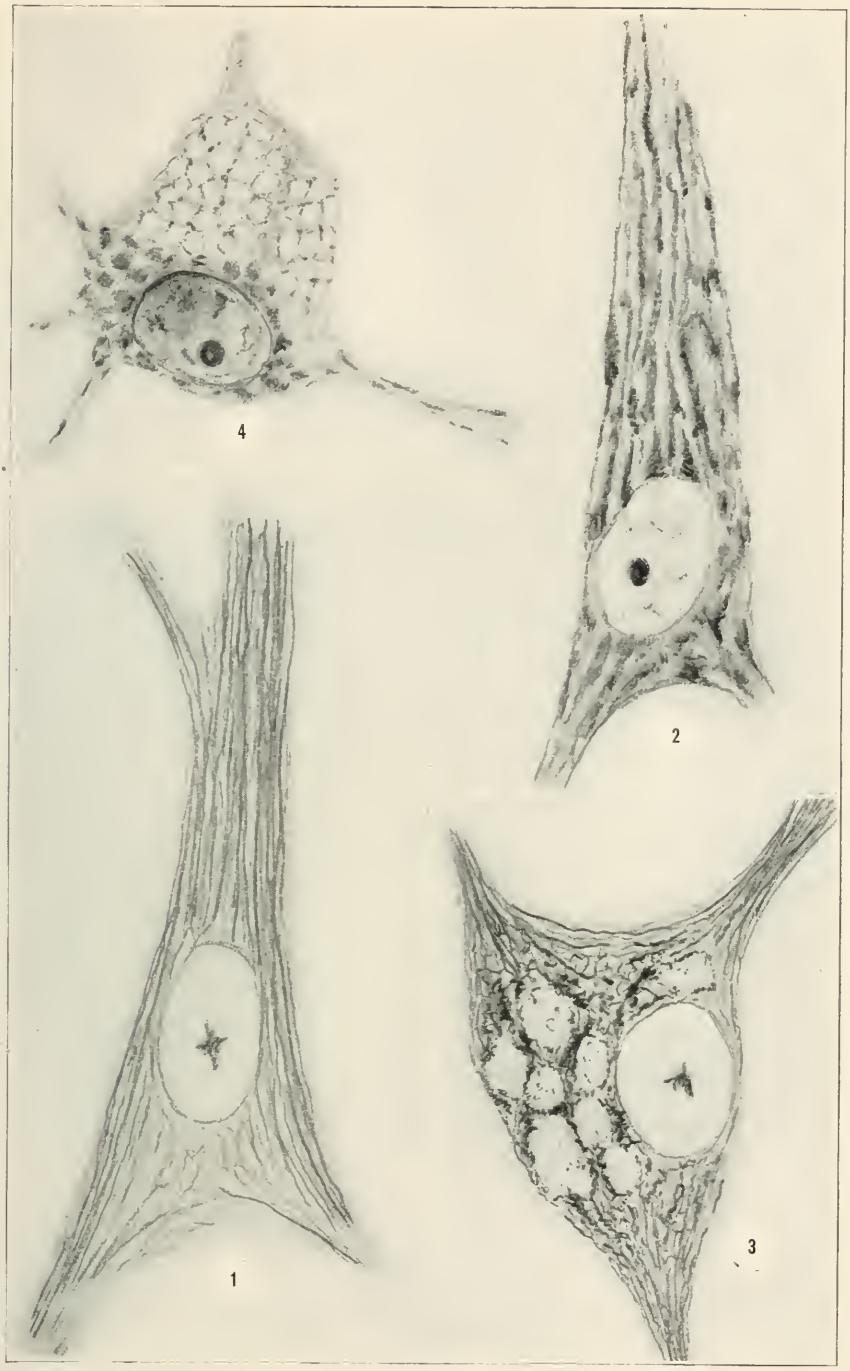

Plate 1.

Fig. 1.—Giant cell from cerebral cortex stained by Bielschowsky's method, showing normal fibrillae.

Fig. 2.—Similar cell from same region stained with methylene blue, showing normal tigroid bodies.

Fig. 3.—Ganglion cell from thalamus stained by Bielschowsky's method, showing vacuolization and marked degeneration of the intracellular fibrillae.

Fig. 4.—Similar cell from same region stained with methylene blue, showing degeneration of the tigroid bodies and the same vacuolization.

ANATOMIC REPORT BY DR. OLIVER

The necropsy examination was performed six hours after death. The body was that of a fairly strongly built, rather emaciated man of about 30 years.

The skull-cap and the external surface of the dura were normal. The superior longitudinal sinuses contained some postmortem clots. The pia over the convexity of the hemispheres showed a mild hyperemia and edema. The pia over the base of the brain was also hyperemic and showed a diffuse thickening around the sylvian fissure. There were no adhesions between the pia and the gray matter. There were a few arteriosclerotic plaques in the vessels at the base of the brain. A section through the brain stem at the pons was apparently normal. The lateral ventricles were not dilated. The large venous sinuses at the base of the brain contained some postmortem clots. The dura and the bone were apparently normal.

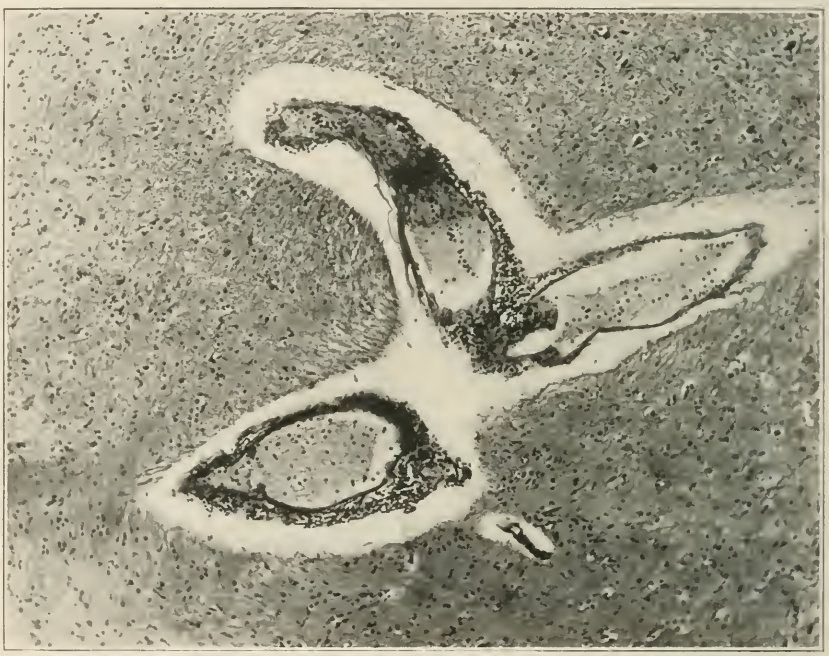

Fig. 1.—Small vessels in the thalamus, showing marked perivascular round cell infiltration.

Gross and microscopic examinations of the viscera were practically negative with the exception of the presence of bronchopneumonia.

After small pieces had been removed and fixed separately in different reagents, the brain was fixed *in toto* in 10 per cent. formaldehyd and was then cut in gross frontal sections. The only gross lesions noted in these sections were hyperemia and red spots which had the appearance of hemorrhages in the region of the substantia nigra.

Microscopic sections were prepared from various levels of the cervical cord, the brain stem, the basal ganglions, the cerebellum and the cerebral cortex, and stained with methylene blue, Bielschowsky's fibrillar stain, the Weigert-Pal method, Hamberger's Victoria blue method for glia, sudan III, van Gieson,

and hematoxylin and eosin. As the lesions encountered are more or less the same in different regions, a general description is first given followed by a topographical study. The lesions found in the more acute type of lethargic encephalitis are only briefly mentioned as they have been described repeatedly.

Lesions of Vessels.—The most striking change was a round cell infiltration around the smaller vessels in the adventitial tissue (Fig. 1). The cells found were those usually described, comprising lymphocytes, plasma cells and a few larger cells of the type of "endothelial leukocytes." No polymorphonuclear leukocytes or eosinophils were seen. Fat stains showed a moderate amount of fat in the form of coarse droplets in the larger type of cell.

Besides these more acute lesions, proliferative changes in the adventitial connective tissue were also present. These consisted in an increase in fusiform cells with large vesicular nuclei and intercellular collagen fibrils. In some regions the adventitia was distinctly thickened by this proliferation.

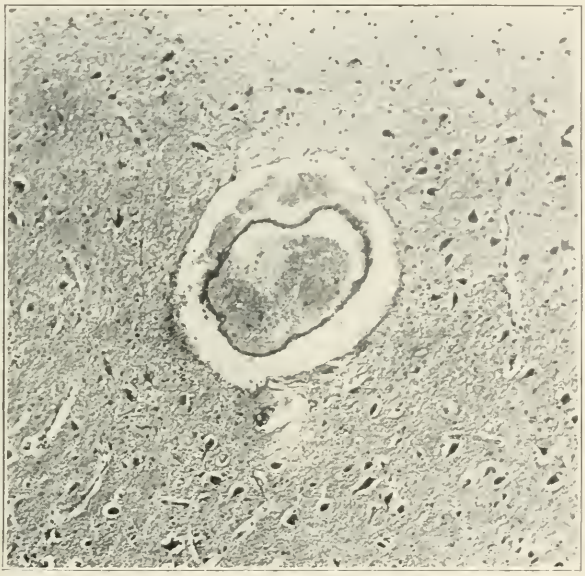

Fig. 2.—Small vessel in the thalamus, showing perivascular hemorrhage.

The other striking vascular lesion was hemorrhage. As a rule this consisted in extravasation of red cells into the perivascular tissues (Fig. 2). More rarely irregular infiltrations into the nervous tissue were found extending some distance from the vessel concerned. In all cases the red blood cells were well preserved so that the hemorrhages had apparently occurred late in the course of the disease.

Lesions in the Ganglion Cells.—Changes in the ganglion cells were studied with methylene blue stains and by Bielschowsky's method. As the cerebral cortex was entirely normal (Plate 1, Figs. 1 and 2), sections of this region served as a control for the staining of cells in the regions which showed abnormalities. Such a control is of importance, especially in using the Bielschowsky method, as it often produces artefacts.

The changes in the cells as studied with the methylene blue stains showed a great variety in types of lesions. Rarely Nissl's so-called "acute" type of degeneration was found. Such cells showed eccentricity of the nucleus and chromatolysis of the tigroid bodies, the process being more advanced as a rule in the neighborhood of the nucleus.

More commonly, however, the appearance was that usually considered typical of chronic degeneration. Some cells were small and shrunken, the chromatophile substance either condensed to an opaque irregular mass or in part dissolved. The nucleus, also shrunken and distorted, lay eccentrically and showed either pyknotic or karyolytic changes. Other cells presented only a shadowy outline of their former appearance.

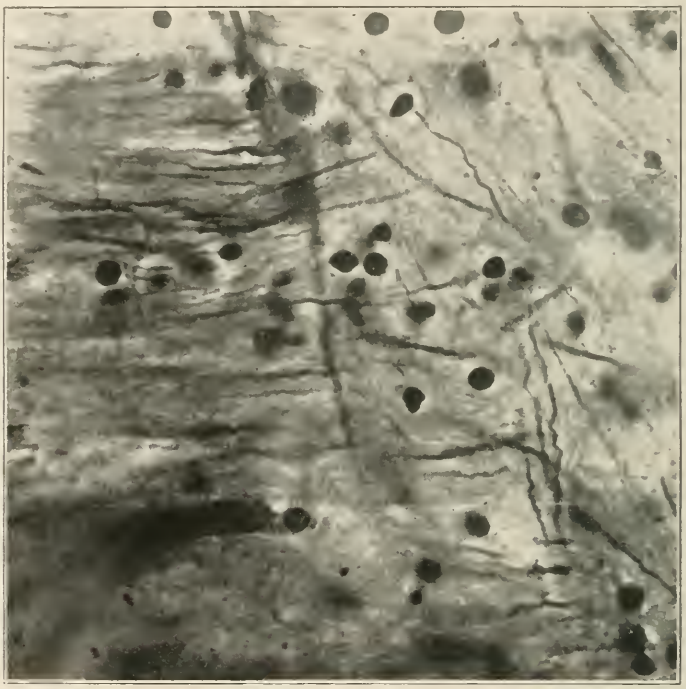

Fig. 3.—Area of gliosis in thalamus, showing the nuclei of many astrocytes and many coarse glia fibrils.

With these changes there was in practically all the regions more severely involved, marked vacuolization of the protoplasm (Plate 1, Fig. 4). These vacuoles were filled with coarse granules, which remained a bright yellow in the blue protoplasm of the cells, and in sections stained for fat, presented a deep reddish-yellow color.

Satellitosis was commonly seen as well as definite neuronophagia. The shadow forms especially were often filled with deeply staining nuclei.

The Bielschowsky preparations showed a normal appearance in the cells of the cerebral cortex (Plate 1, Fig. 1), and as all the tissues were fixed in the same fluid and all run through the staining process at the same time, the changes described in other regions may be considered as actual.

Whereas the intracellular fibrillae of the pyramidal cells were clearly outlined throughout the entire length of the cells and its processes, in those cells which showed abnormalities with the methylene blue stain, striking changes were seen. In many cases the fibrillae of the cell processes, dendrites and axons, were fairly well preserved. At their entrance into the cell body, however, they rapidly lost their normal direction, became involved in an entangled network and ultimately were broken up into fine granules which continued for some distance in the general direction of the fibril from which they arose. Other cells, fewer in number, showed a complete loss of fibrillae in their central portions, which were completely filled with finely granular material. In those cells in which vacuolization has occurred, the fibrillae, besides showing

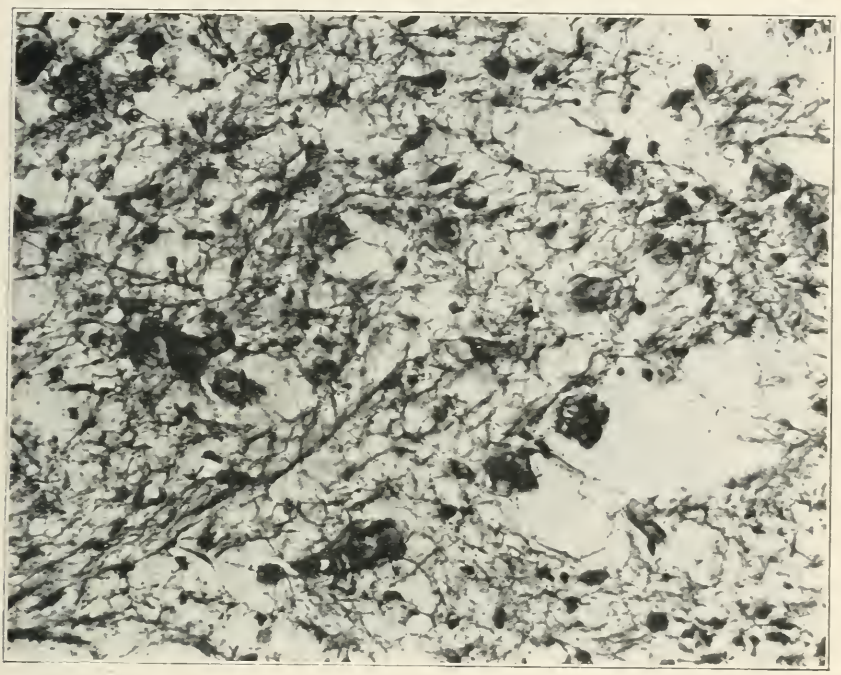

Fig. 4.—Area of spongy gliosis from the nucleus of the ala cinerea.

granular degeneration, were compressed between the clear spaces and were thus heavily outlined in dense black by the reduced silver (Plate 1, Fig. 3). As the vacuoles increased in size this disarrangement of the fibrillae continued until nothing remained except deeply stained fragments and granules densely compressed between the large vacuoles.

Changes in the Neuroglia.—The glia in the regions more severely affected showed definite evidence of proliferation. This consisted in the presence of an excessive number of large cells of the astrocyte type as well as a marked increase in the glia fibrils (Fig. 3). Such proliferation was often found in those nuclei whose ganglion cells showed marked lesions. In such areas of gliosis it was not uncommon to find the fibrils widely separated and so forming a coarse network with clear intervening spaces. The fibrils in such regions were so coarse that they stained well with the picric acid of the van Gieson mixture (Fig. 4).

In many of the areas of glial proliferation were large numbers of amylaceous bodies (Fig. 5). These structures had the usual opaque appearance that is commonly seen in them when occurring in those chronic processes which are accompanied by atrophy of the nerve elements and compensatory gliosis. In spite of this marked proliferation of the fixed glia, amceboid cells or "Gitterzellen" were rarely seen.

Lesions in the Nerve Roots.—The roots of all the cranial nerves were examined and lesions found in several. These were of the same type as those found in the internal portions of the central nervous system, and consisted of round cell infiltration around small vessels and perivascular hemorrhages

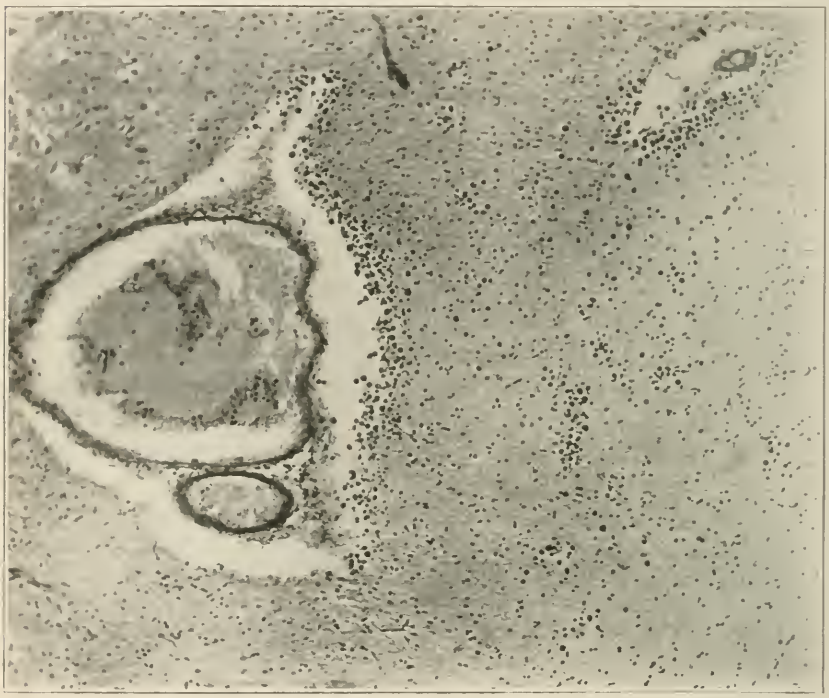

Fig. 5.—Collections of amylaceous bodies around vessels in the subthalamic region.

(Fig. 6). Evidences of chronic processes were also seen, such as increase of glia nuclei and fibrils and the presence of large numbers of amylaceous bodies. These lesions were often most intense at the exit of the nerve roots through the pia.

Lesions in the Myelinated Tracts.—No marked degeneration of any of the long tracts of the brain stem were found. The radial fibers of the cerebral cortex also showed no severe lesions. With the high power lens one could find, however, in practically all regions slight irregularities in the myelinated fibers.

Lesions in the Pia-Arachnoid.—Over the base of the brain, pons and medulla there was a slight increase in the cells of these membranes, consisting in the most part of lymphocytes. As has already been mentioned, these changes were

likely to be most marked at the exit of cranial nerves, and here even hemorrhages might be found, the extravasated red cells lying in the spaces between the connective tissue fibers (Fig. 6).

TOPOGRAPHIC STUDY

Cord: Level of the First Cervical Segment:

No lesions were seen in any of the structures in this region.

Medulla: Level of the Nuclei Gracilis and Cuneatus:

The nucleus gracilis and nucleus cuneatus showed fairly well preserved ganglion cells. The nucleus alae cinereae, however, showed a marked decrease in the number of its ganglion cells, and those remaining were

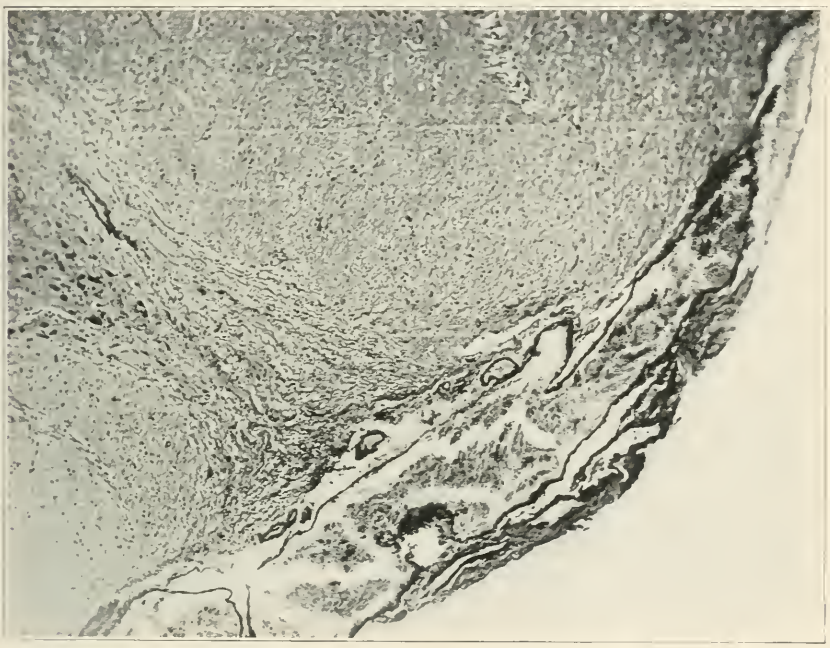

Fig. 6.—Point of exit of the nervus glossopharyngeus, showing a dilated vein and hemorrhage.

either shrunken and heavily stained or showed the reverse chromolytic change. There was marked proliferation of the glia which formed a heavy network of coarse fibrils in which were many cells of the astrocyte type (Fig. 4). There was also a considerable number of amylaceous bodies. The nucleus ambiguus showed moderate lesions of the chronic type in its ganglion cells. The nucleus nervus hypoglossi was entirely normal, its cells well preserved. The ganglion cells of the nucleus olivaris inferior were shrunken and vacuolated and the latter filled with yellow pigment.

The blood vessels throughout the section showed a slight adventitial infiltration with round cells. One perivascular hemorrhage was found.

The root fibers of the nervus hypoglossus were normal. The pia showed no lesions.

Medulla: Level of the Exit of the Nervus Glossopharyngeus:

The nucleus ambiguus, nuclei arcuati, nucleus of the nervus glossopharyngei, nuclei of the nervus cochlearis ventralis and dorsalis all showed lesions of their ganglion cells of the "chronic type," such as shrinkage, poor staining of their tigroid bodies and eccentricity of the nucleus. The nerve roots of the N. glossopharyngeus showed a definite increase in the glia nuclei throughout their medullary course, and a considerable number of amylaceous bodies. In the extramedullary portion of the root of the nervus acusticus was a large perivascular hemorrhage (Fig. 7).

Pons: Level of Exit of Nervus Trigeminus:

At this level the following nuclei showed moderate lesions of their ganglion cells consisting of shrinkage and chromolytic changes. The nuclei motorii of the nervus trigemini, nucleus nervus vestibularis superior

Fig. 7.—Perivascular hemorrhage into the root of the nervus acusticus.

and the nuclei reticularis tegmenti. No definite lesions were found in the root fibers of the nervus trigeminus. Practically all the small vessels at this level showed more or less adventitial infiltration with round cells, but there were only occasional hemorrhages.

Pons: Level of the Colliculus Superior:

The nucleus of the nervus trochlearis showed a peculiar mixture of normal ganglion cells and others with moderate lesions of the type described in the foregoing. Many of the small vessels showed a typical perivascular infiltration with round cells. Hemorrhages were much more frequent than in any of the previous sections.

Pedunculi Cerebri: Level of the Nucleus N. Oculomotorius:

The ganglion cells of the nucleus of the nervus oculomotorius were entirely normal. The cells of the substantia nigra were also normal, both in regard to their tigroid bodies and pigment. The cells in the nucleus

ruber also showed no definite lesions. At the point of exit of the root fibers of the nervus oculomotorius were several large vessels around which there were round cell infiltration and perivascular hemorrhage.

Thalamus: Level of Corpora Mammillaria:

The ganglion cells in the corpora mammillaria showed moderate chronic lesions, and there was definite neuronophagia. In the thalamus the lesions were more marked. In the nucleus anterior, medialis and lateralis thalami the ganglion cells showed the most extreme lesions, consisting of shrinkage, pallor and vacuolization (Plate 1, Fig. 4). It was in this region also that the most marked lesions were found with the Bielschowsky method (Plate 1, Fig. 3). Similar lesions were found in the upper region of the substantia nigra.

The small vessels of the thalamus showed heavy perivascular infiltration (Fig. 1) and many perivascular hemorrhages (Fig. 2). There were also areas of glial proliferation in which selective stains showed many astrocytes and coarse fibers (Fig. 3). Amylaceous bodies were also found in large numbers (Fig. 5).

These lesions were limited almost entirely to the thalamus, the subthalamic region and the tuber cinereum. The glia and vessels in the capsula interna, tractus opticus, and columna fornicis were entirely normal.

Nucleus Lentiformis:

The ganglion cells of the putamen and globus pallidus showed slight lesions of similar type to those described in the thalamus. Many, however, were normal. The small vessels also showed little if any perivascular infiltration, and no hemorrhages were found.

Nucleus Caudatus, Caput:

No definite lesions were found in the ganglion cells, the vessels or the glia of this structure. The ependyma of the ventricle was also normal.

Nucleus Amygdalae:

No lesions were noted in any of its structures.

Cerebellum:

No lesions were found in sections of various parts of the cerebellum. The ganglion cells of the nucleus dentatus and Purkinje cells stained normally.

Cerebral Cortex: Gyrus Centralis Anterior and Posterior:

Sections of the cortex in these regions showed no lesions in any of their constituents. The ganglion cells were of normal appearance when stained with both methylene blue and Bielschowsky's method (Plate 1, Figs. 1 and 2). The vessels, glia and pia also showed no lesions.

DISCUSSION

From both the clinical and anatomic findings it is evident that the case discussed is one of epidemic encephalitis extending over a period of fourteen months. From both standpoints we see evidence not of a healed process with disturbance of function from destroyed structures, but of a continuous progressive process. This is most definitely shown from the anatomic studies. In the same region are found areas of gliosis with amylaceous bodies where the process is quiescent and other areas in which the evidence of most acute inflammation is present, namely, hemorrhages.

That the virus of epidemic encephalitis may continue to live for some time is shown by the experimental transmission of the disease to rabbits in a case of six months standing by Harvier and Levaditi.[1] Economo [2] has also observed a case in which the disease extended over two years and which was studied anatomically after death. Economo describes, besides the usual acute type of lesions, areas of gliosis, some of which were spongelike in appearance, small clusters of cells, which he suggests are remnants of focal neuronophagia, cellular proliferation of the advential tissue of the veins and blood pigment in the perivascular spaces. He therefore suggests the term encephalitis lethargica subacuta for this type of the disease. Strauss and Globus [3] have also recently reported a case of subacute type of this disease, with a necropsy study, which ran a protracted course and presented symptoms of improvement, but the patient ultimately developed bulbar symptoms followed by death. Anatomically, reparative lesions were demonstrated on which were superimposed lesions of an acute type.

Our case is identical in its essentials with the one described by Economo. The distribution of the lesions is somewhat different, as in his case there were areas of gliosis in the cerebral cortex and a resulting secondary degeneration of the pyramidal tracts. The type of lesions is, however, the same, even to the peculiar areas of spongelike gliosis. Our case also shows all the lesions which have been described for the more acute type of the disease, including extensive involvement of the cranial nerve roots, as in the reports of Hammes and McKinley [4] and of Burrows.[5]

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THE SUGAR CONTENT OF THE BLOOD AND SPINAL FLUID IN EPIDEMIC ENCEPHALITIS *

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A number of investigations of the sugar content of the spinal fluid in epidemic encephalitis have been made, though few comparisons of the sugar content of the blood and spinal fluid have been published. Our investigation includes sugar determinations in both blood and spinal fluid.

LITERATURE

Marie and Mestrezat [1] report one case of epidemic encephalitis with 0.094 per cent. sugar in the spinal fluid and give as their normal figure 0.055 per cent. They do not state the method used.

Netter, Block and Dekeuwer [2] investigated fifteen cases. Their figures varied from 0.042 per cent. (fluid obtained an hour before death) to 0.097 per cent. with an average of 0.070 per cent., which is said to be above normal. In three cases the percentage of blood sugar was 0.15, 0.14 and 0.138, that for the spinal fluid from the same cases being, respectively, 0.07, 0.097 and 0.095. Their method is not given. They mention that spinal fluid sugar is slightly increased in meningism, especially in pneumonia, reporting 0.08, 0.099 and 0.063 per cent. They say that the hyperglycorrhachia is not associated with hyperglycemia, much less with glycosuria.

Dopter [3] reported one case of epidemic encephalitis with 0.085 per cent. sugar in the spinal fluid, and thought this above normal. He concludes that the hyperglycorrhachia is due to hyperglycemia.

Foster,[4] using the latest modification of the Folin-Wu method, investigated the spinal fluid in eleven cases and the blood in six of these. The spinal fluid sugar varied from 0.113 to 0.0535 per cent., an average 0.076 per cent. The blood sugar varied from 0.07 to 0.10 per cent., well within the accepted normal limits by the method used. The sugar content of twenty-two normal spinal fluids varied from

* From the Laboratories of Columbia Hospital, Milwaukee.

1. Marie and Mestrezat: Bul. de l'Acad de méd., Paris **83**:103, 1920.

2. Netter, Block and Dekeuwer: Compt. rend. Soc. de biol. **83**:338-339, 1920; abstr. J. Nerv. & Ment. Dis. **53**:56, 1921.

3. Dopter, C.: Bull de l'Acad. de mèd. **83**:203, 1920.

4. Foster, H. E.: Hyperglycorachia in Epidemic Encephalitis, J. A. M. A. **76**:1300 (May 7), 1921.

0.0442 to 0.0614 per cent., with an average of 0.0528 per cent. Of the spinal fluids from patients with encephalitis only one, 0.0535 per cent., comes within the range of the normal.

Kraus and Pardee [5] report twelve cases in which the spinal fluid sugar varied from 0.062 to 0.095 per cent. In their tests made at Bellevue Hospital, the latest modification of the Folin-Wu blood sugar method was employed. The normal figures are given as from 0.08 to 0.12 per cent. for blood, and 0.04 to 0.06 per cent. for spinal fluid. Most of the figures for blood in the twelve cases are below 0.12 per cent. and only two are above it, 0.143 and 0.17 per cent.

Stevenson,[6] using Shaffer's method,[7] reports the sugar content of the spinal fluid in five cases as from 0.043 to 0.069 per cent., an average of 0.06 per cent. One case by the Benedecit [8] method gave 0.054 per cent. (0.043 per cent. by Shaffer's method). He quotes seven results by the Folin-Wu method (probably also included in the investigation of Kraus and Pardee) which averaged 0.0793 per cent. Stevenson calls attention to the difference between the figures obtained with the Shaffer and Folin-Wu methods. He suggests that interfering substances may cause the Folin method to give higher results. Comparisons between the two methods in a series of spinal fluids from sixteen cases of various neurologic conditions, with one exception, gave readings averaging 0.021 per cent. glucose higher by Benedict's than by Shaffer's method.

There is no standard method for determining the absolute amount of glucose in body fluids. Because different methods give different results it is impossible to arrive at a conclusion as to the absolute normal amount of sugar in spinal fluid. Each laboratory must therefore determine its own normals, and the method used must always be indicated.

Schloss and Schroeder,[9] using practically the original technic of Lewis and Benedict, concluded that "In infants and children free from meningeal disease the sugar of the cerebrospinal fluid ranges from 0.05 to 0.134 per cent. (dextrose), approximately the same range as for blood." The fluids examined were obtained from patients convalescing from disease, and so cannot be considered as normal. They also made simultaneous determinations on the blood and cerebrospinal fluid in ten cases. In only two were the values similar. They conclude that

5. Kraus, W. M., and Pardee, J. H.: The Serology of the Spinal Fluid and Blood in Epidemic Encephalitis, Arch. Neurol. & Psychiat. **5**:710 (June), 1921.

6. Stevenson, L. D.: A Comparative Study of the Sugar Content of the Spinal Fluid in Diseases of the Nervous System, Arch. Neurol. & Psychiat. **6**:292, 1921.

7. Shaffer, P. A., and Hartmann, A. F.: J. Biol. Chem. **45**:109, 1921.

8. Benedict, S. R.: J. Biol. Chem. **34**:203, 1918.

9. Schloss, O. M., and Schroeder, L. S.: Am. J. Dis. Child. **11**:1 (Jan.), 1916.

"although the variations in the blood sugar and spinal fluid sugar are practically identical, yet there is no correspondence in the individual case at a given time." It is questionable whether the method they used or those now in use yield figures for sugar alone or for sugar and other reducing substances. The same doubt also exists regarding blood sugar. We believe that the former are neither more nor less reliable than the latter.

Leopold and Bernard,[10] using the Myers-Bailey modification of the Lewis-Benedict method, found the sugar in spinal fluid from ten normal children to vary from 0.07 to 0.107 per cent., the average being 0.074 per cent.

METHODS, MATERIAL AND DISCUSSION

The methods used in this investigation are described in detail in a preceding communication.[11] The results are given in the table of this article. Attention must be called to several details. Most specimens of blood and spinal fluid were obtained before breakfast after a fast of from twelve to fourteen hours. The blood sugar determinations were made by Benedict's and by Myers-Bailey's [12] modifications of the Lewis-Benedict [13] method. Two technics were used in examining spinal fluid by the Benedict modification of the blood sugar method. One was the original, and the other (indicated in the table as "changed") was a modification suggested by Benedict, in which the spinal fluid was diluted with five instead of two volumes of water and six and a half instead of nine and a half volumes of picrate were added in order to reduce the amount of picric acid radical in the filtrate. The protein content of spinal fluid is much less than that of blood. Hence little picrate is removed by precipitation of the protein and, if the original technic is followed, the filtrate will contain more picrate and give a deeper color than the glucose standard. We have specified in the tables the technic used as either "original" or "changed." The Myers-Bailey modification of the Lewis-Benedict method and the latest modification of that of Folin-Wu [14] were also used for the determination of sugar in spinal fluid. In the Folin-Wu method it was not found necessary to use a standard of one half the original strength, as suggested by Foster.

The methods of Myers-Bailey, Folin-Wu, and the "changed" technic of Benedict's modification give figures which are approximately the same. The original Benedict modification yields results from 10.3 to 18.5 per cent. (an average of 13 per cent.) higher than the other methods.

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10. Leopold, J. S., and Bernhard, A.: Am. J. Dis. Child. **13**:34 (Jan.), 1917.
11. Thalhimer, W., and Updegraff, H.: A Comparison of Several Clinical Quantitative Blood Sugar Methods, J. A. M. A. **78**:1383 (May 6) 1922.
12. Myers, V. C., and Bailey, C. V.: J. Biol. Chem. **24**:147, 1916.
13. Lewis, R. C., and Benedict, S. R.: J. Biol. Chem. **20**:61, 1915.
14. Folin, O., and Wu, H.: J. Biol. Chem. **41**:367, 1920.

Tables for blood sugar in normal persons given in a previous communication will be used in interpreting the blood sugar figures in the table of this article. With Benedict's modification in normal blood, taken before breakfast, the amount varied from 0.098 to 0.171 per cent. The usually accepted normal limits are from 0.08 to 0.12 per cent.

The results in three cases of general paresis were included for comparison, since, in this condition, the lesions of the blood vessels in the frontal lobes are comparable to the lesions of epidemic encephalitis in the midbrain region.

A short description of the cases of epidemic encephalitis follows:

1. Severe, lethargic type with a duration of about ten days. The patient died twelve hours after the last spinal fluid examination. Necropsy revealed characteristic lesions of epidemic encephalitis.

2. Moderately severe, lethargic and myoclonic type with gradual recovery

3. Lethargic type, not quite so severe as in Case 2.

4. A girl, aged 17 years, had the lethargic type of encephalitis. The illness progressed during a month and she died in the ambulance on the way to the hospital. Lumbar puncture was performed two hours after death. Necropsy revealed characteristic lesions of epidemic encephalitis.

5. A one and a half year old boy had encephalitis. The disease ran a peculiar course, sometimes with myoclonic twitchings, sometimes with lethargy. Lobular pneumonia and bilateral otitis media also developed. No necropsy examination was made.

6. Mild case with diplopia; recovery.

7. Mild case without lethargy but with marked excitement, sleeplessness and transitory diplopia. The illness lasted about six weeks with gradual recovery.

8. Rapidly fatal, lethargic type of one week's duration. Lumbar puncture was made ten hours before death. Necropsy examination was not allowed.

9. Mild, lethargic type of encephalitis with gradual recovery.

10. Mild case, the main symptom being diplopia; gradual recovery.

11. Mild, lethargic type, with diplopia; gradual recovery.

12. Lethargic type with periods of marked improvement and relapses during eighteen months. For three months before death parkinsonian mask, lethargy and catatonia were present. It was difficult to give nourishment, and there was extreme emaciation. Necropsy examination revealed characteristic lesions of epidemic encephalitis with unusually wide distribution.

13. Moderately severe. Spinal fluid was obtained during convalescence when the patient was almost well.

14. Fulminating case of lethargic type. Death occurred four days after the onset of the disease. Spinal fluid was obtained five hours before death. Necropsy examination was not made.

It is probably safe to assume that the upper limit of normal spinal fluid sugar with the latest modification of Folin-Wu and the method of Myers-Bailey is between 0.06 and 0.065 per cent. With the two Benedict modifications of the Lewis-Benedict method the upper normal

limit is somewhat higher, 0.075 or even 0.08 per cent., with an occasional high normal (similar to an occasional high normal blood sugar) of 0.1 per cent. Certainly some of the figures obtained in epidemic encephalitis, such as 0.117, 0.126, 0.1347, 0.161, 0.177 per cent., etc., are above normal. All are high even if not definitely abnormal.

Similarly with the figures for blood sugar, some are definitely above normal and all are high. Most are above the average obtained by us for normal blood.

More important than the amount of sugar in blood or spinal fluid in epidemic encephalitis is the demonstraton that, whatever the significance of the sugar may be, there is a quantitative relationship between the sugar content of blood and spinal fluid. When blood sugar increases spinal fluid sugar increases also. In fact, it is difficult to understand how the sugar of the spinal fluid can increase without an analogous increase in blood sugar. The constituents of the spinal fluid can come only from the blood.

In the presence of increased blood sugar it is evidently possible that pathologic conditions in the meninges or choroid plexus may hold back the glucose and prevent its entry into the spinal fluid. The patient in Case 25, who had tuberculous meningitis (verified at necropsy), showed a blood sugar content of 0.15 per cent., as high as that in some of the cases of epidemic encephalitis, yet the spinal fluid contained only 0.028 per cent. of sugar. There seems to be no *exact* quantitative relationship between the sugar in the blood and in the spinal fluid or normal persons. In them the spinal fluid sugar is, however, approximately 45 per cent. of that of the blood. In pathologic conditions this ratio changes. In epidemic encephalitis the ratio of sugar in the spinal fluid to that in the blood increases as the blood sugar increases. Thus, in Case 1 (blood sugar 0.297 per cent., spinal fluid sugar 0.177 per cent.), the ratio is 60 per cent. In chronic nephritis, Myers and Fine[15] give the ratio as 57 per cent. In Case 28, diabetes mellitus, the blood sugar was 0.275 per cent. and the spinal fluid sugar 0.234 per cent., the ratio being 85 per cent.

Our results seem to indicate that until the blood sugar reached about 0.19 per cent. there was no marked change in the sugar of the spinal fluid. This might signify that the meningeal choroid complex, as it is called by Flexner,[16] maintains a threshold level for the passage of sugar from the blood into the spinal fluid. This would be similar to the threshold maintained by the kidney for passage of glucose into the urine. It may be noted that the amount of sugar in normal urine is about the same as that in normal spinal fluid.

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15. Myers and Fine: Prac. Soc. Exper. Biol. & Med. **13**:126, 1916.

16. Flexner, S., Amoss, H. L.: J. Exper. Med. **25**:525, 1917; **28**:11-17, 1918; **27**:679, 1918.

RESULTS OF AUTHORS' INVESTIGATIONS OF SUGAR CONTENT OF BLOOD AND SPINAL FLUID IN EPIDEMIC ENCEPHALITIS

No.	Patient	Age	Sex	Date, 1921	Diagnosis	Time Obtained	Blood Sugar		Spinal Fluid Sugar				Spinal Fluid						Blood Wassermann
							Benedict	Myers	Benedict		Myers	Folin	Cells	Albumin‡	Globulin	Reduction with Fehling's†	Colloidal Gold Test	Wassermann	
									Original	Changed*									
1	A. G.	26	♂	2/ 3	Encephalitis	After breakfast	.....	.....	0.161	.....	.....	.....	175	1 mm.	Negative	Increased	Negative		
				2/ 5	Encephalitis	Before breakfast	0.297	.....	0.177										
2	S. L.	53	♂	2/15	Encephalitis	After breakfast	0.182	.....	0.126	.....	.....	.....	8	4 mm.	Negative	Normal	.....	.....	Negative
				2/17	Encephalitis	Before breakfast	0.196	.....	0.134	.....	.....	.....	...	.....	.....	.....	Negative		
				2/25	Encephalitis	Before breakfast	0.208	.....	0.117	.....	.....	.....	...	.....	.....	.....	113331000		
				3/24	Encephalitis	Before breakfast	0.150	.....	.....	0.071									
3	G. I.	42	♂	2/ 8	Encephalitis	Before breakfast	0.174	.....	0.089	.....	.....	.....	37	2 mm.	Negative	Slight reduction	Negative	Negative	Negative
				2/25	Encephalitis	Before breakfast	0.144	.....	0.082	.....	.....	.....	...	.....	.....	.....	1123331000		
4	L. F.	16	♀	3/ 2	Encephalitis	2 hrs. post-mortem	.....	.....	0.079	.....	.....	.....	150	2 mm.	Faintly positive	Increased			
5	S. E.	8 mo.	♂	3/ 7	Encephalitis	4 hrs. after breakfast	0.188	.....	.....	0.090	.....	.....	17						
6	S. M.	35	♀	2/ 6	Encephalitis	Before breakfast	0.159	.....	0.080										
7	M. M.	33	♀	2/16	Encephalitis	Before breakfast	0.155	.....	0.093	.....	.....	.....	40	4 mm.	Negative	Slight excess	Negative	Negative	Negative
				3/ 3	Encephalitis	Before breakfast	0.163	.....	0.084										
8	S. C.	20	♂	2/20	Encephalitis	10 hrs. ante-mortem	0.226	.....	0.125	.....	.....	.....	28	2 mm.	Trace	Marked reduction			
9	S. M.	32	♀	3/12	Encephalitis	3 hrs. after lunch	0.211	.....	.....	0.080			...	.....	.....	.....	.....	Negative	Negative
10	W. A.	33	♀	2/25	Encephalitis	Before breakfast	0.148	.....	0.084	.....	.....	.....	13	2 mm.	Negative	Increased	Negative	Negative	Negative

11	N. J.	20	♀	3/10	Encephalitis	Before breakfast	0.173											
				3/12	Encephalitis	Before breakfast	0.179	.....	.....	0.0854	.....	.....	96	8 mm.	Strongly positive	Increased		
				3/22	Encephalitis	Before breakfast	0.130											
12	M. M.	30	♂	7/27	Encephalitis	Before breakfast	0.115	0.104	.....	0.056	0.060	.....	1	2 mm.	Faint trace	No reduction	.....	Negative	Negative
13	S. D.	60	♂	9/21	Encephalitis (convalescent)	4 hrs. after lunch	.....	.....	.....	0.082	.....	.....	0	2 mm.	Negative	Normal	Negative	Negative	Negative
14	V. E.	45	♂	8/23	Encephalitis	5 hrs. antemortem	.....	.....	0.150	0.136	0.136	0.136	50	3 mm.	Strongly positive	Greatly increased			
15	K. J.	50	♂	3/17	General paresis	Before breakfast	0.146	.....	.....	0.062	.....	.....	13	2 mm.	Positive	Increased	5555555410	++++	++++
16	B. F.	40	♂	3/17	General paresis	Before breakfast	0.141	.....	.....	0.059	.....	.....	...	.....	.....	.....	5555555310	++++	++ +
17	F. L.	50	♂	3/17	General paresis	Before breakfast	0.146	.....	.....	0.048	.....	.....	...	.....	.....	.....	5555553100	++++	++++
18	U. G.	55	♂	3/22	Normal	Before breakfast	0.135	.....	.....	0.055	.....	0.080							
19	H. L.	55	♂	3/21	Normal	Before breakfast	0.158	.....	.....	0.074									
20	G. J.	42	♂	3/22	Normal	Before breakfast	0.129	.....	.....	0.063									
21	B. N.	30	♂	8/24	Normal	Before breakfast	.....	.....	0.064	0.054	0.058	Lost							
22	G. F.	35	♂	8/11	Normal	Before breakfast	0.115	0.094	0.053	.....	0.053	0.058							
23	K. E.	45	♂	8/11	Normal	Before breakfast	0.117	0.100	0.056	.....	0.056	0.058							
24	W. M.	50	♂	6/ 6	Brain tumor	Before breakfast	.....	.....	.....	0.179	.....	.....	...	.....	.....	.....	.....	Negative	Negative
25	T. G.	8	♂	3/18	Tuberculous meningitis	Before breakfast	0.150	.....	.....	0.028	.....	.....	180	5 mm.	Positive	No reduction			
26	M. C.	48	♂	3/12	Brain tumor	Before breakfast	0.158	.....	.....	0.079	.....	.....	10						
27	G. M.	31	♂	8/21	Diabetes mellitus	Before breakfast	.....	.....	0.158	0.143	0.150	0.143							
28	S. G.	55	♂	3/ 8	Diabetes mellitus	Before breakfast	0.275	.....	0.234										

* The technic indicated by "changed" is described in the text.

† It is of interest that the amount of reduction with Fehling's solution did not always agree with the more exact methods of quantitative determination of glucose. Fehling's test was always performed as follows: 1 c.c. Fehling's No. 1 and 1 c.c. Fehling's No. 2 mixed and diluted to 25 c.c. with distilled water. Three cubic centimeters of this dilution are boiled and 2 c.c. spinal fluid added; the solution is then boiled again.

‡ The nitric acid ring test for albumin was used, and the results recorded are the width of the white ring in millimeters.

Benedict, Osterberg and Neuwirth,[17] found that sugar in normal urine varies from 0.05 to 0.1 per cent. They used a method very similar to the Benedict method for sugar in the blood. Because of this similarity it is permissible to compare figures obtained by the Benedict method in normal spinal fluids with those obtained by the method of Benedict and Osterberg in normal urine. This comparison shows practical identity.

Shaffer found lower figures for sugar in normal urine by his method than by that of Benedict and Osterberg. Stevenson found lower figures for sugar in spinal fluid by Shaffer's than by Benedict's method. Neither Stevenson nor other investigators, so far as we have found, have reported results with Shaffer's method in normal spinal fluid.

Just as nephritic kidneys to a certain extent hold back sugar from entering the urine, so perhaps tuberculous meningitis holds back sugar from the spinal fluid. This might also explain the low sugar content of the spinal fluid in cases of acute meningococcus, or other types of purulent, meningitis, better than the breaking down of glucose by organisms present in the spinal canal.

There are three possible explanations of the hyperglycorrhachia suggested by the authors of the first three papers quoted in the review of the literature:

1. The lesions of epidemic encephalitis, situated in the midbrain and about the fourth ventricle, may act like the piqûre of Claude Bernard. The piqûre causes only temporary hyperglycemia and hyperglycorrhachia. The persistence of the lesions in epidemic encephalitis may account for the continued hyperglycorrhachia and increased blood sugar. The fact that in *early* cases of poliomyelitis the spinal fluid sugar remains low (Leopold and Bernard) is a point in favor of this view, since the lesions in this disease are similar to those in epidemic encephalitis although mainly confined to the spinal cord. It would be of interest to know whether the sugar of the spinal fluid is increased in later stages of poliomyelitis with bulbar involvement.

2. Kraus and Pardee suggest that the vascular lesions in epidemic encephalitis may render the walls of the blood vessels more permeable, so that glucose passes more readily from the blood to the spinal fluid. This theory is ingenious but is not necessary to explain the facts since the blood sugar is increased in this disease and the increase of sugar in the spinal fluid is probably secondary to that in the blood.

3. The increase in the sugar of both the blood and spinal fluid may be caused by a general reaction to the infectious agent of epidemic encephalitis. Hirsch[18] has recently shown in animals that the intra-

17. Benedict, Osterberg and Neuwirth: J. Biol. Chem. **34**:217, 1918.
18. Hirsch, Edwin F.: J. Infect. Dis. **29**:40, 1921.

venous injection of bacteria causes a rise in blood sugar. It is also known that many infectious diseases are associated with hyperglycemia.

CONCLUSIONS

1. The sugar content of the blood and spinal fluid is increased in epidemic encephalitis.

2. The sugar of the spinal fluid appears to increase only after a certain level of blood sugar has been reached. This might be considered a threshold level for sugar in the spinal fluid such as the kidneys maintain for sugar in the urine.

3. The hyperglycorrhachia and hyperglycemia may be due to the cerebral lesions of epidemic encephalitis or to the general infection.

4. There must be a considerable extension of our knowledge of the amount of sugar in normal and pathologic spinal fluid before the diagnostic significance of hyperglycorrhachia can be established.

5. At present hyperglycorrhachia can be used chiefly to differentiate epidemic encephalitis from the two conditions with which it is most likely to be confused—tuberculous meningitis and early poliomyelitis.

XANTHOCHROMIA DUE TO ACUTE, PURULENT SPINAL MENINGITIS

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Since Froin's [1] classical studies on xanthochromia in 1903, much has been added to our knowledge of yellow spinal fluid, both as to its chemical and cytologic contents, and the varied conditions under which it may be encountered. Sprunt and Walker,[2] in 1917, analyzed 100 reported cases and added five personal reports. From their conclusions it would seem wise to divide xanthochromatic spinal fluids into two classes which, given in their own words, are as follows:

1. Those in which the color is due to dissolved hemoglobin or its derivatives, and which, as a rule, do not coagulate spontaneously and contain only a small amount of globulin. Such fluids usually are associated with brain tumor in contact with the meninges or the ventricles.

2. The larger and more important group comprises those cases showing the so-called Froin's syndrome, in which the fluid is transparently clear, yellow, coagulates spontaneously, contains large amounts of globulin, may or may not show pleocytosis, and gives no positive tests for hemoglobin. This is a "compression syndrome," its main determinants being the isolation of a lumbar cul-de-sac, in which the spinal fluid stagnates, and probably some vascular changes within its walls.

It is the latter type of xanthochromia that is so likely to be associated with spinal cord tumor, although many other conditions involving the cord have been reported in which the syndrome has occurred. When an actual pocket of the subarachnoid space is not isolated, the syndrome usually differs in some respects from that described originally by Froin, most often perhaps in the absence of spontaneous, "massive coagulation."

Elsberg and Rochfort [3] in a study of ninety-two cases of chronic diseases of the spinal cord found xanthochromatic cerebrospinal fluid in fourteen instances. Of these, twelve were either spinal cord tumor or gumma; one was an example of varicose veins of the cord and one a case of neuritis of the cauda equina. In seven of the cases Froin's syndrome of massive coagulation was present, all being examples of tumor of the conus or cauda equina. The so-called syndrome of Nonne,[4]

1. Froin: Gaz. d. hôp., Sept. 3, 1903.
2. Sprunt and Walker: Bull. Johns Hopkins Hosp. **28**:80-86, 1917.
3. Elsberg, C. A., and Rochfort, E. L.: Xanthochromia and Other Changes in the Cerebrospinal Fluid, J. A. M. A. **68**:1802, 1917.
4. Nonne: Deutsch. Ztschr. f. Nervenh. **47**:436, 1913.

that is, excess of globulin without cell increase, these authors found more frequently in tumors at a higher level.

I herewith report a case not showing coagulation and not due to tumor, although the excessive and heaped-up exudate seemed almost necessarily to have isolated a lumbar cul-de-sac.

REPORT OF A CASE

History.—H. W. J., a white man, aged 61, was seen in consultation with Dr. Rockwell of Cambridge, Mass. The clinical diagnosis of the case was meningitis; xanthochromia. Necropsy revealed a massive, exudative spinal meningitis.

His family and past history were negative. For three weeks before consultation, the patient had had a mild catarrhal rhinitis, with a temperature irregularly elevated, but never above 100 F. He continued going to business until March 18, 1921. On the evening of this date he had a temperature of 101 F. and a pulse rate of 100. The general physical examination was negative. The next morning his temperature was 104, his pulse rate 120, and he suffered from moderate backache, restlessness and anorexia. The same evening his temperature had fallen to 101, but there were periods of Cheyne-Stokes respiration, and the patient perspired freely. Later in the evening he became first semiconscious and finally completely unconscious. The next morning, March 20, he was conscious again; pain in the back continued, and there was a slight unproductive cough. Examination of the lungs revealed a small area in the left upper lobe which was dull, and tubular breathing. The urine examination was negative except for a trace of albumin and an occasional cast.

During the next three days the patient seemed to improve subjectively, was conscious and quite cheerful, though the temperature ranged between 100 and 102 F. During the night of March 23, however, he again became semiconscious, respirations were rapid, and his temperature went up to 103.5. On March 24, I saw him for the first time.

Physical Examination.—The patient was lying in bed with a cold compress on his forehead. He was conscious and answered questions rationally, but there was a tendency to muttering, and his speech was confused at times. Involuntary urination was observed. Temperature by mouth was 104 F. and perspiration was profuse. Respirations were rapid but regular. There was definite, though not marked stiffness of the neck, and Kernig's sign was positive. Knee and ankle reflexes were present and equal on both sides. No ankle clonus was present. The Babinski sign was positive on both sides. The optic disk outlines were distinct with moderate venous congestion but no elevation of the disks.

Lumbar Puncture.—Ten cubic centimeters of canary yellow, slightly turbid fluid were removed. There was no increase in pressure, the fluid coming out in ordinary, rapid drops. There were 250 polymorphonuclear leukocytes per cubic millimeter. The albumin reaction was + + +. There was no sugar. Cultures of the fluid on blood-serum agar showed no growth in two days, and no organisms were seen by smear. The fluid was anticomplimentary to the Wassermann reaction, and it did not clot even after the addition of a drop of blood. The patient's condition continued to become worse, and he died at 6 a. m., March 25. A necropsy confined to the spinal cord was performed on the afternoon of the same day.

Gross Pathology of the Spinal Cord.—The cord was removed from the second cervical segment to the end of the cauda equina. There was considerable yellow, thick, fibrinopurulent exudate extending from about the third cervical segment to between the third and fourth lumbar segment, lying mainly over the posterior and lateral surfaces of the cord and continuing below the third lumbar segment to the posterior surface of the cauda equina for a distance of about 4 cm., but not extending laterally or beyond the lateral surfaces of the nerves making up the cauda. On lifting the cord out, it was noted anteriorly that this exudate, although occupying mainly the regions mentioned, extended around to the ventral surface of the cord over nearly its entire extent, but here it was much thinner and inconspicuous. The principal thing to be noticed in regard to the configuration of the exudate was that beginning at about the eighth dorsal segment and extending downward a distance of 6 cm. on the posterior surface, that is, to the eleventh dorsal segment, the exudate formed a considerable ridge of triangular shape on cross section, its base being on the posterior surface of the cord and the apex of the ridge in its highest point standing 6 mm. above the surface.

Section of cord showing exudate at level of tenth dorsal segment; × 2.

Section from Level of Eleventh Dorsal Segment.—The section showed a thick, enveloping meningeal exudate of polymorphonuclear leukocytes, lymphoid cells and much fibrin. On the posterior surface, this exudate was caked into a layer, somewhat cone-shaped, and about 6 mm. in thickness. Within the meshes of the fibrin there were in places, numerous isolated, round dots, about the size of the ordinary pyogenic cocci. There were no chains or clumps of these elements, and they were entirely extracellular.

COMMENT

Whether the exudate by compression and adhesion actually isolated a portion of the lumbar subarachnoid space, could not be ascertained at the time of the necropsy. This seems probable, however, from the unusual finding of yellow spinal fluid. A substantiating fact, from the bacteriologic side, was the failure of any organisms to grow on blood-serum agar from cultures of the fluid withdrawn at lumbar puncture, the fluid thus obtained coming of course from the presumably isolated lumbar cul-de-sac.

A SUGGESTION FOR THE USE OF DYES IN THE LOCALIZATION OF SPINAL CORD TUMORS AT OPERATION

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The recent work of Ayer[1] on the use of combined cistern and lumbar puncture for the detection of spinal subarachnoid block, and the work of Dandy and Blackfan[2] on the use of dyes in the diagnosis of obstructive hydrocephalus, have suggested a procedure which may be of use in the localization of spinal cord tumors at operation.

In principle the method consists of two steps: first, the demonstration of spinal subarachnoid block, by the Ayer method; second, the injection of a dye into the cisterna magna, or into the lumbar subarachnoid space. The injection is made immediately prior to operation. Assuming that the lumbar route has been used, the dye will diffuse through the subarachnoid space up to the lower pole of the tumor. The existence of a subarachnoid block will prevent its going beyond this point. If the laminectomy opening is below the tumor, on opening the dura a deep blue stained fluid will be encountered. The laminectomy must then be extended upward. If, on the other hand, the laminectomy has been above the level of the tumor, on opening the dura a colorless fluid will be encountered. The opening must then be continued downward.

The two cases here reported in brief have given an opportunity of testing the method.

REPORT OF CASES

Case 1.—*History.*—W. H. G., a man, aged 54, single, seen Nov. 3, 1921, three years ago had pains in the right axilla, gradually increasing in intensity and aggravated by coughing and sneezing. Seven months ago there was numbness of the feet, gradually ascending over the legs and trunk to the level of the second interspace in front. Weakness and stiffness of the legs increased. Bladder weakness was present. For several months he had been bedfast owing to weakness and rigidity of the legs.

Physical Examination.—This revealed: Arms and hands normal; abdominal and cremasteric reflexes absent; marked weakness of the legs, extreme spasticity, exaggerated reflexes, bilateral ankle clonus and Babinski sign. Sensa-

1. Ayer, J. B.: Spinal Subarachnoid Block as Determined by Combined Cistern and Lumbar Puncture, Arch. Neurol. & Psychiat. **7**:38 (Jan.) 1922.

2. Dandy and Blackfan: Internal Hydrocephalus, Am. J. Dis. Child. **8**:406 (Dec.) 1914.

tion: Anesthesia to touch reached the second interspace in front and the fourth dorsal spine behind. It extended a short distance down the inner aspect of the arm.

Diagnosis.—Cord tumor; extramedullary; level of second dorsal segment.

Combined Cistern and Lumbar Puncture.—Puncture revealed:

	Cistern	Lumbar
Pulsation of fluid with pulse and respiration	Very active	Present but less active
Initial pressure	75 mm. water	15 mm. water
After removal of 4 c.c. from lumbar spine	65 mm. water	0 mm. water
After removal of 7 c.c. from cistern	15 mm. water	0 mm. water
Appearance of fluid	Slightly turbid	Yellow
Globulin	++	++++
Cell count	0	1

The findings on combined puncture indicated complete spinal subarachnoid block.

Operation.—Nov. 15, 1921, operation was performed by Dr. T. M. Joyce. Immediately before the operation, with the patient under the anesthetic, 1 c.c. of a concentrated indigo-carmin solution was injected into the cisterna magna. Laminectomy followed at once, including the sixth cervical to the second dorsal laminae. The dura was exposed. The tumor could be palpated beneath the dura at about the middle of the laminectomy opening. A small nick was made in the dura below the tumor. The spinal fluid welling up through the nick showed a faint bluish tinge. A nick was then made in the dura above the tumor. The fluid here showed a deep blue stain. The contrast between the two was marked. It became still more marked on complete opening of the dura. Above the tumor, the arachnoid was bulged out, cystic and stained deep blue. Below the tumor only a faint blue staining of the arachnoid was evident. The tumor which was about 2.5 by 1.5 cm. in diameter was readily removed.

Pathologic Report (by Dr. R. L. Benson).—Endothelioma.

As stated in the foregoing, combined cistern and lumbar puncture in this case showed evidence of a complete spinal subarachnoid block. In spite of this, due doubtless to the relaxation of the tissues attendant on the general anesthesia, a small amount of the dye had leaked past the block, slightly staining the arachnoid and the fluid below the tumor.

Case 2.—*History.*—J. P. F., a man, aged 48, married, seen Sept. 14, 1921, three years ago had a pain in the back, about the level of the third to the fifth lumbar spines, worse on the right. The pain radiated into the side and lower half of the abdomen. It gradually increased in intensity and was worse on coughing and sneezing. Two months ago he felt weak and stiff, first in the right leg then in the left. There was numbness of both legs. He had dysuria for two weeks.

Physical Examination.—This revealed: right upper abdominal reflex weak; left upper better; right lower absent; left lower absent; well marked positive Beevor sign. Legs: Both legs showed marked weakness and spasticity, with exaggerated knee reflexes and Achilles' reflexes, bilateral ankle clonus and a positive Babinski sign. Sensation: There was anesthesia to touch beginning on the right 2.5 cm. below the umbilicus, in front, and at the second lumbar spine behind. On the left the level of anesthesia was about 2.5 cm. lower.

Diagnosis.—Cord tumor; extramedullary; level of tenth dorsal segment.

Combined Cistern and Lumbar Puncture.—Puncture Sept. 17, 1921, revealed:

	Cistern	Lumbar
Initial pressure	150 mm. water	170 mm. water
Appearance	Clear, colorless	Clear, colorless
Globulin	+	++++
Cell count	2	4
November, 1921:		
Pulsation	Very active	Slight
Initial pressure	180 mm. water	160 mm. water
After removal of 5 c.c. from lumbar region	160 mm. water	45 mm. water
After removal of 6 c.c. from cistern	80 mm. water	40 mm. water

The findings on combined puncture again pointed to complete spinal subarachnoid block.

Operation.—Operation was performed by Dr. J. D. Sternberg. Immediately before the operation, with the patient under the anesthetic, spinal puncture was performed. Seven cubic centimeters of fluid were withdrawn and 5 c.c. of a concentrated indigo-carmin solution injected. Laminectomy included the seventh to the tenth dorsal laminae. The tumor, though quite small, was clearly visible before opening the dura. Here again it was possible to nick the dura above and below the tumor. Both fluids were clear and colorless. The dura was then incised for the full length of the laminectomy opening. The arachnoid below the tumor was distended with clear fluid, forming a small, cystlike sac. On incising the sac, a deep blue stained fluid welled up from below. During the removal of the tumor, more of this blue stained fluid flowed out from time to time. The fluid pouring down from above the tumor remained persistently clear and colorless. The tumor was about 1 by 1 cm. in diameter. It was readily removed.

Pathologic Report (by Dr. R. L. Benson).—Endothelioma.

In the two cases presented the clinical picture was clear cut, and an accurate preoperative localization of the tumor was possible. But this does not always happen. At times, only an approximate localization can be made. In such cases, the procedure suggested in the foregoing may prove of value.

COMMENT

One must first demonstrate, by the Ayer method, the existence of a spinal subarachnoid block. If no block is present, the dye will leak past the tumor and stain the arachnoid and the fluid both above and below it. Even when a complete block has been demonstrated traces of the dye may leak past the tumor, as happened in Case 1.

Of the two routes by which the dye may be injected (cistern and lumbar) the lumbar route is preferable. It gives a greater concentration of the dye, and a lesser chance of leakage past the tumor. Five cubic centimeters of a concentrated indigo-carmin solution is sufficient to give a deep stain to the spinal fluid and the arachnoid below the tumor. The solution must, of course, be carefully sterilized.

Having localized the tumor as accurately as possible and chosen the site of operation, spinal puncture is performed; from 6 to 8 c.c. of fluid are removed, and 5 c.c. of the sterile dye solution injected. Laminectomy is then performed. The dura is opened. If one is below

(caudad to) the level of the tumor, a fluid stained deep blue will be found. The laminectomy must then be extended upward. If the opening is above (cephalad to) the tumor, clear fluid will be obtained, and the incision must be extended downward.

It is conceivable that this method may be of value also in outlining the lower margin of arachnoid cysts. These cysts may produce all the symptoms of spinal subarachnoid block and cord compression, but may be difficult to detect at operation owing to the delicacy of the cyst wall. The presence of the dye solution extending up to, but not beyond such a structure, and staining its lower margin, might be of considerable aid in determining the diagnosis at the time of operation.

STUDIES ON THE CEREBROSPINAL FLUID AND BLOOD IN MULTIPLE SCLEROSIS *

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In a disease presenting such marked pathologic changes as multiple sclerosis, one might confidently expect abnormalities, perhaps characteristic, in the cerebrospinal fluid. Yet a review of the literature fails not only to reveal findings pathognomonic of the disease, but shows that many authors regard the fluid as essentially normal. In a recent comprehensive paper [1] dealing with the differential diagnosis of multiple sclerosis the significance of fluid tests is evidently considered nil as no mention is made of them. The opinions of writers prior to 1909 are summarized by Szecsi [2]: of ninety-five case reports collected by him pleocytosis was reported in forty-five. A few years later the gold chlorid test of Lange came into use. Flesch [3] reports a "paretic" colloidal gold curve in six of eight cases; Kaplan,[4] in one of eighteen cases; Hammes,[5] one paretic curve in four cases; Eskuchen,[6] states that 50 per cent. of the fluids are entirely normal; of the 50 per cent. abnormal, increase in pressure, pleocytosis and a strong globulin reaction are found, and in 20 per cent. the paretic colloidal curve. Adams [7] reports the paretic curve in five cases and the syphilitic curve in thirty-four. Moore [8] finds the paretic reaction in eighteen of twenty cases,

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* Read at the Meeting of the Association for Research in Nervous and Mental Diseases, New York, Dec. 28-29, 1921.

1. Rotter, R.: Zur Differentialdiagnose der Multiplen Sklerose, Deutsch. Ztschr. f. Nervenh. **71**:45, 1921.

2. Szecsi, S.: Beitrag zur Differentialdiagnose der Dementia paralytica, Sclerosis multiple und Lues cerebrospinalis, Monatsch. f. Psychiat. u. Neurol., 1909, p. 352.

3. Flesch, M. E.: Die Untersuchung des Liquor cerebrospinalis mit Kolloidaler Goldlosung, Ztschr. f. d. ges. Neurol. u. Psychiat. **26**:318, 1914.

4. Kaplan, D. M.: Die characteristische Ausflockung Kolloidalen Goldes durch der Liquor progressiver Paralytiker, Ztschr. f. d. ges. Neurol. u. Psychiat. **27**:246, 1915.

5. Hammes, E. M.: The Comparative Value of the Wassermann, the Colloidal Gold and Other Spinal Fluid Tests: A Study of 203 Cases, Am. J. Med. Sc. **154**:625, 1917.

6. Eskuchen, K.: Die Lumbalpunktion, 1919, p. 146.

7. Adams, D. K.: The Cerebro-Spinal Fluid in Disseminated Sclerosis, Lancet **1**:420 (Feb. 26), 1921.

8. Moore, J. E.: The Cerebrospinal Fluid in Multiple Sclerosis, Arch. Int. Med. **25**:58 (Jan.) 1920.

with the highest cell count 70, while Warwick and Nixon [9] report only one such reaction in twenty cases, although a "strong" gold reaction was obtained in 45 per cent. of all cases. Thompson [10] reports the paretic curve in five cases of psychopathic persons with multiple sclerosis, one confirmed at necropsy.

Aside from pleocytosis in some cases, never very high; a globulin increase in some cases, seldom great; and a colloidal reaction in some cases, not infrequently in the "paretic zone," no writer claims changes which can be construed as indicative of multiple sclerosis, certainly not pathognomonic.

What are the reasons for such great variations in observations? It is not likely that laboratory errors are as great as the variations here recorded. Unquestionably errors in diagnosis must be considered as possible in this disease; but again, errors in the clinic can hardly account for such great diversity in findings, applying as they do not only to different workers, but to different cases examined by the same person. Is it possible, as Hammes and Flesch suggest, that the activity of the pathologic process determines the type of change found in the fluid?

To add to the cases on record, to attempt a correlation of clinical and laboratory findings, and to add certain chemical studies in this disease is our aim in this paper.

PERSONAL OBSERVATIONS

We were able to collect the reports of thirty-eight cases personally known to one or both of us from a clinical or laboratory aspect. Many of the patients have been followed for a number of years and all show a clinical picture which admits of little doubt as to the diagnosis. Fourteen of these were males, twenty-four females. No case was accepted in which the first symptom developed late in life, and it will be seen in the chart that the fluids examined were mostly from young adults. Furthermore, no patient presenting a positive Wassermann reaction either in the blood or fluid, was admitted.

Character of Fluid.—The fluid was invariably clear, colorless and without clot.

Pressure.—Pressure, measured in a number of the patients, was never above the limit of normal, was usually in the mid-normal zone, but frequently low. There was nothing about the pulse and respiratory oscillations to cause comment, and when jugular compression was employed the rise of pressure was prompt, indicative of the absence of meningeal or other block in the spinal subarachnoid space.

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9. Warwick, M., and Nixon C. E.: A Study of the Colloidal Gold Reaction and Its Clinical Interpretation, Arch. Int. Med. **25**:119 (Feb.), 1920.

10. Thompson, L. J.: Interpretation of the "Paretic Curve" in Lange's Colloidal Gold Test, Arch. Neurol. & Psychiat. **5**:131 (Feb.), 1921.

Cells.—Fifty-one counts in thirty-six patients may be briefly summarized thus: 0-5 cells, 29 counts; 6-10 cells, 8 counts; 11-20 cells, 8 counts; 21-30 cells, 2 counts, and 42 cells, 1 count. Differential cell studies were made only so far as possible in the cell-counting chamber, employing a faint gentian violet stain and acetic acid, and using a high objective. The cells were lymphocytes and large mononuclear cells, the latter probably arachnoid in origin.

Total Protein.—Total protein was estimated by a number of tests, but during the last two years by a quantitative method.[11] Where this latter method was employed the readings were usually found to be just below the high normal limit of 40 mg. per 100 c.c. The highest was 111 mg., the lowest 22 mg. Taking all of the tests into consideration, one half of the patients showed protein increase, never of high degree.

Globulin Tests.—Tests were made almost exclusively by the ring test with saturated ammonium sulphate (Ross-Jones modification of Nonne). Of thirty-one patients in whom this examination was made, twenty-two gave a negative and nine a positive reaction. The globulin ring was never conspicuous; it never approached the density commonly seen in general paresis.

The Wassermann Test.—This test was negative throughout in every case. One weakly positive reaction in a patient presenting on two other occasions negative reactions, one anticomplementary, and one unsatisfactory (unexplained) reaction are exceptions which do not seem to vitiate the diagnosis in these cases.

Gold Chlorid Tests.—The tests in 1914-1917 were performed under the direction of Dr. W. A. Hinton by a method described by him;[12] those of 1920 and 1921 by one of us (H. E. F.) by the following method: To 1,000 c.c. of triply distilled water in an Erlenmeyer flask are added, at 60 C., 6 c.c. of a 2 per cent. aqueous solution of potassium carbonate; immediately 10 c.c. of a 1 per cent. aqueous solution of gold chlorid (acid) are added. A Meaker burner is then substituted for the Bunsen burner and the temperature rapidly raised to 90 C., when 6 c.c. of a 1 per cent. solution of formaldehyd is added drop by drop, the flask being agitated continuously. The flask with its colorless contents is then removed from the flame and gently rotated until a bright cherry-red color, with a light golden sheen, appears, which is usually after three minutes, but before six or seven minutes. Merck's highest chemicals are used.

11. Denis, W., and Ayer, J. B.: A Method for the Quantitative Determination of Protein in Cerebrospinal Fluid, Arch. Int. Med. **26**:436 (Oct.), 1920.

12. Lee, R. I., and Hinton, W. A.: A Critical Study of Lange's Colloidal Gold Reaction in Cerebrospinal Fluid, Am. J. Med. Sc. **148**:33, 1914.

TABLE 1.—Record of Cases

No.	Sex	Age	Date	Fluid from Puncture	Pressure, Mm.	Cells	Total Protein: Alcohol Ppt.	Total Protein: Mg. %	Cerebrospinal Fluid: Globulin	Cerebrospinal Fluid: Wassermann	Cerebrospinal Fluid: Colloidal Gold Test	Cerebrospinal Fluid: Sugar	Cerebrospinal Fluid: Nonprotein N.	Cerebrospinal Fluid: Chlorids	Cerebrospinal Fluid: Acetone	Cerebrospinal Fluid: Creatinin	Cerebrospinal Fluid: Urea	Cerebrospinal Fluid: Uric Acid	Blood: Wassermann	Blood: Sugar	Blood: Nonprotein N.	Blood: Chlorids	Blood: Acetone	Blood: Creatinin	Blood: Urea	Blood: Uric Acid	Symptoms
1	F	29	1915	Lumbar	...	4	sl.+	...	...	—	0123000000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	2 years, progressive
		35	1921	Lumbar	90	2	0	28	0	—	5432100000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	8 years, moderately progressive
2	F	23	1920	Lumbar	100	8	+	...	+	—	5554430000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	2½ years, moderately progressive
3	F	30	1921	Lumbar	...	4	sl.+	38	sl.+	—	5555542100	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	1 year, progressive
4	F	23	1920	Lumbar	70	6	0	38	0	Unsatisfact'y	5553210000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	3 years, progressive
5	F	33	1920	Lumbar	85	7	0	50	0	—	4443211000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	4½ years, progressive
6	F	26	1920	Lumbar	...	12	0	...	0	—	5553100000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	5 years, progressive
7	F	31	1921	Lumbar	...	8	0	47	0	—	5555531000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	2½ years, progressive
8	M	35	1920	Lumbar	50	0	0	24	0	—	5543210000	0.054	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	3 years, slowly progressive
9	M	30	1920	Lumbar	70	0	+	34	0	—	5555321000	0.069	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	Several years, slowly progressive
10	M	70	1921	Lumbar	...	..	sl.+	93	0	—	5554210000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	30-35 years, stationary, asylum ease
11	F	34	Apr., 1921	Cistern	80	2	0	22	0	—	0000000000	.....	....	...	...	....	....	....	..	.....	....	...	...	....	....	....	6 years, moderately progressive
			Apr., 1921	Lumbar	80	2	0	42	0	—	0011100000																
			Nov., 1921	Cistern	...	0	0	28	0	—	5555500000	0.065	28.5	695	0	1.25	24.3	Tr.	—	0.099	40.0	465	0	1.39	26.1	2.8	No apparent change since previous examination
			Nov., 1921	Lumbar	...	1	0	29	0	—	5555521000	0.067	18.7	686	0	1.20	17.5	Tr.									
12	M	29	4/17/20	Lumbar	60	20	+	...	+	wk.+	5555532000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	Rapidly progressive, 1½ years
			5/25/20	Cistern	110	12	sl.+	100	0	—	5555542000																
			5/25/20	Lumbar	...	30	+	111	sl.+	—	5555421000																
			11/21/21	Cistern	120	19	0	22	0	—	5555421000	0.048	25.5	701	0	....	21.1	Tr.	—	0.100	....	...	...	....	....	1.9	Progressive
				Lumbar	...	18	sl.+	42	0	—	.....	0.058	17.0	693	0	....	15.9	Tr.									
13	M	42	1921	Lumbar	...	1	0	69	0	—	0115322000	0.088	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	10 years, not progressive
14	F	38	1921	Lumbar	150	0	0	30	...	—	0001211000	0.067	40.7	651	...	2.38	....	....	—	.....	26.2	404	...	1.88	17.6	....	16 years, not progressive
15	F	46	1921	Lumbar	170	0	0	34	...	—	0122210000	0.080	28.1	672	...	2.30	....	....	—	.....	20.2	463	...	1.91	14.2	....	16 years, not progressive
16	F	48	1921	Lumbar	...	0	0	28	0	—	5310000000	0.061	18.2	662	...	....	....	....	—	.....	....	...	...	....	....	....	2 years, progressive
17	M	64	1921	Lumbar	...	0	0	42	0	—	0000000000	0.088	17.0	746	0	....	14.2	Tr.	—	0.080	23.9	622	0	....	15.1	2.2	About 25 years, not progressive
18	F	56	1921	Lumbar	...	4	0	57	0	—	0000000000	0.069	16.9	685	0	....	....	....	—	0.101	26.2	486	0	....	14.7	1.4	About 25 years, not progressive 3 yrs.
19	F	32	1921	Lumbar	...	4	0	50	0	—	5554310000	0.061	*	681	0	....	0	Tr.	—	.....	....	...	0	....	....	....	4 years, progressive
20	F	60	1915	Lumbar	...	2	0	50	0	—	0000000000	0.077	26.3	703	0	....	....	....	—	0.102	26.3	505	0	....	17.6	2.6	Many years, not progressive
21	M	32	1915	Lumbar	200	..	0	...	0	—	003 311000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	2 years, moderately progressive
22	M	36	1915	Lumbar	120	5	+	...	+	—	0000000000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	6 years, not progressive
23	M	16	1916	Lumbar	...	0	sl.+	...	0	—	0000000000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	8 years, moderately progressive
24	F	18	1915	Lumbar	...	14	sl.+	...	sl.+	—	4445321000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	8 months, progressive
			1917	Lumbar	65	5	+	...	+	—	.....	.....	....	...	...	....	....	....	..	.....	....	...	...	....	....	....	Not progressive
25	F	27	1916	Lumbar	...	0	0	...	...	—	0000000000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	3 years, not progressive
26	F	32	1916	Lumbar	150	3	0	...	...	—	.....	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	11 years, not progressive
27	F	36	1921	Cistern	...	0	0	25	sl.+	..	.....	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	17 years, moderately progressive
				Lumbar	130	0	0	30	sl.+	—	"Paretic zone"																
28	M	35	1916	Lumbar	140	7	0	...	...	—	"Negative"	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	3 years, moderately progressive
			1920	Lumbar	190	4	+	...	0	—	.....	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	Recently progressive
			1921	Lumbar	140	6	+	44	+	—	.....	.....	....	...	...	....	....	....	..	.....	....	...	...	....	....	....	Improving
29	M	29	1912	Lumbar	180	1	0	...	...	—	.....	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	9 years, not progressive
30	F	43	1915	Lumbar	200	12	+	...	+	—	1232100000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	1 year, progressive
31	F	30	Apr., 1919	Lumbar	...	19	+	...	+	Anticomp.	.....	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	4 years, paraplegia recent
			June, 1919	Lumbar	...	24	+	...	+	—																	
			July, 1919	Lumbar	...	42	+	...	0																		
32	M	26	1916	Lumbar	80	10	0	...	...	—	0015554200	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	9 months, progressive
33	F	35	1919	Lumbar	...	0	0	...	0	—	.....	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	9 years, not progressive
34	M	58	1914	Lumbar	...	8	0	...	...	—	0000000000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	18 years, not progressive
35	F	37	12/13/16	Lumbar	...	3	...	...	0	—	0012322100	.....	....	...	...	....	....	....	—	0.133	....	...	...	....	....	....	Rapidly progressive paraplegia, 7 mos.
			1/3/17	Lumbar	...	..	0	..	...	..	5555553200	.....	....	...	...	....	....	....	..	.....	....	...	...	....	....	....	Laminectomy for cord tumor; necropsy: multiple sclerosis
36	F	31	1920	Lumbar	...	2	+	...	0	—	1112210000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	Progressive
37	M	37	1920	Lumbar	...	3	0	...	0	—	.....	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	4 years, not progressive
38	F	34	1916	Lumbar	...	8	0	...	...	—	4001100000	.....	....	...	...	....	....	....	..	.....	....	...	...	....	....	....	3 years, Progressive
			1920	Lumbar	...	0	0	...	0	—	1110000000	.....	....	...	...	....	....	....	—	.....	....	...	...	....	....	....	Not progressive

* Too low to read.

Forty-two gold chlorid readings are available, obtained in thirty-three patients. The results may be summarized as follows: So-called paretic type, 21 fluids in 16 patients; so-called syphilitic type, 7 fluids in 7 patients; other positive reactions, 3 fluids in 3 patients; and negative reactions, 11 fluids in 10 patients. The paretic type was found by us in 50 per cent. of all fluids and also in nearly one half of the patients in whom this test was applied.

Sugar.—Fourteen findings are recorded. The highest is 0.088 per cent., the lowest 0.048 per cent.; the average 0.068 per cent. The method employed was that described in a recent paper,[13] a modification of the Folin-Wu technic for blood.[14]

Nonprotein Nitrogen.—Of the eleven determinations by the Folin-Wu method,[14] one was too low to read. The lowest readable was 16.9 mg. and the highest 40.7 mg. per 100 c.c. The average was 21.5.

Chlorids.—The highest of eleven determinations was 746, the lowest 51, with an average of 688 mg. per 100 c.c. The technic was that described by Whitehorne.[15]

Acetone Bodies.—No evidence of acetone bodies, B-hydroxybutyric acid, aceto-acetic acid and acetone, was found in any of the nine examinations, using the mercuric sulphate method of Van Slyke-Fitz.[16]

Creatinin.—The average of the determinations was 1.78 per 100 c.c.

Urea.—In one of the six determinations a slight trace only was found. The average was 15.5 mg. per 100 c.c.

Uric Acid.—Although a slight trace was present in all of the specimens examined, the amount was too low to read. Creatinin, urea and uric acid were tested for by the methods of Folin-Wu.[14]

OBSERVATIONS ON BLOOD

While the primary object was the study of the cerebrospinal fluid, it seemed wise to correlate the blood findings on specimens taken at the same time as the fluid. Whenever the amount of blood was sufficient, a Wassermann test was made. However, either at this time or at some other, all of the thirty-eight patients have given negative blood Wassermann reactions.

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13. Foster, H. E.: Hyperglycorachia in Epidemic Encephalitis, J. A. M. A. **76**:1300 (May 7), 1921.

14. Folin, O., and Wu, H.: A System of Blood Analyses, J. Biol. Chem. **38**:81, 1919; **45**:449, 1920.

15. Whitehorne, J. C.: Simplified Method for the Determination of Chlorides in Blood or Plasma, J. Biol. Chem. **45**:449, 1921.

16. Van Slyke, D. D., and Fitz, R.: The Determination of B-Hydroxybutyric Acid, Aceto-acetic Acid and Acetone in Blood, J. Biol. Chem. **32**:495, 1917.

Sugar.—All determinations were well within the normal limits, averaging 0.096 per cent.

Nonprotein Nitrogen.—One reading was slightly higher than normal, but the average was 28.1 mg. per 100 c.c. (normal, 25-35).

Chlorids.—The highest reading was 622, the lowest 404, with an average of 490.8 mg. per 100 c.c.

Acetone Bodies.—There were no acetone bodies.

Creatinin.—The highest reading was 1.91, the lowest 1.39, and the average 1.73 mg. per 100 c.c.

Urea.—The highest reading was 26.1, the lowest 1.42, and the average 17.8 mg. per 100 c.c.

Uric Acid.—The results of five examinations range from 1.4 to 2.8 mg. per 100 c.c.

The methods employed in blood analysis were the same as those used in the case of the spinal fluid, with the exception that the Folin-Wu method without modification was employed in determining blood sugar.

DISCUSSION

A study of the foregoing cases shows that when all tests on the cerebrospinal fluid are considered it can rarely be said that the fluid is entirely negative. It is true, however, that the abnormalities may be so slight as to be of little clinical significance except as evidence that a pathologic condition exists. But in approximately half of the fluids there are pathologic changes which cannot be overlooked. Foremost of these significant findings is the presence of a paretic colloidal curve. Formerly thought to be indicative of general paresis, this reaction has occasionally been found in brain tumor, encephalitis, acute alcoholism and other conditions. In this laboratory we have rarely seen it except in parenchymatous syphilitic disease of the nervous system and in multiple sclerosis. Another test appears to be of value when considered with the others: a reliable quantitative test shows the total protein of the fluid to be normal or only moderately increased, usually much less than in the various syphilitic affections of the nervous system, with which this disease is likely to be confused. The cell count is usually low—less than 10 per c.mm.—but being mostly lymphocytes, the cell picture frequently indicates a mild inflammatory or irritative process.

We may say, then, that a fluid obtained under normal or low pressure, containing a few lymphocytes, a normal amount of or only a slight increase in protein, with a negative Wassermann reaction and a paretic colloidal gold curve, is highly suggestive of multiple sclerosis. We may also say that in multiple sclerosis, although we frequently do not

obtain this combination of findings, we find some abnormality as a rule, and we must admit that the fluid is not usually entirely negative.

Is there any reason for these variable types of reaction? Analysis of the activity of the pathologic process might give the clue. Although difficult to be sure of the activity of a pathologic process from clinical observation in any disease, we are confronted in such a consideration of this disease by the fact that we do not even know what the active process looks like. In spite of this fact it seems reasonable to analyze our cases in the following manner: If there has been marked progression in the symptoms or evidence of invasion of new areas of the nervous system within six months of the time of the examination of the fluid, these cases have been considered as "progressive"; otherwise, "stationary." An analysis of this series with reference to the four tests giving abnormal findings is given in Table 2.

TABLE 2.—Analysis of Cases

	Progressive	Stationary
Total protein		
Increase (over 40 mg. per cent. when quantitated)	14	8
Normal	14	8
Globulin		
Present	17	8
Absent	17	8
Cells		
More than 10 per c.mm.	8	0
Less than 10 per c.mm.	21	16
Gold Chlorid		
"Paretic" type	16	1
"Syphilitic" type	5	2
Abnormal reaction	2	1
Negative	3	7

In this table when two or more examinations have been made on one patient only one has been recorded unless the type of reaction differed; for example, Case 11 is represented twice, Case 12 only once. The total number of cases appears to be 41 because three patients (24, 28 and 38) must be classed both as progressive and stationary types.

It is obvious from analysis of this table that total protein and globulin are not increased with certainty in either group and that no dependable guide as to the activity of the pathologic process is to be gained from these tests. The cell count is perhaps of some value in that significant increase is found only in the progressive types; however, a much larger number of fluids from actively advancing cases give cell counts below than above 10 per cubic millimeter. Pleocytosis cannot therefore be considered a reliable criterion of activity. Turning

to the gold chlorid reaction, we are struck by the large number of paretic types obtained in the progressive cases, and by the fact that only three are entirely negative; conversely, the stationary cases yield predominantly negative reactions.

In spite of the obvious inaccuracies in such a clinical and laboratory correlation, there is unquestionably some parallel between activity of the disease and pathologic findings in the fluid. While the laboratory evidence of activity of the process rests on a consideration of all tests, evaluation of these several tests shows that increase in cells and protein are less constant than the change in character of the colloidal gold curve.

Analysis of spinal fluid findings in patients examined more than once is of interest. The spinal fluids of eight patients have been thus investigated. In all no great variation in tests is noted at different times, with the exception of the gold reaction. In Cases 12 and 38 this test remained essentially the same—in the former over a period of seven months, in the latter over a period of four years. The most significant changes are seen in Cases 11 and 35, in both of which the character of the colloidal gold reaction changed materially, in the latter case during an interval of less than one month. In seeming contradiction of the conclusions reached in the foregoing, there was no obvious change in the clinical course of the disease correlative with the change in these tests. It would be of considerable interest to determine in a larger series whether spinal fluid examinations are often as variable in an individual case as is indicated in these two patients.

Three patients presenting symptoms suggestive of spinal cord tumor were examined by means of combined cistern-lumbar puncture. A comparison of the fluids obtained from these two loci at the same time is of interest in that no distinctive difference is seen; this suggests that in these cases the pathologic process is cerebral as well as spinal. The slightly greater protein content of the lumbar fluid is also seen in examination of normal persons.

Concerning our chemical examinations other than the routine tests already discussed we cannot be dogmatic. These studies were made as a matter of research, with the hope of obtaining insight into this disease from possible metabolic disturbances which might show in the blood and spinal fluid. For example, it was possible that with breaking down of myelin sheaths there might be thrown into the blood or fluid certain products of fat metabolism; yet we were unable to detect in either any trace of acetone bodies. Although the normal values of the various substances tested for in the fluid are not as yet certain, judging by the few reports in the literature and by our own work, we must regard the figures obtained in multiple sclerosis as probably within normal limits. Compared with the figures in normal blood, we also find no radical departure in this disease.

CONCLUSIONS

The spinal fluid findings in thirty-eight cases of multiple sclerosis, together with certain blood examinations in a number of these, are given.

There is no single fluid test of paramount value in the diagnosis of multiple sclerosis. However, correlation of all tests ordinarily performed on the spinal fluid indicates that it is seldom entirely normal, and that in 50 per cent. of the cases of this series findings unusual in other diseases were obtained. This group of findings, which we consider important, is as follows: fluid of normal appearance, obtained under normal or low pressure as registered by the manometer, showing a slight increase in cells (lymphocytes and arachnoid mononuclears); total protein normal or only slightly increased; globulin, a slight trace or absent, and a paretic colloidal gold curve with a negative Wassermann reaction.

Correlation with the clinical picture suggests that this type of fluid indicates a progressive stage of multiple scloresis. Conversely, normal or nearly normal fluids were found primarily in patients in whom no clinical progress had recently been apparent. Results of certain chemical studies designed to show disorders of metabolism in this disease, performed on blood and spinal fluid, were normal.

AN ADDITIONAL CONTRIBUTION TO THE SYMPTOMATOLOGY OF EPIDEMIC ENCEPHALITIS *

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At the request of the organization committee, we have reviewed our cases of epidemic encephalitis occurring during the past year, with a view to the discovery of novel symptomatology or disease incidence which might be of either diagnostic or pathologic interest. It has always, of course, been clear that an infection flung far and wide through the nervous system would inevitably produce in different persons extraordinarily diverse clinical pictures. In epidemic encephalitis the diversity observed becomes greater with increased experience, and we have been fortunate enough in the neurologic department of Bellevue Hospital to find many examples of disease incidence in the sensorimotor system both central and peripheral, and, we believe, in the vegetative nervous system as well.

We have grouped cases in this paper under the headings: spinal types, disturbances of metabolism, disorders of motility and symptoms evidencing impairment of the vagosympathetic mechanism. The cord syndromes which have been described heretofore are confined to cords having an affection of the ventral horns and those in which a transverse softening has taken place. It becomes certain, however, that more discrete destruction can occur in the cord giving rise to clear-cut pictures of transient syringomyelia.

One such case was that of a young woman with general constitutional symptoms of infection, who, after having violent shooting pains in the left arm, experienced paresis of the arm, together with pyramidal weakness of the left side of the body and loss of temperature and pain sensibilities over the right side of the trunk between the spinal segments—the fifth cervical and the ninth dorsal. The left hand became swollen and succulent in appearance, indicative of vasomotor stasis, due to the lesion having involved not only the ventral horns and crossed sensory paths but the intermediolateral tracts as well. This grave picture was removed in four months, when the patient's health had been entirely restored.

Our second example was the case of a young man who one of us at first thought had a case of conal tumor. After two weeks of acute insomnia, he developed weakness in dorsiflexion of both feet and abduction of the thighs and clear-cut loss of pain and temperature senses in the skin areas served by the

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* From the Neurological Department, Bellevue Hospital.

lumbar and first sacral segements. The ankle reflexes were abolished and the knee reflexes depressed. The right plantar reflex was of extensor type. There were myoclonic movements of one leg. Entire recovery took place within three months.

DISTURBED VEGETATIVE FUNCTION

We believe that the significance of disturbed vegetative function in encephalitis can hardly be overstated; not only are such cases difficult to diagnose, but some of them may furnish valuable data for a future comprehension of neurotic and psychotic phenomena on a physical rather than on a purely emotional or psychic basis.

H. G., aged 21, served as a private in the United States Marines during the war and was supposed to have disintegrated mentally after an alleged attack of influenza in London, during the month following the armistice. He was placed in a hospital for mental diseases for about eight months after his return home. The clinical picture seen in the spring of this year was sufficiently confusing; a young man of splendid physique, carried his height of 6 ft. 2 in. (1.87 meters) with a pronounced stoop, an acquisition of his illness. Despite the exclusion of the possibility of syphilitic infection, the pupils were distinctly sluggish to light, the right side of the face definitely flattened in its creases, and there was a fine jelly-like, but most definite, nystagmus on lateral conjugate deviation of the eyes to the right or left. There was pronounced tremor in the extended hands. He had lost over 30 pounds (13 kg.) since his illness; but except for the absence of the abdominal reflexes, great increase in the arm, knee and ankle reflexes and involuntary shivering movements of the pectoral muscles, nothing more of pathologic interest could be made out in the sensorimotor system. He suffered, however, from severe nocturnal insomnia, rarely sleeping more than two hours before dawn, after which he would grow drowsy and might sleep three or four hours before noon. Whether he slept or not, during the first part of the day he was utterly inert and exasperated by his inertia. He had the utmost difficulty in accomplishing simple acts, such as shaving, dressing or bathing. He agonized for hours in futile efforts to write a short note or keep an important engagement. In his mental attitude there was not a trace of negativism; he desired passionately to do those things which he could not do at that time, but which later in the day he often could do with relative ease. There seemed to be a distinct resemblance between his inability to perform acts to the completion of which he was urged by will only without the stronger adjuvant of emotion, and the palsy of purely voluntary movements in midbrain encephalitis of the parkinsonian type—palsies so often abolished by affective stimulation. He complained frequently of "numb attacks," during which he felt very cold and during which he shivered and his teeth would chatter like a man with a rigor. During these attacks, even in July weather, his rectal temperature was always subnormal, on several occasions being 97 F.; and on his skin were large patches of goose-flesh which covered a third of the body area at a time and which, under observation, changed their position like a breeze over still water.

In the same general period but not necessarily and indeed rarely at the same hours, he had attacks of disturbed breathing rhythm of from a quarter to half an hour's duration. During these attacks he felt as though he could not fill his lungs with air, and he breathed with all his accessory respiratory muscles

from fifty-six to sixty-four times a minute. At other times he experienced what seemed like a spasm of the laryngeal muscles and breathed more and more stertorously and ineffectively so that the lips were cyanosed and the eyes protruded. Phenomena such as these have appeared at times in hysteria, and various physicians had considered them hysterical in this case. This explanation, however, would not account for the patient's abnormal thirst for ice water. He consumed for a period of eighteen months, between thirty and forty quarts of water every twenty-four hours and had proportionate polyuria.

An analysis of the initial illness in December, 1918, which he had always considered influenza, revealed the only symptoms to have been severe headache and intense sleepiness by day and by night. Two negative features of value, however, were that he had had no feeling of fever and that he had never reported sick to a medical officer. It is highly unlikely that this would be true of any youthful patient with the influenza which was prevalent in London at the end of 1918. Furthermore, after three or four weeks sleepiness disappeared during the night time and was only present by day, a reversal of the sleep mechanism sufficiently familiar to all students of epidemic encephalitis.

This patient's symptoms during the last eight months have gradually improved so that now he is almost normal, with little or no morning inertia, no difficulty with respiration and no rigors, and diabetes insipidus has been reduced to an intake of only 3 quarts of water a day. It is possible that this happy result has been assisted by the constant administration of scopolamin during the last four months of his illness; on this subject more will be said later.

A case brought under our observation recently has afforded us a fortunate diagnostic corroboration in that this strange syndrome is to a large degree duplicated. In this second instance, the patient, a boy of 14 years, had a similar polydypsia and polyuria with tremors in the upper extremities, excessive salivation and similar distressing paroxysmal attacks in which breathing was exceedingly rapid, labored and difficult. At these times there was great emotional distress and suffering. In this boy, acute encephalitis occurred in January, 1920, with visual disturbance, diplopia, fever and excessive insomnia; this was followed for many months by apparent recovery and was then gradually succeeded by a rhythmic incessant cough and thereafter by the distressing symptoms mentioned.

Another example of seriously deranged metabolism was the case of J. D., a well-developed young man of 24, who in the late spring of 1920 had an acute illness accompanied by headache, diplopia, diarrhea and nervousness. Shortly afterward an increasing desire to sleep and difficulty in the use of the right arm, leg and right side of the face appeared. A month later excessive thirst and polyuria developed, and at this time sugar was found in the urine. A low carbohydrate diet for two months improved the glycosuria and entirely relieved his thirst and polyuria. As these symptoms waned a gradually increasing slowness of speech and movement began. In Bellevue Hospital in July of this year, he presented a typical unilateral pseudoparkinsonian syndrome without any evidence of diabetes mellitus.

Another patient, a woman, aged 28, developed severe hypertrichosis of the face and arms following encephalitis. Great increase in body weight has been a fairly common sequel of epidemic encephalitis. It happens that this disturbance of metabolism was seen in our series only in female patients. One patient within a year gained over 100 pounds (45 kg.). She eventually died, probably of myocarditis. Among five other patients, gains of from 40 to 70 pounds (18 to 31 kg.) were noticed. The blood sugar was found to be normal in two instances, but in a woman, aged 52, with an increase in weight of 60 pounds (27 kg.), sugar tolerance was below normal. The climacterium as a contributing factor in the increase in weight could be excluded in all but one of our cases.

DISORDERS OF MOTILITY

Certain disorders of motility, some of which may not be new to other observers, we feel to be worthy of report. In particular, we feel that stammering, rhythmic movements, breathing irregularities and eccentric stations may be attributed to disturbance of the toning mechanism of the muscles.

In five patients, all with a pseudoparkinsonian syndrome, stammering developed as a sequel to their illness. In one of these cases the disorder accompanied a severe relapse, precipitated by a fright occurring two months after the onset of encephalitis. In the other instances, stammering appeared from three months to two and a half years after the first symptoms and without any psychic trauma. Rhythmic movements were observed in three patients. A. B., aged 28, had from the onset of her illness bilateral tremor of the masseters, associated with rhythmic muscular action, which gave a champing movement of the jaws. This was constant during the waking hours, and, with the immobile facies and unwinking stare, resembled remarkably the breathing movements of a fish.

In H. B., aged 32, the left side of the face suddenly began to twitch three months after an alleged influenza in the winter of 1919. The movement involved only the mouth, and did not cease or spread, but gradually the contractions became stronger. E. P., aged 19, had a similar affection from the onset of her illness.

In all these cases the movements occurred about once a second, were not under control of the will or varied by attention or emotion and could not be inhibited by any voluntary use of the involved muscles. The absolute rhythm of these movements distinguishes them, to some extent, from habit spasms, in some of which, however, there may be a striatal origin; indeed, we think many cases of hysteria may be in essence a retreat from a cortical to a more primitive reflex level of motor expression.

Breathing spasms were seen twice. One patient, E. P., just mentioned, had had from the beginning very irregular breathing—both in depth and rate—accompanied by curious noises which occurred only during sleep. S. J., fifteen months after apparent total recovery from encephalitis, had a parkinsonian relapse, accompanied by attacks of rapid deep breathing. These increased in frequency and at length continued through the waking hours, causing much fatigue. Emotion would initiate them, but when started they could not be stopped until their course was run—usually in a minute or two. There was never any feeling of dyspnea, but a sensation that the lungs could not be filled, and he had a desire to expand them as much as possible.

A patient, during the course of encephalitis which began with headache and spinal root pains, soon followed by a hemiplegia and later by various cranial nerve involvement, developed recurrent vomiting which persisted for three weeks. Several times a day, with or without food in the stomach, expulsive movements occurred; we speak of the case at this point in the belief that the vomiting was probably in morbid process analogous to the rhythmic movements and breathing spasms just described, and also analogous to the hiccup seen in certain cases of encephalitis.

Anteropulsion of the trunk was seen in a boy of 12. Another boy, aged 15, maintained when sitting or standing, a deviation of the trunk to the left. Neither patient ever fell. At a certain point the pull would cease and the attitude would be maintained. No cerebellar symptoms were found in either case.

Two parkinsonian patients developed bulbar palsy with lingual and pharyngeal atrophy nine months after the initial illness. Of these, one improved, the other died.

Limitation of parkinsonian symptoms to the upper extremities and the face was observed twice. Another patient presented curious irregularities of posture, owing to acute spasm of particular muscle groups. These phenomena lead us to speculate on the possibility that individual centers in the corpora striata may govern individual spinal segments.

We have the following evidence of disturbance in the vagosympathetic mechanism: In nine of fifteen cases tested there was a strongly positive oculocardiac reflex. Ocular pressure stopped the pulse absolutely in four patients—in one for a period of twenty-eight seconds after pressure was relieved. The pulse rate dropped 15, 20, 35 and 40 beats a minute, respectively, in four other cases. The ninth patient showed a pulse rate increased by twenty beats a minute. The other six patients gave no reaction to ocular pressure. The degree of reaction in a given case could not be foretold on a basis of the general clinical picture and had no relation to the patient's ordinary pulse rate. The percentage

of strongly positive oculocardiac responses is much higher in epidemic encephalitis than in numerous control tests made on a variety of other cases.

EXOPHTHALMOS

In twelve patients we observed exophthalmos. This varied in degree, was most marked in the definite parkinsonian cases, and was accompanied by a diminution of the wink reflex. It is perhaps noteworthy that this exophthalmos, a sympathicotonic sign, was often present in patients who were vagotonic, as judged by a strongly positive oculocardiac reflex.

THERAPEUTIC RESULTS

A few words on the result of treatment of residual cases may be of interest. It has seemed to us that medication should be based on a drug or drugs acting chiefly on the vegetative nervous system. The problem is a broad one and is complicated by the fact that in any given case of encephalitis the symptoms are not characteristic of damage to either the autonomic or the sympathetic system alone. There is instead a confused picture evidencing functional impairment of both divisions of the vegetative nervous system. It is possible in this paper to give only a mere sketch of our therapeutic results, which will have to be corroborated by further observations before any definite conclusion can be reached.

Thyroid and pituitary substances have no effect on residual encephalitic symptoms. Epinephrin, given to three patients in 20 minim subcutaneous doses of 1 : 1,000 solution, increased the pulse rate 50 per cent. and increased the rigidity of extremities for a period of two hours. In three controls the maximum pulse increase was 15 per cent. Nicotin in doses of $\frac{1}{30}$ grain (0.002 gm.) subcutaneously, did not affect the pulse rate, but did decrease rigidity for a period of from ten to fifteen minutes. Atropin, when used in large doses, increased rigidity and made the patient subjectively worse. Scopolamin, doses of $\frac{1}{100}$ grain (0.006 gm.) by mouth three times a day over a period of several days, has produced in about half the cases in which it was used a lessening of rigidity; it has restored facial mobility and has made the patients generally more comfortable. Gelsemium—the fluid extract—in doses of 7 minims (0.42 c.c.) three times a day or gelseminin hydrochlorate $\frac{1}{30}$ grain by mouth three times a day, has an effect similar to that of scopolamin in the same proportion of cases. These favorable effects of gelsemium persist as long as it is used; in one case these effects lasted for a period of over three months.

In perhaps a quarter of the cases, cumulative drug effects have been observed. These consist of heaviness of the eyelids, diplopia and, at times, a feeling of languor and confusion. They disappear within

twenty-four hours of the withdrawal of the drug, and they were alarming only once. In this case fluid extract of gelsemium, 5 minims (0.3 c.c.) three times a day, had been used for six days, and then scopolamin $\frac{1}{100}$ grain (0.0006 gm.) given subcutaneously. Within five minutes after the injection of the latter, the patient became confused, weak to the degree that lying down was necessary and flushed of face, with rapid pulse and dilated pupils. Her severe parkinsonian tremor absolutely ceased. This state lasted four hours. Scopolamin alone by mouth or subcutaneously never had any such effect on this patient. The situation was reproduced, and the same cumulative phenomena recurred. These observations suggest a synergism between scopolamin and gelsemium. The action of gelsemium on true paralysis agitans cases was studied. It produced the same relief which scopolamin has long been known to give. Thus both in true paralysis agitans and in postencephalitic pseudoparkinsonian disease, gelsemium seems to be ameliorative in approximately half the cases. While both scopolamin and gelsemium, according to Cushny, act by depressing the central nervous system, gelsemium has a distinct advantage over scopolamin in that it can be used for an indefinite time and has none of the dangerous concomitant effects of the latter. Why scopolamin, "which produces a sensation of fatigue and drowsiness" and after a dose of which "the patient moves about less and speaks less," [1] can relieve symptoms of the same sort in encephalitis, we cannot yet answer.

Our most striking therapeutic result, however, was obtained in January, 1921. A woman of middle age who had been unable to articulate, chew or move the arms or legs on volition—so intense was the parkinsonian spasm—after a suppository of belladonna, was able to talk fluently, move quickly and with grace, and express emotion easily by gesture and facial expression. Congealment of function gradually returned, but temporary dramatic amelioration has always been possible by the rectal use of belladonna in tolerance dosage.

1. Cushny: Pharmacology and Therapeutics, Philadelphia, Lea & Febiger, 1910, p. 295.

EXOGENOUS CAUSES OF MULTIPLE SCLEROSIS*

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My report has nothing to say concerning possible endogenous causes, and it also excludes certain exogenous etiologic agents such as direct bacterial infections or parasitic invasions, which are to be dealt with by others. The possible exogenous causes that I have to consider are: (1) the influence of earlier infections; (2) the influence of intoxications; (3) thermal and electrical influences, and (4) trauma.

With the aid of Dr. Caroline Latimer and Miss C. J. Smith, I have analyzed forty-four cases from my private practice and from the records of the Johns Hopkins Hospital, all studied between 1905 and 1921.

INFECTIONS

Pierre Marie of Paris has suggested, and the suggestion has been favorably entertained by various neurologists, that multiple sclerosis might be a sequel of various infectious diseases. It has been observed in a certain number of cases, not in many however, that the symptoms of multiple sclerosis began to appear soon after the occurrence of an infectious disease. Possibly in some of these cases it was a disseminated encephalomyelitis rather than a true multiple sclerosis that was dealt with. Granting, however, that occasionally true multiple sclerosis has occurred soon after an infection, this relationship may have been purely accidental. Unless the infection and the onset of multiple sclerosis are chronologically closely related, there could be little justification in considering the multiple sclerosis as a sequel of the infection. It has been fairly well established that multiple sclerosis may undergo exacerbation from intercurrent infection, and it seems probable that the instances in which multiple sclerosis has been supposed to begin after an infection have been instances in which the disease in reality existed unnoticed before the infection, its so-called "beginning" having been called forth by the infection.

If we take into account only cases in which an infection has preceded the apparent onset of multiple sclerosis by, say, two or three months, not longer, the statistics in the literature indicate that only from 3 to 5 per cent. of the cases recorded show such a temporal connection with infection (Berger; Hoffmann). In this country Woodberry (1919) has emphasized the co-existence of chronic tonsillar infections; Gill and Bassoe call attention to the frequency of both tonsillar and dental infections.

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In the cases that have occurred in my own practice and in the Johns Hopkins Hospital, there was a history of one or another infection shortly before the onset of the symptoms of multiple sclerosis in five of the forty-four cases; these infections included gonorrhea (1), tonsillitis (1), nasopharyngitis and otitis (1), abscesses of the teeth (1), and influenza (1). This is a meager showing, and I attach no significance to it. In the distant past of the persons whose cases were analyzed, childhood infections were as common but no commoner than in other patients; five of the forty-four patients had had typhoid fever, five tonsillitis, five abscesses, four scarlet fever, two syphilis and one erysipelas. It will be seen that there is nothing striking about such a record of earlier infections.

Since the outbreak of epidemic encephalitis in 1917 the occurrence of a certain number of cases in which the disease became chronic, with exacerbation, has been noted, and doubtless many have wondered whether or not some of these might follow a course similar to that of true multiple sclerosis or possibly might even be identical with it. In the few necropsies that have been made on such cases, however, the lesions found have not been those of multiple sclerosis.

INTOXICATIONS

It was thought by Oppenheim that mineral poisoning, especially by lead, arsenic and tin, might be responsible for the origin of multiple sclerosis, and von Jaksch believed that poisoning by manganese could give rise to a clinical picture resembling multiple sclerosis if not identical with it. Undoubtedly multiple sclerosis occasionally occurs among workers in metals, and some of the European neurologists have drawn a part of their material from among such workers. But when we consider the total number of cases of multiple sclerosis, a history of poisoning by metals is rare among them, so rare that we can certainly exclude this form of poisoning as a principal etiologic agent. Multiple sclerosis is probably just as common in women as in men, or nearly so, and women are not exposed to metal poisoning. Again, in the majority of cases the disease begins in early life often at a period before the patients could have been subjected to metal poisoning from their occupations. Further, it is scarcely conceivable that the successive exacerbations that are characteristic of the disease can be explained on the ground of a succession of metal poisonings. In my series of forty-four cases, a history of metal poisoning was found in none.

Other poisons incriminated include alcohol and carbon monoxid. Jelliffe mentions alcoholism in 8 per cent. of his cases, a larger incidence, however, than is found in most statistics. Among my forty-four cases there were only two patients who used alcohol to excess; the majority were total abstainers. When one recalls the enormous number of cases

of alcoholism formerly seen and how rare it was to see multiple sclerosis in an alcoholic addict, it is improbable that it could be other than a predisposing or exacerbating factor. The same may be said of carbon monoxid poisoning. Disseminated lesions throughout the brain and spinal cord may occur in carbon monoxid poisoning, but these lesions do not appear to be identical with those of multiple sclerosis.

Dr. A. L. Skoog, of Kansas City, Mo., writes me that he has studied a painter who gave a positive history of intoxication by "volatile oils." None of our patients gave such a history.

In our Baltimore cases there were no intoxications of any sort recorded except intestinal stasis, and this feature was no more common than in the average of patients not suffering from multiple sclerosis.

THERMAL AND ELECTRICAL INFLUENCES

In some of the patients with multiple sclerosis one finds a history of heat stroke, of lightning stroke or of exposure to cold and wet. But such instances are rare, and the hypotheses that have been put forward to explain them (reflex contraction of vessels in the central nervous system due to cold; chemical changes in hemoglobin brought about by thermal influences) seem forced. Krafft-Ebing reported thermic injury in no less than forty of 100 patients. Otto Marburg saw a patient whose clothing, suddenly wet, froze on him; six days later he began to have visual disturbances due to retrobulbar neuritis, after which the typical picture of multiple sclerosis developed. Most critical observers express the opinion, however, that these thermal influences are not the causes of multiple sclerosis but, at most, are injuries that cause an exacerbation of an already existing disease. In our forty-four cases, the analysis does not reveal a single instance in which there had been electrical injuries, thermal injuries, or marked exposure to cold or wet.

TRAUMATISM

Patients with chronic nervous disease are prone to incriminate trauma, physical or psychic, as causative agent. Similarly, multiple sclerosis is not infrequently attributed to traumatic causes. It has been assumed that the trauma injures the blood vessels, does harm by violent commotion in the cerebrospinal fluid or by concussion causing molecular changes in the nerve substance, or by tearing lymph spaces with resulting necrosis in the parenchyma. No one has, however, been able to reproduce the lesions of multiple sclerosis through experimental traumatism to animals. If one adheres to the requirements laid down by K. Mendel, the incidence is small. Mendel laid down as necessary conditions: (1) direct injury to the skull or spine or violent shaking of the same; (2) exclusion of every other cause; (3) demonstration of

complete health before the trauma, and (4) demonstration of a definite temporal connection between the appearance of the first symptoms of the disease and the accident. The incidence when these conditions are regarded varies according to different authors—Schultze, 8 per cent.; Berger and O. Marburg, 9 per cent.; Jelliffe, 12 per cent.

It must be remembered that injuries often occur in multiple sclerosis as a result, rather than as a cause, of the disease, and when multiple sclerosis appears to develop after trauma careful inquiry will often show that symptoms of the disease had been present earlier. It does seem certain, however, that latent multiple sclerosis may suddenly become manifest after a severe trauma (either physical or psychic) and that manifest multiple sclerosis may undergo marked exacerbation after trauma.

In our forty-four cases, eleven patients gave a history of physical trauma of one or another sort, and three gave a history of nervous and mental strain. In most of the instances, however, the trauma had occurred long before the onset of the illness; in only three cases did it occur within a year of onset. Three of the female patients stated that the onset and progress of the disease seemed to be related to childbearing.

CONCLUSIONS

If multiple sclerosis is a disease entity due to a single cause that acts in early life, it may be due to some specific infection, but the evidence available is strongly against its being caused by any of our well-known infections, by any ordinary intoxication (organic or inorganic), or by electrical, thermal or traumatic influences. If the exogenous factors mentioned play any rôle at all in the etiology of the disease, they must act either as predisposing influences for the true cause or as aggravators of a disease already started by the true cause.

MULTIPLE SCLEROSIS

FROM THE STANDPOINT OF GEOGRAPHIC DISTRIBUTION AND RACE *

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The results of the tabulation of multiple sclerosis as one of the defects found in drafted men are plotted on the accompanying map. It shows that the maximum rate for this disease was found in Michigan and Minnesota, in which there were eighteen persons with this disease per 100,000. The Michigan rate is based on six cases so diagnosed by local boards and on nine at Camp Dodge. Excepting Delaware and the District of Columbia (whose rates depend on one and two cases, respectively), the next highest ratio is that for Wisconsin, fourteen per 100,000, where five cases were found by local boards and six by examiners at Camp Grant. That these states with a high ratio for multiple sclerosis are adjacent states, bordering on the Great Lakes, is of great interest. Since examinations were made at three different camps, the result cannot be ascribed to the idiosyncrasy of a neuropsychiatric examiner at one camp (Fig. 1).

The nearest approach to the distribution of multiple sclerosis found in any other diseases is in goiter, exophthalmic goiter, chorea, varicose veins, varicocele and allied diseases and various heart diseases and defects. The cardiovascular diseases are associated with the tall stature of the men living about the Great Lakes—largely Scandinavians. The resemblance between the distribution of multiple sclerosis and chorea is considerable, except that chorea is abundant also in Texas, Mississippi, Missouri and the states of the North Atlantic coast and of the eastern slopes of the drainage basin of the Ohio River; that is, high rates of chorea are more widespread than of multiple sclerosis. It is rather interesting that especially high rates for chorea, as for multiple sclerosis, are found, outside the Great Lakes region, also in the states of Washington, Mississippi and Maine.

The resemblance of the distribution of multiple sclerosis to that of simple goiter is somewhat striking. In both diseases comparatively few cases are found south of the Ohio River. The maximum rate is found in Michigan, Wisconsin and the extreme Northwest.

Various hypotheses are suggested for these facts. One is that some race inhabits the Great Lakes region and the state of Washington that

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* Presented before the Association for Research in Nervous and Mental Diseases, December, 1921.

is especially subject to multiple sclerosis as well as goiter, chorea and cardiovascular defects. One thinks of the big Swedes that live in these parts of the country. Probably the cardiovascular defects are associated with the tall stature of men from these localities. The goiter is supposed to be due to the absence of iodin in the potable waters. Whether or not chorea and multiple sclerosis are especially common among Scandinavians cannot be definitely asserted. The matter is considered later in this paper. It is, of course, possible that in the rapid diagnosis of local boards and camps some cases of chorea may have been diagnosed as multiple sclerosis and vice versa.

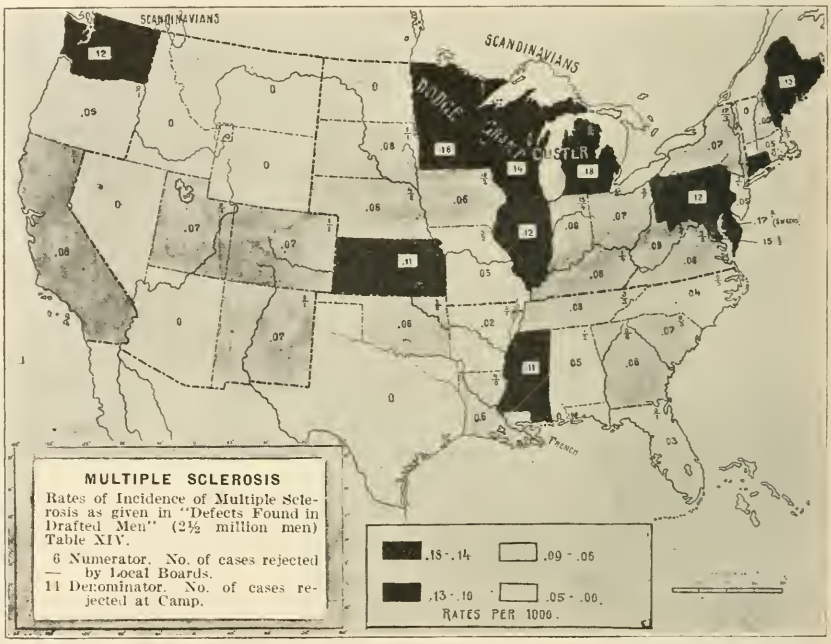

Fig. 1.—Map of the United States showing by states the varying density rate of multiple sclerosis. "Dodge," "Grant," and "Custer" in the Great Lakes region are the names of camps at which the drafted men from those localities were mobilized. (From "Defects Found in Drafted Men.")

RATE OF MULTIPLE SCLEROSIS IN URBAN AND RURAL POPULATION

For the United States as a whole, the defect rate found in the draft was, for multiple sclerosis, 10 per 100,000 of the population examined. The urban rate was 12 per 100,000 and the rural rate 8 per 100,000; thus the urban rate was one-half greater than the rural rate. For four large cities (combined) the rate was 14; the rate for each city was: Philadelphia, 23; Boston, 16; New York, 13, and Chicago, 11.

SECTIONS AND GROUPS OF SECTIONS

The rate per 100,000 men examined in the draft is shown in Table 1.

TABLE 1.—RATES PER 100,000 FOR MULTIPLE SCLEROSIS ("DEFECTS IN DRAFTED MEN").

For southern, prevailingly *white* agricultural communities	7
For southern, prevailingly *colored* agricultural communities	6
For northern agricultural communities, prevailingly native white	8
For northern agricultural communities, prevailingly foreign	10
For mining sections	7
For maritime sections	10
For mountain sections	2
For the "mountain whites" of the South	7
For Indian sections	1
For Scandinavian sections	16
For German and Austrian sections	10
For Finnish sections	29
For French-Canadian sections	8

The high ratios found in Scandinavian and Finnish sections are probably significant. However, both Finnish sections are in the Great Lakes region, which is a region with a high rate of multiple sclerosis.

RACIAL DISTRIBUTION

In 1902, the incidence of multiple sclerosis in New York City among patients with nervous diseases was considered low. The rate was from 2 to 7 per 1,000, except that Dr. Onuf found, among 500 to 600 cases, 14 per 1,000, and Fraenkel found 18 per 1,000 among Jews at the Montefiore Home.

In 1903, Taylor and Myers, in Boston, found only 1 per 1,000 among nearly 10,000 nervous cases. They called attention to the great difficulties of diagnosis. If patients with certain ataxic paraplegias, diffuse degenerations and spastic paraplegias were included, the rate would be increased to 4 per 1,000.

Van Wart, in 1905, on the basis of 500 nervous cases in New Orleans, found a rate for multiple sclerosis of 44 per 1,000 and concludes that in Louisiana and the surrounding states multiple sclerosis is an extremely frequent disease. But this may well be due to the idiosyncrasies of the examiners. Perhaps a prevailing tradition is responsible for the high rate for this disease in Mississippi at the time of the draft.

For other countries the rate is said to be much higher than the 2 to 7 per 1,000 in New York City. Thus the Bramwells (1903, 1915) find a rate first of 20, and later of 32, in Scotland and the North of England. Williamson is said (Collins and Baehr, 1914) to have found a rate in Manchester of 27 per 1,000 and the National Hospital for Paralyzed and Epileptic in London of 60 per 1,000 "nervous cases";

but in this hospital the patients with nervous cases were a more rigidly selected lot than in many of the other instances, so that multiple sclerosis formed a larger proportion of the population than in other hospitals. According to Jelliffe (1904), Jolly of Berlin found 8 per 1,000 multiple sclerotic patients among nearly 10,000 patients with nervous diseases; and Sanger of Hamburg about 10 per 1,000.

Various authors, such as Jelliffe (1904) and Collins and Baehr (1914), give statistics concerning the racial constitution of patients with multiple sclerosis. But in a country whose racial composition changes so rapidly it is difficult to compute satisfactory racial rates. Also, there is reason for thinking that there is a racial selection for particular clinics. Thus, private patients are more likely to include an excess of native Americans and Germans, and the hospital clinics of the later immigrants. The excellent provision made for Jewish patients in special hospitals for that race diminishes the Jewish rate in the general hospitals.

TABLE 2.—Rates of Various Foreign Nationalities in New York and Among Patients with Multiple Sclerosis

1	2	3	4	5
Name of Nation	Number in Greater New York, 1920, per Thousand	Proportion of Total Foreign-Born Population of 1,990,000	Number of Cases of Multiple Sclerosis Listed in the Four Hospitals	Proportion of Entry of Column 4 to 70 Foreign-Born Patients
Russia	480	24.1	9	12.9
Italy	389	19.6	11	15.7
Germany	194	9.8	12	7.2
Ireland	203	10.2	8	11.5
England	71	3.6	5	7.2
Sweden	33	1.7	3	4.3
Norway	24	1.2	3	4.3

Miss Louise A. Nelson has ascertained the birthplace of seventy foreign-born patients with multiple sclerosis from the records of Montefiore Home, Neurological Institute, St. Luke's Hospital and Post-Graduate Medical School. According to the bulletin of the United States Census Bureau, the number of foreign-born persons per 1,000 in Greater New York for the leading countries is as given in column 2, Table 2. The proportion that each number makes of the 1,990,000 foreign-born persons for the seven leading nationalities is given in column 3. The number of cases of multiple sclerosis in these same nationalities found by Miss Nelson is given in column 4. The proportion that each is of the seventy foreign-born patients with multiple sclerosis is given in column 5. Were the patients distributed among the nationalities in the same ratio as the whole foreign population, columns 3 and 5 should be closely similar. Actually they show striking differences. Thus the number of cases among the Russians and Italians are far below expectation. The number of cases among the Irish are

slightly above expectation; the English and Germans have about twice as many cases of multiple sclerosis as expected: Sweden has about 2.5 times and Norway about 3.6 times as many cases as expected. Without laying any stress on the exact multiples, we have relatively more Scandinavians with multiple sclerosis in the hospitals named than we would expect were patients of all nationalities equally likely to go to these hospitals and were the rate of incidence the same in all nationalities. While we cannot assume the first to be true, still there is no obvious reason why it should not be approximately true. If this be granted, it would follow that there is probably an exceptionally high incidence of multiple sclerosis among Scandinavians. Incidentally it may be said that Jelliffe's figures also seem to show that there are more Scandinavian than Russian patients in a New York City clinic. When we recall that in the draft statistics the rate for multiple sclerosis is high in states with a large proportion of Scandinavians, it does not seem unwarranted to suggest that the Scandinavian race may be especially subject to this disease.

It is only right to add that a visit to the Swedish Hospital, Brooklyn, since the foregoing was written, did not reveal any cases of multiple sclerosis there nor listed on the records of the hospital. However, this hospital does not receive many nervous cases.

The negro race is not immune from this disease; although, as indicated by Table 1, it—including mulattoes—is probably less subject to the disease than the white race. Miura (1911) states that the disease is infrequent in Japan, while amyotrophic lateral sclerosis is common.

HEREDITY

If there is any racial tendency in multiple sclerosis in the strict sense of the word, there is an hereditary factor. Usually inquiry of the patient elicits no evidence of the disease or any similar disease in other members of the family. In other cases positive evidence of recurrence in the family is obtained. Multiple neurofibromatosis is hereditary; hence, if multiple sclerosis is a primary hyperplasia of the glia, it might well be hereditary also.

Since it is impossible at this time to make such an assertion, it will suffice to consider the pedigrees of a number of families containing one or more cases of diseases regarded as probable multiple sclerosis.

The most famous instance is that first described by Pelizaeus (1885), and continued twenty-four years later by Merzbacher (1909). This pedigree chart (Fig. 2) is shown herewith (from Arch. Rassen-u. Gesellsch.-Biol., 1909). Some authors doubt the diagnosis in this case and would classify the condition as an hereditary type of "cerebral diplegia."

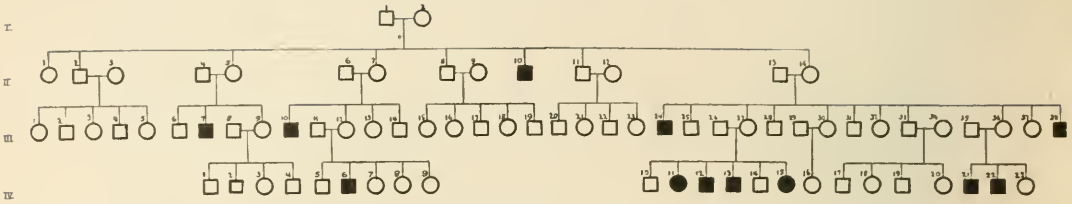

Fig. 2.—Eickhold pedigree of multiple sclerosis of Tübingen and vicinity, Germany. The squares represent males and the circles females. The dark symbols indicate those affected with the disease. The earliest generation is represented by the top line. Merzbachers, Arch. Rassen u. Gesellsch., Biol. VI, 1909.

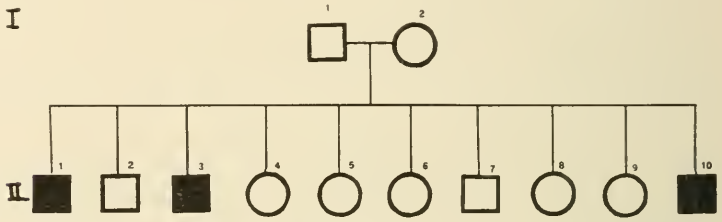

Fig. 3.—Pedigree of multiple sclerosis, showing three sibs affected. Pauly et Bonne, Rev. de méd., Paris, 1897.

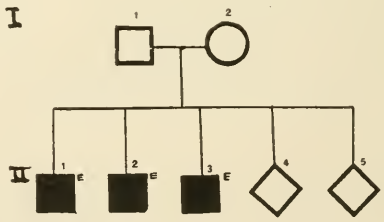

Fig. 4.—Pedigree chart of parents and their children; a Bohemian family. The three dark symbols represent three sons with multiple sclerosis and epilepsy. There are also two normal children and two who died in infancy. Abrahamson, J. Nerv. & Ment. Dis. **33**:200, 1906.

Another considerable pedigree is contributed by Batten and Wilkinson, 1914. As in Merzbacher's report, chiefly males are affected, and the tendency is passed on by mothers who are not themselves affected. This reminds one of the ordinary sex-linked type of heredity. Numerous hereditary data for the disease have been collected by Klausner (1901) and Röper (1913).

Recurrence of the disease in two generations is not common in typical multiple sclerosis, and when it does occur, the mother and child are usually affected. Such is the case of Eichhorst (1896). A woman

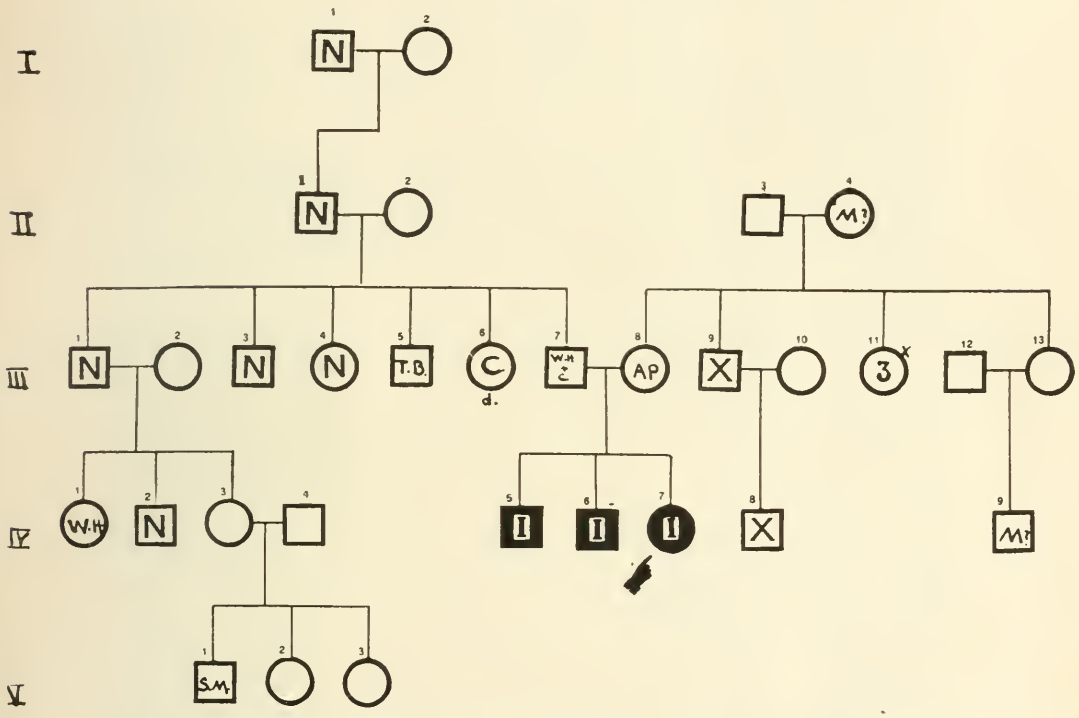

Fig. 5.—Pedigree chart of multiple sclerosis in case of R. J., Central Islip State Hospital. *N* indicates normal; *M?* mentally questioned; *AP*, died of apoplexy; *T.B.*, tuberculosis; *C*, cancer; *W.H.&C.*, weak heart and cardiac disease; *S.M.*, spinal meningitis; *I*, insanity; *X*, little known; dark symbols, multiple sclerosis.

first noticed weakness in the legs, which finally no longer would hold her, and tremor set in. Speech became disturbed and scanning. There was horizontal nystagmus. The optic papillae looked pale. Intention tremor developed. Multiple sclerosis all along the cord was found at necropsy. Her son showed tremors shortly after birth in 1879; he developed weakness of the leg in 1887, then diminished vision, nystagmus and scanning speech. Necropsy revealed sclerotic changes in the

cord only, as in the mother. Groups of atrophic nerve fibers were found, especially in the anterior roots. The mother had three normal children.

Klausner (1901) gives an account of nervous "heredity" in thirty-one of his patients. In one (No. 10) the arms and legs of the mother had been paralyzed for sixteen years, and the daughter began to have symptoms of multiple sclerosis at 18 years of age.

In one of Röper's (1913) cases a mother had paralysis agitans and two sons had typical symptoms of multiple sclerosis.

According to Bramwell (1915), Lenot described an instance in which both mother and child had multiple sclerosis. One of the patients at the Montefiore Home, November, 1921, had a similar history, with paralysis in the grandmother.

Cestan and Guillain (1900), describe the case of a boy of 15 years with paraplegia, highly exaggerated knee and ankle reflexes, a positive Babinski sign, but no speech or macular defect or intention tremor. His father and eldest sister presented the same symptoms.

Cases of multiple sclerosis in uncle and nephew have been described by Reynolds (1904) and by Curschman (1920).

In many cases some nervous defect, such as weakness of gait, tremors, paralysis agitans and progressive paralysis has been described in one of the parents of the patient.

But the commonest condition of recurrence of the disease in the family is that of two or more affected persons in the same fraternity (Figs. 3 and 4).

In conclusion, I venture the suggestion that whatever may eventually prove to be the endogenous cause of multiple sclerosis, the factor of heredity cannot be left out of consideration. Just as tumors inoculated into a mouse will or will not grow, according to the racial constitution of the mouse; and just as *Bacillus tuberculosis* that inhabits the body of all of us does or does not flourish there, depending on the constitution and condition of the person, so probably there are internal conditions that inhibit and others that facilitate the development of this disease or the endogenous factors on which it depends. Therefore the manifestations or symptoms of the disease vary in different persons, and they are sometimes very similar in closely related people because the hereditary factors of the constitution in which they operate are similar.

It seems most probable that the geographic, ethnologic and familial distributions shown by multiple sclerosis depend in part on one or more hereditary factors.

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STATISTICS OF MULTIPLE SCLEROSIS*

INCLUDING A STUDY OF THE INFANTILE, CONGENITAL, FAMILIAL AND HEREDITARY FORMS AND THE MENTAL AND PSYCHIC SYMPTOMS

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This study is based on the records of 1,970 cases of multiple sclerosis. Of the total, 1,773 represent cases culled from literature and 197 those whose records I have personally studied. Of the latter, fifty-five are from the Vanderbilt Clinic, ninety-three from the Mount Sinai Hospital and forty-nine from the Montefiore Hospital.

The object of the investigation was to determine the comparative incidence of the disease in the United States and Europe, the ages (including the ages of onset), average duration, sex, civil status, occupation and nativity. Special study was made of cases reported as hereditary, congenital, familial and infantile. Although the matter of personality (psychic and mental manifestations) does not come within the purview of a statistical study; attention was paid to this aspect of the symptomatology of the disease.

With the exception of a few recent reports in the literature, most of the statistical records date back many years, especially those which have appeared in this country. The diagnosis of multiple sclerosis was more rigidly dependent on the Charcot triad in the earlier days and many reports date back to the time when the Babinski phenomenon was unknown and when the significance of absent abdominals in multiple sclerosis was not appreciated. The more elastic conception of the disease on the part of European (more especially German) neurologists may account for some of the differences in the reported comparative incidence of the disease. It may be said, too, that critical study of case reports frequently leads one to doubt the diagnosis. This is especially true of cases recorded as infantile, congenital, hereditary and familial. I have therefore taken special pains to study, as far as was possible, the histories of many of the cases of multiple sclerosis recorded in the literature, which bore on statistics, especially those of the last mentioned group. I reviewed each of the 197 records of the cases which make up my own study. Another point of importance

* Read before the Association for Research in Nervous and Mental Diseases, New York, December, 1921.

is that, with very few exceptions, all the diagnoses of multiple sclerosis are made on clinical and not on pathologic grounds.

Discrepancies occur in the various totals because the statistics recorded in the literature are not uniform. Some investigators merely refer to the percentage incidence, others speak only of sex, still others only of ages or duration. American records are especially meager, and with the exception of Jeliffe's,[1] rather incomplete. This makes comparison between American and European statistics somewhat uneven; nevertheless, there is a sufficient number of records for a fairly satisfactory comparison. Perhaps it should be pointed out that the continental statistics cover practically the whole of Europe, whereas the

TABLE 1.—NUMBER OF CASES IN THE UNITED STATES

Jeliffe	109	Frankel	18	
Hammond	47	Sachs	15	
Collins	46	Taylor	9	
Stieglitz	34	Fisher	8	
Starr	27	Onuf	8	
Total			321	
Mount Sinai Hospital (1912-1920)			93	
Montefiore Hospital (1914-1921)			49	
Vanderbilt Clinic (1918-1920 and half of 1921)			55	
				518

NUMBER OF CASES IN EUROPE

Berger	207	Lent	51	
Klausner	126	Lotsch	45	
Bramwell	100	Mauschner	40	
Kraft-Ebbing	100	Berlin	39	
Hoffman*	100	Birley and Dudgeon	35	
Uhtoff	100	Morawitz	33	
Gaehlinger	86	Blumreich and Jacob	29	
Müller	75	Nolda	26	
Bruns	70	Redlich	23	
Jolly	59	Marburg	22	
Schupfer	59	Sanger	17	
				1,452
Total number of cases of multiple sclerosis				1,970

* Hoffman, J.: Die multiple Sklerose des Centralnervensystems, Deutsch. Ztschr. f. Nervenh. **21**:1, 1901-1902.

American statistics, if not limited to New York City, embrace only a small part of the country. Some of the totals recorded by European observers, especially in the infantile group, embrace a number of cases which have been included by other compilers in their study of statistics. By referring to the originals and by cross references I have tried to avoid recording the cases more than once.

TOTAL NUMBER OF CASES

Of the 1,970 cases recorded, 518 are from America and 1,452 from Europe. Deducting the 197 cases personally studied there remain 321 American cases whose records date back many years, none being more

1. Jeliffe, S. E.: Multiple Sclerosis: Its Occurrence and Etiology, J. Nerv. & Ment. Dis. **31**:446 (July) 1904.

recent than 1903. Most of the European statistics are not any more recent, but they are spread over a greater number of years.

INCIDENCE

In America multiple sclerosis used to be looked on as a rare disease. Recent records prove that it is not so uncommon in this country as was formerly believed. Morawitz [2] states that it is the most common organic nervous disease in rural populations and gives the following figures: multiple sclerosis thirty-three cases, tabes twenty and cerebrospinal syphilis ten. Cassirer [3] says that next to tabes and syphilis of the nervous system multiple sclerosis is the most common disease. Müller [4] also speaks of it as the most common organic disease. Neither gives figures. These statements are not quite borne out by my records. While there were forty-nine cases of multiple sclerosis in the Montefiore Hospital between 1914 and 1921, there were 167 cases of syphilis of the nervous system divided as follows: tabes eighty-five, general paresis seventeen and cerebrospinal syphilis sixty-five. In the Mount Sinai Hospital there were 562 cases of syphilis of the nervous system to ninety-three of multiple sclerosis, almost 6 to 1, divided thus: tabes 160, general paresis eighty-five and cerebrospinal syphilis 317. It should be explained that the Mount Sinai figures are not statistically conclusive for the reason that during the period covered special study of syphilis of the nervous system was carried on and effort was made to admit an unusual number of cases.

The highest percentage recorded in Europe is that by Mauschner [5] in the Tubingen Clinic, that is, 2.5. The lowest by Jolly (Berlin) as 0.84. Williams of England gives a percentage of 2.2. The highest of the older American statistics is that of Frankel, 1.7 and the lowest by Taylor [6] 0.09, even if we include his doubtful cases.[7] Frankel's figures were high because they represented the incidence among organic cases only. The recent Montefiore Hospital records (1914-1921) show a percentage incidence of 4.3 while the recent Mount Sinai Hospital records (1912-1920) give 2.9 per cent. Both these figures, repre-

2. Morawitz, P.: Zur Kenntness der multiplen Sklerose, Deutsch. Arch. f. klin. Med. **82**:151, 1904-1905.

3. Cassirer, R.: Ueber eine besondere Lokalisations—und Verlaufsform der multiplen Sklerose, Monatsch. f. Psychiat. u. Neurol. **17**:193, 1905. Die multiple Sklerose in Wichtigsten Nervenkrankheiten in Einzeldarstellung, Leipzig, 1915.

4. Müller, Eduard: Die multiple Sklerose des Gehirns und Ruckenmarks, Jena, 1904.

5. Mauschner, Ernest: Multiple Sklerose und Unfall, Arch. f. Psychiat. **3**: 1917.

6. Taylor, E. W., and Meyer, J. W.: Boston M. & S. J. **148**:393, 1903.

7. Unless otherwise mentioned, the percentages stated refer to the total number of cases both organic and functional.

senting ward (organic) cases, are lower than Bramwell's,[8] which are 5.5 per cent. for all ward cases (also presumably only organic). Bramwell's figures for all clinic patients are 1.7 per cent.

Computing all the European records together we get an average incidence of 1.33 per cent., while all the old American records gave only 0.36 per cent. These figures may be compared with what Bramwell found in 1903, that is 1 : 82, or 1.2 per cent., in Europe, and 1 : 219, or 0.46 per cent, in the United States. The recent American figures

TABLE 2.—Percentage of Incidence in the United States

	Old Records		Percentage
Jeuffe	109 cases out of	31,502	0.34
Hammond	47	10,000	0.47
Collins	46	9,508	0.5
Starr	27	10,056	0.27
Frankel	18	1,050	1.7
Taylor	9	9,783	0.09
Fisher	8	2,451	0.32
Onuf	8	500	1.6
Total	272	74,850	0.36
	Recent Records		Percentage
Mount Sinai Hospital	69 cases out of	2,359	2.9
Montefiore Hospital	49	1,144	4.3
Vanderbilt Clinic	55	11,859	0.46
Total	173	15,362	1.1

TABLE 3.—Percentage of Incidence in Europe

			Percentage
Bruns (Hanover)	70 cases out of	5,500	1.33
Bramwell (England)	100	5,825	1.7
Jolly (Berlin)	59	6,979	0.84
Mauschner (Tubingen)	40	1,602	2.5
Saenger (Hamburg)	17	1,684	1.0
Total	286	21,590	1.33

show a percentage of 1.1 of all cases, which is three times the old ones, and almost approaches the European. Combining the Mount Sinai and Montefiore records,[9] 2.9 per cent. and 4.3 per cent., respectively, we

8. Bramwell, Byrom: The Prognosis of Disseminated Sclerosis, Rev. Neurol. & Psychiat. **3**:161, 1905; Relative Frequency of Disseminated Sclerosis in Scotland and North of England and in America, ibid. **1**:12, 1903.

9. It will be noticed that the Mount Sinai Hospital percentage is computed on a total of sixty-nine cases out of 2,359, whereas the total number of histories of multiple sclerosis numbered ninety-three. This is because the diagnosis was doubtful in twenty-four cases, and I included only those in which it was absolutely certain clinically. The same applies to the Montefiore Hospital records; only of this group I excluded, besides doubtful cases, also records of patients who had previously been at the Mount Sinai Hospital. Had I included the latter, and for the purpose of computing the statistics of the Montefiore Hospital alone there is reason for doing so, the percentage incidence of that institution would have been considerably higher.

get a percentage of 3.36 for organic cases. It will be seen, therefore, that the average incidence of multiple sclerosis in this country has risen considerably during the last twenty years; but whether due to more accurate diagnosis or extension of the disease concept or to actual numerical increase cannot be stated from the figures alone.

AGE

Multiple sclerosis occurs in all ages, from early childhood to very old age. It has been described in about 100 cases in children. (This will be discussed fully when we come to consider the infantile, congenital, familial and hereditary forms.) In the literature mention is made of patients as young as 1½ and 3 and 4 years. The youngest

TABLE 4.—AGES OF PATIENTS WITH MULTIPLE SCLEROSIS

Combined Vanderbilt Clinic, Montefiore and Mount Sinai Hospitals			Klausner		Marburg		Müller	
Age	Number	Percentage	Age	Number	Age	Number	Age	Number
Below 10	1	0.5	0- 5	2	10–20	4	15–20	12
11–20	11	5.7	6–10	2	21–30	9	21–30	33
21–30	65	33.5	11–20	17	31–40	6	31–40	23
31–40	72	37.0	21–30	38	41–50	1	41–50	6
41–50	36	18.5	31–40	36	51–60	1	51–60	1
51–60	8	4.1	41–50	17				
61–65	1	0.5	51–60	7				
			61–65	2				
	194			121		21		75

Berger		Jeliffe		Morawitz		Borst (from Literature)	
Age	Number	Age	Number	Age	Number	Age	Number
0- 8	8	0–10	9	0–10	1	1- 5	5
10–20	49	10–20	8	10–20	16	6–10	10
20–30	83	20–30	21	20–30	14	11–20	45
30–40	51	30–40	27	30–40	10	21–40	306=70%
40–50	10	40–50	20	40–50	2	41–50	41
50–60	5	50–60	19			51–60	29
						61–65	2
	206		104		43		438

recorded by myself was 10 years, with the onset of the illness at 7. Crocq (quoted by Jeliffe) speaks of a patient of 81 years, but in all other records no mention is made of patients above 65. The disease is most common between the ages of 20 and 40, about 70 to 75 per cent. of all cases. Cassirer thinks it is most common in the third decade. Of a total of 428 cases collected by Borst,[10] 306, or 70 per cent., were between 20 and 40. Birley and Dudgeon[11] give the average age as 28.6 years. Jeliffe records an unusually large number between 50 and 60—18 per cent. Table 4 may serve for comparison.

10. Borst, Max: Die multiple Sklerose des Zentralnervensystems, in Lubarsch u. Ostertag: Ergebnisse der algemeinen Pathologie **9**:66, 1903-1904.

11. Birley, J. L., and Dudgeon, L. S.: Clinical and Experimental Contribution to the Pathogenesis of Disseminated Sclerosis, Brain **44**:150, 1921.

DURATION

Two different notions are implied under the term duration. One refers to the length of the period from the onset of the first symptom to the time the patient comes under observation, the other is the total duration from the onset of the illness to death. The first, assuming it is always possible to tell the time of onset of the first symptom, is somewhat easier to estimate than the second, because most patients are not followed to the very end. Indeed nearly all the records refer to the first notion of duration. It is important to bear in mind these two different notions in the bearing they have on prognosis, because it is obvious that the same patient the duration of whose illness under the first concept is estimated, say, at six months, may still be alive twenty years hence, and in a subsequent study be classed under the second notion of duration.

TABLE 5.—Duration of Illness

	Combined Vanderbilt Clinic, Montefiore and Mount Sinai Hospitals	Bramwell		
Less than 6 months	31	Fatal Cases:		
7 months to 1 year	15	1- 4 years	10	
13 months to 2 years	47	5- 9 years	13	
2- 3 years	27	10–14 years	8	
3- 4 years	11	15–21 years	4	
4- 5 years	15			35
5- 6 years	7	Alive—Worse		33
7–10 years	28	Unimproved		16
11–15 years	9	Improved		8
16–20 years	1	Well		4
21–25 years	1	Unknown		14
	192			110

Birley and Dudgeon give the average duration from the onset of the illness to the time of examination as four years, the shortest being three weeks and the longest fourteen years. Marburg[12] gives the duration in twenty-two cases he studied as from twenty-six days to thirteen months, one exception being three years. Bramwell gives the average duration in thirty-five fatal cases as seven years and nine months—(seven months to twenty-one years). He records the longest duration in a living patient as thirty-three years, and six cases between twenty and thirty years. My own records show one patient with a history of twenty-five years' duration. Five of my patients gave a history of one month or less. Comparative tables are given in the following.

12. Marburg, Otto: Die sogenannte akute multiple Sklerose (Encephalomyelitis periaxialis scleroticans), Jahrb. f. Psychiat. u. Neurol. **27**:211, 1906.

SEX

The male sex is more often affected than the female, in the ratio of nearly three to two. Of twenty-six records only six speak of greater incidence among females, the latter being those of Charcot, Berlin, Müller, Bruns [13] and Stelting, Morawitz and Birley and Dudgeon.

TABLE 6.—Sex of Patients with Multiple Sclerosis

	Europe					United States		
	Male	Female		Male	Female		Male	Female
Berger	140	66	Berlin	13	26	Jelliffe	68	41
Klausner	78	44	Morawitz	15	18	Stieglitz	17	17
Kraft-Ebbing	58	42	Charcot	9	25	Sachs	10	5
Uhtoff	67	33	Birley & Dudgeon	12	23	Moran	4	4
Müller	35	40	Blumreich & Jacob	23	6	Montefiore Hosp.	26	23
Hoffman	53	47	Nolda	16	10	Vanderbilt Clinic	36	19
Probst	34	24	Redlich	12	11	Mount Sinai Hosp.	55	38
Bruns & Stelting	13	25	Marburg	11	11			
Lent	37	14	Cassirer	2	4			
Lotsch	30	15						
				658	484		216	147
				or	or		or	or
				58%	42%		57%	43%

	Male		Female	
	Number	Per Cent.	Number	Per Cent.
European cases	658	58	484	42
United States cases	216	57	147	43
Total cases	874	58	631	42

These figures represent about 15 per cent. of the total number of cases reviewed. The American and European statistics very nearly coincide in this respect.

OCCUPATION

Morawitz states that multiple sclerosis is most common in the rural (agricultural?) population. It is said to affect mainly the laboring class. My own statistics do not confirm either view, though it is hardly fair to contradict the first statement since all of my patients come from

TABLE 7.—Occupation of Patients

Soldier	Pressman	Candymaker	Newsdealer
Cashier	Salesman	Student	Domestic
Teacher	Carpenter	Storekeeper	Bellboy
Machinist	Houseworker	Weaver	Artist
Tailor	Roofer	Printer	Chauffeur
Pedler	Cook	Baker	Iron worker
Laborer	Clerk	Cigarmaker	Policeman
Painter	Driver	Bartender	
Cutter	Butcher		

New York City. Practically every occupation is represented in my list of cases, as shown in Table 7. Obviously all general ward patients come from the working people.

13. Bruns, L.: Ueber die Erkrankungen der Sehnerven im Fruhstadium der multiplen Sklerose, Neurol. Zentralbl. **18**:475, 1899.

NATIVITY

The following figures are practically limited to New York City, and it is obviously not altogether true to speak of them as representative of the whole United States. There are more than four times as many cases among those of foreign birth as among natives. Even allowing for the great number of foreign born in New York—and they constitute roughly only two fifths of the population—it is difficult to account for the unusual excess of foreigners over natives. The fact in itself, however, may possibly account for the greater incidence of multiple sclerosis in Europe as compared to America, although in his study covering fifteen years (1888-1903) Jeliffe gives more nearly even figures: Forty-seven native and fifty-four foreign born. The following table refers to my own cases.

TABLE 8.—Nativity of Patients with Multiple Sclerosis

	Native		Foreign Born	
	Number	Per Cent.	Number	Per Cent.
Mount Sinai Hospital	11	11.8	82	88.2
Montefiore Hospital	6	12.2	43	87.8
Vanderbilt Clinic	19	34.5	36	65.5
Total	36	18.3	161	81.7

CIVIL STATUS

Multiple sclerosis is more common among married people than among single ones, but this fact is accounted for by the greater incidence of the disease during the ages between 20 and 50. The fact, therefore, cannot be said to have special significance. Except my own, there are no statistics bearing on this point.

TABLE 9.—Civil Status

	Married		Single	
	Number	Per Cent.	Number	Per Cent.
Mount Sinai Hospital	60	64.5	33	35.5
Montefiore Hospital	23	60.5	15	39.5
Vanderbilt Clinic	35	63.6	20	36.4
Total	118	63.5	68	36.5

MULTIPLE SCLEROSIS IN CHILDREN

Opinions vary as to the existence of multiple sclerosis in children. In alluding to four cases of early multiple sclerosis which he had seen (4, 7, 12 and 13 years, respectively) Oppenheim [14] expressed the opinion, in 1887, that "the beginning of multiple sclerosis in adults

14. Oppenheim, H.: Zur Pathologie der disseminierten Sklerose, Berl. klin. Wchnschr. **24**:904 (Nov. 28) 1887.

cannot infrequently be traced to the very earliest childhood." Müller states that "proof of the existence of infantile multiple sclerosis is still missing, but it may trace its beginning to childhood" and "the development of the process on the basis of a congenital predisposition (is) most likely." It may be pointed out that congenital predisposition is a vague expression, capable of numerous interpretations.

One of the early, exhaustive studies of infantile multiple sclerosis was made by Schupfer.[15] He studied fifty-eight cases recorded in the literature up to 1902 and included one case of his own. This was in a child of 11, who at 9 had an acute illness with fever, coma, convulsions, paralysis and ocular palsies. Although Schupfer includes this case in his group of multiple sclerosis, it is obvious from the history, no matter what the clinical findings were at the time of the examination, that he was dealing with a case whose inception corresponds to a meningitis or meningo-encephalitis. Most of the cases he records are neither clinically nor pathologically multiple sclerosis. Congenital syphilis would account for many of them. Hereditary spinal spastic paralysis, Friedreich's ataxia, hereditary cerebellar ataxia, encephalitis, tumors of the brain, cerebral palsies of children, the Little and Foerster types, all these are represented in the group recorded by Schupfer. Nevertheless, it must not be inferred that this author has not critically analyzed his material; he would still include twenty-eight of the fifty-nine cases as true instances of multiple sclerosis in children.

In 1909 Gaehlinger[16] reviewed the histories of eighty-six cases of multiple sclerosis out of a total of ninety-one reported as having occurred in children below 15, some even in infancy. All the cases were taken from the literature and included those recorded by Schupfer (1902) and Baboneix (1904). Gaehlinger concluded that "none of the observations have given us absolute proof of the existence of infantile multiple sclerosis." This despite Oppenheim's ingenious theory that all multiple sclerosis begins in infancy and only manifests itself later in life. Gaehlinger also emphasizes the difficulty of diagnosis. To which may be added the unreliability of most histories, the unusual difficulty in tracing the onset of the earilest symptoms and the inability to exclude fever or infectious diseases as etiologic factors. The same author also mentions Friedreich's ataxia, chorea, Little's disease, cerebral sclerosis, family spastic paraplegia, tumors of the brain, disseminated syphilis (congenital), hysteria and encephalomyelitis, as more likely diagnoses. The recent epidemic of encephalitis justifies the addition of this disease as a likely possibility.

15. Schupfer, F.: Ueber die infantile Herdsklerose, Monatschr. f. Psychiat. u. Neurol. **12**:61 and 89, 1902.

16. Gaehlinger, M. H.: Contribution à l'étude de la sclérose en plaque infantile, L'Echo méd. du Nord. **13**:37 (Jan.) 1909.

Eichhorst [17] reviewed the literature up to 1896. He mentioned the fourteen cases recorded by Marie up to 1883, the nineteen by Unger up to 1887 and those by Nolda [18] up to 1891. Eichhorst added a case of his own, that of a boy of 8. (His mother had multiple sclerosis, as was shown at necropsy.) The boy also died and came to necropsy. Microscopic section of the boy's cord showed multiple sclerosis. Of the other twenty-six patients only three came to necropsy. In those three instances the cord was not examined, and the reports show that other brain changes besides sclerosis were found. Nolda's case was that of a boy of 9 whose disease began at 7 and whose clinical picture was typical of multiple sclerosis. Weisenburg [19] reported the cases of a girl of 4 and a boy of 15—brother and sister.

Armand-Delille [20] described a case of multiple sclerosis in a child of 5. Raymond and Beaudouin [21] reported the case of a girl of 13 whose symptoms began at 10. Neither is conclusive. Raymond and Lejonne [22] speak of a girl of 9 years whose condition was progressive and whose signs and symptoms were apparently those of multiple sclerosis. But the history was that of a disease with an acute onset which lasted three weeks, and leaves the question of meningitis unanswered. Stieglitz [23] records three cases in which the patients were 9, 11 and 15, respectively. All three are doubtful from the description of the clinical picture; but in fairness it must be said that the diagnosis of multiple sclerosis was definite in that author's mind.

Schuler, mentioned by Nolda, reported a case of multiple sclerosis in a child, which was proved by necropsy. Rauschburg,[24], 1909, reported the case of a boy of 7 who had partial paraplegia, intention tremor and slight speech disturbance. The disease began at 1½ years of age; there was no history of previous illness and no hereditary factor. Although the case is not proved pathologically, the diagnosis seems not

17. Eichhorst, Herman: Ueber infantile u. hereditare multiple Sklerose, Virchows Arch. f. path. Anat. **146**:173, 1896.

18. Nolda, August: Ein Fall von multipler Hirn—und Ruckenmarksklerose im Kindesalter, Arch. f. Psychiat. **23**:565, 1891-1892.

19. Weisenburg, T. H.: Multiple Sclerosis. Its Occurrence in a Family, Arch. Diagnosis **2**:167 (April) 1909.

20. Armand-Delille, M. P.: Symptoms de sclérose en plaques chez un enfant de cinq ans et demi, Rev. neurol. **13**:243, 1905.

21. Raymond and Beaudouin: Sclérose enplaque infantile, Rev. neurol. **13**: 647, 1905.

22. Raymond and Lejonne: Encephalomyelite consecutive a un etat meningé chez une fillette de 9 ans, Sclérose en Plaque? Rev. neurol. **17**:367, 1909

23. Stieglitz, L.: Multiple Sclerosis in Children, with a Report of Three Cases, J. Nerv. & Ment. Dis. **24**:174, 1897.

24. Rauschburg, P.: Ein kindischer Fall von Sklerosis multiplex, Neurol. Centralbl. **28**:622, 1909.

improbable. Schlesinger,[25] 1909, described the case of a boy whose history, signs and symptoms pointed to a subacute process. The diagnosis of disseminated sclerosis was made because of the multiplicity of symptoms and the eye signs (optic atrophy). Encephalomyelitis was considered as a possible cause. The patient died and came to necropsy. Macroscopic and mircoscopic study confirmed the diagnosis of subacute multiple sclerosis.

In my record from the Mount Sinai Hospital there is the history of a boy of 10 who was normal up to the age of 6½ when he developed sudden paralysis of the right arm and later of both legs. There was no fever, headache, vomiting or other symptoms of acute illness. Abdominal reflexes were absent; there was a left Babinski sign and normal electrical reactions. He recovered from this attack and within the next three years had four others in which he had ataxia, tremor, the Babinski sign and laughing spells, and the abdominal reflexes were absent. Fairly good recovery followed each attack. The remissions, together with the signs and symptoms, seemed to justify the diagnosis of multiple sclerosis. In the Montefiore Hospital records there is the history of a girl of 18 whose illness began at the age of 8 with difficulty in walking, weakness of the hands, incontinence of urine. Physical examination revealed a spastic gait, tremor of both hands, lively deep reflexes, bilateral clonus, a Babinski sign and the absence of abdominal reflexes. Clinically there seems to have been no question as to the diagnosis of multiple sclerosis. Another case is that of a young woman of 27, the onset of whose illness dates back definitely to the age of 13. Physical examination revealed nystagmus, intention tremor, absence of abdominal reflexes, bilateral Babinski sign and pallor of the optic disks.[26]

There are eight other cases in my records which began, respectively, at 14, 15, 16 and 17 years. The histories of three of these are not reliable, and the diagnoses are doubtful. There remain five cases, one in a patient of 14, two of 16 and two of 17, in whom the clinical diagnosis of multiple sclerosis was not to be questioned. As the period of childhood cannot be stretched beyond 15 years, there remains only one other case of 14 which may be included in the group of early multiple sclerosis. We have, then, four cases occurring in a total of 197 children, or 2 per cent.

From this study one may draw a fairly definite conclusion as to the existence of multiple sclerosis in children. The vast majority of

25. Schlesinger, Hermann: Zur Frage der akuten multiplen Sklerose und der Encephalomyelitis disseminata im Kindesalter. Arbeiten aus dem Neurologischen Institut. Wien. **17**:410, 1908-1909.

26. These cases will be reported at greater length in a special paper on "Multiple Sclerosis in Children."

cases stand unproved. In those instances the diagnoses were erroneous; yet it is difficult to explain why careful observers should have attempted to prove the existence of infantile multiple sclerosis by means of doubtful cases. Those were very likely atypical, but could be better explained by the diagnosis of congenital disseminated syphilis, various traumatic birth palsies, spastic diplegias, Little's or Foerster's types of disease, family spastic paralysis, Friedreich's disease, tumors of the brain, hysteria, encephalomyelitis and cerebral sclerosis. Nevertheless, a few authentic cases remain. These have been proved, both clinically and pathologically, to have been multiple sclerosis. Its existence, therefore, in children, while rare and in need of scrutiny, cannot be doubted.

FAMILIAL, CONGENITAL AND HEREDITARY MULTIPLE SCLEROSIS

The question of familial, congenital and hereditary influence in disease in general and multiple sclerosis in particular is in need of strict definition. Loose interpretation of the meaning of those terms is responsible for many broad and erroneous conclusions. To speak of a congenital or hereditary predisposition, while possibly permissible, is not very meaningful. In order that a disease be considered congenital one must prove its existence in the parent at the time of or subsequent to inpregnation, that it was transmitted to the germ plasm or embryo or fetus in utero and that it was present in the child at birth, although it need not have manifested itself immediately afterward. So, too, to speak of heredity one must show that the disease existed in some of the ascendants and collaterals, that it manifested itself in the descendants and that it affected the various persons with a fair degree of consistency or regularity. True mendelism will not accept, of course, an interpretation of heredity which does not conform to its laws. Further, one isolated instance cannot be accepted as proof of a general conclusion because there are too many possibilities by the law of chance, among so many hundreds and thousands of cases, that the disease may appear hereditary. The same may be said, although with less emphasis, about familial influence in disease.

There are, moreover, two distinct notions of hereditary or familial influence in nervous diseases which are current in medical literature. The older, which is gradually being discarded, is to consider any nervous disease in the family as a possible influence on or cause of any other nervous disease. Thus it is not unusual to find epilepsy, alcoholism, insanity, hysteria, neurasthenia, fright and exhaustion mentioned as possible hereditary (!) causes of multiple sclerosis. The more recent view, of course, and perhaps sounder, is to accept only the given disease in the consideration of familial, hereditary and congenital factors.

Whether or not these factors operate in multiple sclerosis cannot be definitely answered, but there are numerous instances in which the disease occurred in parent and offspring. Among my own records there is one instance in nearly 200 cases; it is that of a woman of 55 who had multiple sclerosis, which began at 50, whose son died from the same disease at 22. This instance cannot be looked on as congenital as the mother developed the disease twenty years after the birth of her son.

Eichhorst cites a case in which there may have been a congenital factor. A woman who had typical multiple sclerosis for two years gave birth to a child who developed the disease. The mother died at 42 and the child at 9. Necropsy showed a typical sclerosis of the cord. Two children born before their mother had the disease did not have it. Pelizaüs [27] reports an hereditary disease which occurred in three generations of males and was transmitted through the mother. It showed itself in one son, three grandsons and one great grandson. Pelizaüs believes that the disease was multiple sclerosis. The clinical picture was the same in all cases and came on at the same ages in all. There was bilateral nystagmus, speech disturbances, spastic paraplegia without atrophy, increased reflexes, intact sensibility and moderate dementia. Although persual of the clinical histories does not altogether convince one, Pelizaüs seems to be of the opinion that all were cases of multiple sclerosis.

Klausner [28] reports two cases in a brother and sister of 25 and 27 years, respectively. Weisenburg reports two cases in a brother and sister, whom he personally observed, and a third member of the same family who is said to have suffered from the disease. The brother developed the disease at 15 and the sister at 4. The family was English. Reynolds [29] reports three cases, the second, fourth and sixth in one family, a sister and two brothers of 33, 30 and 27 years, respectively. The parents were psychopathic. He further quotes another English family in whom the first and third developed multiple sclerosis at 25 and 15 years, respectively. Frerichs and Erb (quoted by Borst) mention the disease in siblings, Totzke in two sisters of 11 and 14 years and Elta in mother and son. Among the records of the Montefiore Hospital are found two instances in which the disease occurred in brother and sister.

27. Pelizaüs, F.: Ueber eine eigentümliche Form spastischer Lähmung mit cerebralerscheinungen auf hereditärer Grundlage, Arch. f. Psychiat. **16**:1885.

28. Klausner, Irma: Ein Beitrag zur Aetiologie der multiplen Sklerose, Arch. f. Psychiat. **34**:841, 1901.

29. Reynolds, E. S.: Some Cases of Family Disseminated Sclerosis, Brain **27**:1904.

Merzbacher[30] reports the case of a family with eleven members in whom a disease very much like multpile sclerosis developed in the fourth month of the lives of the persons. The patients had nystagmus and tremor of the head. One came to necropsy at the age of 20 and on microscopic examination the myelin sheaths were found totally absent. No extensive description is given. Coriat[31] reports a peculiar form of family nervous disease resembling multiple sclerosis occurring in children. There were four patients of Russian Hebrew parentage, two of them being a brother and sister, one a boy of 18 and one a girl of 8.

From these cases it may be seen that the evidence is not conclusive. Eichhorst's isolated instance may be looked on as possibly illustrating congenital transmission. The numerous other instances in which the disease occurred in more than one member of a family or in parent and offspring cannot be considered, in view of its comparative prevalence, as absolute proof of familial and hereditary forms of multiple sclerosis. In this connection, too, one need consider the relation of the experimental investigations as to the etiology of multiple sclerosis. This disease has come to be looked on as the result of a subacute or chronic infection, and the gliosis has been interpreted as a reaction to inflammation. Obviously it makes some difference so far as this discussion is concerned whether the inevitable focal infection plays any causative rôle or a spirochete is the etiologic factor or "abiotrophy" and "systemic degeneration" are invoked to explain the genesis of the disease. It is quite possible, however, that the discovery of the causative agent of multiple sclerosis will clear up the question of the existence of familial, hereditary and congenital types.

PSYCHIC AND MENTAL DISTURBANCES

Attention has commonly been called to the existence of psychic and, more especially, emotional disturbances in multiple sclerosis, and numerous reports of cases in which the patients showed those symptoms are to be found alike in American and European literature. Comparatively fewer statistical facts bearing on mental symptoms exist in American literature, whereas a number of European writers have reported extensively on this subject. In many cases it is not easy to draw a sharp line between mental and psychic symptoms. Oppenheim, for instance, looks on the impulsive laughter occasionally found in multiple sclerosis as a neurologic sign of thalamic involvement and not as a psychic symptom as commonly understood.

30. Merzbacher: Eine eigenartige familiäre Erkrankung des Zentralnervensystems, Neurol. Centralbl. **26**:1139, 1907.

31. Coriat, Isador: A Peculiar Form of Family Nervous Disease Resembling Multiple Sclerosis Occurring in Children, Boston M. & S. J. **160**:506, 1909.

Under psychic symptoms are mentioned general nervousness, irritability, sleeplessness, mild depression, lack of concentration, emotional or affective disturbances. While these symptoms are commonly encountered, they cannot be said to be characteristic of multiple sclerosis. Many patients, however, show graver disturbances, and indeed to such an extent as to dominate the whole clinical picture and to lead to erroneous diagnoses. This is especially true of hysteria. More rarely hysteria simulates multiple sclerosis. Thus Parhon and Goldstein [32] mention a case of hysteria which simulated multiple sclerosis so closely that the diagnosis was made only at necropsy. Zilgien [33] reports the case of a young man of 23 who for two years had hysterical symptoms, stammering and laughter, and was ultimately proved to have multiple sclerosis. The same author also speaks of a woman of 33 who for four years, up to the time of her complete recovery, was looked on as having multiple sclerosis. Healey [34] reported a case in which the diagnosis between multiple sclerosis and hysteria was doubtful for a long time.

Mendel believes that psychic symptoms are present in all cases of multiple sclerosis and Lannois is convinced that they occur quite regularly (quoted by Raecke [35]). Berger [36] mentions nervousness as occurring in nineteen, or 9 per cent., of his cases and pronounced psychic disturbances, such as irritability, depression, memory defects in twenty-four, or 12 per cent. Incidentally he mentions three cases of epilepsy in his 206 cases. Fourteen of his patients showed irritability, eight mild depression, four euphoria and eighteen mild memory defects. Morawitz mentions memory weakness in eight of thirty-three cases.

Next to hysteria, paresis is said to occasion diagnostic difficulties. Raymond and Touchard [37] report a case of multiple sclerosis which began with symptoms simulating general paresis. The patient had epileptiform attacks, change of character, defective memory and disturbances of speech. It is well known, of course, that paresis may for a time simulate multiple sclerosis. I have even now a patient under observation whose symptoms for many months consisted of spastic

32. Parhon and Goldstein: Un cas d'Hysterie simulant la sclérose en plaque et la syringomyelie, Rev. neurol. **13**:862, 1905.

33. Zilgien, H.: De l'importance des symptôms hystériques dans l'étude de la pathogénie et du diagnostique de la sclérose en plaque, Rev. méd. de l'Est. **37**: 673, 1905.

34. Healey, W., Jr.: J. Nerv. & Ment. Dis. **36**:164, 1909.

35. Raecke: Psychische Störungen bei der multiplen Sklerose, Arch. f. Psychiat. **41**:482, 1906.

36. Berger, Arthur: Eine Statistik über 206 Falle von multipler Sklerose, Jahrb. f. Psychiat. u. Neurol. **25**:168, 1905.

37. Raymond and Touchard: Sclérose en plaque debutant par des troubles mentaux simulant la paralysie général, Rev. neurol. **17**:224, 1909.

paraplegia, ataxia, tremor, nystagmus and scanning speech. It was only after many months that pupilary changes and mental deterioration called attention to the paretic picture. The diagnosis was confirmed by the positive Wassermann reaction in the blood and spinal fluid. Geay,[38] in speaking of psychic symptoms in multiple sclerosis, stresses the point that the disease is mostly to be differentiated from hysteria and paresis and concludes that the mental symptoms may range from simple enfeeblement of memory to complete obnubilation. Spiller and Camp[39] reported a patient (the case came to necropsy) with suicidal tendencies. Charcot early called attention to dulness, indifference, slowness to grasp things and delusions, besides memory weakness and impulsive laughter. Probst found a few patients (five out of fifty-eight) with high grade dementia.

Raecke has made an excellent study of psychic and mental symptoms in multiple sclerosis. He reviewed the literature extensively and included a review of thirty-seven cases of his own. He states that thirteen patients showed definite dementia and nine others psychic disturbances. The initial symptoms usually were depressive and maniacal, with, at times, delirial episodes. The latter were particularly to be found in patients with convulsions. Affective disturbances were common. He quotes a number of authors on the subject. Thus, Gowers spoke of rare cases of insanity based on multiple sclerosis. Redlich mentions idiocy, confusion, irritability and hallucination as being more common in multiple sclerosis than was formerly believed. Meinert speaks of general disturbances of intellect and enumerates eroticism, irritability, memory weakness, melancholia, depression, insomnia, euphoria, paranoidal delusions and suicidal trends as possible mental symptoms. Oppenheim, on the other hand, believes that high grade dementia and delusions are uncommon in multiple sclerosis. Seiffer[40] also made a comprehensive study of mental disturbances in multiple sclerosis. His conclusions are: 1. The disease may be totally free from mental symptoms. 2. The longer the duration of the disease the more likely and the more pronounced the disturbances of intelligence. 3. There is no correspondence between the intelligence defect and the educational level of the patient. 4. There is a close connection between the intelligence defect and the clinical type of the disease, patients with cerebral defects giving the most symptoms and those with spinal signs fewest or none. 5. The dementia of multiple sclerosis

38. Geay, A.: Des trouble psychique dans la sclérose en plaque, Thése de Lyon, 1904; Rev. neurol. **13**:900, 1905.

39. Spiller, W. G., and Camp, C. D.: Multiple Sclerosis with a Report of Two Additional Cases, with Necropsy, J. Nerv. & Ment. Dis., July, 1904.

40. Seiffer, W.: Ueber psychische, insbesondere Inteligenzstörungen bei multipler Sklerose, Arch. f. Psychiat. u. Nervenkrank. **15**: 1905.

cannot be strongly differentiated from other dementias though that of the former shows great liability of mood. These sudden changes are quantitatively high and stand in no relation to the degree of dementia.

In the records of my own cases little mention is made of outspoken organic mental changes. Psychic symptoms, such as irritability, depression and general nervousness, mild memory defects and emotional changes are frequently noted. Impulsive laughter and euphoria are occasionally referred to. Hysteria seems not infrequently to have been considered as an alternate diagnosis for a time. Marked dementia was rarely encountered, delusions and hallucination practically not at all. Considering that a great many of these patients had the disease for years and years and that quite a number were inmates of the Montefiore Hospital for a very long time, it is noteworthy how few showed definite mental symptoms. In none of the cases recorded was there a complete psychosis or organic dementia.[41]

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41. In addition to the references given, the following may be of interest: Abrahamson, L.: Familial Multiple Sclerosis, J. Nerv. & Ment. Dis. **33**: 1906. Batten, F. E.: Proc. Roy. Soc. **22**:35, 1908-1909.

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Tredgold, A. F.: Rev. Neurol & Psychiat., July, 1904.

Abstracts from Current Literature

HALLUCINOSIS AND HALLUCINATIONS. P. Schroeder, Monatschr. f. Psychiat. u. Neurol. **49**:189 (April) 1921.

According to Wernicke, who coined the name, hallucinosis is characterized by the following syndrome: unimpaired consciousness; normal power of thought and undisturbed orientation; intense fear; numerous auditory hallucinations, which accord with the content of the fear; finally, a decided tendency to rapid systematization and development of delusions of persecution, generally directed against definite persons. According to Bonhoeffer, the two characteristic features are: (1) auditory hallucinations clothed in words, and (2) fear. "Gedankenlaut-werden"—the thoughts becoming audible—plays an important rôle. Explanatory delusions are common, but a closed systematization is not a part of the picture.

The author reports four cases of hallucinosis of different types. In all, the most interesting symptom is that of the thoughts becoming audible. For weeks the patient in Case 3 said that every word he said he heard repeated after him. Everything he thought he heard and recognized as his own thought content. The content of what he heard was usually indifferent. The sound was that of his own voice.

The patient in Case 1 reported that at the outset every word he read was read after him. Whatever he thought he heard spoken aloud in his own dialect. In quieter periods he was conscious that they were his own thoughts which he was hearing, but often, especially when excited, it was "someone" speaking to him.

The patient in Case 4 heard partly indifferent or senseless remarks, in part connected conversations. Frequently he was conscious that they were merely a repetition of his own thoughts. What he thought he heard at the same time. What he wanted to say he heard twice.

The patient in Case 2 at first recognized what he heard as his own thought. Later, it was others who spoke and whispered to him.

There is considerable difference between the different cases and between the condition of the same patient at different times. When insight is adequate the patient recognizes the "voices" as his own thoughts; but when a clear interpretation is no longer possible, the "voices" are frequently projected into the environment and attributed to others. According to the clarity of insight we find these various stages:

1. Echo-like repetition of thoughts.
2. Perception "as if" they were spoken.
3. Projection of what is heard to others.

From expressions of the patients we learn that the phenomenon of the hearing of thoughts — the thoughts becoming audible in Wernicke's sense — has nothing to do with auditory perception. "Hearing" refers to a form of perception for which he has no better word. One hears the voices "in his own head." Another "grasps" or "appreciates" them, saying that they do not come in through the ears. Still another says that speech, thought and hearing are not sharply separated, but glide into each other imperceptibly, and the name given varies between thought, hearing and speaking, frequently qualified by

"as if." During quiet periods, this distinction is clear. Under the influence of fear and excitement the "as if" character may be lost, and the auditory hallucinations develop a living reality.

The author describes a second type of "hearing voices" best studied in certain paranoid states in the fourth and fifth decade—where they occur in patients who are mentally clear and easy to study. These are patients who always say they are suspected—are being discussed, are being accused. They are always hearing envious words, secret whispers, sarcastic sayings. These things are not said to them, but they know it concerns them. The voices often come from a distance or through the ceiling, etc.

Unlike the "audible thoughts" these auditory hallucinations are not formulated in words. They represent the content of the anxiety or fear which is bothering the patient. The elementary factor is not thoughts become audible but an anxious delusion of reference.

The acoustic sense deceptions of the patients with hallucinosis are not as a rule true hallucinations in the textbook sense; they lack actuality; they are not equivalent for the patient to actual perception. It is only under certain conditions (excitement and fear) that they acquire reality. Generally they belong to the group of pseudohallucinations.

The author discusses at some length this distinction between hallucination and pseudohallucination. We continue to use the term hallucination in its original connotation, as defined by Esquirol—a definition which stresses the perceptual side. "An individual who has a firm conviction of a true sensation, when there is no external object in the surroundings to give rise to the sensation, such an individual has hallucinations." In the mass of cases this does not hold; the patient does not accept his hallucinations as true perception; he recognizes the distinction, and so the great majority of what we call hallucinations are really pseudohallucinations. We should cease to begin our definition of hallucinations with the usual "Hallucinations are sensations," etc. Clinical experience teaches that hallucinations are varied conscious processes in which doubts or confusions arise as to the justification for projection externally. They are not sharply demarcated from other psychopathologic phenomena in patients and not sharply separated from all processes in the normal person.

To the latter belong dreams, waking dreams, etc. The comparison of hallucinations with dreams is old, and the study of dreams will help our study of hallucinations.

Normally we have a constant activity of consciousness. This drops low at times and in deepest unconsciousness is practically nil. It is greatly influenced by external stimuli and the emotions and impulses to which they give rise, but continues to flow in the absence of such stimuli. In sleep, with its dreams, sense stimuli are absent, or almost absent. In dreams ideas have for the dreamer the full value of perception, in the absence of any sense perception. Thus to appreciate anything as real, at least under certain conditions of consciousness, adequate sense stimuli, any sense stimuli in fact, are unnecessary. If the dream material remains for a time in consciousness, it is corrected, chiefly on the basis that it does not fit into our other experiences—is in contradiction to them; according to the same standard, the cured psychotic patient corrects his psychotic experiences.

Psychologically, closely related to the dream is the delirium. Conscious processes of the value of perception without adequate stimuli characterize it as well as the dream. In content it has the same jumpiness (Sprunghaftig-

keit) and the same lack of critique, with lowered attention. The delirious patient differs from the dreamer in that he does not sleep, in that he moves and accompanies his experiences with gesture or reacts to them with actions. Hallucinations are actualities for the delirious patient, and the hallucinations of delirious patients are most real of all hallucinations. They differ so in this regard that we may consider them a third type of hallucination [(1) hallucinosis, (2) hallucination in the anxious delusion of reference, (3) delirium].

SELLING, Portland, Ore.

TORTICOLLIS AND TORSION SPASM. R. CASSIRER, Klin. Wchnschr. **6**:53 (Jan. 8) 1922.

The chapter on torticollis belongs to the "Schmerzenskindern" of neurology. The objective picture presents both an organic and a functional coloring which at times makes a differentiation impossible, and many observers continue to consider all these affections functional.

The author states that it is difficult to demonstrate any lesion of the nervous system to account for the clinical picture. Strümpell suggested a striate syndrome for torticollis resulting in abnormal tonus, spasms, movement anomalies, slowing of motion and even tremor.

In torsion spasm, which the author discusses under the heading of torticollis, there are no signs of pyramidal lesion, and one may speak of an extrapyramidal disturbance. Sensory changes do not occur. The right to speak of a striate syndrome is based on the work of Wilson, and on the works of Vogt, who, under this heading, consider a group of diseases whose likeness rests on the characteristic movement disturbances. The major portion of our knowledge in these conditions is expressed by using the term extrapyramidal movement disturbances. In two cases of torticollis observed by the author the possibility of a striate syndrome presented itself.

CASE 1.—This patient, now 58 years of age, was first examined by Oppenheim, who diagnosed the case as torticollis. Following an operation by Krause he experienced little relief, but after a year his head again became straight. This slow improvement has been noted previously in operations for torticollis. Four years after the operation the patient again noticed difficulty in muscular movements, especially in the right hand and arm. In 1913, Oppenheim advised a partial section of nerves, but because of the war the patient did not have this done. In 1920, because of the progression of the disturbance, the patient's triceps tendon was lengthened, making it again possible for him to write. After a lapse of three months the symptoms recurred with marked hyperextension of the limb and some muscle cramps in the right leg. The examination by the author at this stage of the process revealed a paralysis of the left trapezius and sternocleido mastoid. The right trapezius tendon was cut, the head was bent forward and in the right shoulder muscles there was considerable spasm. The right arm was pressed tightly against the chest, the forearm pronated and the hand held in a flexion cramp. Voluntary movements would bring on this hyperextension, and all purposeful movements were markedly impaired. The muscles of the back also showed alternating spasms so that the buttock would be pulled to the right and at times pulled about the sagittal axis. In walking the right foot had a tendency to be supinated. There were no pyramidal signs; sensation was intact and cerebral functions were unaffected. On June 6, 1921, Krause performed tenotomies and nerve sections with apparently satisfactory results.

In this case, then, there first appeared a left-sided torticollis. Later the right side became involved, and gradually there was an extension involving the entire musculature. In the literature progressions of torticollis are rarely mentioned. Lucas described a case in which the spasm involved the buttock and caused a deformity of the lumbar region. Dercum also described a similar case.

The second patient was a man, aged 29 years, who was first examined by Oppenheim in 1890. He was well up to the age of 7. At that time a change in gait was noted. He walked with his left foot turned in. When examined at the age of 12 both feet were held in adduction. The toes were dragging on the ground, and the right knee had a tendency to flexion. No diagnosis was made at that time. He was treated from a psychic standpoint without any result. The condition gradually progressed and several operations were performed without success. When examined by Cassirer the head was pulled back almost continuously. Short periods of relaxation would occur, but it was only with the greatest difficulty that the head could be approximated to the chest. Both trapeziis were missing. On the right the accessory nerve had been cut and on the left a muscle section had been performed. The buttock was held anteriorly. As a result of the former operations there was paralysis of all the foot and toe flexors and extensors on the right side. Beyond the paralysis and sensory disturbances, due to operation, no signs of pyramidal tract involvement occurred.

The author made a diagnosis of dystonia musculorum or torsion spasm, though the possibility of a functional condition was considered. On July 25, 1917, he was operated on, the deep muscles of the neck being severed. Death occurred a few hours later. The postmortem examination showed that the internal organs were normal.

In the two cases reported, the chief findings were muscle spasms, in the first case beginning in the neck, in the second case occurring first in the legs and after a lapse of ten years involving the neck muscles. The functional possibility, according to the author, could be dismissed. He believes that the two cases may be placed in the group of dystonias because of the lack of pyramidal tract involvement, the lack of a reflex spasm and lack of sensory changes. This is in accord with the ideas of Förster and Babinski. Oppenheim refers to this same possibility. Thomalla reports postmortem findings in a case of dystonia which resembled the picture of a Wilson's disease. This has also been reported by Wimmer and Neel.

In the author's second case there was no special striate pathology, although there was a distinct anatomic change. He believes that his case disproves the psychogenic theory, although the possibility of affective changes and influences may still be present as in chorea.

Cassirer believes that torticollis may be a form of dystonia. However, an hysteria may simulate the picture so closely that only the most careful study can differentiate the condition. Whether the pathologic picture is constant remains to be determined.

MOERSCH, Rochester, Minn.

THE TREATMENT OF BRAIN TUMORS. WALTER E. DANDY, J. A. M. A. **77**:1853 (Dec. 10) 1921.

The author deals, not with a new form of treatment, for there can be, at least for the present, only one treatment, namely, surgical, but rather with an intensive development of this field, largely by the innovation of new diag-

nostic methods and also by an entire reconsideration of old time-worn and unpractical operative procedures, and the institution, in their stead, of surgical efforts directed solely to the eradication of the cause.

The author states that every tumor can and should be localized at once, and a large percentage can be removed in the earlier stages. A great number of brain tumors are infiltrating. Their removal should be made by including the extirpation of some of the healthy brain tissue, since many areas of brain permit such removal without injury.

Decompression is only a palliative form of treatment and is never performed with hope of curing the patient of a brain tumor. There are two types of decompression, subtemporal and occipital, and these procedures may occasionally give relief. They are attended with a certain operative risk, and on exploring the brain in the presence of an old decompression one finds a certain amount of damage to the underlying brain tissues, which can never be repaired. While the decompression is supposed to relieve pressure, it is at once replaced by an increase of intracranial fluid made possible by increase of the lateral ventricle. The author advises against lumbar punctures and advocates ventricular puncture in an attempt to relieve intracranial pressure. He states that the radical treatment of brain tumors depends on: (1) early diagnosis, (2) precise localization, (3) accurate and adequate operative approach to the tumor with the object of (4) removing the tumor in toto if possible, and (5) the production of the maximum palliation at the same operation if the tumor cannot be removed.

The conception that brain tumors are rare is erroneous. This is in large part due to a mistaken and incorrect diagnosis, and to the varied manifestations which make the diagnosis confusing and difficult. In the Johns Hopkins Hospital, brain tumors rank third in frequency, being exceeded only by tumors of the breast and uterus. In every case in which careful anamnesis, neurologic and roentgenologic examinations are of no avail (and this group comprises half the cases of brain tumors), the tumor can be diagnosed and located or its existence eliminated by cerebral pneumography. The author does not wish to convey the impression that air is to be injected into the brain of every patient regarded with suspicion, but that in every case in which a careful anamnesis and neurologic and roentgenologic examinations are of no avail, a neurologist or neurologic surgeon of large experience can differentiate the vast majority of cases of tumors from other lesions, and he urges the use of pneumography only when imperative and when all other means fail to aid in a diagnosis of localization.

The author says that he has had opportunity in more than 200 injections to locate tumors in every part of the brain, and has yet to fail to make an accurate localization; nor has he failed to find the tumor at operation. Some of these tumors have been far below the surface of the brain, in fact so far below that there has not been the slightest change in the surface of the cerebral or cerebellar convolutions or sulci to suggest the presence of a tumor. In other words, the evidence from cerebral pneumography has been so absolute that the author has been sufficiently certain of the location of the tumor to make a transcortical incision of varying depth until the tumor has been exposed at the expected location.

In his summary the author states that in order to obtain the best operative results, brain tumors must be diagnosed and localized in the earliest stages. Decompressions performed according to routine are among the most harmful and indefensible operations in surgery and should never be performed for

unlocalizable tumors. They should be performed only as a last resort—when the tumor cannot be removed, and then only after the location of the tumor is known, for in one half of the cases of brain tumor, no good can possibly be derived from a decompression. They are the exact equivalent of giving morphin for abdominal pain; the symptoms are masked until it is too late. Scientific accuracy must supplant guesswork in diagnosis and in directing the treatment. Early and accurate localization and thorough operative treatment will eliminate all unnecessary and harmful operations. The treatment of brain tumors can only be a direct eradication of the cause—prompt and efficient. He calls attention to the value of pneumography as a means of early diagnosis and states that he has been successful in 200 consecutive cases. He also makes a plea to abolish the use of palliative decompressions and employ more radical surgery.

While the results obtained by pneumography are quite astounding, I feel that the author is stressing a very important point when he pleads for earlier diagnosis and more radical surgery. I believe that there is a certain group of diffuse infiltrating gliomas that are better if not operated on. Decompression should be used only as a last resort; even that procedure has proved of no value in the presence of a rapidly increasing choked disk due to an internal hydrocephalus.

Adson, Rochester, Minn.

CONTRIBUTION TO THE MORPHOLOGIC STUDY OF THE THYROID GLAND IN EMYS EUROPAEA. Sante Naccarati, J. Morphol. **36:** 279, 1922.

In *Emys europaea* the thyroid is a single medial organ of spheroid form and pinkish color, located in the cavity of the arch formed by the truncus innominatus. The thymus, when it exists, is a long, double, light gray organ, located in front of the carotids, with which it is in close contact, at the point of junction of the neck with the thorax. The volume and weight of the thyroids of *Emys europaea* are very variable, due to the size and age of the animal. In adults weighing about 275 gm. the thyroid has an average weight of 0.025 gm. In general, 100 gm. of body weight corresponds to about 10 mg. of thyroid. In an animal of 300 gm. the maximum diameter of the gland is about 5 mm. The gland is a little to the right of the middle. In front it is separated from the thoracic wall by a tough, transparent, lamellar connective, continuous below with the pericardium and surrounded above by the large vessels of the neck. The rear wall of the gland is in front of the trachea but not in contact with it. In *Emys europaea* the trachea divides into two bronchi a little above the thyroid, and in *Testudo graeca* the division occurs much higher near the base of the tongue.

The thyroid is highly vascularized, the blood flowing to it through the two superior and the two inferior thyroid arteries. The inferior pair are short, issuing from the truncus innominatus, and penetrating the gland at right angles, passing through its outer inferior margin. The superior arteries are longer and thinner; they branch from the carotids, turn downward and inward, and issue in the outer superior margin of the thyroid gland. These arteries are sometimes missing. There are many variations in them. The veins originate in the form of fine branchlets traversing the vesicles, composing a network on the surface of the gland, from which issue the principal veins; the latter unite with the accessory pectoral veins and empty into the subclavian vein formed by the confluence of the jugular and axillary veins. The

lymphatics are numerous, arising as small vacuoles between the cells lining the vesicles. The innervation of the thyroid is by the sympathetic, the fine non-medullated fibers accompanying the arterial ramifications. The vagus also sends two fine branchlets into the gland through the laryngeal nerves.

The histologic structure resembles that of other vertebrates. Externally there is a fibrous connective-tissue capsule containing occasional pigmented cells. From this capsule issue numerous connective-tissue septums, forming a network, enclosing the vesicles. These vesicles are irregularly rounded, and are lined with simple cuboidal epithelium. In the vesicular cavity is the colloidal fluid, an amorphous, homogeneous substance. The interior surface of the epithelial cells has a broken appearance. The protoplasm is homogeneous and contains fine grains. The gland is subdivided into lobules by connective-tissue septums. The blood vessels, lymphatics and nerves run into the intervesicular and interlobular septums forming a complicated network. The intervesicular substance is scanty, consisting of areolar connective-tissue, elastic fibers and capillaries. The granules of secretion appear to be larger and less numerous than the granules of fat and the mitochondria. They stain red when stained according to the method of Galeotti.

WYMAN, Cambridge, Mass.

SURGERY OF THE TRIGEMINAL TRACT. CHARLES H. FRAZIER, J. A. M. A. **77**:1387 (Oct. 29) 1921.

The author reviews briefly the history of the development of surgery of the trigeminal tract. J. Ewing Mears of Philadelphia was the first to propose the removal of the gasserian ganglion. In 1891, Hartley of New York first performed this operation, by the so-called Hartley-Krause method. The technic was considered to be a hazardous, adventurous procedure, and at that time was associated with a serious mortality. In the Transactions of the American Surgical Association, in 1896, Tiffany published a number of cases with a mortality of 22 per cent. DaCosta in his "Modern Surgery," placed the mortality between 10 and 17 per cent. The author states that in his last 177 consecutive operations he had only one operative fatality.

During the period from 1891 to the present, the peripheral operations on the terminal branches of the several divisions have been abandoned, and alcoholic injections have taken their place. During the same period operations on the gasserian ganglion have been replaced, with trivial exceptions, by operations on its sensory root. The procedures which the author included in the title of this communication under "The Surgery of the Trigeminal Tract," are: (*a*) subtotal resection of the gasserian ganglion; (*b*) resection of the sensory root, subtotal; (*c*) resection or avulsion of the sensory root, total, and (*d*) preservation of the motor root.

In his discussion of subtotal resection of the gasserian ganglion he says that it is not necessary to resect the ganglion if the sensory fibers are divided posteriorly to the ganglion. The approach for the various operations on the ganglion is the same, and complications such as facial paralysis, etc., are practically nil. The author believes that facial paralysis can be avoided by using the flap incision. He has performed 121 consecutive operations, none of which have been followed by facial paralysis.

He states, further, that it is possible to perform a subtotal resection of the sensory root, and by leaving one of the inner fasciculi intact it is possible to prevent an occasional atrophic keratitis. He believes that it makes no dif-

ference whether the sensory root is avulsed or resected. The physiologic results are the same, and one procedure can be as readily executed as the other. The most recent modification of the radical operation concerns the conservation of the motor root as this prevents a depression over the zygoma, owing to the atrophy of the temporal muscle. It prevents the pull to one side of the mandible on opening the mouth, owing to the preservation of the nerve supply to the temporal internal masseter and pterygoid muscles, this being extremely important if the patient should happen to have double trifacial neuralgia.

In his conclusion the author says that it is just twenty years since the sensory root operation by Spiller was first performed. It has more than fulfilled the claims of its sponsor, and is safer than a gasserectomy—with all the assurance of permanent relief. In these two decades the modifications of the technic in minor details have been made from time to time, until today the operation might be said to be a finished product, the author himself having operated on 221 patients with only two recurrences, and these should not be charged to the principle underlying the sensory root operation, the recurrences being due to the failure in dividing all of the sensory root fibers.

In discussing Dr. Frazier's paper, which was read before the Section on Surgery at the Seventy-Second Annual Session of the American Medical Association in June, 1921, Gilbert Horrax of Boston reported 345 consecutive cases in which the patients were operated on for trifacial neuralgia without one death. He took exception to the subtotal resection of the sensory root, feeling that trifacial neuralgia is a progressive disease and will sooner or later, in a large percentage of cases, involve the ophthalmic division. The results from the radical operation have been most gratifying; it has relieved patients of pain and agony, probably the most severe that the body is called on to endure. The operation has been improved so that it is attended with an extremely low mortality, and the results presented by both Frazier and Horrax at Brigham Hospital are most enviable. On the other hand, one must not be too cautious, and fail to relieve a sufferer or patient who is a poor surgical risk.

I have observed numerous patients who have received repeated injections of alcohol until the injections failed to give relief and a radical operation was the only procedure remaining, even though it was not unattended with a great surgical hazard.

Adson, Rochester, Minn.

PRIMARY NEUROMERES AND HEAD SEGMENTATION. Horace W. Stunkard, J. Morphol. **36**:331, 1922.

In the early neural groove stage of Amblystoma, faint alternating lighter and darker areas may be seen, but these are so irregular as to preclude interpreting them as segments. After the anterior parts of the neural folds have risen prominently, faint transverse grooves appear in the anterior part of the medullary plate, but they are inconstant in number and irregular in position. Sometimes similar divisions appear posterior to these, but they are less distinct. Some of the grooves shift slightly or fade out entirely and others appear in different positions. Divisions of the neural plate caused by these transverse grooves could not be clearly demonstrated in sections. With the appearance of the grooves the mesoderm is assuming a segmented condition, and the formation of the grooves is due to the formation of the mesodermal somites. It is possible that they are also due to pressure produced by the multiplying cells and the infolding of the neural crests. In the lateral ridges

a beaded appearance is sometimes present, but it is not regular in size or arrangement. The number varies from two to fifteen on a single side, and there is no correspondence between the lobulation of opposite sides. Sections of the crests showed no segmentation, the lobulation being due to centers of rapid cell proliferation. No relation between the median divisions and the three primary brain vesicles could be determined.

In the chick no indication of anything that could be interpreted as segmentation could be observed in the primitive streak or before the neural folds were clearly outlined. Lobulated irregularities are formed along the elevated margins of the medullary plate and are present in most embryos up to the closure of the neural tube. They are irregular in number and do not correspond in two sides of the same individual. They vary in size and are probably due to differences in the rate of cell proliferation along the expanding wall of tissue. As the neural crests increase in size faint lines appear in them, but they are irregular and variable. Faint constrictions appear on the external surface of the neural folds, but they are irregular in number and position. They do not regularly encircle the encephalon and the number of constrictions is different for two sides of it. Internal grooves do not regularly correspond with external constrictions. After the closure of the neural tube there are clearly six segments anterior to the auditory invagination. In these divisions there is present the definite cell arrangement distinguishing true neuromeres. In the open neural groove there is no suggestion of a segmental condition.

The so-called "primary metamerism" of chick and Amblystoma embryos is based on incorrect observation and cannot be accepted.

WYMAN, Cambridge, Mass.

INTRACRANIAL AEROCELE FOLLOWING FRACTURED SKULL.

GILBERT HORRAX, Ann. Surg. **73**:18 (Jan.) 1921.

The author reviews briefly a case of intracranial aerocele resulting from trauma to the skull, as well as some cases previously reported.

A girl, 19 years of age, was admitted to the Peter Bent Brigham Hospital in September, 1919. She had been injured on June 9, 1919, and was taken to a hospital. A roentgenogram at that time showed a compound comminuted and depressed fracture of the skull extending from near the vertex slightly to the left of the midline, downward and forward to the occiput, forward through both orbits, and presumably through the base of the skull. All loose bone fragments were removed at operation and hemorrhages were controlled. There was considerable laceration and loss of substance in the left frontal lobe. The wound was closed, a small drain being left in place. The postoperative course was uneventful.

The patient came to the Brigham Hospital to the service of Dr. Harvey Cushing three months after her injury because of weakness of the right side of the face, blindness of the right eye, deafness of the right ear and loss of the sense of smell. Neurologic examination verified the complaints. A roentgenogram of the skull showed an area of decreased density corresponding to the palpable defect in the cranium. It extended from the left frontal sinus upward for a distance of 6.5 cm., and its greatest diameter was 4 cm. On comparing this roentgenogram with others which the patient had brought with her, it was evident that another and somewhat different area of decreased density had been present at an earlier date. The previous plates had been taken two months before her admission to the Brigham Hospital and one

month after her initial injury and operation. At this time the plates showed that the area was due to the cranial defect. There was also a lobulated shadow of decreased density underlying the bony defect, which looked like a conglomerate mass of bubbles, the picture indicating clearly that this irregular area represented an accumulation of air within the cranium. Its extension backward within the cerebral tissue of the left frontal lobe for a considerable distance was shown by the lateral plate. The origin of this gaseous matter—presumably air—was unquestionably a crack in the frontal sinus.

The author calls attention to the fact that there are few accounts in the literature of such air-containing cavities in the brain. This seems strange as the condition must occur fairly frequently following gunshot wounds and other cranial injuries. After intracranial operations there must often be inclusions of air which lie surrounded by cerebral substance, either covered by dura or below places from which the dura has been purposely removed. Apparently no specially significant features are associated with such inclusions, either in the way of subjective sensations, or in the manner of wound healing, except their possible relation to subsequent "traumatic cysts," as mentioned by Potter.

Seven cases were recorded. Four of the patients died as a result of the injury or its complications. Recently it has been shown experimentally by Dandy that air can be introduced into the cerebral ventricles or into the spinal subarachnoid space, and this fact has been utilized clinically for the confirmation or determination of certain pathologic intracranial processes. In Dandy's experience, no deleterious results have followed such injections, except an occasional headache, which is easily relieved by ventricular puncture.

In the author's case, the skull injury occurred on June 9, 1919, but no reference to air within the cranial cavity was obtained until the plates of July 8, 1919, were taken. Between this time and Sept. 2, 1919, when the final plates were made, the air had disappeared and had caused no serious symptoms so far as could be learned from the history. No operative measure seemed indicated, and the patient was consequently discharged.

Adson, Rochester, Minn.

THE DIAGNOSIS OF BRAIN TUMORS BY THE BÁRÁNY TESTS. WITH REPORTS OF CASES PROVED BY OPERATION OR NECROPSY. Lewis Fisher, J. A. M. A. **78**:1515 (May 20) 1922.

The author emphasizes the value of a complete ear examination by the so-called Bárány test as an aid to the neurologist and neurosurgeon. He believes that such an examination, when made by an experienced otologist, will frequently clear up many of the difficult and perplexing cases. He has found that tumors located in the cerebellopontile angle give the most constant complex of findings, indeed, so constant that in a number of cases in which neurologic data were most confusing and even indicative of lesions elsewhere, these tests were the only means of localizing the lesions accurately.

The typical picture of a cerebellopontile angle tumor is as follows: Total deafness with no response from the horizontal and vertical semicircular canals of the affected side. On the opposite side the hearing is good; the vertical semicircular canals produce no response at all, while the horizontal canal produces good nystagmus, vertigo and past pointing. The nonresponsive and deaf ear on the affected side is accounted for by the neoplasm destroying the eighth nerve, while the absence of responses from the vertical semicircular

canals of the opposite side is probably the result of pressure. He believes that in tumor in the cerebellopontile angle these tests are practically absolute.

In tumors of the posterior fossa vertigo and past pointing responses are particularly affected, while the eye responses are either normal or exaggerated. In lesions located "higher up," the Bárány tests will also be of value. In supratentorial lesions the vertigo responses are found to be either normal or subnormal, while the past pointing is exaggerated both in extent and duration. In cases of neoplasm of the pituitary body the first effects of the pressure are exerted against the vestibulo-ocular tracts. In these cases the examination reveals an exaggerated nystagmus, but normal vertigo and past pointing. He believes that the Bárány tests are of great value in differential diagnosis between a subtentorial and supratentorial lesion and that these tests are also helpful to a lesser degree in lesions in the middle or anterior fossa.

NIXON, Minneapolis.

FRACTURES OF TRANSVERSE PROCESSES OF THE LUMBAR VERTEBRAE. GEORGE G. DAVIS, Surg., Gynec. & Obst. **33**:272, 1921.

The author calls attention to fractures of the transverse processes of the lumbar vertebrae, a lesion of not infrequent occurrence, but one that is frequently overlooked. With the aid of the roentgen ray, intensifying screens, and especially the Potter-Bucky diaphragm, many cases formerly diagnosed as "sprained back," are now recognized as fractures of the transverse processes. Writers on this subject have expressed considerable difference of opinion as to the etiology. The cartilaginous vertebra is ossified from three primary centers, two for the vertebral arch and one for the body. The ossific granules appear first in the situations where the transverse processes afterward project, and spread backward to the spinous process, forward into the pedicles, and laterally into the transverse process. At birth the vertebra consists of three pieces: the body and the halves of the vertebral arch. Before puberty no further changes occur, except a gradual increase of these primary centers, the ends of the transverse processes being cartilaginous. About the sixteenth year, two secondary centers appear, one for each transverse process. These secondary centers fuse with the transverse process at about the age of 25. From this secondary center the transverse process of the first lumbar vertebra is sometimes developed as a separate piece which may remain permanently ununited with the rest of the bone, thus forming a lumbar rib. Some believe that fracture of the transverse process of the lumbar vertebra is due to a weak point between the transverse processes and the rest of the vertebrae.

The author reports eight cases and illustrates the article with numerous roentgenograms. The symptoms of fractures of the transverse process are definite, backache being the first symptom. The pain, which is well localized, constant and nonradiating, is exaggerated by any motion that changes the line of the weight of the body. Rising from the incumbent to the sitting position or from the sitting to the erect position increases the pain. Flexion and hyperextension of the spine, and lateral bending, both toward and from the injured side, cause pain. In no position other than lying relaxed in bed is the patient free from pain. Bending toward sometimes causes more pain than bending from the injured side. Muscular rigidity and a point of exquisite tenderness over the fractured process are noted. The pain in the back is not accompanied by any neurologic symptoms. In some cases, however, the symptoms are so slight that the patient goes back to his occupation in a few weeks complaining very little.

The diagnosis is made by the history of a fall or injury to the back resulting in an area of localized tenderness lateral to the median line of the spine. As is the case in fractures of long bones this localized tenderness is the most reliable sign. The roentgen ray, of course, will show the fractures. Many cases which would not be recognized by the roentgen ray have doubtlessly been overlooked and considered only as sprains.

CONCLUSIONS

Indirect violence plays the most important rôle in these fractures.

The occurrence is noted in patients of advanced years, men beyond the age at which we would expect separation of the secondary ossific centers from the primary ossific centers of the transverse processes.

The condition is often associated with osteo-arthritis.

Adson, Rochester, Minn.

THE NATURE OF MENTAL DEFICIENCY. A. F. Tredgold, J. Neurol. & Psychopath. **2**:311 (Feb.) 1922.

The highly suggestive method of study here advanced is not as inelastic and dogmatic as might appear from this abstract. A brief résumé of mental evolution arranged diagramatically in four stages is given: (1) the unconscious, instinctive adjustments of the primitive vertebrate; (2) the higher mammalian level; (3) primitive social man, and (4) civilized man. At this last level perception has evolved into "learning," apperception into "wisdom" and feeling into "sentiment." Each of these three is subdivided, tentatively, into three subheads: Learning includes (1) complex concepts, ideation and imagination; (2) complex abstract ideas, and (3) complex symbols. Wisdom includes (4) deliberation, discrimination and reasoning, (5) volition and resolution, (6) prudence, planning and inventiveness. Sentiments are divided into (7) esthetic, (8) religious, and (9) social and moral.

Examples of mental deficiency are then analyzed on the basis of these nine elements. Legal mental deficiency is found to depend essentially on apperceptive defect. The idiot, imbecile, low grade and high grade moron (the author uses the English equivalent, feebleminded) correspond practically with arrest of development in the four different levels mentioned in the foregoing, but with special deficiency in apperception. The author is careful to point out that development is irregular and that these degrees of deficiency are not simply atavisms.

In addition to these committable types, there are many examples of mental deficiency which may or may not permit social adjustment, largely dependent on the complexity of the social environment and the degree of apperceptive endowment. Thus the "subnormal" or simple person who may just get by shows a general deficiency in level 4 but full endowment at level 3. The person with good learning and sentiment but lacking in wisdom is "the moral, conscientious, learned fool." Another type, often practically successful, lacks learning and sentiment but has plenty of good "common sense" or wisdom. The potential criminal, deficient in moral, and possibly also in religious sentiment, is kept from crime by fear of consequences for he possesses learning and wisdom. Finally, the "moral imbecile" or inherent criminal has much learning but neither wisdom nor sentiment. This last type is also legally committable under the British Mental Deficiency Act of 1913.

Singer, Chicago.

THE PATIENT AND HIS ATTITUDE TOWARD HIS NEUROSIS. Douglas A. Thom, Ment. Hygiene **6**:234 (April) 1922.

Dr. Thom presents a broad and useful differentiation of the neuroses based on the attitude of the patient toward his illness. To the active group belongs the person who seeks refuge in his neurosis. He is apt to be inherently unstable; the motive is obvious to the psychiatrist and the symptomatic expression is crude. On the other hand, the passive type is overtaken by the neurosis. He is more likely to be potentially stable; the purpose is obscure and the symptomatic mechanism intricate largely because the original stimulus "is not in operation in conjunction with the symptoms, but only the emotion that was attached to the primary experience." During the war the active attitude was represented by the anticipatory neurosis and now by the compensation reaction while the passive attitude has its prototype in the amnesias or psychasthenias. The practical distinction lies in the prognostic hopefulness of the former and the doubtful outlook for the latter.

In formulating therapeutic suggestions Thom recalls the now well-known differences between prewar and postwar treatment conditions. During active hostilities the apparently insurmountable difficulties were more than overbalanced by the intrinsic advantages of the situation. The psychiatrist in the line of combat was dealing with a soldier and not a pensioner; he had authority; he could appeal to patriotism and military traditions. Finally, and occasionally even consciously, the choice of the patient was apt to be in favor of a return to duty as against monotonous hospital life. In civil life the odds are rather against the psychiatrist. There is no legal or military control; a soldier may refuse treatment; there is no patriotic urge, and there is the glamour of the pension. The present problem relates largely to the active group, in which all sorts of environmental circumstances, such as, for instance, marital difficulties or economic stress, which are entirely foreign to the war, may precipitate the neurosis.

The author is opposed to prolonged hospitalization. He favors the outpatient neuropsychiatric clinic, which with its medical, psychologic and social service adjuncts offers the best opportunity to rehabilitate the dangerously large number of actively neurotic ex-soldiers.

Strecker, Philadelphia.

THE REACTIONS OF AMBLYSTOMA TIGRINUM TO OLFACTORY STIMULI. J. S. Nicholas, J. Exper. Zoology **35**:257, 1922.

Observations were made on both larvae and adults of *Amblystoma tigrinum*. Four series of larvae were used: (1) larvae with the optic vesicles removed; (2) larvae with the nasal placodes removed; (3) eyeless and noseless larvae, and (4) normal larvae. A corresponding series of adults was used, namely, blinded, nose-stopped, both blinded and nose-stopped, and normal animals. Earthworms, beef-juice and strips of beef were used as the stimulating substances.

General observations on the growth and behavior of larvae operated on show that the visual sense is the primary sense used in obtaining food. When motionless food substances are the only ones present, the olfactory apparatus functions to a greater extent in eyeless larvae than it does in normal animals. The experiments on adult animals indicate that while the eye is the most important agent in obtaining food, with the nose alone the animals are capable of detecting and locating definite food substances. When the animals are tested

in darkness the evident retardation in the time of reaction is due to the dependence of the animal on the sense of sight. After the removal of the eyes of the animals they become accustomed to use the olfactory organ only, and in this way the remaining sense organ is correlated to the needs of the animal. Experiments performed with diffusing and nondiffusing substances demonstrate the fact that an animal possessing the optic sense is stimulated by nondiffusing substances, while those possessing the olfactory sense are stimulated by diffusing substances. Odor streams involving the use of a number of substances elicit no further response on the part of the animal unless the substance used possesses irritating properties, in which case the animal responds by a decided motor reaction. Responses to motionless test substances in air show that the animal can find food substances, although the reaction time is longer than if the animal and the test substance are submerged. The experiments indicate clearly that there is a definite olfactory sense in both the larvae and the adults of *Amblystoma tigrinum*.

WYMAN, Cambridge, Mass.

THE SOCIAL SIGNIFICANCE OF DEMENTIA PRAECOX. EDITH M. FURBUSH, Ment. Hygiene **6**:288 (April) 1922.

Statistics are usually uninteresting and often deceptive, but sometimes the lesson they teach is so impressive that they demand the closest attention. This is true of the statistical study of dementia praecox contributed by the statistician of the National Committee for Mental Hygiene. Any doubt as to which psychosis furnishes the largest and most serious institutional problem is at once removed by the observation that the permanent dementia praecox population of state hospitals is at least 130,000 which is increased annually by 13,000 new cases. On such a basis, this form of mental disease is twice as important as tuberculosis. In the New York institutions 73 per cent. of the patients come from urban centers; the incidence is higher among the foreign-born and the racial distribution among those of native birth shows a preponderance in the Irish (16 per cent.), Hebrew (12 per cent.) and German (11 per cent.). Peculiar clinical interest should attach to the fact that 32.6 per cent. of the patients in the praecox group die of pulmonary tuberculosis. Even the quite conservative economic conclusions which are given are staggering in their magnitude. The annual economic loss to the nation which is estimated from the cost of maintaining patients plus the loss of their earning power is placed at $123,650,000! In this connection it may be well to remember that the hospital residence time is longer than in any other psychosis, and in twenty-six of every 100 schizophrenic patients amounts to twenty years or longer.

It is a rather serious commentary on psychiatry that concerning the etiology, diagnosis, prognosis and treatment of dementia praecox, our information should be most thorough and exact only in respect to the gloomy outlook for the patient. The natural defense is that funds are not available for research as they are for the study of tuberculosis or cancer. It is possible, however, that the effort to awaken the public has been somewhat lacking in determination. The presentation of the problem in the practical terms of Miss Furbush's article is a long stride forward.

STRECKER Philadelphia.

DEMENTIA PRAECOX AND SYPHILIS. Ransom A. Greene, Am. J. Psychiat. **1**: No. 3 (Jan.) 1922.

Greene investigated the frequency of syphilis in dementia praecox. The statistics are rather surprising. Of 495 patients with schizophrenia included in 2,117 hospital admissions, only eight had syphilis. A more extended search of the hospital records discovered twelve syphilitic patients in the entire dementia praecox group. An interesting suggestion is that as a part of the characteristic seclusive makeup onanistic or masturbatory excesses occur rather than promiscuous cohabitation, and thus the psychopathology of the psychosis automatically protects the patient from syphilitic infection. Naturally, with the evidence submitted one must concur in the conclusion that syphilis is not to be considered a direct causative factor of dementia praecox.

Strecker, Philadelphia.

PROGRESSIVE LIPODYSTROPHY: REPORT OF CASE. August Strauch, J. A. M. A. **78**:1037 (April 1) 1922.

The case reported is that of a woman, aged 27. Between the ages of 11 and 17 she had had a rather full figure, and the lower extremities were somewhat stout. At 17 her weight was 150 pounds (68 kg.). From the age of 19 her face and neck became progressively emaciated and at 20 the chest, arms and upper part of the abdomen were similarly involved.

The increase of adipose tissue occurred only in the lower part of the body. Her height was 5 feet, 3½ inches (160.8 cm.) and her weight was 149 pounds (67.5 kg.).

The condition in this case corresponds to that described by Simons in 1911 in which there was a symmetrical atrophy of the subcutaneous fat tissue of the upper part of the body and, a few years after the onset, in most cases an excessive accumulation of adipose tissue in the gluteal region, on the thighs and also on the rest of the legs. As evidence of this anomalous condition it is noted that the circumference of the waist line and the thigh were the same in the patient reported. The author gives complete measurements for comparison with other cases reported.

Nixon, Minneapolis.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY

March 7, 1922

FOSTER KENNEDY, M.D., *President, in the Chair*

A CASE OF PSEUDOTUMOR, WITH NECROPSY FINDINGS. DR. BEATRICE FAIRBANKS (by invitation).

In February, 1921, a student, 21 years old, developed headache, vomiting, dizziness and weakness, which increased in the succeeding months, accompanied by transitory aphasia, numbness, confusion and slight disturbance of consciousness. Later diplopia appeared.

Dr. Ward Holden examined the eyes in June, 1921, and said that the fields indicated pressure on the chiasm. He found the pupils slightly irregular, with sluggish reaction to light. There was slight divergence of the eyes to near fixation. A crossed diplopia was present with red glass, with images close together and an equal distance apart, both in looking to the right and left. Vision was 20/40 in the right eye and 20/20 in the left. In each temporal field there was a long oval scotoma extending from near the fixation point to beyond the blind spot. Movement of the fingers was seen in these areas, but the scotoma was absolute for a 5 mm. test object. The fundi showed a bilateral papilledema with many hemorrhages and patches of exudation. The top of each disk was plus four and the retinae zero.

Clonus was present on the right side but not on the left. This was also true of the Babinski sign. There was more power on the left side than on the right. The patient could not remember events of the previous day.

At this time radiographic study of the skull showed a suggestion of intracranial pathologic changes and displacement of the pineal gland downward. The spinal fluid was not examined, but the Wassermann reported was negative. In July Dr. Elsberg performed a subtemporal decompression; nothing abnormal was noted in the dura, but considerable subdural pressure was present. Later in August further decompression was done, after which a left hemiplegia developed. In October the patient became blind, and was treated with radium at the General Memorial Hospital. From this time he suffered tremendous thirst necessitating drinking several liters a day. There was great cranial herniation. Spinal drainage was performed eight times. One week before death the patient had a transitory convulsion, having great respiratory and cardiac difficulty, and two days later acute edema of the entire left side set in. The patient was cheerful and optimistic, but very forgetful, and remained oriented until the last.

Pathologic Findings: The whole brain was hardened in formaldehyd. Externally in the cortical region, corresponding to the right island of Reil, there was a cavity, into which it was possible to introduce the forefinger, with extensive roughening and laceration of the cortex in the vicinity, and extending upward and forward over the rolandic area. On section the lesion was

found to communicate with the posterior horn of the lateral ventricle, impinging slightly on the external border of the lenticular nucleus, and extending as far forward as the anterior horn, sloping outward so that at its most anterior point it was found only in the plane of the cortex. The vertical diameter was about 2 cm. at its widest point.

The macroscopic appearances were not those of a glioma with hemorrhage and necrosis, as we expected. It is always possible in these tumors, however rapid the degeneration has been, to find a zone of the familiar pearly color and gelatinous consistency between the necrotic area and the normal tissue. On the other hand, although the brain substance was normal in color and consistency, the edges were ragged to a degree incompatible with a porencephaly or a congenital hydrocephalus, where the convolutions usually dip smoothly down into the cavity. There was no evidence of a cyst wall, which is a perfectly definite structure microscopically, and there were no indications of abscess. Neither did the naked eye appearances suggest a gumma, which is usually surrounded by a distinctly hyperemic zone.

Microscopically we examined sections from blocks taken from all points of the circumference. Professor Ewing examined them thoroughly, and confirmed my opinion that there was no tumor present. Haidenhain's iron alum and ordinary hematoxylin gave the most useful results. All sections showed a slight increase in the number of large cells of undoubtedly glial origin. The small ones appeared to be lymphocytes. If the glial cells were small and of the type frequently found in the so-called glial sarcoma, we should expect to find transition types between them and the large cells, which were not present. There was a thickening and a slight increase in the cells of the subpial glia, a proliferation of the small vessels and a thickening of the large ones. There was a general perivascular infiltration, more suggestive of a chronic inflammatory condition than a neoplasm, particularly a gliomatous one, where the vessels are liable to be thin-walled and easily ruptured. There were no compound granular corpuscles.

I think we can eliminate the question of tumor. There remain lethargic encephalitis, syphilis and pseudosclerosis. However, I do not think we need to consider encephalitis, as the sections nowhere displayed the typical cuffing of the arteries which would be inevitable in a case of such long standing. Against the diagnosis of syphilis are the negative Wassermann reaction and the social history of the patient. In favor of the diagnosis there are the pathologic appearances which suggest an early stage, not more than secondary, which might fail to give the reaction, and the clinical history, points of which, such as the recurring diplopia, are rather suggestive of syphilitic disease. I sent the sections and the history to Dr. Greenfield, pathologist at the National Hospital, London. Although unable to make a diagnosis, he thought the lesions most probably syphilitic in origin. As to pseudosclerosis, the rapidity and course of the disease in this case are entirely opposed to what we know of this pathologic process. On the other hand, we know almost nothing of the factors controlling it, except in Wilson's disease, in which the fons et origo mali would appear to be the liver, and there is now no evidence that a similar process might not represent the reaction to some other primary infection. If so, it probably began in the island of Reil.

Microscopically, the abrupt transition between the normal tissue and the cavity, the type of large cells, and the perivascular gliosis are reminiscent of

the description Wilson gave of those cases of lenticular degeneration which he personally examined. The process must have been a slow one, owing to the extreme passivity of the tissues surrounding the cavity, possibly supervening on some slight congenital defect, and the tumor symptoms are largely referable to the hydrocephalus resulting when the cavity extended into the ventricle.

DISCUSSION

Dr. Smith Ely Jelliffe: It would be presumptuous at this time to hazard a suggestion as to the diagnosis. There will be more to say when serial sections are made. These may show foci in which a serous exudate has pushed through and destroyed the tissues in other portions of the brain.

Dr. Foster Kennedy: Perhaps the difficulty which Dr. Fairbanks finds may be due to the fact that radium had been heavily used, and this treatment may have destroyed typical cells. This has not perhaps been sufficiently taken into consideration.

Dr. Fairbanks, closing: I have not studied the effects of radium on the human brain. These results are not compatible with those I have seen in radiumized dogs. I do not think it would be possible for one type of cell to be so completely destroyed without affecting the others.

IS THE STOMACH A FOCUS OF INFECTION IN THE PSYCHOSES?

Nicholas Kopeloff, Ph.D., New York State Psychiatric Institute (by invitation).

Dr. Kopeloff presented a critical analysis of this question as determined by the Rehfuss fractional method of gastric analysis. The conclusion arrived at on the basis of the experimental evidence advanced (illustrated by lantern slides) was that the bacterial content of the stomach is influenced by the saliva and that the Rehfuss method of fractional gastric analysis cannot be considered an adequate criterion in determining whether the stomach is a focus of infection.

Quantitative as well as qualitative studies were made of the bacteria found at different stages in the digestive process, the fractional method of gastric analysis being employed. In order to investigate the influence of saliva on the bacterial flora of the stomach, in some experiments, a dental suction tube was kept in the subject's mouth for the removal of saliva during gastric analysis. This made possible a comparison of gastric fractions contaminated and uncontaminated by saliva. Bacterial counts showed a striking reduction in numbers in gastric fractions when saliva was inaccessible. The highest number of bacteria per cubic centimeter in a psychotic patient (manic-depressive, manic) when saliva was not removed was 48,000; when saliva was removed the highest number found was 32. Similar results were obtained with a normal person and with other patients having the same diagnosis. These data take on an added significance when it is remembered that the swallowing of saliva is particularly difficult to control in manic patients. Furthermore, it is important to note that this reduction in numbers of bacteria when saliva is removed, occurs alike in patients having low gastric acidity and in those of a more normal type.

No correlation was found between high acidity in the stomach and low bacterial numbers or vice versa. Streptococci were found associated with high, as often as with low, gastric acidity. Consequently, there seems to be no reason to attach undue importance to their presence, or therefore to con-

sider the stomach as a focus of infection. This means that another factor, the saliva, is of greater importance, determining the bacterial content, within certain limits. Furthermore, the fact that the bacterial count on the "fasting contents" is usually considerably lower than during the process of digestion, indicates that little or no multiplication of bacteria takes place when the stomach is relatively at rest. As might be expected, the micro-organisms found in the different gastric fractions with greatest frequency are yeasts, staphylococci, streptococci and members of the lactic-acid and aerogenes groups. Invariably these are found in the saliva of the same patient or in the food given. Consequently, they cannot be regarded as constituting a true bacterial flora of the normal stomach. It is of interest in this connection to note that a similar study of normal persons yielded a bacterial flora qualitatively and quantitatively similar to that found in persons with psychoses.

From these various considerations, it may be inferred that the stomach is not acting as a focus of infection, but merely as a receptacle for the bacteria poured into it. This is in agreement with the conclusion of others as a result of bacteriologic investigations, namely, that gastric acidity is sufficient to prevent bacterial development.

DISCUSSION

Dr. Smith Ely Jelliffe: This method is a valid means of approach to this problem, and can be used as a corrective way of checking up assertions made by Dr. Cotton and others. There are, however, other factors involved in the point of view taken by Dr. Cotton which are not quite covered by the observations here set forth. While I do not hold a brief for Dr. Cotton's statements, I think his point of view embraces the idea that the long-standing focal infections produce such a lowering of resistance that the coordinating factors represented by the cerebral cortex are interfered with; that is, if we are to understand the psychoses of the dementia praecox variety, about which type Dr. Cotton concentrates his work, we must grant that the cerebral cortex in its organizing capacity attempts to coordinate the activities of the various organs. If any organs, therefore, are thrown out of order or interfered with by chronic focal infections, such a degeneration must be represented in the cortex itself in its higher organizing function. If the organs which contribute to the organism as a whole are infected, the result is a lack of synthesis of their activity in the cortex. Along these lines Dr. Cotton's observations are not entirely negatived by the presentation made this evening. If we do not find a decreased amount of bacteria relative to diminished function of the stomach the observations only confirm *a priori* the conclusions that common sense would bring us to believe. I believe these facts are worthy of consideration in the study of all the psychoses.

Dr. Kopeloff, closing: I am in general agreement with Dr. Jelliffe's point of view. The material presented was only a small part of the work actually completed. We have conducted a number of experiments in regard to the influence of operative and nonoperative treatment on the psychoses. In this paper I discussed the question of stomach infection along the lines indicated by Dr. Cotton. He claims that the stomach is a focus of infection, that is, shows low acidity and presence of bacteria, and he gives autogenous vaccines on the strength of that. The next gastric analysis shows increased acidity and absence of bacteria. My work negatives these results. Other work to be reported at the American Psychiatric Association will deal with the results of operative treatment in the psychoses.

CONSIDERATIONS OF SOME EXPERIMENTAL STUDIES ON THE DEVELOPMENT OF THE NERVOUS SYSTEM. Dr. Charles R. Stockard, Cornell University Medical College (by invitation).

We shall consider in a brief and informal way some of the primary problems in the development of the nervous system.

The nervous system belongs to the general skin system, and may be called a modified part of the skin system. It is the appreciative portion of the wall or sac which separates the organism from its surroundings. The appreciative portion must be capable of affecting the underlying parts so as to call forth a response to the stimuli received from the environment. This demand seems to stand behind the evolution of the nervous system. We may scan the scale of elementary nerve arrangements as follows:

The simplest animal cell is an irritable contractile body and may in certain cases contain a fibrillar-like "nervous system."

Kleinenberg long ago recognized in the ectoderm cell of Hydra an outer sensory part and an inner contractile portion; he therefore designated it the "neuro-muscular cell."

In slightly higher forms the sensory and contractile parts apparently separate into two distinct cells connected by a fiber which passes from the superficial sensory cell to excite the more deeply placed contractile cell. In still higher forms the sensory cell becomes divided into a superficial end-organ and a deeper placed nerve cell, the cell on the surface communicating through a nerve cell with a muscle cell.

Comparable successive differentiations actually take place during the embryonic development of higher forms, as may be illustrated by the case of the vertebrate retina which is derived from the primitive ectoderm cells and becomes differentiated into the end-cells which are the rods and cones, and the ganglion cells with their various connections. In the development of these complexes it may be shown experimentally that one part may be suppressed or absent and the other parts may finally become well formed, as, for example, the end organ or retina may not develop, or may be removed, and yet the brain center cells may arise and persist.

In higher vertebrates and in man the separation of the nerve tissue from the general skin or ectoderm takes place at an early time in the embryo; in fact, the central nervous system is one of the earliest organs or systems to express itself in development, being second only to the primitive intestine, if even to that. From this early start it continues to develop and undergo change until long after birth. Thus the interval of development for the nervous system is extremely long. This fact renders the nervous system liable to arrests or developmental interferences, since any unfavorable condition occurring at any time during development acts particularly on those parts which are developing at the given time. Some element of the nervous system would, therefore, be affected at almost any time. We may now review a number of experiments that I have carried out which throw some light on this subject.

Effects of Arresting the Growth of the Primary System: Growth in general has an initial linear stage and a subsequent lateral expansion stage which takes place after the high rate of the linear impulse has been spent. If the initial linear stage of the central nervous system in a vertebrate embryo is suppressed the differentiation of the body of the individual entirely fails to occur and only an amorphous embryonic mass results which soon dies.

On the other hand, if growth is arrested or injured after the linear growth has begun, some of the lateral outgrowths, such as the optic vesicles and hemispheres, may be suppressed in various combinations, or all may be suppressed. In the latter case only a simple tubular brain develops which resembles the anterior end of the spinal cord. Fish embryos with such brains as this may develop to the stage of hatching but do not hatch. They are eyeless and deformed in other ways. In other cases tubular brains may develop with eyes or cyclopean eyes. Thus it is possible to suppress one group of lateral outgrowths, such as the eyes, and yet have another, such as the hemispheres, develop, or vice versa.

Asymmetrical Conditions and the Question of Bilaterality: If one examines the early optic vesicles and neural folds of various vertebrate embryos, it will be noted that one lateral half or side is developing slightly faster than the other. It would seem as if the two sides were somewhat independent, or rather competing with one another. In this competition the advantage of one side over the other may be the underlying cause of left-sidedness or right-sidedness. The eye on one side comes off somewhat earlier and is at first slightly larger than the other, although finally the two eyes become practically equal in normal development. In extreme cases, however, monophthalmia may result. This also is true in the development of the primary brain ventricles, which may be very small on one side. Thus a general developmental basis for unilateral arrests and malformations is clearly present in the embryonic system, and one side of the body may be well developed while the other side is paralyzed and deformed.

Localization of Future Stuffs or Parts in the Neural Plate: The early localization of materials for future structures in the neural plate of the embryo may be illustrated by studies on the eye or retina, since this is so definite a structure and becomes extremely large before undergoing normal differentiation. A number of workers had taken it for granted that since the eyes are finally lateral in position, they originally arise from lateral positions in the neural tube. Operative experiments had been conducted from this standpoint. The "lateral" portions of the anterior neural plate were cut away, and following this operation no eye developed, but no significance was laid to the fact that the cut had really removed the central as well as the lateral portion of the neural plate. In attempting to account for certain conditions shown by cyclopean eyes I was forced to assume that the earliest eye stuff must be originally located in the midline of the neural tube and it only later develops laterally from this origin. Stuffs located in lateral parts of the early neural plate become dorsomedian since this is where the lateral tissue is finally carried. Had the eye originally been lateral the optic nerve would have grown into the side of the brain and its fibers would have crossed inside instead of outside and ventral to the brain. Though median to begin with, the eye forming material develops lateral to the midplane and finally becomes divided into two definite eyes. Other parts are also similarly located in the median plane and have to shift to their final lateral positions.

Independence of Secondary Centers: The study of the eye parts of the brain have also shown that some of the secondary nerve centers are independent, in their development, of the existence of other parts of the complex organ. For example, the retina may be completely absent, there are no ganglion cells present to send their fibers into the brain, and so no optic nerves and no primary optic tracts, but the optic radiations and optic centers in the occipital lobes may be fully developed. This is shown in the brains of eyeless guinea-pigs.

Late Growth and Differentiation: An experiment which illustrates strikingly the long period of development of the brain was recently performed by Dr. H. G. Bagg, connected with our laboratory. He found that when solutions of radium emanations were injected into pregnant rats one or two days before the birth of the young, the radium affected the brain cells of the young to the extent of destroying many of them. It is well known that dividing cells are particularly sensitive to radium, and the brain at this time is injured because it has so many cells in mitosis while at this time other organs are more nearly in a resting condition. The testes are also greatly affected since here too active cell division is taking place. Thus, injurious effects of the environment may so act as to injure the development of the central nervous system from the earliest moments of development right up to the time of birth, and as all know, long after that. The variety of the stimuli which cause these injuries have little to do with the type of injury. The kind or quality of injury depends chiefly on the developmental moment when the effect takes place. Early injuries are, as a rule, more serious than later ones. For example, all of the brain cortex may become degenerated following a late injury, as with radium, and notwithstanding this, many animals continue to live.

The Endocrine Glands in Determination of Kind and Quality of Central Nervous System: Many claim that the brain develops entirely as a response to the glands of internal secretion. It is obvious that this overstates the case. The experiments mentioned in the foregoing show that many external conditions tend to decide the manner of brain development. And certainly a study of the embryology of the nervous system shows clearly that heredity, quite aside from the heredity of internal secretions, determines the general character of the central nervous system, for example, whether it shall become the brain of a tiger or of a dog, of a monkey, or of a man. Nevertheless, changes in the developmental rate of the central nervous system effect its quality and in so far as the rate of development, rate of metabolism or rate of oxidation is influenced by an internal secretion during later developmental stages, we may admit that the smaller peculiarities of brain growth and development are modified by the internal secretions. This is strikingly shown in the case of the cretin with an arrest of mental development corrected by thyroid administration. In the presence of such secretion the brain promptly responds.

The central nervous system in common with all body systems has a definitely normal rate of development. Any cause that modifies this rate to a marked degree will also modify the quality of nervous development, and the type of central nervous defect resulting depends on the developmental stage at which the interference took place and not necessarily on the nature of the irritant producing the arrest.

The same poison or mechanical irritant may be used to induce every known deformity of the nervous system if applied at different periods of development. A hundred different irritants will induce exactly similar deformities if applied to the embryos at the same developmental stage. From the large, easily seen deformities resulting from severe or crude treatment, it follows that many pathologic conditions and subnormal nervous reactions are the result of unfavorable environments acting on the nervous system during development. These arrests probably make up the greater part of congenital nervous conditions, feeblemindedness and other conditions. Probably only a few such conditions are strictly speaking actually inherited per se, though this in no sense would indicate that they do not tend to recur in families. The excit-

ing cause itself may be associated with some hereditary structural condition, such as a poor uterine development and bad placentation due to weak or abnormal ovaries. This again shows how, in mammals at any rate, the glands of internal secretion may have something to do with malformations of the central nervous system, since they may effect the manner of placentation and thereby the supply of oxygen to the embryo and its rate of development.

DISCUSSION

Dr. Smith Ely Jelliffe: Would it be valid to say that in the early linear stage of development we are concerned with the older phyletic system so that the lateral buds go through a separate development for the projicient system? I would also like to know whether the olfactory segments can be isolated. Can one draw any inference as to the development of the phyletic stage? Can one cut out the eighth nerve and eliminate the auditory and vestibular tracts which are of great importance in the projicient segments?

In another type of question, removed from the foregoing discussion, and relating to every-day matters, it is said that in the development of any series of segments there are times regulated by mitoses when certain effects can be produced. Has this any relation to the common statements in folklore regarding prenatal influences, which result in deformity to the child? We all know the common stories. A window drops on a pregnant woman's wrist, and her child is subsequently born without a thumb or with a stump for a wrist. There is the mass of contradictory evidence of other women who suffered the same accident and had normal children. Can this mean that in the first case the accident happened at a time when the finger buds were in active developmental stages of mitosis and thus sensitive to deforming effects?

In regard to the pigmental system: Can Dr. Stockard's remarks be said to extend to other types of pigment than the retinal pigmental system, such as the malpighian layer? In the rats which showed hemorrhagic spots of the skin what possible embryonic relations could that have to pigment layers of the eye? Is the whole pigment system in a class phyletically related to pigments of the eye? Or is it related to the older vegetative system?

Dr. Gregory Stragnell, by invitation: I should like to inquire about certain postnatal conditions which seem related to the points emphasized by Dr. Stockard. We encounter results which are not perhaps so marked as in prenatal interference, but are far more complex because they occur later. Clinically we see cases in which infections interfere with the normal development and growth of the child. In children between the ages of 6 and 10 years, at the time of secondary dentition, the enamel buds are interfered with. We also encounter precocious gonadal developments, such as pubertas praecox, due to endocrine interference, although we do not exactly know what its mechanism is. It is more intricate but it apparently resembles prenatal interference. This brings up the question of what part the endocrins play between the nervous system and the muscular and general development. Can we have any information as to what endocrine disturbances have been observed when chemical or mechanical interference took place in the development of the embryo?

Dr. C. R. Stockard, closing: In regard to the vegetative nervous system, as contrasted with the the central nervous system, I think there is a little evidence that the early straight shaft might be looked on as vegetative rather than central. During the last two years interesting anatomic work, not yet published, has been done by Professor Edwin Smith of the University of London. He has shown that the vegetative system is in the central part of

the brain. All the other developments are secondary and grow into the central nervous system. The blood supply lies between the primary and secondary parts. Some years ago I thought the invertebrate nerves comprised the sympathetic system, but I am not of such an opinion now. The invertebrate system controls all kinds of muscles. Arthropods have striated muscle, and this looks more like the central nervous system than the involuntary system. I have not worked on the olfactory segment, but when you get cyclopia you get one naris. The auditory system is not strictly central nervous system. You can suppress the inner ear portion. Fishes do not have a middle ear, they have gills. The ampulla is first in the development of the cyst. You can get a big dilatation of the otic vesicle and fuse the ear right through the brain. The bony part of the middle ear will depend on the membranous labyrinth. If you transpiant otic tissue anywhere you will get a cartilaginous formation around it.

In regard to prenatal impressions: I do not think there is any evidence to connect these two things. You cannot associate the condition in the embryo with any accident to the mother, except in so far as shock to the mother will arrest development. I recall one case of an achondroplastic dwarf, called the "turtle baby" whose mother was said to have been badly frightened by a large turtle; but, as we know, achondroplasia is a hereditary condition, a true germinal mutation.

In regard to the pigmental system: The retinal pigment is different from the rest of the pigment. Other pigment is really mesenchymal, formed from migratory cells which become chromatophorous.

In reference to postnatal effect: I should have said that the further back you get in the embryo, the more fundamental the modifications are. You have the beginnings or "anlagen" as it were; later the effects are more complex. In regard to postnatal work: We must not regard birth as anything more than an accident in the development of the person. To say that the baby is increased by four times its weight after birth is nothing to the enormous increase, about 1,000 times, in the first nine months of its existence. The thymus cannot inhibit that growth, so that the endocrinal influence has definite limitations. In studying the question of growth we must look on life as a whole. Trees, for instance, show a steady generalized growth, but if they have glands of internal secretion we do not know what they are. The invertebrates reach a large growth, but they have no glands of internal secretion. The giant squid goes on growing as long as it lives; if you cut a limb off, it regenerates; and the same with amphibians. In the more complex organisms, the mammalian and avian embryos, there is another influence besides the older generalized power of growth. The egg increases 100 times, without differentiated glands, but when it reaches a certain stage it cannot do without the stimulus of internal secretion. The human baby cannot progress without the thyroid gland.

In the salamander, experiments were worked out with the attempt to bring about metamorphosis by addition of thyroid, but it was found that these creatures had a well-developed thyroid, and yet lived in the larval stage. The addition of hypophyseal secretion brought about metamorphosis. Thus it seems that the thyroid secretion could not become active without the pituitary. In the more complex stages of development the endocrine secretions become hooked up and interdependent. Until then the animal has the generalized power of growth. This stage is important in the development of the child as it influences the rate of oxidation and through this the determination of postnatal abnormalities. Interference always slows oxidation and retards the parts that should be developing rapidly.

An interesting phenomenon is seen in cattle with twins. This is rare, but when twins of the same sex occur, they are normal. When, however, there is one male and one female twin, the male twin develops the testicle before the female develops ovarian cells. The fluids of the male pass through the female. There being an arterial anastomosis of the two placentae the fluids pass through the two embryos. The female is born with defective sexual development. The male twin cannot be similarly affected, as it possesses an immunity to the maternal secretions. The hormones of the male differ from those of the female, and the egg which produces the male is different from that which produces the female. Thus it is seen that the glands of internal secretion begin to play a part at an early stage of development.

The Society adopted resolutions on the death of Dr. Pearce Bailey.

CHICAGO NEUROLOGICAL SOCIETY

Regular Meeting, March 16, 1922

CHARLES F. READ, M.D., *in the Chair*

A CASE OF INTENTION TREMOR AFTER ENCEPHALITIS APPARENTLY NOT OF THE EPIDEMIC TYPE. HUGH T. PATRICK.

A girl, 16 years old, was in good health until February, 1917, at which time she is said to have had scarlet fever and diphtheria. Antitoxin was given and there was a positive throat culture. After a few days of acute illness she developed marked shaking and tremor of the head and trunk, on a few occasions being thrown out of bed by the violent muscular contractions. About two or three weeks after the onset she remained for about a week with the eyes closed. Whether she had double ptosis or was partially unconscious is undetermined, but at the end of a week, when she opened her eyes, there was no strabismus and vision was unimpaired.

Following this there were three large abscesses in the back. She was in bed for three months and for six months was unable to stand or walk alone. Since then the condition has remained much as at present. When at rest nothing is to be observed except perhaps a lack of facial expression. She is quiet and comfortable. As soon as she begins to move marked tremor appears.

Apparently she had something like encephalitis almost two years before epidemic encephalitis appeared in this part of the country. The condition is like that presented by some patients following epidemic encephalitis. The intention tremor of the arms is not exceedingly marked, but any test will bring it out. As not infrequently in multiple sclerosis, tremor of the head and trunk shows very well when she walks and tests show marked intention tremor of the legs. She walks a little wide footed because the shaking affects equilibrium, but there is no real ataxia. Aside from this really typical general tremor, no ill effects are apparent from this acute illness, except that she is not able to wrinkle her brow or her nose. The pupils are not irregular, and respond to light and accommodation. She is intelligent and not nervous though somewhat sensitive. She has attended school and two years ago passed a written examination for which she had to be allowed additional time, but it was legible. There is no tendency to stammering though the tremor slightly affects her speech.

I have given scopolamin and belladonna, but with practically no effect. I shall next try gelsemium which Dr. Foster Kennedy has found useful in some cases of post-encephalitic tremor.

DISCUSSION

Dr. Sanger Brown: Many years ago Dr. Ringer reported many cases of tremor in which he thought he secured results from calabar bean.

Dr. I. B. Diamond: I saw this patient when she had scarlet fever, at the time she was peeling. There was marked twitching of the body, and she could hardly be kept in bed. She is much better now. She was then emotional, excitable and greatly emaciated. I diagnosed the case as chorea and gave her arsenic.

A CASE OF UNUSUAL RIGIDITY FOLLOWING LETHARGIC ENCEPHALITIS. Hugh T. Patrick.

This man, 36 years old, illustrates two features of epidemic encephalitis which we have learned to recognize during the last two or three years. In November, 1918, he suddenly became ill with fever, chills, considerable prostration, aching of the legs and excessive perspiration. He was in bed about a week, then gradually recovered and worked as usual ten hours a day for nearly a year, running a rip saw in a box factory.

After about eleven months, he had a severe headache one morning; in the afternoon he had to stop work. The headache continued for about four weeks, was frontal and quite severe. During this period he felt drowsy but could not sleep and had diplopia for about two weeks. Insomnia was extreme and hypnotics were deemed necessary for about three months. The insomnia gradually disappeared, but the patient felt prostrated, was without ambition and was unable to work for five months, when he resumed his former occupation but not with former strength and vitality. At this time the gait and movements of the extremities are said to have been normal. He continued work until October, 1921, but laid off for periods of one day to a week on account of general weakness. During the summer of 1921 his movements gradually became slower, more clumsy and more difficult. By October he was unable to work. His face became expressionless and speech slow, so that by the end of October a physician considered that he was mentally unsound. He was sent to the Psychopathic Hospital where he was found mentally intact and the real condition recognized.

At present the patient presents the picture of the parkinsonian type of postencephalitic condition. He has practically no tremor, but the so-called rigidity is marked to an unusual degree. Sometimes it is fully a minute before he can start a desired movement. This delay applies to all extremities but is exceedingly variable. This variability in motor capacity in this disease, as in dystonia musculorum and other extrapyramidal motor disorders, frequently has led to a diagnosis of functional disease.

A case similar to this but much more severe occurred in a lad of 15. For months the patient was supposed to have purely functional disorder, and I had him under observation for several weeks before I reached a definite diagnosis. In this case also the trouble steadily progressed for more than a year after the onset. At no time was there any paralysis, but the difficulty in initiating movement was so great that sometimes it took him three or four hours to eat a meal, and at times two or three hours to put on one or two garments. On one occasion, when the bowels were loose, he succeeded in reaching the toilet, but having arrived there could not turn around to seat himself in time to avoid an accident.

DISCUSSION

Dr. A. B. Yudelson: Have you observed that when these patients are asked to do something with their arms in adduction they can do it more readily and there is less tremor than when they execute an act with the arms in abduction, away from the body? I have observed this phenomenon in several cases examined.

Dr. Patrick: I never have.

Dr. G. B. Hassin: I wish to call attention to the anatomic changes assumed to be responsible for the clinical symptoms in the two cases presented. The choreiform movements and tremor of the girl are most likely due to a lesion of the corpus striatum, while the rigidity, masklike face and the slowness of movements so well shown by the other patient indicate, according to some investigators (Foerster, C. and O. Vogt and others), a globus pallidus lesion. The anatomic designation would seem more appropriate, for by using the terms pallidal or striatal syndromes we do not commit ourselves to the etiologic factors, such as syphilis, arteriosclerosis, inflammations, which all may cause lesions of the above structures and similar clinical pictures.

Dr. J. Elliott Royer: The syndrome of the second case I believe is due to a bilateral lesion of the pallidal system: First, his rigidity is plastic or waxlike in character in contradistinction to the spastic and elastic type found in pyramidal tract lesions. Second, there is paralysis of automatic and associative movements with preservation of acquired or educational movements as shown when the patient wrote for us so well. It would appear that the motor system of the corpus striatum, the large pallidal cells, which have been shown to be the most essential lesion in the production of the syndrome of paralysis agitans, controls the automatic and associative movements and functions through the extrapyramidal motor tracts.

AN UNUSUAL CASE OF TABES WITH ARTHROPATHY OF THE SPINE. Hugh T. Patrick.

The patient with tabes is unable to be present, because he suddenly became paraplegic following an intravenous injection of arsphenamin. He is a man 43 years old, whose family and previous history are of no particular importance except for gonorrhea twice at 25. He persistently denies chancre but has a cicatrix on the penis. For a number of years apparently he had some rheumatism, but the tabes probably began four or five years ago with rather typical pains in the legs. He went the course of the ordinary nonataxic tabetic, except for enormous loss of weight without any known cause. He had weighed when well 268 pounds (121.5 kg.), and in the course of four or five years he went down to 134 pounds (60.7 kg.) and less, about half his former weight.

The next interesting feature is flaccid palsy of the peroneal group of muscles of the right leg with foot-drop and marked atrophy. There is also some wasting of the right calf and thigh. Such palsies in the course of tabes have often been described, especially by Déjerine and his pupils. Occasionally they add difficulty to the diagnosis. Evidently the lesion is in the anterior horn, the anterior roots or the nerve trunk.

The third feature of note is that results of examination of the blood and spinal fluid by different men have always been negative.

Fourth, the patient has a knuckle of kyphosis involving especially the first lumbar and last dorsal, and roentgenograms show distinct lesions of the bodies of two vertebrae, with practical collapse of one and detritus about them. This lesion is painless and not tender to pressure either vertical or lateral, but heavy

percussion (fist) over it causes a shooting pain into the left thigh. At this time I cannot positively exclude tuberculosis, but everything points to tabetic arthropathy.

Is the atrophic, flaccid paralysis due to the bone lesion? I think it unlikely. Such palsies are exceedingly rare in spinal arthropathy, and in the vast majority of paralytic cases no bone lesion has been present. If the paralysis were due to involvement of the nerve roots by the bone lesion, one would expect pain and probably pain with anesthesia in the peroneal region. These sensory symptoms are not present. Nor are there other symptoms indicating involvement of the cord or cauda equina at the level of the spinal lesion.

Aside from the negative serologic findings and the absence of ataxia, practically all indications of tabes are present. The pupils are irregular, unequal and with the Argyll Robertson sign. The knee reflexes are absent, the left Achilles reflex is good, on the right not to be obtained. There is analgesia of the ulnar trunk, testicular analgesia and a zone of trunk anesthesia, wider for touch than for pain; also some analgesia of the legs. The shooting pains are quite typical.

DISCUSSION

Dr. James C. Gill: Was there any disturbance of the upper extremities?

Dr. Patrick: Practically none.

Note: This patient was seen again April 2. The paraplegia had largely disappeared and his condition was much as before except that flexion of the left thigh was feeble. Apparently the paraplegia had been due to a moderate Herxheimer reaction, although an acute exacerbation of tabes, such as reported by Dr. Holmes at the last meeting of this Society, could scarcely be excluded.

A CASE OF TABES WITH ARTHROPATHY OF THE SPINE. William H. Holmes.

C. W. (Case No. 97514), a white man, aged 52 years, was admitted to Wesley Memorial Hospital, Feb. 24, 1922. He complained of urinary incontinence, difficulty in walking and intolerable pain in both lower extremities. His family and early personal history was negative except that he had a double venereal infection twenty-two years ago and a serious accident twenty years ago, which may have a bearing on his present condition. The wire cables used in hoisting a steel girder parted, the girder fell, pinning the patient between it and another girder. He sustained a serious fracture of the right shoulder and contusions of the neck, chest, right arm and lumbar spine.

Immediately after the accident he experienced difficulty in controlling his urine, which has persisted to the present time. No attention was paid to the injury of the back which was regarded as unimportant. Ten years ago while employed in a position which required the lifting of heavy objects he suffered pain in the lumbar region. Aside from this short period there has been no disability because of backache. About five years ago severe lancinating pains in the abdomen and legs and nausea and vomiting began. A diagnosis of duodenal ulcer was made and an operation was performed. No evidence of ulcer or other abdominal disease was found, and reexamination resulted in a diagnosis of tabes dorsalis. Five weeks prior to his recent admission to the hospital there was a recurrence of lightning-like pains in both legs and in addition a more or less constant pain limited to the dermatomic distribution of the right fourth lumbar nerve. This pain sometimes disappeared on changes in position, more especially by flexing the spine and by reclining on the right side with the knees drawn up.

On recent admission to the hospital examination revealed all the classical symptoms of tabes. The right leg from a point just below the knee to a point just below the ankle on the inner surface was hyperesthetic and corresponded to the area in which the patient experienced pain. The tabes did not seem satisfactorily to explain the constancy of one type of pain in a limited area which could be alleviated by changes in posture. Examination revealed absence of the normal lumbar curve. The spinous process of the third lumbar vertebra was unusually prominent. Deep percussion did not cause pain. There was no muscle rigidity. Flexion of the spine was performed without difficulty. Rotation movements and lateral bending to the right were also well performed. Lateral bending to the left was limited and extension movements of the spine were quite impossible because of fixation and not because of muscle rigidity or pain. An antero-posterior roentgen-ray view of the spine in the lumbar region shows extensive deposits of new bone involving all the lumbar vertebrae with the most marked change in the second. There is marked lipping of the third, fourth and fifth vertebrae. When discharged from the hospital on February 27, his physician was advised to produce immobilization of the spine in extension by means of a plaster body cast.

DISCUSSION

Dr. Peter Bassoe: I might mention a case somewhat similar to the one reported by Dr. Patrick, with foot-drop, which shows that we should not be so pessimistic regarding therapeutic results. Ten years ago I saw an apparently hopeless case of what may be called paralytic tabes. The man had had tabes for many years with so much pain that he was addicted to opiates. He was lying down practically all the time and could not walk. He had optic atrophy, and foot-drop on the right side. He had a marked deformity of the lower lumbar spine, a marked prominence and hypermotility so that there was a grating sound when he moved his back. This did not cause any pain, and it was plainly a Charcot spine. Roentgen-ray examination showed that the fourth or fifth lumbar vertebrae were greatly affected.

I began treatment with mercury and then gave arsphenamin, but something peculiar happened: he received Swift-Ellis treatments and after one he suddenly developed left foot-drop. This came on like a Herxheimer reaction, and continued for some time but improved steadily. In a general way also he improved. Dr. Ridlon saw him and applied a spinal jacket. The man has continued to improve and is able to go to business. He walks poorly but can get out and into an automobile, go to his work and stay there all day. He is practically free from pain and has gained much in weight and general health.

I think the foot-drop in that case must be considered to be connected with the deformity, perhaps by traction on the cauda equina.

Within two days of the time I saw that case I saw another—that of a tabetic with great pain and bladder disturbance who also had arthropathy, but without much deformity or difficulty in locomotion. He soon developed pneumonia and died.

Dr. Elven J. Berkheiser: Dr. Ridlon has taken care of patients with these cases which are not so uncommon, as Dr. Funston of Iowa City, in a recent report in *The Journal of the American Medical Association*, would have us believe. Dr. Ridlon remembers four such cases. He emphasizes some points in the orthopedic treatment.

In one of his earlier cases he used a spinal brace to relieve the symptoms and prevent increase of the deformity. Little relief was obtained. In another case the patient was a large man who did hard work. A leather jacket was applied, which when new gave relief, but after it had been worn for a long time and became soaked with sweat it lost its shape and the symptoms recurred on account of the lack of proper support.

The two other patients have been relieved of symptoms by wearing a jacket made over a corrected torso. One has been wearing such a jacket for eight years. At first he had a great deal of discomfort, disability and paresthesia and was scarcely able to get about. After making an ordinary plaster form of this person, filling it with plaster and correcting this so that there would be some pressure on the convexities and room over the concavities, the man has been very comfortable and there has been no increase of deformity.

CASE OF MYOTONIA ACQUISITA. Lewis J. Pollock.

A woman, 29 years old, has been married for seven years and has had three children. Following the birth of the second child, four years ago, she awakened on the fifth day with her arms and forearms spasmodically flexed and her hands semiclenched. She was unable to overcome the contraction, but I have been unable to determine whether the spasms were paroxysmal or continuous. Six months after the onset they were definitely more or less constant, and at this time affected the lower extremities as well as the upper. In addition to the constant hypertonicity there were spasms which appeared at the beginning of any intended movement and diminished with each succeeding one. During the last two years the disease has been almost stationary.

An examination revealed a more or less constant spasm in the legs, producing bilateral hammer toes, and a rigidity of the feet which it was difficult to affect by passive movements. There was marked hypertrophy of the muscles of the legs. In the upper extremities there was marked hypertrophy of the deltoid and particularly of the muscles of the forearm. The hands were held in a position of ulnar deflection with the thumbs extended and the fingers flexed at the metacarpophalangeal joints. The arms were adducted and the forearms flexed to a right angle. Passive movements of the upper extremity were difficult. Following deep pressure over the biceps and deltoid muscles a groove was formed from which a slow wave of contraction of the muscle was seen. There was an increase in the idiomuscular reflex in the deltoid. Voluntary closure and opening of the hands was accomplished at first with great difficulty which became less with each succeeding trial. In the lower extremities relaxation did not follow successive movements.

There was no Trousseau or Chvostek sign. Electrical examination did not reveal a true myotonic reaction. It was observed that after the normal, quick response to cathodal closing stimulation there occurred a slow, tetanic spasm of the extremity, which did not correspond to the contraction of a group of muscles supplied by any one nerve. To faradism the reaction was normal.

Myotonia acquisita occurs as a complication of a number of diseases, such as syringomyelia, certain types of progressive muscular dystrophy and atrophy. In some cases of tetany myotonic phenomena have been present. Schiefferdecker and Schultze, in discussing tetany with myotonic phenomena, reported a case of gastric tetany with Trousseau's sign but no Chvostek sign, in which a long lasting after-contraction was present in a muscle after percussion. Schultze, in 1882, had already called attention to the intention spasm in tetany,

reporting two cases. Frankl-Hochwart, in 1891, cited two cases, one showing a Trousseau but no Chvostek sign. Kasparek reported a case of tetany with intention spasm, as did Hoffman. Bettman reported a case of Thomsen's disease with tetany and Trousseau's sign; after two years the tetany disappeared, but the myotonia remained. Von Voss described a case of tetany with myotonic disturbance and recalled the observation of Koester, who observed myotonic spasms in a case with irregular localized tetany.

My case shows phenomena which occur in both tetany and myotonia. The onset following pregnancy, the continued spasm of sudden onset and the position of the hands and feet indicate tetany. The presence of marked muscular hypertrophy, increased idiomuscular reflex and intention spasms indicate myotonia. I am inclined to classify this case as an atypical, chronic tetany with myotonia.

DISCUSSION

Dr. E. B. Yudelson: Were the ocular movements normal?

Dr. Pollock: There was no change in the ocular movements. There was no discernible change in the thyroid. Metabolic studies revealed nothing definite. I administered parathyroid gland, and she immediately became worse.

Dr. H. I. Davis: Was her breathing normal?

Dr. Pollock: Perfectly normal. I think the tetany was probably related to the puerperium. As myotonic reactions have not been infrequently described, I would say that the same toxic factor which produces the tetany might produce the myotonia.

Book Reviews

L'ENCÉPHALITE LÉTHARGIQUE. Par le Pr. Achard, Professeur de Clinique Médicale a la Faculté de Médecine de Paris. Paper. Price. 16 francs. Pp. 324, with 15 illustrations. Paris: Librarie J.-B. Baillière et Fils, 1921.

The author goes back to a description by Camerarius of an epidemic in Tübingen in 1720 of what was called sleep sickness, and he believes that more careful research would bring to light much older records of like events. Indeed, reference is made to a number of much older statements which may perhaps have related to lethargic encephalitis. From these early indications the history is traced to and through the manifestations of the late epidemic.

The description of this polymorphous disease is full and accurate, the vastly different types being sufficiently emphasized. The pathologic anatomy is clearly presented and an attempt made to correlate the lesions of different parts of the central nervous system with the various symptoms.

Epidemiology, etiology and the relation of lethargic encephalitis to other diseases are duly considered, followed by diagnosis, prognosis and treatment. One could wish for more detailed information on prognosis but perhaps at the time the manuscript was finished, the author had not yet seen the manifold relics of the disease which have been so ubiquitous in the last couple of years and which give the prognosis such a somber cast. Recrudescence or return of progressive symptoms receives definite notice.

The entire monograph is good and constitutes a satisfactory, systematic treatise on this exceedingly important disease. The bibliography is extensive (about a thousand references), and should be most helpful to any one looking up the literature. The illustrations are well chosen, and the book (paper bound) is well printed on good paper.

AN ESSAY ON THE PHYSIOLOGY OF MIND. An Interpretation Based on Biological, Morphological, Physical and Chemical Considerations. By Francis X. Dercum, A.M., M.D., Ph.D., Professor of Nervous and Mental Diseases in the Jefferson Medical College. Cloth. Price, $1.75 net. Pp. 150. Philadelphia: W. B. Saunders Company, 1922.

This small volume, as indicated by the subtitle, deals with the mechanisms of neuron activity as applied to the study of human behavior. It is admirably written and makes excellent use of the work of Parker, Herrick and Sherrington. As a mechanistic foundation for the study of mental activities it contains much of value, even though the title is in some respects misleading. The author is deeply impressed with the conception that "mental phenomena are in their essence physical," and he carefully omits consideration of the dynamic factors which differentiate living from nonliving matter. Much is said of the influence of external "impacts" and their mode of transmission from receptor to effector, but the forces inherent in life, which surely are important determinants in the selection of reactions to these impacts and thus to self and race preservation, are almost entirely ignored. That such forces, primarily unconscious, may be the origin from which are evolved the mysterious instincts, feelings, desires and will is not considered.

As a direct consequence of this studied avoidence of the dynamic aspects of mind, instincts and affects are briefly mentioned, and the explanation is given that "a detailed consideration of the affective qualities of mind would lead us too far afield." But even here the author does not refrain from suggesting that, in the *production* of affects, "the internal secretions, the hormones, and the sympathetic and autonomic nervous system play an important part; at times the active cause is to be sought in toxic substances bred within the body or taken in from without." Melancholia and mania are cited as affective upsets with the somewhat naive suggestion that blocking of a synapse by toxic action "may itself be cause of pain *in the neurone*" (italics by reviewer) and that the "expansion" of the manic may be due to "the general release of inhibition" by toxic damage of synapses.

In dealing with the evolution of the nervous system and the development of associative chains of neurons, in discussing consciousness and its relations to neuron activity in the telencephalon and to "adjustable" as opposed to automatic or fixed responses, the author is on safe ground and handles his material ably. But even here, unfortunately, he is at considerable pains to brush aside the need for recognizing any vital force "an immaterial something of unknown and unascertainable character." He offers instead descriptive concepts such as chemotaxis, neurobiotaxis and ameboid activity of neurons which are in some way activated by external impacts, and one is left to wonder why evolution occurs at all.

That it is the purpose of the author to offer explanations of behavior rather than simply to describe the mechanisms through which this is manifested, is proved conclusively by the "addendum on pathologic physiology of mind" which occupies the last sixteen pages of the book. We can agree heartily with Dr. Dercum that there is urgent need for the student of mental activities and disorders to keep his feet solidly on the rock of observable fact, undoubtedly the main reason for the writing of this book, but surely it is just as unscientific to fight against the recognition of unknowable forces and their effects in biology as it would be to deny the force of gravity in the study of physics. The deletion of desires and affects makes of behavior a dynamo without magnetism, a lifeless mechanism which cannot be vitalized even by the most ingenious hypotheses of chemistry or physics. Unfortunately the elimination of this force is the keynote of the book and thus seriously mars the good qualities it possesses.

LA REACTION DU BENJOIN COLLOIDAL ET LES REACTIONS COLLOIDALES DU LIQUIDE CEPHALO-RACHIDIEN. Par Georges Guillain, Professeur agrégè à Faculté de Médecine de Paris, Guy Laroche, Médecin des Hôpitaux de Paris, et P. Lechelle, Ancien interne des Hôpitaux de Paris. Paper. Price, 12 francs net. Pp. 146, with illustrations. Paris: Masson et Cie, 1922.

As the authors of this little monograph point out, several attempts have been made to find a test for the study of variations in the cerebrospinal fluid, especially in syphilitic conditions, which may be used either as a substitute for the Wassermann test or as an adjunct to it. The most important of these is, of course, the Lange colloidal gold test, which is excellent and usually satisfactory, but which often leads to erroneous results owing to the fact that the solution is improperly prepared or is not stabilized. The mastic reaction of Emanuel has not proved sufficiently uniform in its results to warrant its

adoption, while the Berlin blue test of Kirchberg does not give typical precipitation curves, although it may show an intensity somewhat proportional to the increase in protein bodies.

The authors experimented with a large number of colloidal solutions until they finally adopted a colloidal suspension of benzoin resin. This test is based on the fact that colloidal suspensions of benzoin resin tend to flocculate and sediment out in proportion to the amount of protein, especially the globulin element of the spinal fluid to which they are added. As a test solution the authors use a colloidal suspension of the amygdaloid Sumatra benzoin.

In nonsyphilitic diseases of the nervous system, the authors assert the result is always negative. They made tests in cases of dementia praecox, old melancholic states, manic-depressive psychosis, alcoholic psychosis, morphinomania, cocainomania, uremic coma, arteriosclerotic hemiplegia, pseudobulbar paralysis, Parkinson's syndrome, chorea, amyotrophic lateral sclerosis, syringomyelia, paraplegia of old age and other conditions.

With different clinical forms of cerebrospinal syphilis the reactions are positive but vary in degree and somewhat in type. (1) In general paralysis the test is quite strongly positive and parallels the Wassermann and Lange tests. (2) In tabes this reaction presents different degrees of intensity which have some value in judging of the activity of the process. In progressive developing tabes it is as marked in some cases as in general paralysis, while in others it is less intense. In fixed tabes the reaction assumes the subpositive type, while in very old tabes the reaction may be negative. (3) In acute or subacute cerebrospinal syphilis, this reaction is positive, the precipitation occurring in the syphilitic zone. When the evolutionary syphilitic processes have ceased and such conditions as hemiplegia, monoplegia and paraplegia arise, the reaction is most often negative: in other words, the test in its positive phase has a definite relation to developing syphilis and not to the remote consequences of such conditions. (4) In the course of secondary syphilis, which is not associated with definite meningeal involvement but with slight lymphocytosis and a small degree of hyperalbuminosis, the benzoin test is negative. When, however, the Wassermann test is strongly positive and the lymphocytosis and hyperalbuminosis are distinct, the benzoin test assumes either the subpositive or positive phase. The authors classify the lesions of secondary syphilis into four groups: (*a*) Those showing no meningitic reactions; (*b*) those having slight meningitic reactions with weak lymphocytosis and hyperalbuminosis and with negative Wassermann and benzoin tests; (*c*) those with more marked hyperalbuminosis and lymphocytosis but still with negative Wassermann and benzoin tests, and (*d*) those with marked hyperalbuminosis and lymphocytosis and with a positive Wassermann reaction and a positive or subpositive benzoin test. Patients with secondary or tertiary syphilis, with intense meningeal reactions may show just as strongly positive results as do patients with general paralysis or tabes; that is, this benzoin test is a syphilitic reaction of the cerebrospinal system and not a test of the type of syphilis. The benzoin test, according to the authors, parallels the Wassermann test in general paralysis and in active tabes; in fixed tabes the parallelism exists in most cases but there are occasional divergences. In acquired cerebrospinal syphilis, variable results have been reported, in some cases the Wassermann test being positive and the benzoin negative, while in others the reverse is true; but such variations are relatively infrequent. In all cases studied by these authors, as well as in analysis of reports of others, the Wassermann and benzoin tests were simultaneously positive in 83 per cent. of cases with a

variation in 17 per cent., of which 11 per cent. showed a positive Wassermann and a negative benzoin test and 6 per cent. showed a negative Wassermann and a positive benzoin test. These two reactions appear to be complementary, the benzoin test directing the diagnosis to a cerebrospinal syphilis while the Wassermann test appears secondarily after reactivation by treatment.

This test cannot be applied to cerebrospinal fluids which are purulent, turbid or contain blood or derivatives of it (xanthrochromatic fluids).

While the test has been favorably reported on by many writers, there are a few who doubt its value as a substitute for the Lange test. However, the results seem to parallel those of the Wassermann test in as large a percentage of cases as do those of other tests, and the preparation of the colloidal solution is much simpler and more constant than is that of the Lange test. The reviewer, from his experience with the colloidal benzoin test in his own laboratory, can recommend its use as an adjunct to the Wassermann reaction and believes that it will be found to be quite as reliable as the Lange test, especially if proper care be exercised in obtaining the amygdaloid variety of benzoin as advocated by the originators of the test.

Details of technic and guidance in interpretation are fully given in the monograph.

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INTER-RELATIONS OF THE DOMAIN OF NEUROPSYCHIATRY *

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BALTIMORE

The fact that the American Neurological Association entrusted to me the chairmanship of this forty-eighth annual meeting places on me the responsibility of opening the session with some pertinent remarks. I would have these take the form of an attempt to answer a question which I consider of great importance to us, namely: How can we state clearly and simply what constitutes the field of neuropsychiatry?

At this time there is especial need for clearness on this subject. Ours has always been a very responsible field, but today it is all the more responsible since the war has added large numbers of victims of neuropsychiatric disorders. Members of this organization, among them Thomas W. Salmon and our much lamented Pearce Bailey, shaped a definite neuropsychiatric domain. For the first time in the history of the country psychiatrists and neurologists cast their lot together in a remarkable unitary organization. Noteworthy immediate services were rendered at the front and in this country during the war. Now, as lies in the nature of our field, we shall for years to come have to help maintain a worthy follow-up service for the country and for the men and women who rose to meet the great emergency. What can be held out to the public and to the medical profession as the foundation, scope and goal of neuropsychiatry?

THE DOMAIN OF NEUROPSYCHIATRY

The task is not only the care of paralyzed legs and arms and troublesome nerve growths and brain lesions accompanied by impaired speech and other disorders; it is especially the so-called mental aspect, including the understanding of the *person;* of that aspect of the person which is likely to guide *or* misguide public opinion—that which constitutes the moods and morale of the patients, and the willingness and capacity to accept and use assistance, and to develop a real *conscience* about *health.* All this is the domain of neuropsychiatry.

* President's address read at the Forty-Eighth Annual Meeting of the American Neurological Association, May, 1922, Washington, D. C.

My principal appeal in an effort to formulate a generally intelligible and yet scientifically valid and practically suggestive delineation of the main aspects of our work leads me to the following considerations:

Every domain of medicine has, generally speaking, two problems: the study and management of the special *organ or function* on its own ground, and the study and management of the patient as an *individual personality* and member of a group, as it affects the special organ or function.

Neuropsychiatry is quite specifically responsible in both lines, because the very organ of concern to us is also the principal organ for the integration of the individual as a personality. It is, however, equally essential that we should recognize that some familiarity with the science of man as a personality is as necessary for the gastro-enterologist or surgeon or any physician or student of any problems pertaining to man, as it is for the psychiatrist and neurologist. But it behooves the neuropsychiatrist to know the psychobiologic methods and facts especially well, because he deals with the principal integrating organ. Unfortunately, there are many who want to make a puzzle out of this simple proposition.

My principal claim is that there is no call for the traditional attitude of bewilderment over how to fit the personality-facts into the scheme of objective sciences and practical medical data. The interesting reasons for the difficulty of physicians and laity in the presence of psychiatry, so admirably outlined by Lewellys F. Barker in his Bloomingdale address [1] and what we note from our own experience, resolve themselves into this: There is too much of the bad habit of expecting that the mental problems and mental conditions should be intelligible out of one's understanding of mere words and ponderings, when, as a matter of fact, one should have some first-hand experience with real and tangible human reactions and life factors and the methods of work with them.

THE PATIENT AS A UNIT

It so happens that the leaders of medical organizations largely familiar only with other aspects, such as bacteriology, i. e., facts outside of man, and with physiopathologic part-functions, have treated with undue suspicion the effort of those who see in psychology frankly and directly the study of the patient as a unit or personality, and we find ourselves today confronted with the demands of an intelligent public to furnish trained neuropsychiatrists fit to be social psychiatrists and neuropsychiatrists, with the alternative that the public may have to go elsewhere, outside of medicine, for help.

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1. Barker, L. F.: Psychiatry in General Medicine: A Psychiatric Milestone. Bloomingdale Hospital Centenary. Privately printed by the New York Hospital, 1921, pp. 59-75.

Neglect of the simple common-sense way of recognizing the study of the function of the whole individual or the patient in addition to the function of the parts is largely responsible for much confusion on the part of the medical profession and the public, whereas, as I hope to show, its recognition in terms of plain critical common-sense gives us a sound approach, scientifically and logically, on safe ground and standing the test of direct and simple applicability, objective and constructive.

Unfortunately the public, and even the medical profession, gropes for unsound types of psychology and many a would-be neuropsychiatrist is apt to talk confusingly to the profession and to the public. A frank acceptance of psychology as the study and control of the functions and behavior of the individual organism as a unit or personality gives us a perfectly sound objective basis and sound methods of procedure. The concept of integration and the understanding of the principle of symbolization give us the orderly natural-history view of man which allows us to do justice to the whole personality and the parts, and to the demands of sound medical and hygienic practice.[2]

The principle is not difficult to grasp. We find that the universe of which we are a part presents a vast problem of science, that is, of systematic formulation and experimental and practical control. The all-pervading realm of fact and of method of approach is that of physics and chemistry. But the masses or entities we meet are specifically integrated. From a certain level of complexity, they show more or less individuation and constitute finally what we call biologic units and groups of units. The special types of this whole large group can be presented in terms of a fraction, the denominator being the formulation of the facts of life in general—metabolism, growth and organization and reproduction. The numerator is one or another type or degree of development of the general biologic type: the purely vegetative type with only limited and incidental motion; then the branch of life characterized by motion and all that which goes with the animal type of life forming the numerator of our fraction. Within this we have first the forms with a type of behavior possible without a nervous system, and other forms in which the numerator crystallizes a definite nervous system with a literal *organization* of *reflex* process. It is within this that another specialization occurs, namely, that of symbol activity and what in ourselves we know and describe as integration in more or less of consciousness. The swinging in of a nervous system brings us an organ working essentially as an integrator, with no special meaning and value as such, remarkably economizing, little energy-consuming and

2. Contributions of Psychiatry to the Understanding of Life Problems, in A Psychiatric Milestone, pp. 21-54.

with little fatigability, unable to live and work by itself but serving the task of unification in the form of reflexes and their combinations. On this ground, among the many exigencies of life there expands a special type of *organization not only of structure but specifically of function,* an organization in what we know as more or less "conscious" *activity.* This organization takes place through that tremendous development which has as its essence the *use of symbols,* or symbolization, in the form of sensation standing for certain facts, perception and images, memories, picture-formation, and language, all unified in subject-organization and psychobiologic integration. Thus human behavior becomes the behavior of an integrated individual brought into psychobiologic organization with the help of all that which makes up man's specifically "mental" equipment and symbolizing or representative reactions hanging together in more or less consciousness. This realm of function is justly combined into a special topic of psychology or psychobiology, in contrast to or in addition to the science of *reflexes* which do not involve symbolization, and do not depend on integration with the help of signs. But in distinction from tradition we do not treat the "mental" or "conscious" data as a detached and special purely subjective realm of facts; we study them as a special incident of the objectively observable behavior.

As soon as sensations and perceptions, memories, images and ideas, fancy and reasoning, forecasting and deliberation, are involved in reaction and actions, we find a type of function or behavior which constitutes itself as "function or behavior of the *individual,*" in what I call *subject-organization,* not merely as an abstract mind, as tradition has it, but as a specifically integrated type of activity of the cerebrally integrated *organism;* not as a part of a detached world but as the natural form of a psychobiologically integrated life and behavior—physics and chemistry, if you please, but biologically, vegetatively, reflexly and psychobiologically integrated physics and chemistry, not only dealing with new words but with specific functions and coordinations and discriminations of behavior of definite kinds of organisms. Psychobiologically integrated activity, or behavior with the help of *mentation,* or we might say in an even more telling manner, "behavior with the help of *imagination,*" implies naturally and inevitably this new development: the inclusion or insertion in the *reflex-type* of function, of *symbolizing functions* of the highest possible saving in energy consumption; it *implies* the "*mental*" *activity,* which, however, is definitely recognized as cerebrally integrated activity of the organism, but making possible a *new* "*state of function,*" the organization as an "individual in action as an agent or subject," as the "he" or "she," the "you" or "I" we know as a biologic individual and social entity. Just as *metabolism*

constitutes the special feature of the domain of physics and chemistry that makes up biology, so *symbolization*, the development of sign-function, establishes the psychobiologically integrated types of organism and function. Instead of acting as an ordinary mechanistic reflex-machine, the organism constitutes itself as a *subject*, with all the mind and soul that our anthropomorphic parlance chooses to emphasize, attained through the incorporation of symbolization among the other biologic or life-dependent functions and activities.

SYMBOLIZATION

The concept of symbolization, that is, treating the mentally integrated states and activities as brought about with the help of sign activity and its organization, is not difficult to grasp. It shows in the production of sign reactions from simple sensations up, that is, activity not necessarily of any special potency of effectiveness by itself through the actual physical energy-display it contains or implies, but *getting its meaning and potency through its service in an associative system*, a system which constitutes itself concretely as the variously adapted *subject or personality*. It shows in part individually and in part socially, as in the form of gesture, emotional display and language and their silent forms, built up out of perceptive-cognitive-discriminative and affective and conative assets of response and construction. It brings about something that activity *not* integrated with this help could not produce with such a degree of differential adaptation. Just as logarithms and algebraic notations bring in simplifications and new possibilities of operation, so the introduction of the sensory-cognitive and conative and affective assets in overt form or overt behavior, or in their economizing so-called "mental" type experienced as mental activity or mentation, gives us means of psychobiologic integration, so remarkably organized as *using on the same level reality and fancy, past, present and future, one's own ideas and those of others, in overt effective and expressive action* or in the specifically economizing form of implicit symbolization.

Jelliffe and White in their "Textbook of Neurology and Psychiatry" recognize this formulation and give us the data of neuropsychiatry in three long chapters on the physico-chemical systems with the *vegetative* nervous system, the *sensorimotor* systems, and the psychic or *symbolic* systems. They give us a very concise and essentially American conception in a pithy paragraph (p. 21): "The *hormone* is the type of tool at the physico-chemical level, the *reflex* at the 'sensori-motor' level, and finally the *symbol* at the psychic level." My own conceptions are very similar, only I prefer to speak outright of the vegetative, the reflex and the psychobiologic types of function or levels, and I prefer to claim

as frankly unnecessary the confusing contrast of physical and psychic, as indicated in various older discussions of mine.[3]

We have, then, a formulation of the facts we deal with that keeps us on the ground of *objective data*, with our eyes clearly open to the specific precautions needed in this field of relativities, with methods correspondingly adapted and safeguarded and without any call for mystical notions on the one hand or neurologizing psychophobia so confusing to common sense on the other hand.

With such a philosophical and practical conception, one learns to subordinate the exaggerated contrast of mind and body, and to speak of reactions of the internal or visceral organs, the nervous segmental and suprasegmental organs and functions as such, or as parts of the reactions of the cerebrally integrated *person*. The nightmare of neuropsychiatric dilemma has no place. What the patient does, feels and thinks ceases to be made a puzzle; one either finds objective facts calling for one's attention or one does not.

How do these general conceptions present themselves concretely? Our objective psychobiology expresses itself concretely and simply in certain definite aims in our medical curriculum. It is my ambition to organize the essentials as a scheme of neuropsychiatric work that will give us a right to insist on a comprehensive picture of the entire domain and on absolute clearness of the essential *lines* so that they may become usable in *all* medical practice. All our medical schools of today train the student to include a minimal number of neurologic routine tests in any medical examination. But how many medical teachers of today and how many neurologists make it an acknowledged practice to include planfully the minimal number of questions and tests that will draw out the reactions disclosing at least the most tangible psychobiologic problems? There is no difficulty in this. One simply has to be at least as familiar with *some ordinary human problems and standards of adaptation* as one is with the facts of reflexes, ataxia, tremor and palsies, anesthesias and decerebrate rigidity and fits. After testing the principal reflexes, one should ascertain how the patient reacts and responds to a minimal number of simple questions: What difficulties do you want help for? What is your work and how does it agree with you? Have you had any special experiences, or moods or fancies, fears or worries, or imaginations which you could not throw off? Does fate and everybody treat you all right? How does your memory serve you?

3. Especially in the review of Moebius: The Hopelessness of All Psychology, Psychol. Bull. **4**: No. 6 (June 15) 1907; an article in J. Insanity **65**: pp. 39-52; and in a later article that may have sounded strange with its provocative title: "Objective Psychology or Psychobiology with Subordination of the Medically Useless Contrast of Mental and Physical," J. A. M. A. **65**:860 (Sept. 4) 1915.

Wherever evidence calls for it, a small number of performance tests give us the memory data.

We add today to a reasoned scheme of working in anatomic and clinical neurology a gradual working out of a general and special psychobiology and psychopathology for the student, beginning with the technic and practice of the simple life-study of an average person and average problems of psychobiology, and extending it to the work with the fundamental reaction-types and problems of psychopathology and psychiatry.

Instead of considering psychiatry a field of asylum diseases, let us see what we find wrong in behavior and mentation, without damning it at the outset by a terminology derived from merely possible terminal developments. The personality-reactions present themselves to us concretely in terms of reaction-groups: mood disorders, fears, obsessions, states of panic, seclusiveness, fancy states, simple or disorganizing, and memory, retention, judgment and behavior disorders—plain facts which do not necessitate any very learned or bewildering vocabulary. We look for concrete mismanagement of home situations, for discrepancies of ambition and performance, existing difficulties and failures, problems of adaptation and problems of desensitization; and doing so, we shall be helpful to our patient instead of sacrificing him at the altar of vocabularies dealing with terminal states and with fixed fatalistic "constitutions" and too dogmatically fixed "disease entities."

THE SCOPE OF THE EXAMINATION

We must get away from the idea that one examines only for some all-inclusive asylum diseases like dementia praecox and manic-depressive insanity and paresis. One examines primarily for the range of personal capacity to help in an examination and to cooperate in any plan for treatment, that is, assets as shown in plain life problems and successes and failures. If there *are* any failures, one determines whether there are any toxic or infectious intruders, any disorders of the internal organs and their functions, any neurologic disorders (including the suprasegmental as well as the segmental symptoms); and finally any disorders of behavior or of mental reactions, not in the abstract but in terms of what the patient does with the jobs, with the family, with other people, and with his own worries, and feelings, and notions and moods, the thoughts he cannot throw off, the memory and judgment, and the speech and writing, and the management of his eliminative functions and sleep and appetite. One does not fish merely for a few so-called "frontal lobe symptoms."

I am more concerned with having the best possible understanding of the condition and needs of the patient at the *time*, than with the customary relatively uncertain guesses as to the ultimate fate. I want

to make sure that my attention is focused on all the points which might make a difference in the immediate treatment and guidance of the patient, *without* therefore losing sight of the long-term problems, the future and the ultimate fate. In some conditions, such as delirium, agitation, depression, or states of panic, the immediate problems are as clear and urgent as in any acute disease of general medicine; in other cases the broad long-term problems must lead us rather than the immediate appearance, as in the temporary spurts or temporary improvements of paresis or of paranoic or deterioration or psychoneurotic states. In all cases we need a sane elastic balancing of the facts, and I feel that we can show that this is possible with a theoretically and practically sound scheme, without leading the student first through a stage of dogmatic cocksureness of ultimately unattainable nosology and general pathologic assumptions.

I am told that when I outlined a similar point of view at the Bloomingdale centenary, one of our colleagues turned to his neighbor with the remark: "How is this to help us in a case of brain tumor?" It is true I did not then discuss brain tumors specifically, but the "Contributions of Psychiatry to the understanding of Life Problems." But does not the plan of attack bring a certain clearness into the study of any patient? Assume that even the brain tumor patient, like E. W. Taylor's case, is one who has for years been troubled by obsessions; or that the condition is one of a korsakow-like collosal syndrome. In the former case we must know that the mental disorder is *not*, and in the latter that the mental disorder *is*, naturally accounted for by a focal disorder. In either case an examination and study of the facts as we find them in mental or psychobiologic terms are necessary before we dismember the data.

It is clearly important that we should guide the public to recognize quite frankly a call for an obligatory practical pluralism in the use of the facts and methods required in the understanding and treatment of our patients. The layman understands at once what we mean by a study of the special organs and the study of general conduct and behavior and mentally organized functions. We study not an abstract "mind" but the functions and *activities* which constitute the facts of mind—just as we might study water and not "wetness," and living *things* and not life as a detached problem. To be sure, the public with its ideas of a detached mind is today as much as ever under the influence of one-sided fads, all kinds of one-sided faith-healing, and all kinds of temporarily successful cults; even physicians send patients deliberately and without further guidance to the healing cults and to consultants and healers inadequately trained—apparently without knowledge of or trust in the conscientious efforts of physicians with all-round training. As a compensatory reaction still others refer the public to a one-sided

infection theory, or to a one-sided endocrinology, or the patient takes refuge with the osteopath or other types of chiropractor's work because of their grossly tangible display of curative efforts—their doing something with their hands, that which gives the surgeon his name. Our responsibility is great. As neurologists let us profess frankly that we are *really neuropsychiatrists,* that is, physicians with a comprehensive scope of interests and methods; and let us also see to it that the spreading of frank and intelligible views of the nature of the life problems and the psychobiologic symbolizing level becomes a necessary and obligatory concern of the rank and file of physicians, appreciated in its right importance by both physician and patient.

A NEUROPSYCHIATRIC ASSOCIATION

Whether, in view of the practical exigencies, and for the sake of greater clearness in the mind of the public, our Association should, on the occasion of its fiftieth meeting, call itself the American Neuropsychiatric Association, in keeping with the composition of its programs, and in memory of Pearce Bailey and those who did and do the war work, is a question worth raising. This would not mean any submerging of either neurology or psychopathology. There will but rarely be physicians who can cover the whole field, and each investigator will have his own choice of problems. But one thing is certain: We do demand of every one a reasonable training in the *entire domain,* including the functions of the organism constituting the personality. We want neuropsychiatrists—not merely neurologists and not merely psychologists, but primarily physicians able to study the entire organism and its functions and behavior and more especially the share of the nervous system and of the general problems of adaptation.

As we deal with the policy of the care of the war veterans, let us not enhance the inevitable traditional and personal difficulties and confusion among physicians and patients by overemphasizing a split between the neuroses, psychoneuroses and psychoses, and the like. Let us remember that many psychoneuroses as problems of general adaptation are infinitely more problematic and difficult to treat than the frank psychoses. The maintenance of the necessary self-discipline and the practical use of judgment is often much more difficult to obtain in the so-called psychoneuroses. The actual work of study and readjustment requires a high degree of cooperation on the part of the patient. Let us do our best not to give cause for outcries of indifference on the part of the physician through disregard of the personality facts, and for the patient's untimely and arbitrary withdrawal from experienced guidance. Let us see that the policies can be shaped by those who are able to study and master the facts about the parts as well as the personality, by those who know *best* and work *most,* rather than by the sensational magazine

literature and the exploiters of dissension in the neuropsychiatric camps. To attain this we have to be creative and constructive and in the front line, and we cannot trust the old policy of mere following and drifting when we come to the psychobiologic problems. We must travel under one flag and with a clear aim.

There may be a few among us who feel that neurology should maintain its exclusive and dominant attitude by pointing to psychiatry as an extraneous and practically negligible asylum and sanatorium field, and that what can be handled at large should be handled under a vernacular of general medical and neurologic camouflage sparing the public's feelings about the mind. Neither the conscience of the profession nor the state of public opinion can drift profitably in this manner. The most practical step toward the solution of our problem is the rounding off of our training among ourselves and in our general medical curriculums by giving the student and worker good foundations for the simple and every-day tasks of psychobiology and understanding of ordinary personalities and their problems and needs. Let us realize among ourselves that neuropsychiatry stands for making organized and critical medicine a field of work with personalities as well as with the part-organs and functions, and that while there *must* be special workers devoted to special research in the special fields, no physician and no intelligent lay person can afford to disregard the gains by the modern readjustment: the recognition of life problems on the psychobiologic level of integration, the promotion of a training in medicine dealing with the defective and unusual child, the growth of interest in the minor difficulties of human behavior and mentation, and the humanizing of the work with all states and conditions of disease and maladaptation.

You may think me visionary for expecting very much from a broadcast recommendation of apparently a kindergarten measure, yet my long experience convinces me that even simple and practical working habits mean more than long reasoning. In every ordinary medical examination today we require a summary examination of reflexes and fundamental sensorimotor functions, and we now add to this, as equally obligatory, an inquiry into the patient's feeling of content or discontent, mood or spirits, special preoccupations and strains, the sex-adaptations and the essential points of life-problems calling for proper hygienic regulation. We recognize in these inquiries into the assets and tendencies and problems of the personality the basic and necessary rounding off of the study of any patient.

In the patients in whom psychobiologic problems *predominate*, we study the reactions and resources of the person as simply and as fully as we study the reflexes, accepting the data frankly as psychobiologically integrated facts or data of behavior of the individual as a person.

We work with a reasonably limited number of reaction sets, that is, groups of facts that have a specific meaning to us. These may be of

the nature of part-disorders—the irritable weakness type, the anxiety-reactions, the hypochondriacal, the dysmnesic-hysterical, the obsessive-ruminative and the simple defect type of facts; or we consider the more sweeping reaction sets, the thymergastic or affective, the parergastic or twist, the dysergastic or toxic, and the anergastic or organic defect complexes, always remembering that any *one* patient can present *more* than one of these sets of facts. We study the factors entering into the disorders, the poisons and infections (exogenic), the metabolic (organogenic) components, and then the constitutional and the more definitely modifiable and adjustable psychogenic experience-determined factors and special function-tendencies.

The fundamental inter-relations of neurology as the study of the part-functions of the nervous system, and of psychobiology as the study of the total reactions of the individual integrated by the cerebrum, are only one example of the general call for study of the functions of the parts and the functions of the whole.

Since the nervous system forms the essential basis of neurology and psychobiology or personality-function, neuropsychiatry furnishes the general science of man and medicine with the simple as well as the detailed methods needed for the study of structures and parts and the study of the patient as an individual.

In all this we are turning into a planful technic and philosophy that which physicians and patients have always *needed* and physicians have sometimes *practiced*. Neuropsychiatry must work out general methods and principles to be of service in the practice of medicine as a whole; and with growing simplicity and clearness neuropsychiatry may furnish the veteran and the rank and file of humanity a safe and sane conception of human life and its health, and of the range of medical helpfulness.

It is easy to put it quite simply:

We consider it obligatory in the study of the reactions of man not only to test the pupil and patellar reflex, but also a few essential reactions to life problems and the essential ways of using and adapting one's self. Let us trust that such a conception of neuropsychiatry may become a general one in practice and in teaching.

The public will then learn how to use the neuropsychiatrist, and especially how to cooperate and what to expect. That the medical profession appreciates the change is, I believe, adequately shown by the frequency with which not only long mismanaged cases but acute cases are given the benefit of timely neuropsychiatric discussion and study among the junior members of our medical staffs. Let us show the world that even we of the older generation have some of the plasticity and vigor of ever-growing youth.

SUBACUTE EPIDEMIC (LETHARGIC) ENCEPHALITIS*

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In acute epidemic encephalitis the characteristic anatomic changes are perivascular infiltrations, a moderate amount of neuronophagia, a mild degree of glia proliferation and occasionally hemorrhagic foci. These changes are most commonly found in the region of the midbrain and basal ganglions; more rarely other parts of the central nervous system are involved.

But these changes do not exhaust the histopathology of acute epidemic encephalitis. The material studied by the earlier workers was limited to that form of the disease often fatal in its early stage; as material becomes available from cases that have run a more or less protracted course, new findings may be expected.

Economo [1] has reported a case which he called "chronic intermittently progressive lethargic encephalitis." His patient, 45 years of age, insidiously developed atypical lethargic encephalitis, characterized by alternate episodes of delirium and lethargy, dysarthria and the Babinski reflex with no ocular or other palsies or other neurologic signs. For two months the condition remained unchanged, and was then followed by partial improvement. The delirium and lethargy disappeared; the Babinski phenomenon could not be obtained; but dysphagia, paresis of the tongue and choreiform contractions of the extremities appeared. The later course was characterized by alternate improvement and decline in the condition of the patient, death occurring about a year and a half after the onset of the disease.

The histologic changes in the brain stem led Economo to conclude that he was dealing with a chronic epidemic encephalitis, with the addition of an acute process in the terminal stage. The anatomic changes which he considered as incurred during the early, acute period of the disease, were: (*a*) areas of softening with or without accumulation of granular cells; (*b*) bands of dense glia fibers; (*c*) small collections of glia cells, which apparently were at one time concerned with the process of neuronophagia; (*d*) mild degenerative changes in the axis cylinders of long projection tracts. He described recent perivascular hemorrhages, degenerative changes in ganglion cells and perivascular infiltrations, and considered them as evidence of acute recrudescence of the

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1. Economo, C. von: Ein Fall von chronischer schubweise verlaufender Encephalitis Lethargica, München. med. Wchnschr. **46:** (Nov. 14) 1919.

disease. He suggested that this recrudescence was probably due to incomplete elimination of the virus during the early period of the disease, and that a highly suggestive analogy was thus established between chronic progressive muscular atrophy in its relation to acute anterior poliomyelitis, and this chronic form of lethargic encephalitis in its relation to acute epidemic encephalitis. It would appear from the clinical history of Economo's case that an attempt toward healing must have occurred in the course of the disease, but his histologic descriptions fail to show any reparative change in the brain, the lesions described, such as softening, accumulation of granular cells and extravasations, pointing mainly to a lesion of destructive character.

Watson [2] has reported the case of a young woman who suffered for several weeks with insomnia, became extremely anxious about her condition, and fearing that she was going insane, attempted suicide. She was sent to the hospital, where on admission she presented a picture of agitated "melancholia" with suicidal tendencies. For four months her condition remained unchanged. Within the next two months there was improvement in her mental condition, but toward the end of this period she began to complain of pain in the back and left thigh, and was confined to bed. This condition persisted for two months, with progressive development of symptoms, such as inability to speak and paralysis of the right half of the tongue. She fell into a lethargic state, out of which she could easily be aroused to answer questions. A right hemiplegia with anesthesia and analgesia developed eleven days after the onset of paralysis. The deep reflexes were exaggerated and the abdominal reflexes were absent on the paralyzed side. Optic neuritis of moderate intensity developed. She died a week later. The temperature throughout the illness was subnormal; the blood count showed definite leukocytosis.

Necropsy revealed a large area of recent softening with pia adherent in the left cerebral hemisphere. The involved area showed no gross hemorrhages. Microscopically this area showed enormous increase in the vessels, with marked cellular infiltration. The brain stem showed: smaller areas of softening, irregularly distributed throughout the brain substance; marked changes in blood vessels, consisting of infiltration of adventitia with small round cells, polyblasts, epithelioid cells, plasma cells, pseudoplasma cells, thickening of adventitia through proliferation of polyblasts and adventitial cells, swelling and proliferation of intimal endothelium, perivascular hemorrhages, thrombosis of smaller blood vessels, sievelike areas of rarefication about the blood vessels, mild gliosis, but no monster cells. Watson concludes that the changes were more hyperplastic than hemorrhagic in character.

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2. Watson, G. A.: A Case of Encephalitis Lethargica Involving Chiefly the Cerebral Cortex, J. Neurol. & Psychopath. **1**:34 (May) 1920.

Watson demonstrated an important departure from the observations of Economo. We record changes in the central nervous system that indicate a well-defined tendency toward repair, similar in some respects to the changes described by Watson.

Our cases may be grouped clinically with the mild protracted forms and may be termed subacute epidemic encephalitis. Early in the course of the illness the patients showed a well-defined tendency toward recovery, but they eventually passed into an acute and rapidly fatal stage. It was our belief before anatomic studies were made that on the subacute, mild, self-limiting form of the disease, an acute, possibly hemorrhagic, attack was superimposed, causing a fatal issue.

REPORT OF CASES

Case 1.—*History.*—I. G., a man 53 years of age, a tailor, was admitted to the Mount Sinai Hospital, complaining of double vision, weakness of the left upper and both lower extremities, which had caused several falls, headache and vertigo. His family and personal histories were negative, with the exception of an attack of grip four years previously, when he suddenly developed retention of urine for thirty-six hours. He made an apparently uneventful recovery.

The present illness dated back about six months, when he began to complain of occasional headache and vertigo, not associated with any mental or organic neurologic disturbance. There was no apparent change in personality. The attacks of vertigo were never associated with convulsions. Ten days before admission he complained for the first time of double vision, and a week later, while his eyes were being examined, his knees suddenly gave way, and he would have fallen, but for support. The following day his left hand became weak; he was unable to hold light objects; a day later this weakness became more pronounced, and he could not flex the middle finger of the left hand. The weakness of the lower extremities grew rapidly and progressively worse so that on the two days directly preceding his admission he became extremely unsteady. He fell frequently and had to be assisted to rise.

Physical Examination.—The patient was well developed and well nourished. There was paresis of the lower extremities. He had difficulty in gaining and maintaining the sitting posture. Mentally he appeared alert, showed no impairment of judgment or intelligence, and was normal in his reactions to his surroundings, displaying no unusual irritability or depression. Aside from the neurologic findings he showed no signs pointing to a disturbance of the cardiovascular, respiratory, alimentary or genito-urinary system.

Neurological Findings.—The pupils were normal in outline and in reaction to light and in accommodation. In the left eye there was complete paralysis of the external and internal recti and incomplete paralysis of the superior and inferior recti and superior oblique. In the right eye there was incomplete paralysis of the internal rectus. The fundi were normal. There was weakness of the left orbicularis palpebrarum. Motor power was markedly diminished in all extremities, but more on the left; there was no atrophy or fibrillary twitchings; repeated rapid movements of an extremity caused fatigue without direct recovery of strength on resting. There were myasthenic electric reactions. All deep reflexes were equally increased; the abdominal reflexes were diminished, but equal; there was no clonus; there was a tendency toward

a Babinski sign on the right. Coordination tests could not be carried out because of extreme weakness of the extremities. The spinal fluid was under increased pressure, it contained no cells, a faint trace of globulin, a trace of albumin, and the Wassermann test was negative. The blood Wassermann test was negative. The urine contained no albumin or casts. The temperature remained normal except during the terminal stage, when it reached 100.2 F. The blood pressure was: systolic, 120, diastolic, 75.

Course of Illness.—Soon after admission there was slight improvement. There was some increase in the motor power and the excursions of the left eye increased in range. These findings and the general cheerful attitude of the patient made the outlook appear promising. After five weeks in the hospital, a sudden decline in his condition was shown by increased ptosis, further limitation of eye movements, motor weakness, nasal speech, dysphagia with slight regurgitation and by accumulation of mucus in the nose and throat. During the next and last eight days of the patient's life, the symptoms rapidly became worse. We noted complete bilateral external ophthalmoplegia, extreme paresis of all extremities and paresis of the muscles of mastication. To this were added masklike facial expression, nearly complete dysarthria, inability to swallow, denoting a rapidly advancing bulbar paralysis, culminating in death.

Case 2.—*History.*—B. B., a girl 18 years of age, a stenographer, was admitted to the hospital on March 9, 1921. The family history had no bearing on the case. The patient gave a history of measles, diphtheria and scarlet fever in childhood. Four weeks before admission she complained of dimness of vision, diplopia associated with slight vertigo and gradually increasing weakness of all the extremities. There were no convulsions or twitchings; sleep was not disturbed, neither was there somnolence. The weakness of the extremities gradually increased so that the patient became fatigued on the slightest exercise. A week before admission she began to have difficulty in swallowing and mastication. There were no cardiac or respiratory complaints.

Physical Examination.—The patient was fairly well developed and not acutely ill. She was confined to bed because of general weakness. Both eyelids drooped, the left slightly more. The right pupil was a trifle larger; both reacted to light and in accommodation. The fundi were normal. There was slight weakness of the external rectus, weakness of both orbiculares palpebrarum, and flattening of both nasolabial folds. The tongue protruded centrally and showed neither tremor nor atrophy. There was an irregularly intermittent tic-like movement of both eyelids. The soft palate did not move in phonation, but palate reflexes were active. Sensation of the face and of the cornea was normal. Muscles of mastication were normal. The patient raised the arms to a right angle with difficulty and could not maintain this position more than a few seconds. The weakness was greatest at the shoulders and the posterior portion of the deltoids was atrophic. The left side seemed to be more severely affected and the deep reflexes at the wrist and elbow were increased on the left. No tremor or ataxia was noted. The muscles of the neck and of the trunk were weak. The lower extremities presented no atrophy or disturbance of tone, but were paretic. The electric muscle reactions were normal. Knee and ankle reflexes were exaggerated, the left slightly more so. There was no clonus and no definite Babinski sign. The abdominal reflexes were normal. The spinal fluid was clear, under normal pressure, and contained no cells; the Wassermann test was negative.

Course of Illness.—The patient's condition remained almost stationary for some time. There were occasional periods of more difficulty in deglutition and phonation, choreiform movements in the arms, and nystagmoid movements. However, at the end of her stay in the hospital she began to show signs of improvement, as she was able to walk about. She was discharged April 23, 1921, as improved, with the neurologic findings but slightly changed. There was no rise of temperature during this period. She remained at home, her condition unchanged until ten days before her second admission, Oct. 9, 1921,

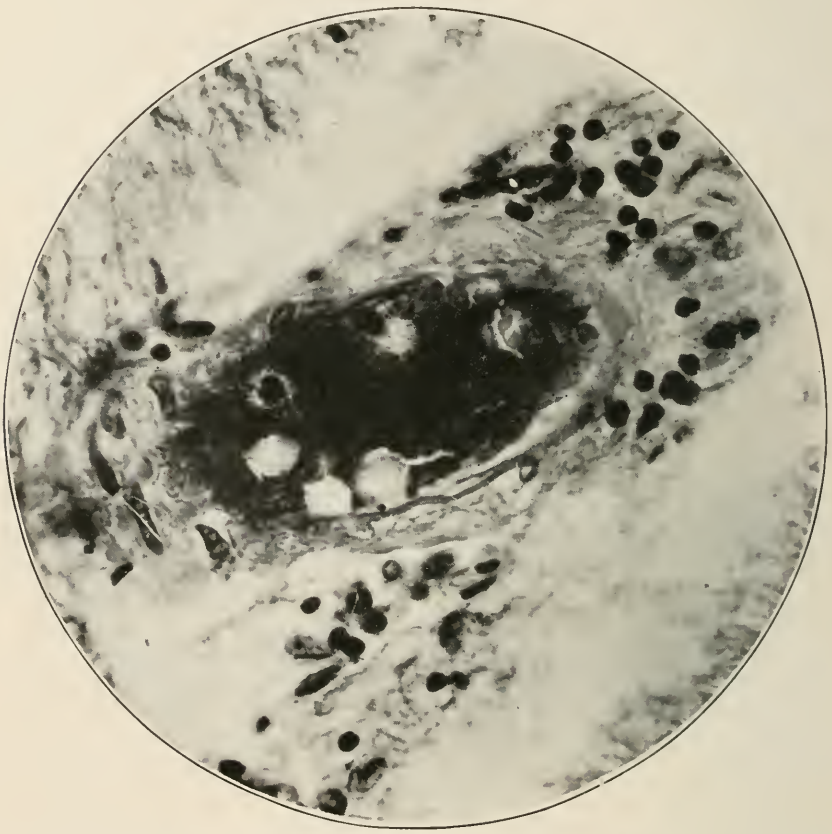

Fig. 1.—Section of the optic thalamus (midbrain). Medium sized vessel showing typical adventitial infiltration.

when she began to complain of headache; pain in the right side of the chest increased on inspiration and cough. She had increasing difficulty in bringing up mucus which accumulated in the throat and tended to choke her. Six days later she became unable to swallow food and had great difficulty in talking. Respiration became labored and difficult. There were no chills, fever or vomiting.

On readmission, the patient appeared acutely ill, breathing with difficulty, with the accessory muscles brought into play. Double ptosis was noted, also clonic-like elevations of the eyebrows. The pupils were widely dilated and fixed, the fundi normal; there was no paralysis of the extrinsic ocular muscles

or nystagmus. There was no sensory disturbance. The deep flexes were normal. The abdominal reflexes could not be elicited. There was a masklike expression of the face. The patient could not protrude her tongue, nor move it from side to side; it was atrophied. She could not swallow; fluids were regurgitated. The palatal reflexes were lost. There was marked dysarthria which gradually led to complete loss of speech. The temperature remained normal. Her condition declined rapidly, and after two days in the hospital she died from respiratory paralysis.

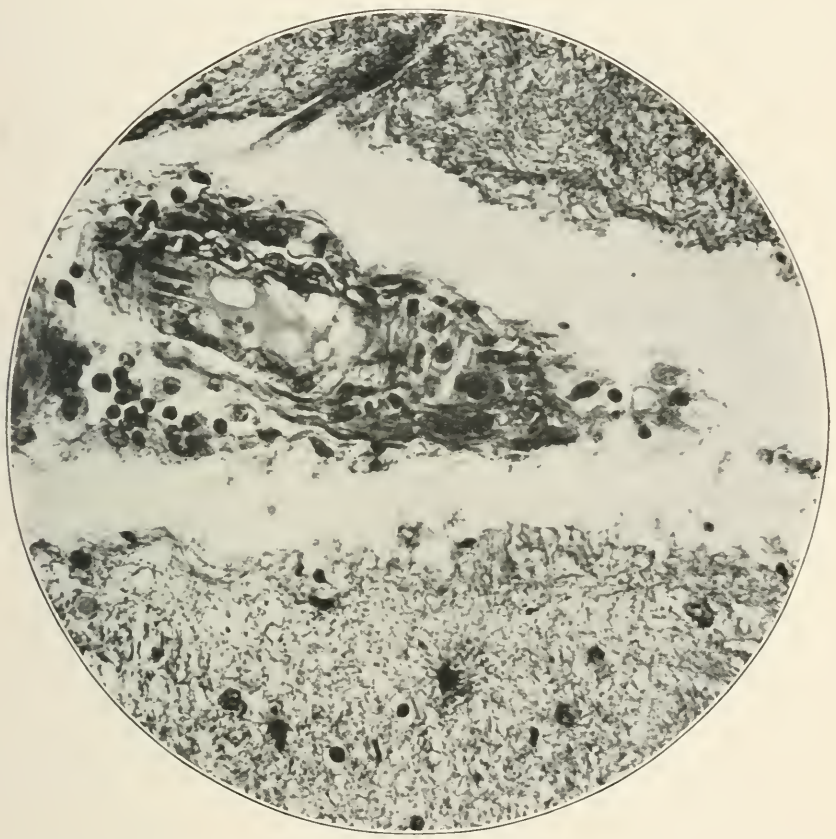

Fig. 2.—Gray substance, lateral to the aqueduct of Sylvius; medium sized vessel, showing early adventitial changes, such as formations of fibroblasts. Various elements of perivascular infiltration are still in evidence. Small lymphocytes, glial cells, granular cells and fibroblasts are among them.

Case 3.—*History.*—M. P., a woman 22, married, developed pain in the lower part of the abdomen and slight vaginal bleeding five months previous to admission. Ectopic gestation was suspected and a laparotomy performed. A bicornate uterus and evidence of early pregnancy in one horn were disclosed. Abortion followed. After discharge from the hospital, the patient's condition remained below par. She complained of frequent headaches and blurred vision for four months preceding the onset of acute symptoms. Two weeks before

admission she suffered from coryza and cough but remained up and about for a few days, when she had a slight chill, followed by a rise of temperature. She was put to bed, and soon showed improvement; two days later she developed high temperature, cough, severe headache, and signs of pneumonia in the left lung. Attacks of vomiting followed, accompanied by delirium and retention of urine. She became somnolent the day before admission.

Physical Examination.—The patient when admitted was comatose and restless. There were no ocular palsies; the pupils were dilated, the left more than

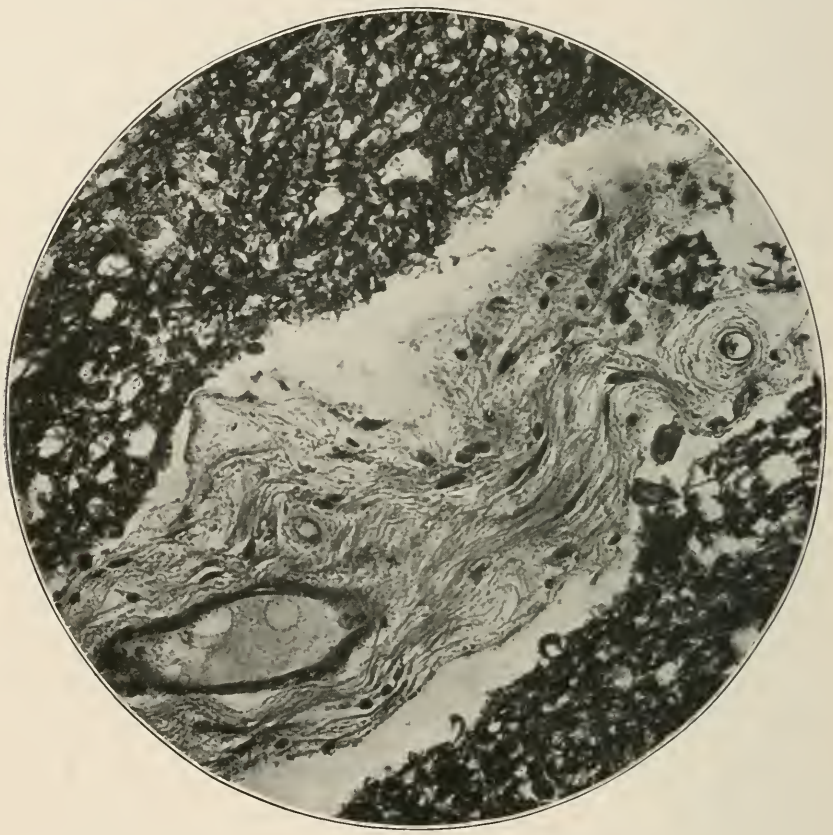

Fig. 3.—Vessel showing the marked increase in adventitia, giving rise to a fibrous scar.

the right; neither reacted to light. The eyes rolled from side to side. There was no asymmetry of the face or rigidity of the neck. The heart was normal; the lungs showed pneumonic signs in both lower lobes. The abdomen was normal. The extremities showed no paralysis and no Kernig or Brudzinski sign, but a slight exhaustible ankle clonus, and a bilateral Babinski sign. The blood picture was negative. The urine was normal, except for a faint trace of albumin. The temperature, from the day of admission to the day of death, rose gradually from 99 to 104.6 F. The spinal fluid was clear, under normal pressure, with 80 lymphocytes per cubic millimeter.

Course of Illness.—On the day after admission the patient remained comatose; there was no definite ocular palsy but a limitation of eye movements to the extreme right and left. The left pupil was larger than the right, and did not respond to light; the right responded only slightly. The fundi were normal. Ptosis was noted, also slight flattening of the lower part of the left side of the face, but no paralysis of the tongue or palate and no rigidity of the neck. The knee and Achilles jerks were not very active. A bilateral Kernig sign and occasional myoclonic movement were noted. On the following day the coma persisted, Cheyne-Stokes respiration developed and death occurred from respiratory paralysis.

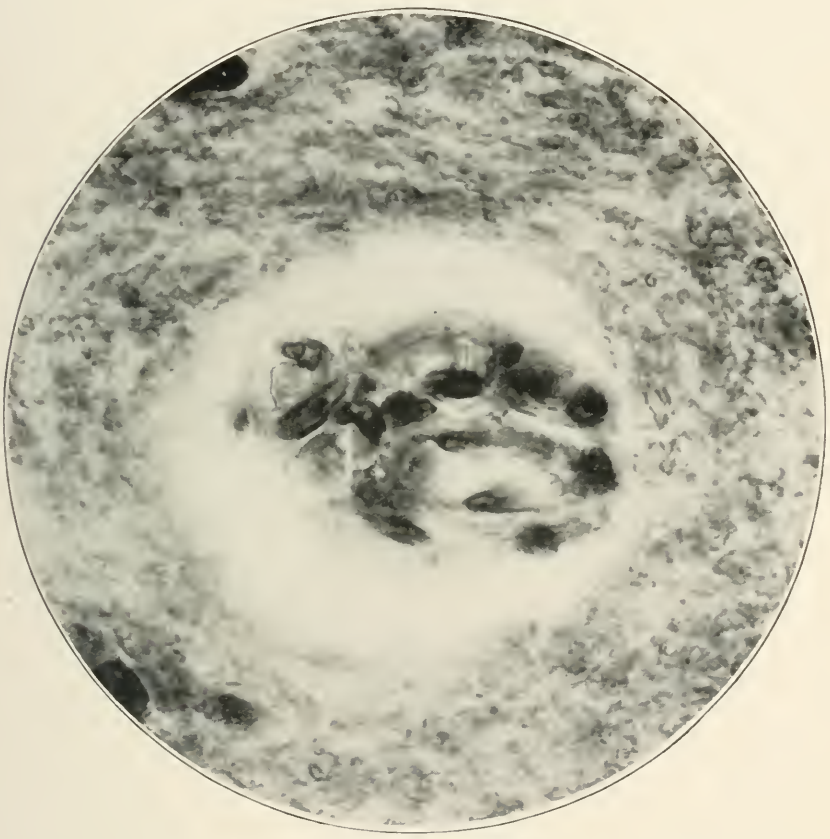

Fig. 4.—Small capillaries; type of vessel found most frequently but not exclusively in the midbrain. About a definitely thickened capillary there is a group of apparently newly formed, patent blood vessels.

Case 4.—*History.*—S. B., a woman 33 years of age, married, was admitted to the hospital on Sept. 10, 1921, complaining of frequent vomiting for over six weeks and cough of one week's duration. The family and previous medical histories were unimportant. Four years before she had been treated for three weeks at the Manhattan State Hospital for neurosis, and a year before had had pneumonia with uneventful recovery.

The repeated vomiting made her think that she was pregnant. The vomitus was occasionally greenish, but never bloody. After two weeks a curettage was performed with no relief. She was able to retain only small amounts of food. There was neither jaundice nor heartburn. A week before admission a persistent cough began with neither hemoptysis nor night sweats. She began to have occasional frontal headaches. It made her dizzy to rise.

Physical Examination.—She was well developed, well nourished and apparently not acutely ill. The chest and cardiovascular system were normal.

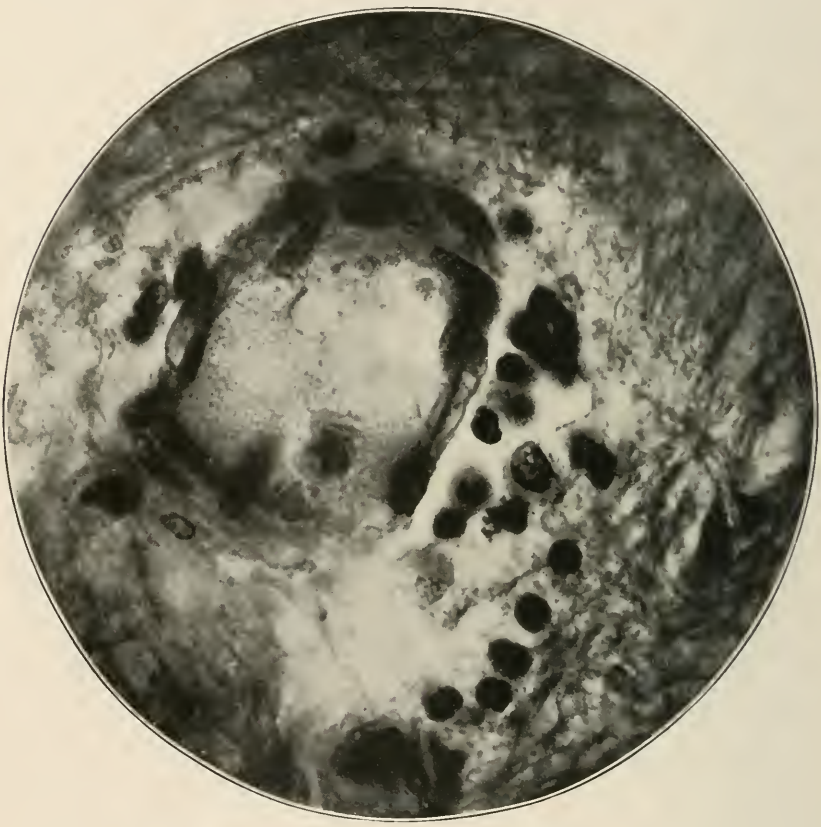

Fig. 5.—Vessel showing reduplication of the endothelial lining. Very close to the vessel there is a collection of glial elements and a few gitter cells.

The abdomen showed practically no abnormal findings. The extremities were normal. The abdominal reflexes were absent, the deep reflexes equal and hyperactive. There was no Babinski sign and no clonus. There were leukorrheal discharge, a lacerated cervix and pelvic exudate on the right. The blood count was normal, and the blood pressure was: systolic, 120; diastolic, 80. The Ewald test showed absence of free hydrochloric acid.

Course of Illness.—The patient was sent home, improved, and readmitted five days later, October 11. Persistent vomiting had recurred with severe

continuous sticking pains in both thighs. Weakness in both lower extremities was so marked that she could not stand without assistance.

Physical Examination on Readmission.—Examination revealed: paresis of both lower extremities, absence of knee and ankle reflexes, marked hyperesthesia over both legs, but no loss of sensation.

Course of Illness.—Three days after readmission, she had a general convulsion; there was no rise of temperature. The blood count and urine were normal. The spinal fluid was clear—four lymphocytes per cubic millimeter.

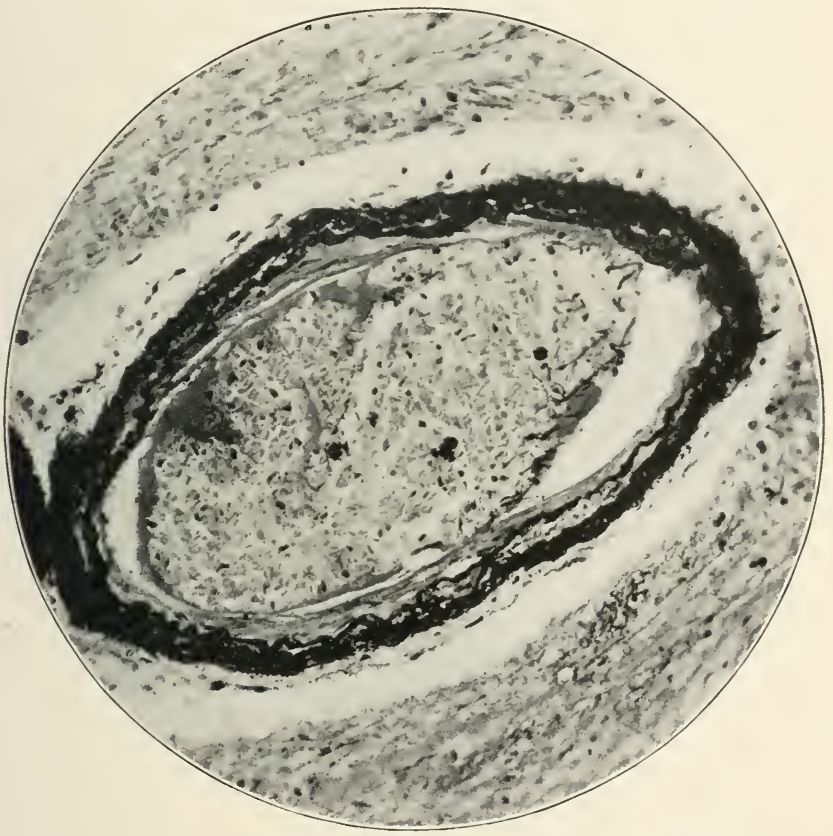

Fig. 6.—Lenticular nucleus; medium sized vessel showing the accumulation of a lipoid substance in its adventitia and media.

On October 18 paresis of both external recti was noted, nystagmus similar to that obtained on stimulation of the semicircular canal and marked engorgement of the vessels in both disks. Blood count: 18,000 white cells, polymorphonuclears 80 per cent. On October 19 paresis of the external recti became more marked, chiefly on the right. The right palpebral fissure had become wider. Hyperesthesia in both lower extremities persisted. The patient complained of severe pains. Knee and ankle reflexes were absent. Vomiting was less intense. Beginning choked disk was noticed. The muscles of the legs were

tender. There was no Babinski sign and no atrophy. Hearing was normal. From this day until October 24 there was slight improvement. The vomiting had stopped. Paresis of the eye muscles had become less. On this date the nystagmus increased. The patient choked on taking fluids; she had difficulty in clearing her throat of mucus. There was paresis of the palate; speech was nasal. Tenderness in the legs had increased. The pulse was very rapid. Death occurred on October 25 from respiratory paralysis. The temperature rose to 100.4 F. a few days before death. At the time of death it was 102.2 F. The urine showed a faint trace of albumin.

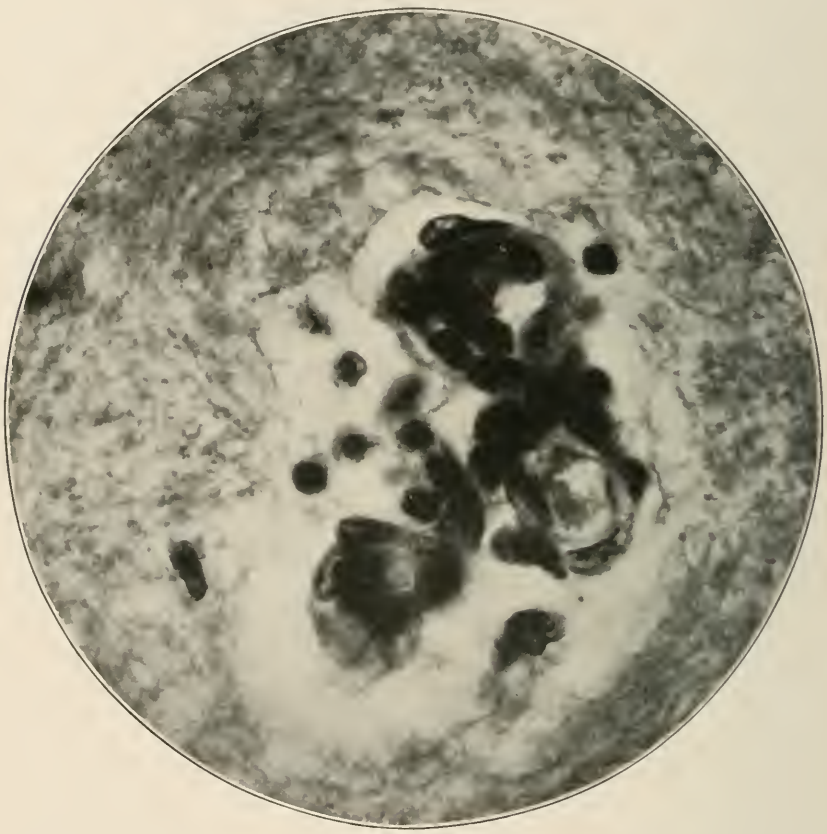

Fig. 7.—Three small capillaries showing swollen endothelial lining; adventitia thickened and surrounded by a small number of gliogenous, granular cells.

COMMENT

Subacute encephalitis has certain common clinical characteristics. There are two groups. In one the onset is acute with the clinical picture of that stage. In the other, the onset is insidious and the nature of the infection often is not recognized. In these cases there is a history of headache, malaise, dizziness and weakness; occasionally blurred vision, rarely transient diplopia; frequently a history of catarrhal inflammation

of the upper respiratory tract. This condition may last for weeks without being regarded as of serious moment. In both groups there follows a stationary period or one of improvement for a variable length of time. In the last stage there is rapid development of serious symptoms referable to extensive involvement of the midbrain and the medulla, with rise of temperature, generally a rapid pulse and fatal outcome from respiratory paralysis.

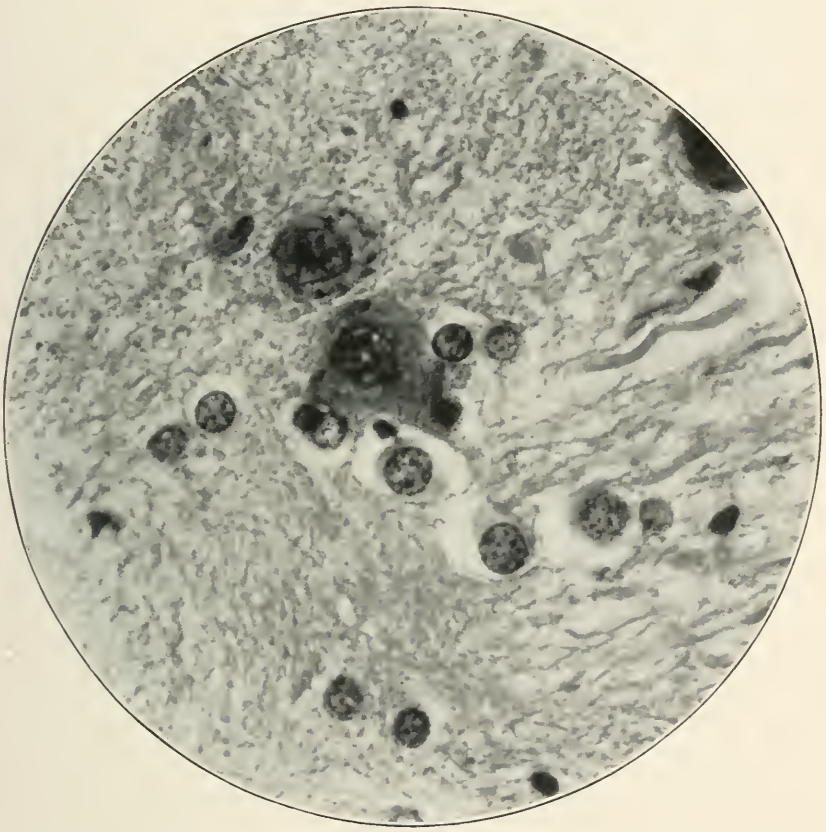

Fig. 8.—Area of glial-proliferation. Glial cells are seen here with mitotic figures.

PATHOLOGIC ANATOMY

We present herewith results of examination of the brain of each of the cases reported above. Particular attention was paid to the midbrain, basal ganglions, the region of the dentate nucleus in the cerebellum, and the medulla oblongata. The spinal cords were not available and in only one case were the thoracic and abdominal viscera examined. Formaldehyde solution, Weigert's glia mordant, and Zenker's fluid were employed for fixation. Celloidin paraffin and frozen sections

were prepared. Delafield and Heidenhain's hematoxylin, Bielschowsky's silver stain, van Gieson's resorcin fuchsin, Spielmeyer's myelin stain and Herxheimer's fat stain were used.

Gross Anatomy.—The dura in all cases was normal. The pia-arachnoid was smooth, glistening, somewhat edematous, but extremely congested. The congestion imparted to the surface of the brain a deep purple hue, most marked on the ventral surface of the pons and medulla. There were no subpial or sub-

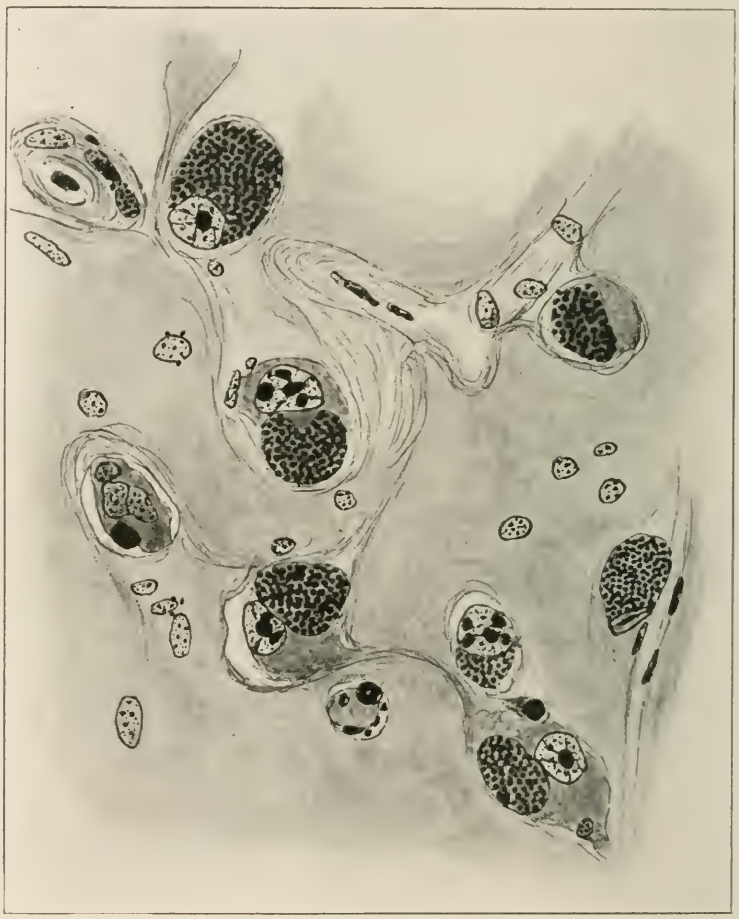

Fig. 9.—Ganglion cells from the floor of the aqueduct of Sylvius. Note the enormous amount of fat displacing the nucleus, and giving it the appearance of a giant fat cell (Camera Lucida drawing).

arachnoid hemorrhages. In Case 3 there were two small areas of thickening in the pia-arachnoid, one at the occipital pole, the other on the ventral surface of the left cerebral peduncle. The vessels at the base showed no atheroma and their small branches were patent and unchanged. No gross areas of softening were found. Small areas of reduced consistency and darkened color were

found surrounding medium sized vessels, believed to be a beginning process of softening. Engorgement of blood vessels throughout the brain was striking, most prominent in the medulla and pons, the region of the dentate nucleus and around the aqueduct of Sylvius.

Microscopic Anatomy.—A limited number of small and medium sized blood vessels enveloped by fairly thick mantles of lymphocytic infiltration were found (Fig. 1). This infiltration was fairly definitely limited to the Virchow-Robin space (true adventitial infiltration), a condition invariably found in acute epidemic encephalitis.

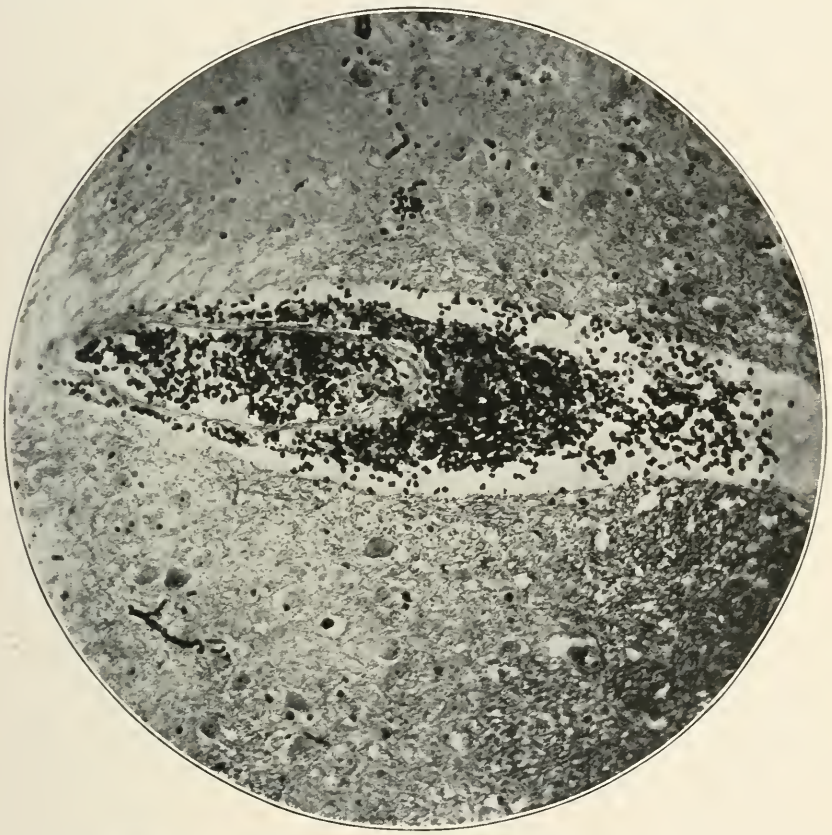

Fig. 10.—Midbrain, cerebral peduncle. Perivascular hemorrhage; also found in the midbrain and basal ganglions, but not to the same extent as in the medulla. Note the poor staining quality of the vessel coat.

The dominant type of cell in this infiltration was the small lymphocyte, but large mononuclear leukocytes, so-called endothelial leukocytes, polyblasts and a few granular cells, were also present. The granular cells were identified in frozen sections by fat stains. Fat granules, however, were not limited to these granular cells, but were also present in the endothelial cells of the blood vessels, suggesting a phagocytic function of these cells. Vessels showing this adventitial infiltration appeared to be limited to certain zones, such as those about

the aqueduct of Sylvius, the inferior olive, and the dentate nucleus. It is rather significant that they should be found in limited numbers and be restricted to the parts that were affected early, if not first, by the disease.

A widespread and more obvious alteration of the structure of the mesodermal elements was found in the productive changes in the adventitial coats of the blood vessels. Throughout the brain stem, vessels, though variable in number and in intensity of reaction, presented a striking thickening of the adventitial coat. Apparently this thickening was brought about by proliferative changes in the adventitia; polyblasts and recently formed fibroblasts were found in abundance and apparently had led to the organization of fibrous tissue in the wall of the vessel. Various stages in the development of fibroblasts and resultant mature fibrous tissue were observed. There were vessels in which polyblasts were most numerous, with only a few fibroblasts (Fig. 2); also vessels in which young fibroblasts predominated; and, finally, there were vessels in which the polyblasts and fibroblasts were completely replaced by mature connective tissue (Fig. 3). These changes almost completely overshadowed the infiltrative reactions and should be regarded as the sequel of the latter.

The formation of new blood vessels is another feature of no less importance. Groups of small, recently formed, already patent capillaries existed in all parts of the brain stem (Fig. 4). Rod cells (Stäbchen) were present in large numbers all through the brain, but especially in the regions with many new capillaries. In several instances such cells were found branching out from adventitia (Fig. 2). In medium sized vessels the endothelial cells frequently were swollen and increased in number (Fig. 5). In Case 1, medium sized vessels in the region of the dentate nucleus and in the lenticular nucleus showed in the intima and adventitia accumulations of lipoid substance resembling arteriosclerotic plaques (Fig. 6). In Case 3, in which arteriosclerosis is ruled out by the age of the patient, the same changes in the same region were present. Furthermore, special stains failed to show any change in the elastic membrane.

The glia changes were mainly mild forms of proliferation and mobilization of glial elements about blood vessels and in the subependymal layer of the floor of the fourth ventricle and of the aqueduct of Sylvius. These changes were seen near small arterioles and capillaries (Fig. 7). There were small accumulations of glia cells in groups of five to eight about ganglion cells undergoing neuronophagia, but this grouping frequently bore no relationship to degenerating ganglion cells. Economo's view that they represent landmarks of ganglion cells undergoing phagocytosis is probably correct. These changes were limited to the brain stem and basal ganglions.

"Gitter" cells, probably glial in origin, were found in fairly large numbers in proximity to medium sized blood vessels, in areas which we had noted in the macroscopic examination as being probably areas of beginning softening. The myelin sheaths of nerve fibers in these areas were swollen, and there was some fragmentation. There was also evidence of active glial proliferation. Numerous mitotic figures were present (Fig. 8). The form of glia cells developed was of the ameboid type; no monster fiber forming glia cells were found.

Evidence of an extensive degenerative process in the ganglion cells was shown in chromatolysis, displacement of the nucleus, neuronophagia and abnormal quantities of fat-staining bodies. The last were often in such masses as to displace the nucleus and produce the appearance of a giant fat cell (Fig. 9). These changes were most marked in the basal ganglions, the midbrain and

medulla, and were found to a lesser degree in the cerebral cortex. This process led to accumulation of large quantities of fat in the adventitial spaces of the neighboring blood vessels.

Perivascular and extravascular hemorrhages (Fig. 10) were numerous in the medulla, pons and midbrain. That these hemorrhages were not agonal is shown by the presence of blood pigment in the adventitial spaces in parts of the brain remote from the seat of the extravasation of blood. It is also noteworthy in its bearing on the clinical course of the disease that the hemorrhages were most extensive and most frequent in the medulla oblongata. Another noteworthy point is that wherever hemorrhages occurred the walls of the vessels showed no thickening or perivascular infiltration. Apparently these vessels were spared in the first phases of the disease, and during its exacerbation the adventitia was damaged to such an extent that it was incapable of proliferative changes and could not withstand the pressure of the vascular engorgement. Such changes were rarely found in other parts of the brain.

SUMMARY

The lesions of the small vessels form an uncommon and most prominent feature in these cases. With the findings in six cases of the acute form of lethargic encephalitis, they lead us to believe that the primary attack of the virus is on the small and medium sized vessels, and that these are affected to a degree proportionate to the virulence of the virus.

It appears to us that the production of elements of infiltration, destined perhaps to repair damage occurring in the immediate vicinity of the vessel, is an important function of the adventitia. Thus, when a virus or even a mineral poison (Hassin[3]) reaches the adventitia, it reacts by formation of adventitial elements, provided that the vessel wall is not damaged to the extent of losing its potency for further proliferation. Should the virus or toxin be so destructive to the vessel wall as to incapacitate it for cell proliferation and weaken it so that it cannot withstand the pressure of vascular engorgement, perivascular hemorrhages would occur in large numbers, as happens in the acute, virulent type of the disease. When the virus reaches the vessel in a small amount or in attenuated form, changes pointing to subacute lesions follow, as was shown in our cases.

Such interpretation of the histologic changes leads us to suggest the following division of epidemic encephalitis:

1. An acute infiltrative form, the dominant feature being perivascular infiltration.

2. An acute hemorrhagic form, in which the virulence of the disease is indicated by numerous extensive hemorrhages.

3. Hassin, G. B.: Histopathologic Findings in a Case of Superior and Inferior Poliencephalitis with Remarks on the Cerebrospinal Fluid, Arch. Neurol. & Psychiat. **5**:552 (May) 1921.

3. A subacute productive form, as described in this paper.

The acute infiltrative form is the early state of any acute form of epidemic encephalitis, which may pass into the fatal hemorrhagic type or the protracted, mild productive form.

The anatomic changes in these cases afford sufficient basis for the hypothesis that the sequellae which frequently follow an attack of acute epidemic encephalitis are due mainly to vascular changes with consequent gliosis and degenerative changes in the parenchyma. Thus, it is not improbable that in various post-encephalitic conditions of a progressive character (E. J. Parkinson type), there may be a more or less localized lesion, characterized by progressive changes in the adventitia and intima of the cerebral vessels, accompanied by gliosis and secondary parenchymal degeneration, directly responsible for the clinical manifestations.

THE CRANIAL HYPEROSTOSES PRODUCED BY MENINGEAL ENDOTHELIOMAS*

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This communication will be chiefly devoted to but one of the many interesting features of the endotheliomas, namely, the hyperplasia of the adjacent bone. That the relationship between the meningeal tumor and the hyperostosis is not generally understood was brought out at a recent meeting of the Society of Neurological Surgeons held in Philadelphia. At that time Professor Spiller exhibited many interesting specimens from his extensive collection of brain tumors. In showing some examples of endotheliomas he stated that these tumors were sometimes associated with an overlying cranial hyperostosis which he considered to be the cause of the subjacent growth. This opinion was so contrary to that which has long been held and taught in the writer's clinic, that this occasion is taken to present some data bearing on this particular aspect of these lesions.

It is quite probable that the true character of the bony tumor has often been overlooked because the necessity of decalcification has deterred observers from making a careful histologic study of the adjacent portion of the skull as well as of the tumor proper. This, I must admit, applies to some of the early examples of hyperostosis cranei accompanying endotheliomas in my Johns Hopkins series. My attention was first drawn to the true nature of the bony tumor by an experience which may be briefly stated.

The patient came under my care in February, 1910, giving the following history: Twelve years before he had received a sharp blow on the vertex of the head approximately at the rolandic point. This point remained somewhat tender, and in the course of time a local prominence of the skull, attributed to an epicranial exostosis, became apparent. Occasional attacks of focal epilepsy involving the left foot and leg subsequently occurred, and under the assumption that these attacks were produced by cortical irritation, a surgeon in 1905 trephined and removed the small area of thickened bone. The underlying dura which was exposed was thought to be normal, and the membrane was not opened. The thickened disk of bone which had been removed showed tumor on microscopic examination. It was classified by a pathologist as a primary psammosarcoma of the diploe.

For the next five years the patient's jacksonian attacks continued unabated, with increasing disability and spasticity of the affected foot. There was no local recurrence of the tumor at the site of the bone defect, and in the absence

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of the usual manifestations of pressure (headache, choked disk, etc.) an intracranial tumor was not suspected by any of the several neurologists and surgeons who were subsequently consulted.

By the time of his admission to the hospital in 1910 the left arm had begun to be involved in the spasticity and an osteoplastic exploration was decided on. This disclosed a large potato-like psammo-endothelioma which had greatly deformed the right hemisphere. The tumor, which weighed 198 gm., was successfully enucleated. Its meningeal attachment was situated alongside the sinus sagittalis, directly under the small bone defect made at the original operation.

Though the dural attachment of the tumor at the sinus was not removed and was unquestionably infiltrated by tumor, there has been no evidence of continued growth though twelve years have elapsed.

Since this experience, areas of cranial thickening, whether disclosed by palpation or by roentgen ray, have always been looked on with the suspicion that they might overlie a meningeal endothelioma. It, however, was not appreciated for some time that these tumors in their intradural aspects might be of two distinct types: (1) *massive tumors* with a relatively small area of meningeal attachment, and (2) *tumors en plaque* which are but slightly elevated though they may involve a considerable area of dura. Though the former may in a certain percentage of the cases be accompanied by an overlying hyperostosis, the bony thickening is apt to be much more pronounced in the case of the flat tumors. As a matter of fact, were it not for the hyperostosis and its consequences, many of these meningeal tumors would pass unrecognized, for they may give no intracranial symptoms of tumor either general or localizing. Indeed, the massive, potato-like endotheliomas may sometimes attain very large dimensions before general pressure symptoms, such as choked disk or headaches, are manifested. This was true of the patient with the 198-gram tumor whose case has just been mentioned.

The endotheliomas have their definite seats of predilection, a full discussion of which must await a subsequent and more extensive report. It will suffice, for the present, to say that the tumors which are parasagittal in origin, and those which arise from the temporofrontal meninges adjacent to the sylvian cleft seem to be accompanied by a hyperostosis cranei more often than those in other situations.

For purposes of this report, a single comparatively recent example of one of these temporal lesions has been chosen. The region is one in which endotheliomas frequently arise, and when they are associated with marked hyperostosis, as in this particular case, exophthalmos is almost invariably produced.

REPORT OF A CASE

Left temporosphenoidal endothelioma en plaque, with invasion and thickening of overlying bone and extracranial involvement of temporal muscle.

April 18, 1921.—Admission of Mrs. Mary D., aged 39, referred by Dr. Byrnes of Springfield, Mass., with a bony tumor of the orbit, producing exophthalmos.

Past History.—No apparent bearing on present trouble. Excellent general health. No recorded trauma. Occasional headaches since childhood: none for past year. Married at 27 years; six pregnancies with only two children surviving. Four of them were stillborn at seven months: attributed to renal complications. Last pregnancy was terminated June, 1920, because of eclampsia and convulsions: placenta praevia.

Present Complaint.—For possibly ten years the left eye has been somewhat more prominent than the other. No significance was attached to this, even when in September of 1919 the eyelids on this side became somewhat edematous. As she had some albuminuria and her ankles were apt to be swollen, the puffiness of the eyelids, though unilateral and persistent, was discounted. In Febru-

Fig. 1.—Appearance on admission, showing exophthalmos. The bony protrusion is evident, though partly concealed by her hair.

ary, 1920, she first observed a swelling in the anterior part of the left temporal fossa. It was painless, hard, not sensitive to pressure. Her physician at the time evidently regarded the condition as syphilitic and prescribed the usual drugs, but she did not persist in their use.

On the termination of her pregnancy in June she first noticed some slight loss of visual acuity in the left eye.

For the next six months there was a slow but steady enlargement of the aforementioned bony tumor of the temporal fossa, accompanied by an increasing prominence of the eye and edema of the lids. For the three months before admission the symptoms had developed more rapidly.

Physical Examination.—This was essentially negative except for the obvious local lesion, namely, a smooth, hard tumor, slightly tender on pressure, filling out the left temporal fossa and obliterating such bony landmarks as the external

angular process and zygoma. Associated with the growth was a moderate unilateral exophthalmos with edema of the eyelids (Fig. 1). The exophthalmos was without bruit or pulsation, though over the bony tumor the extracranial vessels were noticeably dilated. The patient was markedly myopic and a slight hyperemia, particularly of the left optic disk, was present. The visual fields were normal. There was slight weakness of the left abducens.

The situation of the growth was obscurely shown in a series of stereoscopic roentgen-ray plates. These (Fig. 2) indicated an area of increased density in the region of the squamous wing of the temporal bone, the sphenoid, and left side of the orbit.

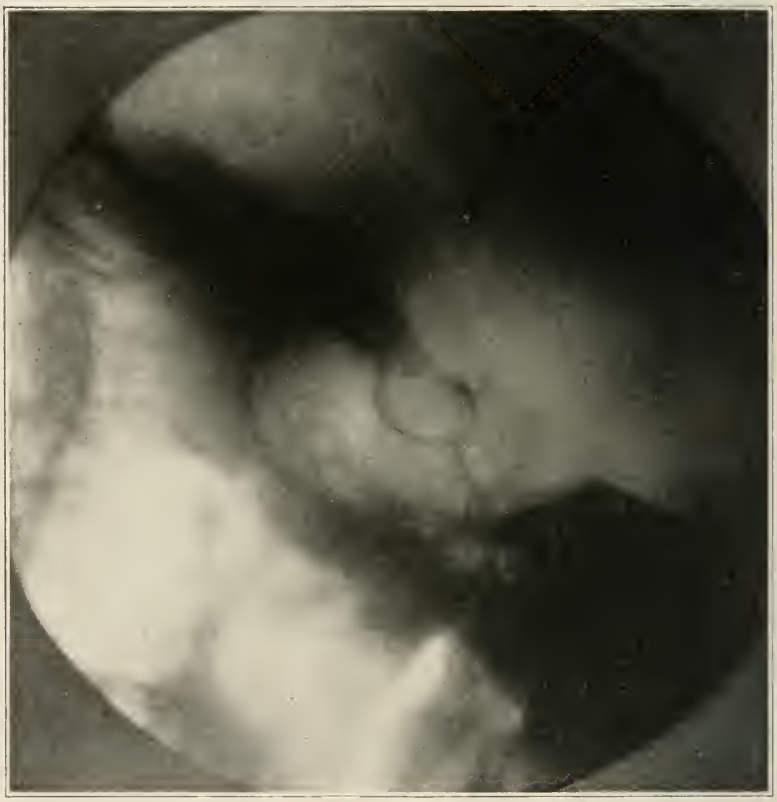


Fig. 2.—Lateral roentgenogram of sellar region showing area of increased density.

The neurologic examination was negative in all respects. The Wassermann reaction was negative. Urine showed a trace of albumin, but functional renal tests revealed no such degree of dysfunction as to contraindicate operation.

May 4, 1921: Operation. Extirpation of hyperostosis together with underlying dura and its subjacent flat tumor.—A curvilinear incision (Fig. 4) was made with its base between the external angular process and the tragus. On reflecting the scalp and temporal muscle so as to expose the bony lesion, it was found that the lower layer of muscle fibers were infiltrated by tumor over the most prominent part of the bony protuberance. The skull at this point was

considerably roughened, and the muscle was adherent to it. This small area of obvious involvement of extracranial tissues was excised and an immediate frozen section showed endothelioma.

The area of hyperostosis, which was difficult of access, was then attacked by making a circle of perforations at its periphery. These perforations, made by using a succession of motor-driven burrs of graduated size, were carried down through the dense bone to the dura. It would probably have been easier to have "burred" away the entire hyperostosis in this fashion, but it was desired to preserve an intact portion of the thickened bone for subsequent study.

Fig. 3.—Print of postoperative radiogram showing extent of bony removal and situation of clips outlining area of excised dura.

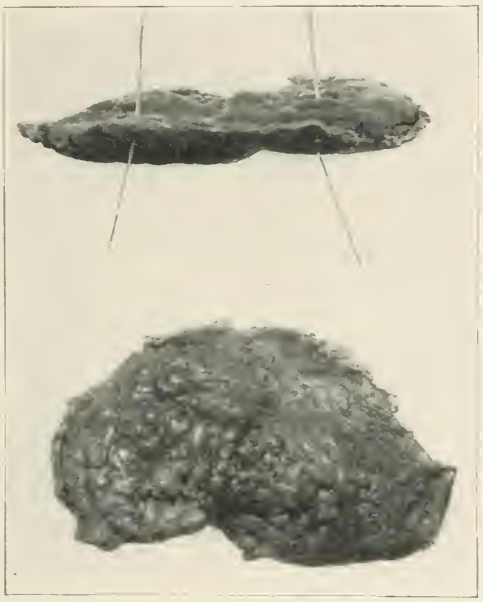
The chief difficulty lay in the complete removal of the hyperostosis at its anterior and lower periphery. In this situation it was necessary to carry the perforations obliquely through solid bone which proved to be 3 to 4 cm. in thickness, before the orbital cavity was reached. The remaining central and posterior mass of bone (Figs. 9-11) was then broken out in a single piece. With the view thus given it was possible, with the further use of burrs and rongeurs, to enlarge the opening until all the thickened bone so far as could be told, was removed. In this procedure the entire outer side of the orbital contents, which had evidently been considerably encroached on by the growth,

Fig. 4.—Twelve days after operation, to show the field and situation of the curved incision, its limits indicated by crosses.

Fig. 5.—Condition ten months after operation (for comparison with Fig. 1).

was fully exposed. Removal of the sphenoid wing was carried inward to the region of the left anterior clinoids in the depths of the sylvian groove.

At the bottom of the bone defect thus made, roughened dura was exposed covering practically the entire tip of the temporal lobe. There was no certainty as to what underlay this thickened dura, whether an endothelioma of the plaque variety or a rounded tumor. The membrane was opened at the upper margin of the bone defect where it was evidently normal in appearance and the edge of a flat endothelioma was seen. The incision in the membrane was then carried around between normal dura and the edge of the tumor, giving the latter a free margin of a few millimeters.



Figs. 6 and 7.—Photographs (natural size though considerably shrunken by fixation) of major portion of tumor; seen on edge in upper figure and from the inner dural surface in the lower figure.

It is quite possible that at the very depth of the sylvian cleft where the field became somewhat inaccessible, some portion of the involved bone and dura may have been left behind.

The dura was so vascular that silver clips were placed on its margins for purposes of hemostosis as the incision to outline the growth was being made. The situation and extent of the flat tumor is consequently well shown in the roentgen-ray picture subsequently taken (Fig. 3).

The operation, though a prolonged one, was well borne. Convalescence was uneventful (Fig. 4), and at the time of her discharge the exophthalmos and edema of the orbit had largely disappeared.

At the present writing, ten months later, she remains free from symptoms; there is no indication of any tumor growth from the possible remaining fragment; the exophthalmos has almost completely subsided (Fig. 5).

Pathologic Report.—The three chief fragments of tissue saved for study consisted of: (1) the primary tumor adherent to the under surface of the dura; (2) a portion of the thickened overlying skull; (3) a fragment of the temporal muscle.

1. *The tumor proper.* There are two fragments. The larger (Figs. 6 and 7) shows a flat growth with nodular surface, springing from the under side of a semicircular piece of dura measuring 5 by 3.5 cm. in diameter. A margin of free dura surrounds the growth except at one portion of the specimen where the tumor has been cut into. At its thickest place the growth is only about 4 mm. in thickness. On section it shows a typical endothelioma which is plastered on the inner surface of the membrane, the cell masses being arranged in fibrous alveoli (Fig. 8).

2. *The bone fragment.* (Figs. 9-11.) This is a wedge-shaped piece of bone measuring 5 by 3 cm. in its surface diameters, and nearly 3 cm. in its greatest thickness. The outer surface is roughened and irregularly grooved, and some fragments of muscle adhere to it. The inner surface, likewise, is rough and grooved, with fragments of firmly adherent dura. The third surface shows a cup of smooth eburnated bone evidently made by a large burr. A histologic study of the bone showed that its canals are everywhere invaded by tumor (Fig. 12).

3. *The fragments of muscle* removed early in the operation show on section (Fig. 13) invasion with tumor cells arranged in characteristic endothelial alveoli.

Dr. Victor Jacobson's pathologic note regarding the hyperostosis reads as follows:

"The bone is of cancellous type with the marrow spaces containing large groups of spindle cells arranged in the whorl-manner of dural endothelioma and similar to the tumor in the muscle described. The bone is dense and arranged in trabeculae. The resulting spaces contain the tumor cells which are surrounded by a thin compact layer of fibroblasts which in turn are separated from the bony trabeculae by loose connective tissue in which are a few thin-walled blood vessels. There is no apparent intravascular growth of tumor but the tumor cells have gained access to the marrow spaces and grown in them, often compressing the marrow vessels but not penetrating them. In one marrow space active hematopoiesis is in progress."

INCIDENCE

At the present writing (Jan. 1, 1922), in a series of considerably over one thousand presumptive cases of tumor, the lesion has been verified in 748 instances.[1] Without going into the detail, unnecessary for our present purposes, of distinguishing between the various subvarieties of gliomas, adenomas and so on, these cases may be tabulated

1. The significance of the term "verified" and the way in which the brain tumor cases in the clinic are classified as *verified, non-verified and tumor-suspects* has been made clear in recent papers by Percival Bailey (Concerning the Clinical Classification of Intracranial Tumors, Arch. Neurol. & Psychiat. **5**:418-437 [April] 1921) and by C. E. Locke (A Review of a Year's Series of Intracranial Tumors, Arch. Surg. **3**:560-581 [Nov.] 1921).

as follows, in order to indicate the ratio of the endotheliomas to other main tumor groups:

	Number of Cases	Percentage
Glioma	312	41.7
Adenoma (chiefly pituitary)	174	23.2
Endothelioma	80	10.7
Neurinoma (acoustic)	60	8.0
Congenital tumors	40	5.3
(a) Suprasellar tumors (chiefly of pharyngeal pouch origin 34		
(b) Cholesteatomas and dermoids 6		
Granuloma	34	4.5
(a) Gumma 13		
(b) Tubercle 21		
Papilloma (choroid plexus)	8	1.1
Angioma	6	0.8
Metastatic and invasive	24	3.2
Unclassified	10	1.4
	748	

Thus, of the brain tumors encountered and histologically verified in this personal series, the endotheliomas represent 10.7 per cent. and occur in the ratio of one to four of the gliomas.[2]

HYPEROSTOSIS CRANEI

Of the eighty endotheliomas, twenty were accompanied by a recognizable thickening of the overlying bone. For reasons not as yet entirely clear, endotheliomas *en plaque* are more likely to provoke bony thickening from tumor invasion than are the large rounded tumors. Leaving out of consideration a few of the spreading endotheliomas of the basal meninges, such as those which arise from the gasserian envelops,[3] nearly all of the flat tumors of the type recorded in the foregoing case report have produced an overlying hyperostosis. There have been eight of them in all, five in the anterior temporal region, as in the case recorded, usually with unilateral exophthalmos, and three in the parasagittal region of the vault.

The other twelve examples of hyperostosis have accompanied the rounded tumors which cause marked cerebral deformation. It was my early impression that these tumors were less likely to invade the bone because of their relatively small area of meningeal attachment. However, this cannot be the actual explanation, for the reason that there are several cases in the series in which a pronounced hyperostosis overlay an enucleable spherical endothelioma which proved to have a comparatively small area of meningeal attachment.

2. In his recent article on "The Accomplishments of Intracranial Surgery" (New York State J. M. **21**:369, 1921), Dr. Frazier has made the statement that 60 per cent. of his cases were sarco-endotheliomas and only 38 per cent. gliomas.

3. Reference has already been made in another connection to the four endotheliomas in my series which have apparently arisen from the trigeminal sheath. "The Major Trigeminal Neuralgias," Am. J. M. Sc. **109**:157, 1920.

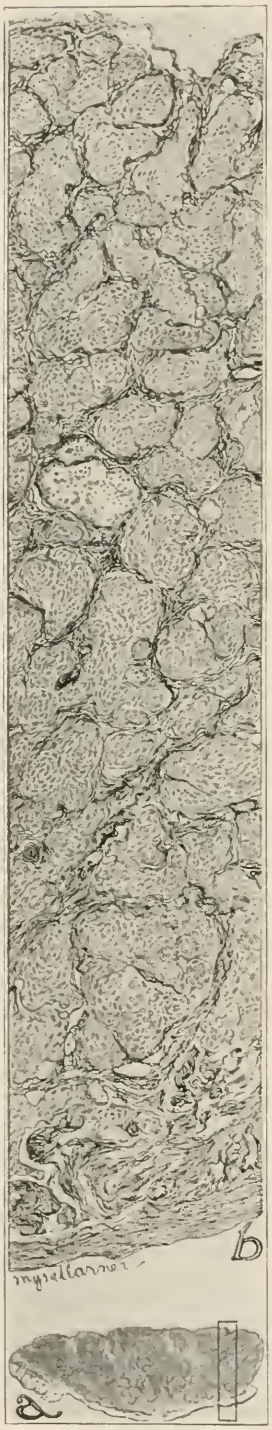


Fig. 8.—Microscopic low-power drawing through entire thickness of tumor.

The endotheliomas must be regarded of course as benign tumors, but it is known that the growth tends to insinuate itself into crevices and may surround and incorporate important anatomic structures like the blood-vessels of the cranial base without damaging them.[4] In view of this it might be assumed that under the influence of intracranial tension the tumor cells in the process of their multiplication become crowded into and through the vascular dural spaces and finally into the canaliculi of the bone. In consequence of this the bone becomes irritated, with subsequent osteoblastic proliferation which provokes the hyperostosis. There can be little doubt that the thickening occurs in this way, but intracranial tension can have nothing to do with it, in view of the fact that the flat endotheliomas which do not increase tension are, as we have seen, those which most often tend to invade the bone. There must be some other reason, therefore, to account for this peculiar process. One occasionally finds a meningeal endothelioma in which there is a tendency to bone formation within the tumor itself, and therefore the process may bear some relation to the bone-forming properties of the meninges, but without further data on the subject speculation is futile.[5]

4. In another connection (with C. B. Walker) an example has been given of a basal endothelioma which had extruded itself far into the vaginal sheath of both optic nerves without destroying the tissue relationships. This case, one of the typical tumors arising from the olfactory groove, an example of which was pictured by Cruveilhier, was first reported in my monograph "The Pituitary Body and Its Disorders," Philadelphia, W. B. Saunders Co., 1912, and later on from its ophthalmological aspects with C. B. Walker: Arch. Ophth. **45**:427 (Sept.) 1916, p. 427.

5. In an article with Lewis H. Weed (*loc cit.*) we described and figured one of the endotheliomas of this series in which there were deposits of true bone, not only in the tumor but also in the arachnoid elsewhere.

The twenty examples of hyperostosis in the series of eighty endotheliomas represent one in four, but unquestionably this is too small a percentage if one takes into consideration the cases in which a slight thickening is observed on the inner surface of the skull alone. In most

Figs. 9, 10 and 11.—Three views (natural size) of bone fragment, showing its outer surface in the upper figure, the dural surface in the lower figure, and its thickness in the middle figure. The dark points on the burred surface of the middle figure represent macroscopic evidences of tumor.

of the tumors of spherical type the point of origin of the growth from the meninges is clearly apparent. At this central core of the tumor the dura is apt to be indented by a slight endostosis, often too

small to be recognized by the roentgen ray and in the operative notes of this long series of cases the particular fact may not always have been recorded.

In short, the tumors do not always behave alike in their effect on the bone. In some cases, aside from the increased vascularity with widening of the diploetic venous channels owing to stasis, there is no apparent change. In others, the bone may become greatly thinned

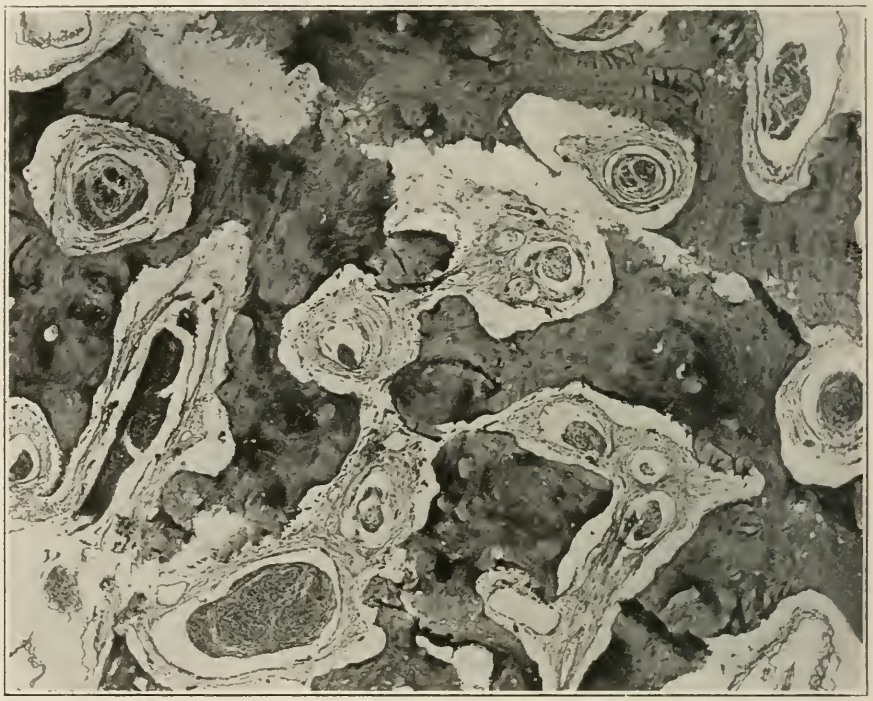


Fig. 12.—Low-power photomicrograph (×60) of section of endothelial hyperostosis.

and the tumor find its way to the surface without any actual tumor penetration of dura. In still other cases, when a marked hyperostosis has been produced, the central portion of the hyperostosis may through subsequent absorption become occupied by tumor cells to the exclusion of anything more than occasional bony spicules, and in these cases the appearance of the bone in the roentgen ray may closely simulate a primary sarcoma of malignant character.

Apart from their relation to the cranial hyperostosis, these tumors have many features of unusual interest. Some of these points have been touched on in other connections. Thus, in a paper with Weed in our series of articles on the cerebrospinal fluid, the fact that they are in all probability of arachnoid rather than dural origin, as commonly

believed, was touched on. It is our belief that they arise from the cell-clusters of the arachnoid villi projecting into the dura.[6]

Cruveilhier's designation of these tumors, which he so well described, as "tumeurs cancéreuses des meninges" means little more to us today than does the "fungous dura matris" of his predecessors; and as the term commonly employed, namely, dural endothelioma, gives the wrong impression of the membrane from which the growth has originated,

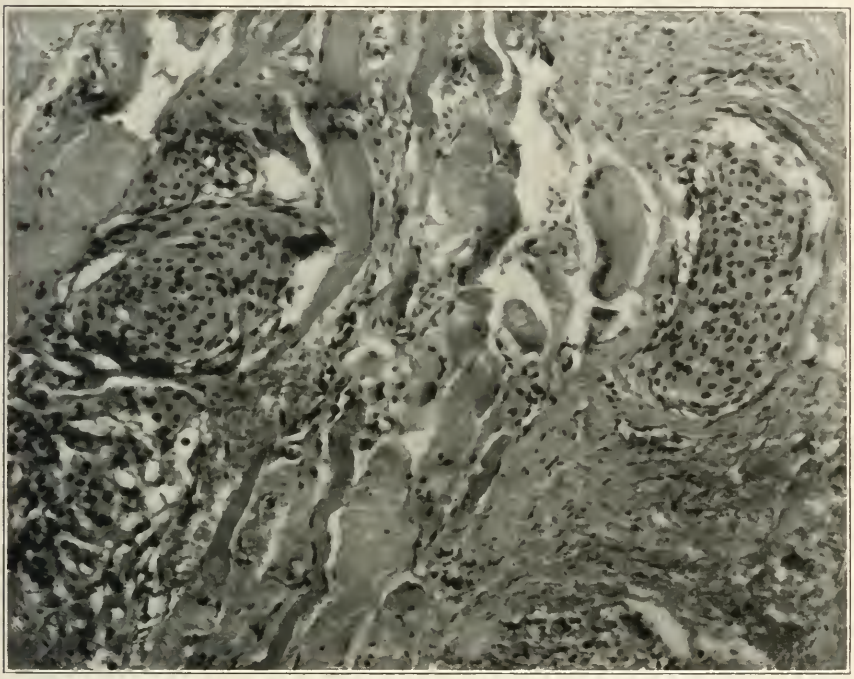


Fig. 13.—Section of temporal muscle (× 170) showing extracranial endothelial invasion.

the designation *meningothelioma* or *meningioma* is suggested as a compromise. This at least avoids the objections which the embryologist might raise, for strictly speaking the growths would seem to be properly called mesotheliomas of arachnoid origin.[7]

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6. Cushing, H., and Weed, L. H.: Studies of the Cerebrospinal Fluid and its Pathway. IX. Calcareous and Osseous Deposits in the Arachnoidea, Bull. Johns Hopkins Hosp. **26**:367-372 (Nov.) 1915.

7. There are other varieties of endotheliomas from which these common tumors must be distinguished, such as those of supposedly pial origin which have no dural attachment. These are exceedingly vascular growths, sometimes designated as hemangio-endotheliomas. Another type of tumor which is exceedingly rare in man but more common especially in the horse, is that form of endothelioma which arises from the choroid plexus. These tumors have been classified with the cholesteatomas, though the latter are of dermoid or epidermoid origin and bear no relation to the endotheliomas. With endothelial tumors of these sorts we are not here concerned.

Needless to say, were all these tumors associated with cranial hyperostoses they would be easily recognized and localized. Unfortunately they are not. Hence, in the absence of general pressure as well as of localizing symptoms, they may remain for a long time unrecognized and may ultimately reach such a size that their removal, even when they are accessible, is a most formidable operation. The largest tumor in the series weighed 246 gm., and was attended by extreme circulatory stasis. Even when focal symptoms do appear in the course of time, they may be of false localizing value, as was the case with one of these growths described in another connection.[8]

The meningiomas, if they may be thus called, have certain definite seats of predilection, and for the most part each group, on the basis of its anatomic seat of origin, gives a very definite and characteristic symptomatology. A discussion of these matters must await a more extended report on the subject. It is sufficient for this preliminary note to point out in summary:

1. That, in a series of over 700 verified tumors there have been eighty endotheliomas, their ratio to the gliomas being about one to four.

2. That at least 25 per cent. of the endotheliomas are accompanied by an overlying hyperostosis cranei which is either palpable externally or demonstrable by the roentgen ray. This process is due to invasion of the bony canals by tumor cells, with resultant stimulation of osteoblasts and the production of new bone.

DISCUSSION

Dr. William G. Spiller, Philadelphia: In 1899 my attention was first called to the subject Dr. Cushing has discussed, and in that year Dr. Kirkbride and I reported a case of localized bony enlargement of the skull over a meningeal tumor before the Section on General Medicine of the College of Physicians of Philadelphia. I believe this was the first report of a case of this kind in literature. The condition was an endothelioma growing from the cerebral dura with endothelioma cells within the bony enlargement.

In 1903, Brissaud and Lereboullet reported two cases in which they considered the tumor of the brain as secondary to the enlargement of the bone of the skull. In one of these cases there had been an enlargement of the bone since childhood, and it was not until the age of 29 that symptoms of tumor developed. Multiple tumors were found growing from the dura. In 1907, I published a paper in *The Journal of the American Medical Association* containing in full a report of my first case, with the report of another similar case. In this second case the patient was syphilitic, and I believed that syphilis was the cause of the bony growth of the skull. A few other cases were reported before 1907.

It has seemed important to recognize that where there is a localized large bony growth of the skull, tumor is likely to be found beneath or near it

8. Anosmia and Sellar Distortion as Misleading Signs in the Localization of a Cerebral Tumor, J. Nerv. & Ment. Dis. **44**:415-423 (Nov.) 1916.

growing from the dura, and this fact is of great importance as regards operation. In one such case, with this thought in mind, I urged exploratory operation although the symptoms of intracranial tumor were not severe. The man refused operation and at necropsy a tumor growing from the cerebral dura was found.

I should like to ask Dr. Cushing in how many of his cases of meningeal tumor microscopic examination of the bony growth was made, and in what proportion of his cases he found by such microscopic examination tumor cells within the bony enlargement. I am willing to acknowledge that tumor cells may be found within the bony enlargement, and in my first case, reported in 1899, such cells were found, but I have not been convinced that the bony enlargement in these cases is always secondary to the meningeal growth.

The matter is one of great importance. If we may believe that the bony enlargement is primary, we may hope to prevent the development of a meningeal tumor by operation at an early date.

Dr. Charles A. Elsberg, New York: I have seen quite a number of cases with the bony changes of which Dr. Cushing has spoken; in two of the patients I had an experience concerning which I would like to ask Dr. Cushing. The involvement of the bone was so extreme that it would have meant an extensive removal of the cranium. In both I did not remove all the tumor containing bone. These patients have remained well, one for five and one for seven years, without further enlargement of the bone and without any symptoms, and apparently either the tumor in the bone grew very slowly or the bony growth was interfered with after part of the tumor had been removed.

Dr. Archibald Church, Chicago: The lack of symptoms in some of these cases is rather a startling clinical feature. I recall an elderly woman who developed a paraplegia with the symptoms of spinal cord tumor. Incidentally one day, to calm her, I put my hand on her head and felt a large defect in the skull. A little further investigation revealed three openings in her skull, in any one of which a hen's egg might have been placed. These findings were confirmed by a roentgenogram of the skull. She never had had a head symptom nor had she complained about her head. At her death, three of these growths which had produced the large windows of the skull were found and also a somewhat similar growth causing spinal paraplegia.

In other cases affecting the brain and leading to operation, the symptoms had been comparatively insignificant.

Dr. Cushing, in closing: In answer to Dr. Spiller's question, the reason why these conditions have not been fully studied is because there is a good deal of difficulty in sectioning bone; and when there is an obvious tumor, the histologic nature of which can be verified easily without decalcification, the overlying bone has been neglected.

In the preparation of this paper I have gone over all of the old specimens and practically all of them have been sectioned. I confess to a certain amount of hesitation, when the nature of a tumor has been verified, to subject an overburdened department on pathology to the necessity of decalcifying the accompanying fragments of bone. However, tumor has been found in every case examined, and I judge that twenty or thirty have been gone over recently.

Dr. Elsberg's point is one with which I can fully concur. These growths are what Paget calls locally malignant tumors. The cases which I have chosen for the lantern slide demonstration in connection with my paper have been the

sphenotemporal tumors. On one slide half a dozen of them were shown. The bone, under those circumstances, is extensively involved throughout the whole temporal fossa The outer side of the orbit is involved, causing exophthalmos, and it is practically impossible in these circumstances to remove all of the affected bone. It is of course not difficult when the area of bony involvement is less inaccessible.

In reply to Dr. Church's question as to the lack of symptoms, the tumors may be multiple, but that is true also of the neurinomas, that is, the acusticus tumors, and there is a very interesting relation between these tumors and the meningiomas. My tumor series now includes sixty-seven acoustic tumors, all of them unilateral. When these lesions are single, there may be slight manifestations of a Recklinghausen's syndrome—a few fibromas on the skin, for example—but usually that is all. When, however, an acoustic tumor is bilateral, as they sometimes are, it is often accompanied by multiple meningeal tumors of the type under discussion. Dr. Bassoe and others have reported cases of this kind. Hence, there is some relation between tumors of these two types, but it is rare to find the lesions multiple.

HISTOPATHOLOGY OF CEREBRAL CARCINOMA*

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CHICAGO

In carcinoma of the brain the parenchyma of the invaded portions appears to be replaced by more or less dense masses of carcinoma cells grouped around distended blood vessels, or it may remain in the form of islets surrounded by strands of cancer tissue. Buchholz,[1] Gallavardin and Varay[2] assert that the brain tissue is not actually destroyed but is merely "pushed aside" by the tumor mass within it ("eingesprengt") without provoking reactive phenomena. They say the glia may show proliferation in the immediate neighborhood of the tumor, but the mesodermic tissues—blood vessels and pia—show no reaction. De Fano[3] also emphasizes the absence of mesodermic reaction in carcinoma produced experimentally by transplantation in the brains of mice and rats. Only in animals "partially immune" did he find plasma cells or lymphocytes and "the nerve elements, the ganglion cells, undergoing atrophy." "Lasting proliferation of neuroglia seems," he says, "to appear only under certain conditions."

The pia is variously described by different authors. Siefert[4] says that the pia is more or less involved in every case, either directly or through propagation along the lymph spaces. Girardi[5] found no pial

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* From the Division of Neurology of the College of Medicine of the University of Illinois and the Pathology Laboratories of the Illinois State Psychopathic Institute and Cook County Hospital.

1. Buchholz: Casuistischer Beitrag zur Kenntnis der Carcinome des Centralnervensystems, Monatschr. f. Psychiat. u. Neurol. **4**:183, 1898.

2. Gallavardin, L., and Varay: Etude sur le cancer secondaire du cerveau, du cervelet et de la moelle, Rev. de méd. **23**:441-561, 1903.

3. DeFano, C.: Intracerebral Transplantation of Malignant New Growths, Folia Neuro-biol. **6**:109, 1912.

4. Siefert, E.: Ueber die multiple Carcinomatose des Centralnervensystems, Arch. f. Psychiat. **36**:720, 1903.

5. Girardi, P.: Ueber Karzinommetastasen im Kleinhirn, Monatschr. f. Psychiat. u. Neurol. **31**:184, 1912.

infiltration and Fischer [6] affirmed its absence even when the cancer came in direct contact with the membrane.

Equally contradictory are the opinions as to the mode of propagation of the tumor cells. Siefert [4] believed that the tumor masses spread from the cortex downward into the depths of the white matter along the course of the pial prolongations. He concluded that propagation is "toward the center"; that is, away from the subarachnoid space. Yet in a spinal cord surrounded, mufflike, by carcinoma he found no cancer cells in the parenchyma or septums of the cord. Bastiaanse [7] is more explicit. In a "primary" carcinoma of the left cerebellar hemisphere, he found numerous "metastases" in the cortex and invasion of the subarachnoid space. He therefore concluded that the carcinoma cells were carried to the brain from the subarachnoid space by the cerebrospinal fluid.

Nowhere have we found any description of the condition of the choroid plexus.

Our knowledge of the histopathology of brain tissue when invaded by carcinoma is in confusion, the few contributions on the subject being contradictory. The reason probably lies in the nature of the material studied. When the growth is far advanced the changes are so marked that their interpretation is almost impossible. Only in exceptionally favorable instances can the evolution of the cancer growth and the accompanying phenomena in the parenchyma, glia and mesodermogenic tissues be followed.

We have had the opportunity to study eight cases of intracranial carcinoma,[8] one being especially instructive because the metastatic nodules were young and not broken down, hence especially suitable for study of the problems mentioned. It has been used as the basis for this work, the findings being compared with those in the other cases. From these studies we believe it possible to establish certain features as common to all cerebral carcinomas.

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6. Fischer, O.: Zur Kenntnis des multiplen metastatischen Carcinoms des Zentralnervensystems, Jahrb. f. Psychiat. **25**:125, 1904.

7. Bastiaanse, B.: Primäres metastasierendes Gehirncarcinom, Ztschr. f. d. ges. Neurol. u. Psychiat. **27**:96, 1915.

8. Two were cases of carcinoma of the meninges and six of the brain proper. One of the former has already been reported (Hassin, G. B.: Histopathology of Carcinoma of the Cerebral Meninges, Arch. Neurol & Psychiat. **1**:705 [June] 1919). The second was furnished by Dr. William Thalhimer of Milwaukee. We are indebted to Dr. Peter Bassoe of Chicago for the opportunity to study four and to the Cook County Hospital for two carcinomas in the brain. All showed metastases; two were carcinomas of the lungs, two of the uterus, one of the pancreas, one of the breast, one of the intestine and one probably of the prostate.

MACROSCOPIC APPEARANCE OF THE TUMORS

The tumors appeared as foci of varying size scattered irregularly through the gray and white substance, sometimes transgressing the pia. They were well defined, loosely attached to the surrounding tissues and extremely soft. The smaller foci were more solid and suitable for frozen section. In one case there was a single metastatic tumor involving the area of the basal ganglions, extending into the third

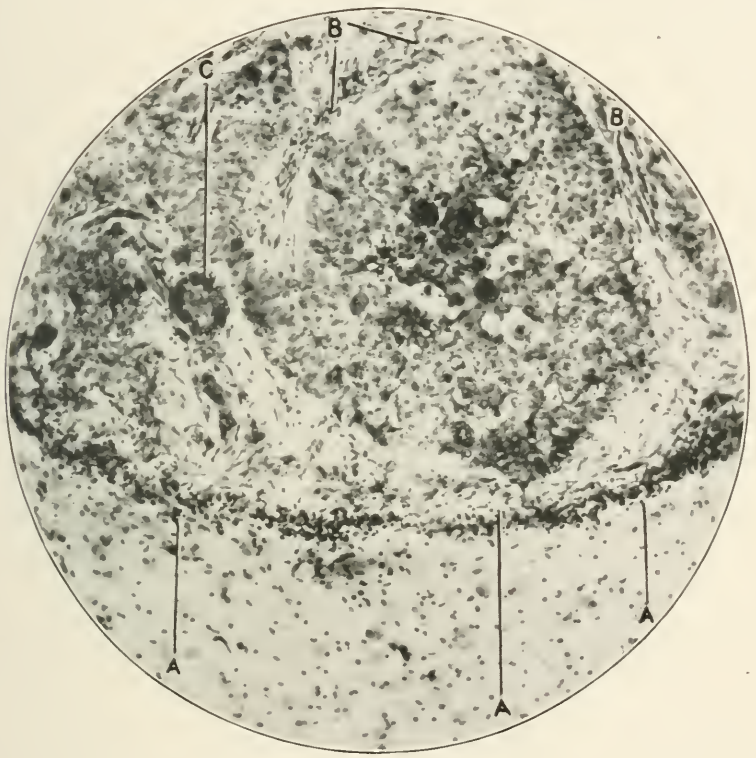

Fig. 1.—Demarcation zone *A,A,A*, dividing the brain below from the cancer foci above; *B*, bands of connective tissue enveloping the larger focus; *C*, a ganglion cell invaded by cancer cells (reproduced under higher power in Figure 3). Thionin; × 125.

ventricle, corpus callosum, cortex and almost reaching but not invading the pia. Here the affected areas were separated from the noncancerous tissue by a well marked zone of demarcation (Fig. 1).

MICROSCOPIC EXAMINATION

The microscopic appearance of the invaded area, the zone of demarcation and the cerebral tissue adjacent to and remote from the

tumor differed from one another. The histology of the carcinoma needs no description; we shall limit attention to the brain tissues.

The Invaded Area.—This presented an areolar appearance with islands of cells separated by bands of connective tissue (Fig. 1). These cells were for the most part ganglion cells in various stages of alteration. The more normal presented a swollen, deeply stained cell body with visible processes and a dislocated nucleus, rich in chromatin. The majority, however, were grossly changed, sometimes to such an extent

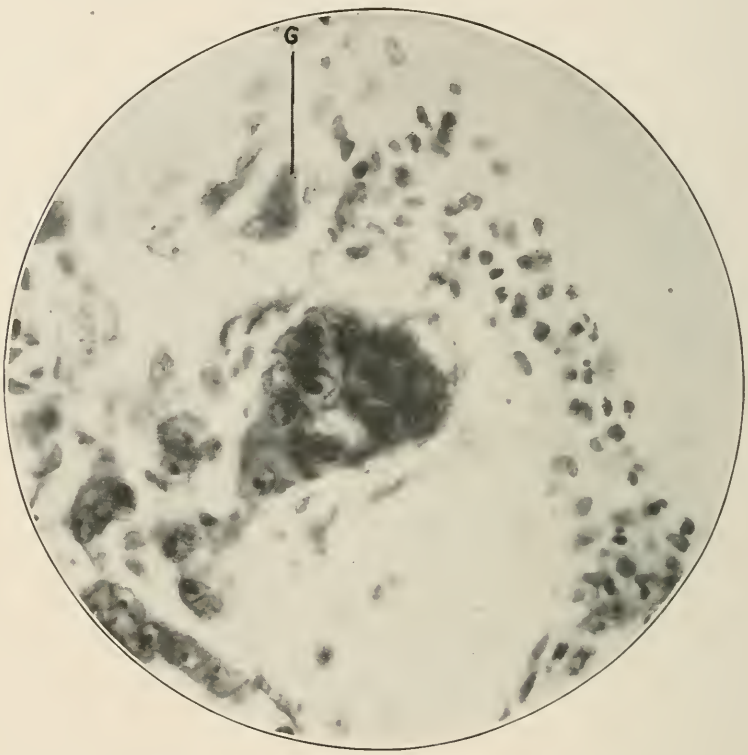

Fig. 2.—The center of the picture is occupied by a ganglion cell, swollen and packed with carcinoma cells, which occupy also the apical dendron. To the left are two smaller ganglion cells also invaded with cancer cells; at *G* a ganglion cell with dislocated nucleus. The elements to the right are lymphocytes, plasma cells, gitter cells and others described in the text. Thionin; × 480.

as to be unrecognizable without further study. As a rule, the cells were large, some truly gigantic (Fig. 2), larger than those to be found in any other central nerve lesion, not excepting amaurotic family idiocy. They were round or irregular in shape, usually pale, some darkly stained, homogeneous or finely granular, devoid of any trace of Nissl's bodies, and the processes were more or less completely obliterated.

The nucleus was swollen, pale and eccentric, the chromatin broken up, but the membrane and nucleolus almost always intact. Sometimes the nucleus stained so faintly that it could be detected only by the presence of the nucleolus. Many of the ganglion cells were vacuolated, others broken up or unevenly stained. With the Bielschowsky silver impregnation some showed a reticulum but, as a rule, the neurofibrils were absent.

The majority of the ganglion cells showed inclusions: granules scattered through the protoplasm, vacuoles containing polymorpho-

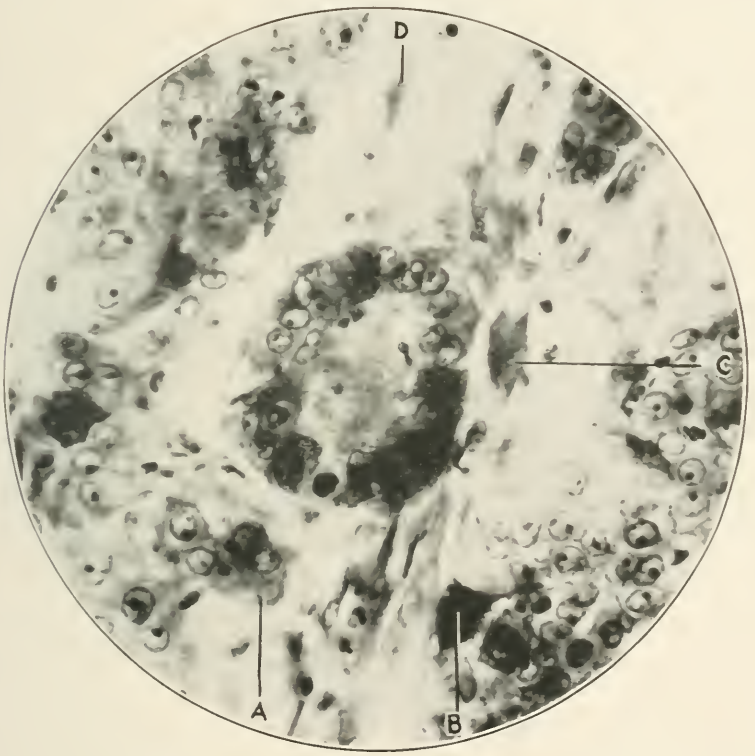

Fig. 3.—Types of altered ganglion cells in the invaded area. The periphery of the cell in the center contains a number of cancer cells; the central portion has numerous granules (Abbaustoffe) and several vacuoles containing lymphocytes and polymorphonuclear cells (use hand lens). At *A*, there is another ganglion of smaller size filled with cancer elements; at *B*, a dark homogeneous cell without inclusions; at *C*, a new formed capillary; at *D*, a fibroblast; the numerous round, pale bodies with distinct nucleoli are cancer cells. Thionin; × 480.

nuclear or mononuclear leukocytes and—of especial interest—cancer cells. In some instances these last occupied the entire ganglion cell body, including the processes (Fig. 2); in others they were collected

in a dense cluster in the center or in a crescentic mass at the periphery of the cell (Fig. 3).

With scarlet red, Marchi and lichtgrün-fuchsin stains minute fat-granules were demonstrable in the ganglion cells but were absent from the cancer cell bodies. With lichtgrün-fuchsin many ganglion cells showed numerous granules or droplets of fairly large size which stained various colors and may correspond to the so-called fuchsinophil (Fig. 4), lichtgrün and lipoid granules (Fig. 5).

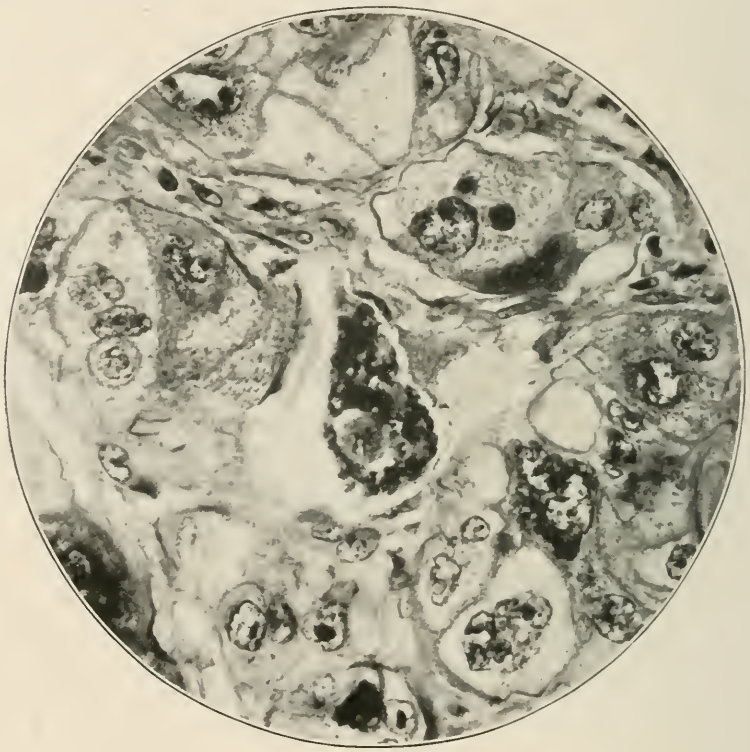

Fig. 4. — Ganglion cell in the center packed with granules (fuchsinophil, lichtgrün and other catabolic products). The rest are swollen and greatly liquefied ganglions. Lichtgrün-fuchsin; Alzheimer method VI; × 560.

The included cancer cells stained much more brilliantly than did the ganglion cells, and thus gave the section a deeply colored appearance. In places the greatly swollen ganglion cells were pressed so closely together as to form giant cells containing several nuclei. It was not always easy to differentiate between the nuclei of the host and those of the included cancer cells.

Some of the most damaged ganglion cells appeared structureless, colorless, devoid of chromatin and often without inclusions (Fig. 4)

but with a large pale nucleus, free from chromatin but possessing a membrane and visible nucleolus. Many could be recognized only by a careful study of the numerous transition types. So manifold were these that description is impossible. Some conception of the shape, size and general appearance may be gained from Figs. 3, 4 and 5. The process in general appeared to be progressive liquefaction and tumefaction with neuronophagy, the invaders being cancer cells, lymphocytes and polymorphonuclear leukocytes, the first being by far the most numerous.

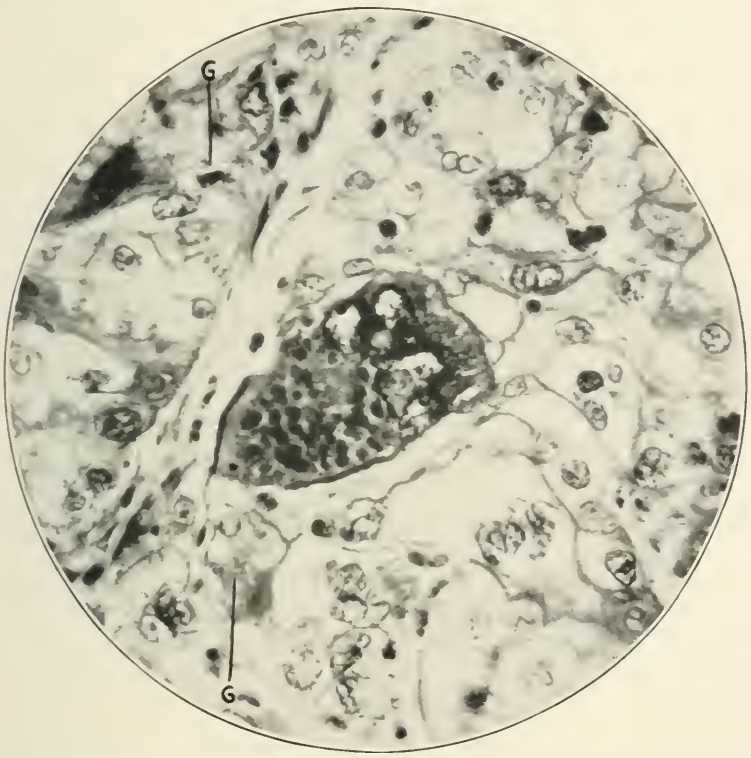

Fig. 5.—In the center of the photomicrograph is a large swollen ganglion cell invested with a connective tissue membrane. It contains large globules of lipoids and four vacuoles in which cancer cells can be seen with a hand lens; at *G G* are liquefied ganglion cells; the apical dendron of the upper one appears intensely dark and contains the nucleus. The rest of the picture shows numerous cancer nuclei within greatly changed and liquefied ganglion-cells; some of these appear entirely colorless and empty. Lichtgrün-fuchsin; × 480.

It is noteworthy that within the tumor mass there was no glial proliferation. Instead, connective tissue fibers enclosed groups of nerve cells or even single cells. In the latter case the ganglion cell appeared to be invested with a connective tissue membrane (Fig. 5). The connective tissue was derived from the blood vessels and pial pro-

longations and often formed broad strands which usually were entirely devoid of carcinoma cells but contained many plasma cells, lymphocytes, polyblasts, polymorphonuclear leukocytes, fibroblasts and numerous gitter cells packed with lipoids (Fig. 2). Here and there a ganglion cell or glia cell was found. The former were shrunken, homogeneous and atrophic with obvious, tortuous processes and an oblong nucleus, poor in chromatin. The glia cells were less frequent and occurred with large cytoplasmic bodies or as glia nuclei lodged within ganglion cells.

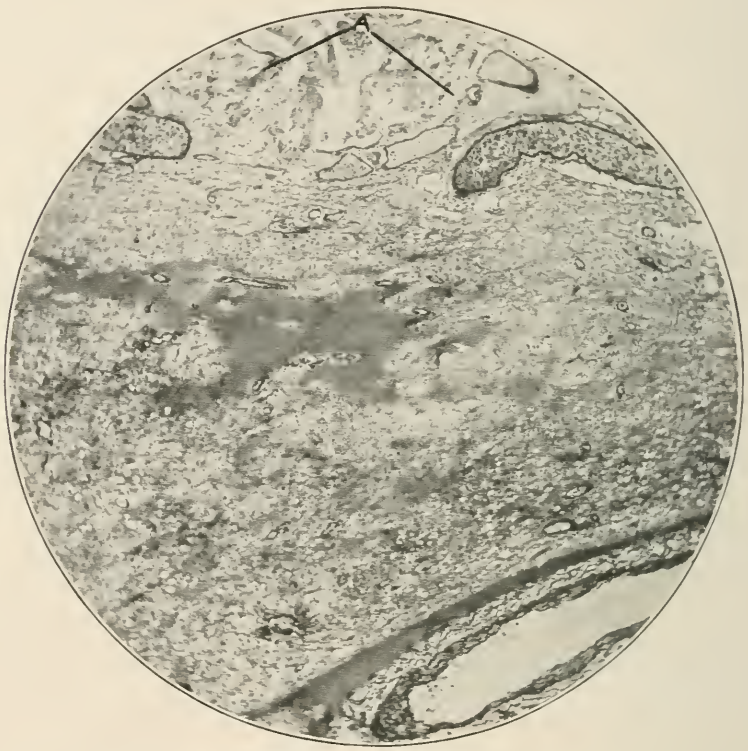

Fig. 6.—Transition zone occupying the entire picture except a small sector of cancer tissue at *A*, above. It shows colloid masses, cytoplasmic glia (use hand lens), hyperemic vessels with hyperplastic adventitia and a colloid ring around a large blood vessel at the bottom. Bielschowsky stain counterstained with Alzheimer-Mann; × 40.

Zone of Demarcation.—In the zone of demarcation, between the area invaded by the carcinoma and the more normal appearing brain tissues, there were a few ganglion cells invaded by glia nuclei, and numerous other cells. Among these, plasma cells were especially prominent, some containing two typical and well stained nuclei; in others the nucleus showed only remnants of chromatin. Polyblasts, shrunken

polymorphonuclears and gitter cells were also numerous. In the majority of our cases a demarcation zone was absent and replaced by a transition zone (Fig. 6). Here the tissues were markedly rarefied, vacuolated and appeared as a so-called glia reticulum. Glia cells were prominent, with abundant cytoplasm, homogeneous and pale and an eccentric nucleus rich in chromatin. Blood vessels were numerous, the adventitial spaces distended and infiltrated with gitter cells, lymphocytes and even cancer cells. They were often surrounded by a ring of a colloid substance occupying the areas assigned to the spaces of His.

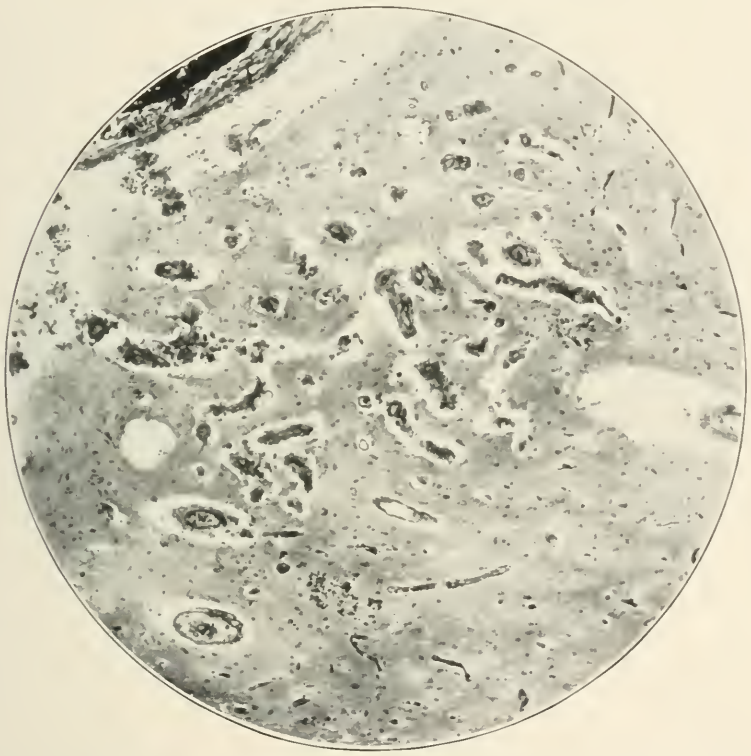

Fig. 7.—Microscopic cancer foci. Small blood vessels invested with carcinoma cells and surrounded by clear spaces. Alzheimer-Mann; ×70.

Such colloid material was not found in the tumor masses proper, the connective tissue stroma nor in the demarcation zone. It was common, however, and especially well developed in those cases in which no distinct demarcation zone was present. It appeared, then, in the form of islands of homogeneous, jelly-like material, much resembling ameboid glia (Fig. 6). In addition, there were present large numbers of amyloid bodies. Ganglion cells were present but were scanty in the transition zone. They were very pale and showed marked chromatolysis.

In some instances the transition zone was not pronounced but, with special stains (scarlet red, Alzheimer-Mann), it could be demonstrated as a narrow space filled with gitter cells, proliferated glia and, in some instances, cancer cells.

The transition zone may thus be regarded as an area in process of invasion by the tumor mass spreading by direct penetration, the tissues becoming so damaged as to offer little resistance. The demarcation zone, on the other hand, consisted of more vigorous elements which

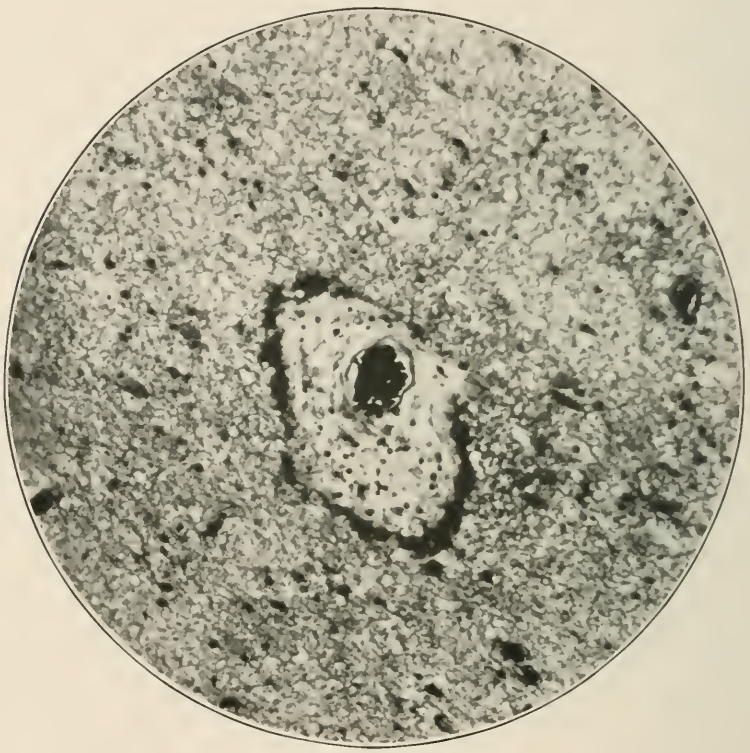

Fig. 8.—An area outside the demarcation zone. The glia reticulum is marked; a blood vessel in the center shows a greatly rarefied brain tissue containing lymphocytes, plasma cells and gitter cells and is surrounded by a ring of syncytial glia. Bielschowsky stain counterstained with Alzheimer-Mann; × 170.

afforded some protection but yet, as will be seen, failed to save the rest of the brain from damage.

Separated, at times even remotely, from the main tumor mass were numerous microscopic foci of cancer cells (Fig. 7). Such foci consisted of a small blood vessel, infiltrated or occluded by large tumor cells, with nuclei very rich in chromatin and provided with a well developed membrane. Sometimes the cells were confined to the Virchow-

Robin spaces, but often they had broken through and, by proliferation, formed a larger focus. Then no trace of blood vessel could be detected, and the reactive and other phenomena approximated those of the main growth already described.

Regions Remote Even from Microscopic Foci.—These regions at first glance appeared normal. Closer study revealed universal pathologic changes. The ganglion cells were often swollen, with chromatolysis, eccentric nucleus, neuronophagia and fat infiltration. The glia cells were hypertrophied ("cytoplasmic") or proliferated in the

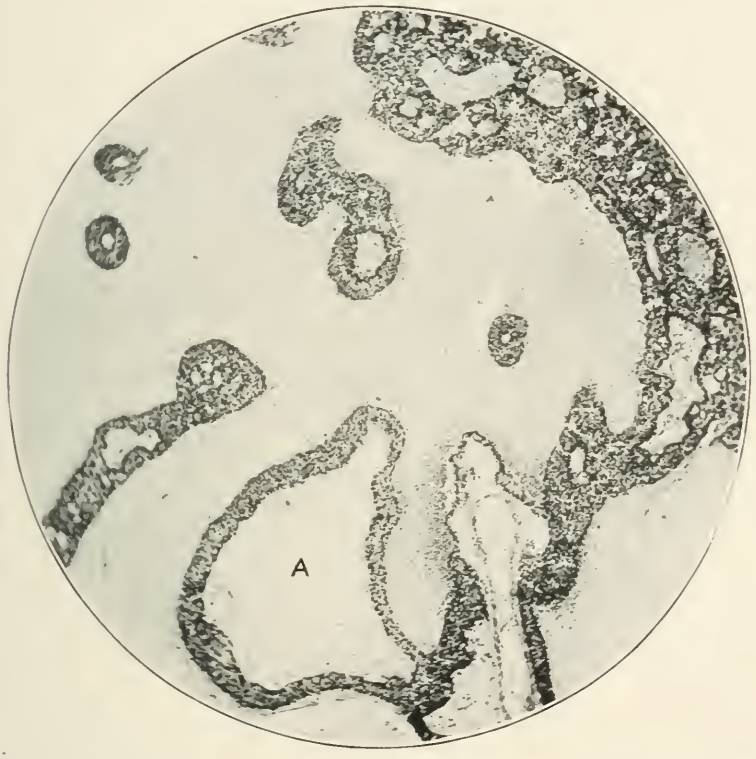

Fig. 9.—Necrotic areas with islands of carcinoma. The small area *A* shows a colorless center, devoid of vessels, surrounded by a zone containing a few degenerated cancer cells and an outer dense ring of well preserved cancer cells. Toluidin blue; × 36.

form of "rosettes." The vessels were dilated, and there were many new formed capillaries. Some vessels were surrounded by a ring of syncytial cytoplasmic glial cells (Fig. 8). Masses of pigment granules were contained within the proliferated adventitial and endothelial cells. The nerve fibers in places appeared swollen and spindle-shaped but not fragmented. In short, there was a generalized condition of toxic encephalitis.

Of the foregoing changes those most constant were: general toxic encephalitis, the colloid masses and the processes in the transition zone. In most of the cases the demarcation zone, as stated, was absent, and invasion of the ganglions by cancer cells was not observed. In these cases the tumor masses often presented large areas of central necrosis (Fig. 9) in which no cells could be detected. Surrounding such areas there were scattered, shrunken and poorly stained carcinoma cells (intermediate zone) and next to these again a larger zone of more or

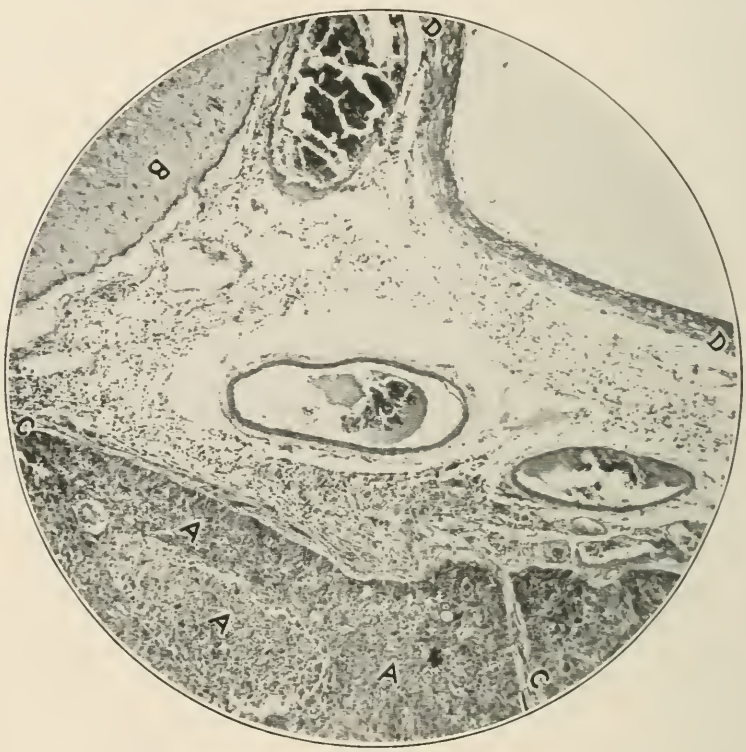

Fig. 10.—Pia-arachnoid—distended, the subarachnoid space packed with cell bodies. *A,A,A,* foci of carcinoma separated from the proliferated pia (*C,C*) by an empty space which should be compared with the well formed pial covering of the brain at *B,D,D*—hyperplastic arachnoid. Van Gieson; × 60.

less well preserved cancer tissue, richly supplied with blood vessels. For the most part blood vessels were lacking in the central and intermediate zones; if present, they were dilated and enormously infiltrated with well formed cancer cells. Such infiltrated vessels stood out as beautifully stained islands in a colorless, necrotic mass (Fig. 9).

The Pia-Arachnoid and Choroid Plexus.—Whatever the type and extent of parenchymatous destruction, changes were constantly present

in the pia-arachnoid and the choroid plexus. The pial changes were most marked when the tumor almost reached the membrane. The pia-arachnoid then appeared as a mass of cancer tissue. Distant from the tumor, the membrane showed distended meshes with unusually prominent and numerous collagen fibers, the vessels were dilated and hyperemic, some new-formed with proliferating adventitial and endothelial cells and many fat globules. Often the meshes were scantily lined with cellular elements; in others these were present in large numbers (Fig. 10). Mesothelial cells predominated but fibroblasts,

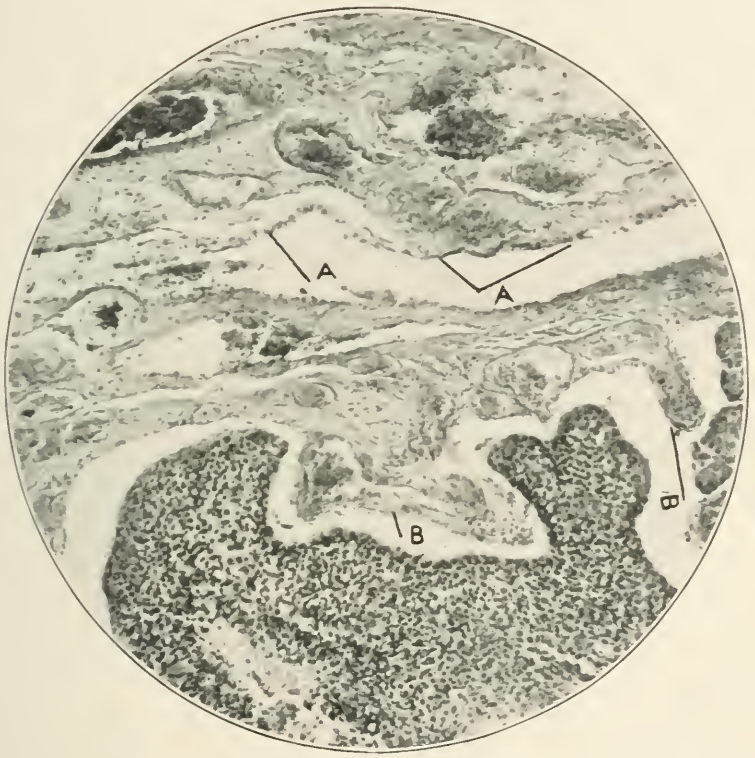

Fig. 11.—Choroid plexus invaded by carcinoma. *A,A,* epithelial tuft cells; *B,B,* tufts of the plexus, much resembling the villi of the arachnoid; the mass below is a carcinoma focus. Van Gieson; × 80.

lymphocytes, polyblasts and many gitter cells packed with lipoids were present. In addition, cells of distinctly epithelial character, much resembling carcinoma cells, were frequent. In advanced cases the arachnoid usually appeared hyperplastic (Fig. 10) and formed a dense connective tissue strand. The appearance in these membranes varied in different regions and cases but careful study always revealed pathologic changes.

In the choroid plexus the connective tissue stroma was usually proliferated and formed a homogeneous, hyperplastic strand, in some instances enormous. In one case it was invaded with foci of cancer cells (Fig. 11). In this case the tumor formed a protrusion of the brain substance into one lateral ventricle, compressing and almost invading the plexus. It is noteworthy that cancer cells were also found in the choroid plexus of the opposite lateral ventricle. In no other case were foci of cancer cells found; there were, however, somewhat indefinite mononuclear cells in the spaces between the blood vessels and the tuft cell covering.

The tuft cells sometimes formed several layers, were distinctly granular, large in size and brightly stained. The nuclei were rich in chromatin and located centrally or at the base of the cell. In the majority of the cells there existed a distinct vacuole of varying size which enclosed some amorphous substance. The blood vessels were hyperemic with hyperplastic walls, proliferated adventitial and hypertrophied endothelial cells. Colloid material, found so abundantly in the brain substance, was not observed here, and there was no thrombosis or hyaline degeneration. Calcareous bodies or psammomas were numerous in some cases.

SUMMARY AND DISCUSSION

1. In the invaded areas there were macroscopic and microscopic foci of carcinoma cells which in some cases invaded the ganglion cells. Glial or mesodermogenic reaction was absent.

2. There was a gradual propagation of the growth with formation of a transition, and more rarely a demarcation, zone with marked reaction phenomena.

3. Proliferation of connective tissue in the form of bands, derived from the pial intracerebral prolongations and blood vessels, outside the foci.

4. Toxic encephalitis throughout the brain.

5. Accumulation of catabolic substances (Abbaustoffe), especially colloid masses, around the vessels and in the tissues.

6. Changes in the vessels, pia and choroid plexus.

The changes enumerated in the foregoing—a combination of focal (tumor masses) and diffuse (encephalitic) lesions—were present in all our cases of cerebral carcinoma but were lacking in the meningeal neoplasms. In the latter, the brain substance proper was free from carcinoma cells. This is in accord with Pachantoni [9] who asserts that in the "majority" of cases of meningeal carcinoma (with the exception

9. Pachantoni, D.: Ueber diffuse Carcinomatose der weichen Hirnhäute. Arch. f. Psychiat. **49**:396. 1912.

of the case of Saxer) the brain was not involved. In one of our cases the most superficial strata were invaded. But in this case the meningeal infiltration was enormous, and the cells were probably spread by sheer pressure from the subarachnoid space into the adventitial spaces of the neighboring vessels. The deeper strata were entirely free from invading elements, and neither they nor remote areas of the brain showed signs of encephalitis or any other change. There is thus an essential difference between the cerebral and meningeal growths. This difference is most probably due to the direction of flow of the cerebrospinal fluid. The experimental work of Weed[10] and some facts of histopathology[11] demonstrate that the spinal fluid flows from the brain toward the subarachnoid space and possibly also toward the ventricles. This current carries with it the waste products of the brain, be these blood pigment from a hemorrhage, tubercles, fat substances or, as in the present instances, carcinoma cells and the products of their decomposition. These waste products are found in the subarachnoid space and there provoke reactive phenomena, mainly manifested by proliferation of mesothelial cells. The direction of flow of these tissue fluids will also explain the freedom of the brain tissue in carcinoma of the meninges. Unless the subarachnoid space is so packed with tumor cells that the pressure forces them into the adventitial spaces, there is complete immunity on the part of the brain, and where this condition does obtain only the most superficial layers are invaded.

Once within the brain tissues, the carcinoma cells give rise to reactive phenomena. These are evidenced mainly by connective tissue proliferation around or within the tumor mass. A demarcation zone may thus be formed and serve to limit the further extension of the growth. In the absence of such a zone, the surrounding tissues show changes indicative of gradual destruction before becoming invaded by and transformed into a mass of carcinoma cells. The further from the tumor, the less evidenced are these changes: rarefaction of the parenchyma with formation of a glia reticulum, hyperemia, deposits of colloid substances, lipoids and amyloid bodies. The further spread of the tumor may be limited by the development of a demarcation zone or

10. Weed, L. H.: I. Studies on Cerebrospinal Fluid. II. The Theories of Drainage of Cerebrospinal Fluid with an Analysis of the Methods of Investigation, J. Med. Res. **26**:21, 1914-1915. III. The Pathways of Escape from the Subarachnoid Spaces with Particular Reference to the Arachnoid Villi, ibid., 51, 1914-1915. IV. The Dual Source of the Cerebrospinal Fluid, ibid., 93, 1914-1915. The Anatomical Consideration on Cerebrospinal Fluid, Anat. Rec. **12**:461, 1917-1918.

11. Hassin, G. B.: Histopathology of Carcinoma of the Cerebral Meninges, Arch. Neurol. & Psychiat. **1**:705 (June) 1919. Histopathology of Brain Abscess with Remarks on Intraspinal Therapy, ibid. **3**:616 (June) 1920.

be continued progressively by the formation of fresh transition zones. Even when a well marked demarcation zone is established, the carcinoma cells spreading along the perivascular spaces may lead to the formation of fresh miliary foci in regions more or less remote from the original focus and may even reach the pia-arachnoid. A cerebral carcinoma is thus propagated not only by direct continuity through the progressive infiltration of adjacent areas but also by way of metastases carried along the adventitial spaces of Virchow-Robin.

In addition to these two agencies—infiltration and metastasis—cerebral carcinoma also damages the brain tissues by chemical or toxic action. This is evidenced by the diffuse encephalitis. The toxic manifestations are especially marked in the foci themselves where the ganglion cells appear liquefied and invaded by cancer cells. Such cell invasion was not constant, being absent in the majority of our cases. It has not been mentioned in the literature. Fischer[6] alone described something resembling it in the envelopment of the bodies and processes of the ganglion cells by cancer cells. They filled up what he thinks are the pericellular spaces but did not invade the cells themselves.

In the majority of our cases no ganglion cells were found in the foci, which appeared necrotic or contained areas of so-called degenerative softening. Both the necrosis and softening are final stages in the parenchymal destruction. Their occurrence depends not only on the age of the focus but also on the virulence of the toxins elaborated by the tumor cells, deficient blood supply and purely mechanical factors (accumulation of vast numbers of cells). Of these factors—toxic, mechanical, trophic—the first is certainly the most important. In all probability it is responsible for many nervous and mental symptoms presented by patients with brain carcinoma which cannot be accounted for by focal lesions.

CONCLUSIONS

1. The brain lesions caused by carcinomatous growth are both focal and diffuse.

2. The focal lesions are due to direct invasion by carcinoma cells. The diffuse lesions are of the type of a toxic (noninfiltrative) encephalitis.

3. Reactive phenomena are mainly of connective tissue and may result in the formation of a demarcation zone.

4. In the absence of a demarcation zone a transition zone is constant and indicates destruction of the adjacent parenchyma prior to invasion by carcinoma cells.

5. Propagation of the tumor takes place by infiltration and along perivascular spaces.

6. Reactive phenomena occur in the pia-arachnoid and in the choroid plexus.

DISCUSSION

Dr. Adolf Meyer, Baltimore: These pictures of invasion of an area outside of the demarcation zone appear to me to be a demonstration of the chance for immigration into those regions, even if there is not the preformed space. In the examination of kindred specimens, I feel that the diffuse neighborhood invasions are relatively rare, when one deals with a large focal metastasis. It is evidently rather the unusual case that shows that biologic injection process.

With regard to the conception of an encephalitis, I am not quite as sympathetically disposed. I think it is extremely difficult to differentiate simple degenerative processes from anything which would be a toxic process of a more inflammatory character. It is difficult to know what circulatory or pressure disturbance may have been at the bottom of some of those neighborhood reactions. They are practically the same in all conditions which are space consuming, and that makes me rather suspicious of its being essentially a degenerative pressure effect and not so certainly a toxic effect.

Dr. Hassin, in closing: When I designated the changes in the cerebral tissues not invaded by the carcinoma toxic encephalitis, Dr. Singer strongly objected. He offered to call the condition degenerative encephalitis; but the latter term is as improper and misleading as that of degenerative myelitis, and therefore I retained the name "toxic."

The invasion of the so-called pericellular spaces by cancer cell bodies has been described by only one author, Oscar Fischer, of Prague. In 1904, he published a case of cerebral carcinoma in which the cancer cells were crowding the dilated spaces around the ganglion cells. Such spaces, however, are most likely artefacts.

METABOLISM STUDIES IN DEMENTIA PRAECOX AND MANIC-DEPRESSIVE INSANITY*

SECOND PAPER: GLYCEMIC REACTION TO THE INTRAMUSCULAR ADMINISTRATION OF EPINEPHRIN

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AND
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In view of the variant blood sugar tolerance reaction reported in dementia praecox and manic-depressive insanity [1] as compared to the so-called normal response, it was considered that it might prove of some value to study a group of such cases from the point of view of glycemic response to the intramuscular administration of epinephrin. Although the reaction in normal subjects to this reagent has not as yet been unequivocally established, fairly conclusive findings have been reported. Thus Hamman and Hirschman,[2] in a series of seven normal persons, who, after an overnight fast, were given 50 gm. (771.6 grains) of glucose by mouth, report the reaction as attaining its peak in one hour after the administration of from 0.66 to 1 mg. of epinephrin with complete subsidence at the end of the second hour, the reaction having been followed for three hours. Definitely delayed reaction was noted in persons with diabetes; and Cowie and Beaven [3] more recently, on the basis of data secured in the study of two normal subjects after the injection of 1 mg. of epinephrin, determined the reaction acme as occurring from the end of the first to the end of the second hour with subsidence by the end of the third hour. Estimates made at the end of the fifth hour showed a slight depression in the curve below the fasting level. In a series of influenza and influenzal pneumonia cases these authors found the reaction was definitely delayed, and on this basis they considered the possibility of endocrine dysfunction in such cases, particularly of the suprarenal system.

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* From the State Psychopathic Hospital, Ann Arbor, Mich.

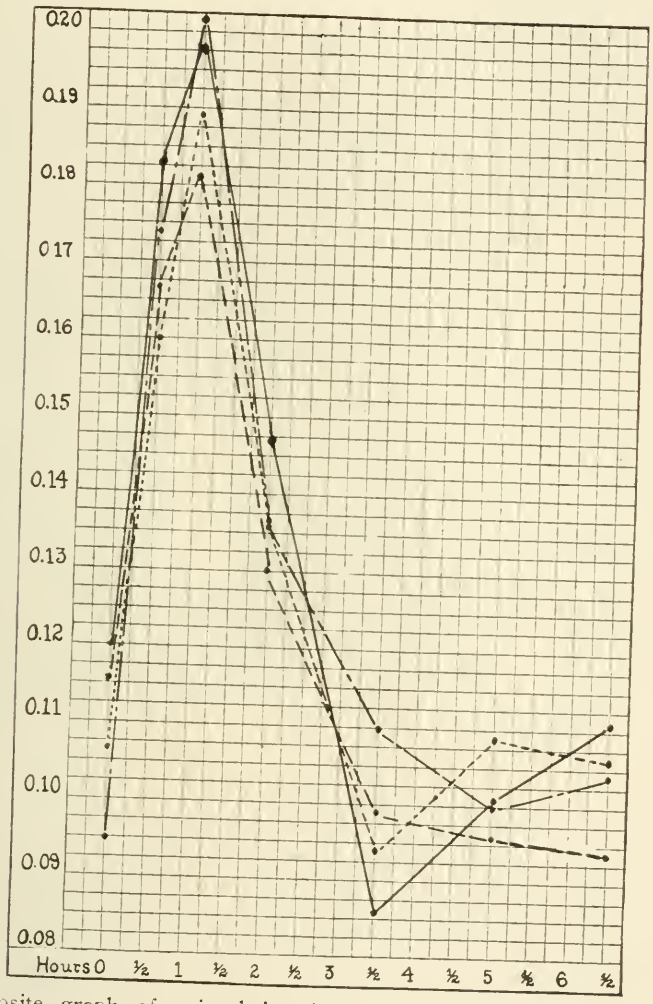
1. Kooy, F. H.: Hyperglycemia in Mental Disorder, Brain **42**:214 (Oct.) 1919. Raphael, T., and Parsons, J. P.: Blood Sugar Studies in Dementia Praecox and Manic-Depressive Insanity, Arch. Neurol. & Psychiat. **5**:687 (June) 1921.

2. Hamman, L., and Hirschman, I.: Studies on Blood Sugar—Alimentary Hyperglycemia and Glycosuria as a Test of Sugar Tolerance, Arch. Int. Med. **20**:762 (Dec.) 1917.

3. Cowie, D. M., and Beaven, P. W.: On the Clinical Evidence of Involvement of the Suprarenal Glands in Influenza and Influenzal Pneumonia, Arch. Int. Med. **24**:78 (July) 1919.

PROCEDURE

Comprising the present series (Table 1) there were three normal controls, nine cases of dementia praecox (including simplex, hebephrenic, paranoid and catatonic types) and six cases of manic-depressive insanity (including three patients in the excited or agitated phase and



Composite graph of epinephrin glycemia. The continuous line indicates the blood sugar percentage in normal persons; the short and long dashes, in patients with dementia praecox; the short dashes, in manic-depressive (excited) patients; the long dashes, in manic-depressive (depressed) patients.

three in the depressed phase). The psychotic subjects were all in the acute phase of their specific disorders.

The exact procedure employed in this study may be detailed as follows: After an overnight fast (6 p. m. to 7 a. m.), initial or

control blood samples were drawn and 1 mg. of epinephrin (1 c.c. of epinephrin chlorid, Parke, Davis & Company) was administered intramuscularly. Following this, blood samples were drawn after half an hour, one hour, two hours, three and one-half hours, five hours, and six and one-half hours, and blood sugar determinations made essentially according to the Lewis-Benedict method, as described in full in an earlier paper by Raphael and Parsons.[1] No food was given during the experiment period, and the subjects were kept at absolute rest as far as possible.

Abstracts of Cases 6, 7, 9, 10 and 15 follow; abstracts of the remaining cases were prepared in connection with the first report, already mentioned, and may there be found.

TABLE 1.—Series of Normal Persons and Patients Studied by Authors

Number	Case	Age	Sex	Type	Grade
Normal Subjects—					
1	W. A.	25	Male		
2	T. D.	38	Male		
3	A. N.	18	Male		
Psychotic Subjects—					
Dementia Praecox:					
4 (10) S.P.H. 2590	C. M.	22	Male	Simplex	Acute
5 (9) S.P.H. 2589	L. H.	19	Male	Hebephrenic	Acute
6 S.P.H. 3102	J. M.	21	Male	Hebephrenic	Acute
7 S.P.H. 3159	H. B.	29	Female	Hebephrenic	Acute
8 (11) S.P.H. 2528	H. T.	27	Female	Hebephrenic	Acute
9 S.P.H. 2987	B. K.	28	Female	Hebephrenic	Acute
10 S.P.H. 3144	M. T.	34	Female	Catatonic	Acute
11 (15) S.P.H. 2410	F. W.	20	Female	Paranoid	Acute
12 (8) S.P.H. 2560	N. S.	25	Male	Paranoid	Acute
Manic-Depressive Insanity:					
13 (22) S.P.H. 2610	R. W.	23	Male	Hypomanic	Acute
14 (29) S.P.H. 2597	A. R.	32	Female	Agitated depression	Acute
15 S.P.H. 3109	E. O.	29	Female	Manic	Acute
16 (25) S.P.H. 2566	R. R.	37	Female	Depressive	Acute
17 (23) S.P.H. 2582	M. L.	28	Female	Depressive	Acute
18 (24) S.P.H. 2583	M. P.	36	Female	Depressive	Acute

REPORT OF CASES

Case 6.—Diagnosis: dementia praecox, hebephrenic type.

J. M., a young man, single, aged 21, was admitted to the hospital May 21, 1921. His mother and sister had been committed to the Newberry State Hospital, with cases diagnosed as dementia praecox. His personal history was negative until the beginning of the present trouble. For about three weeks prior to admission the patient had become seclusive, irritable, suspicious, destructive and impulsive, with ideas of reference and various somatic complaints. Under observation in the State Psychopathic Hospital the patient was found to be definitely autistic, poorly accessible, apparently disoriented and indifferent and had marked affective deterioration. There was also evidence of auditory hallucinosis of an essentially erotic nature, grimacing and silly, apparently unmotivated laughter, and an occasional homicidal impulse.

Physical and neurologic examinations were essentially negative.

At the time this study was made the psychiatric status was still definitely as described.

Case 7.—Diagnosis: dementia praecox, hebephrenic type.

H. B., a man, single, aged 29, admitted to the hospital July 28, 1921, had a negative family history. His personal history was apparently negative until the beginning of the present trouble which was reported to have had its onset after an "indefinite illness" while he was in the service in 1918. He became disoriented, confused and hallucinated. Following admission to the State Psychopathic Hospital the patient was definitely autistic, disoriented, somewhat confused, obviously indifferent and apathetic and presented marked delusional thought content of an extremely fantastic nature associated with auditory and visual hallucinosis and a tendency toward attitudinizing of a symbolic nature, unmotivated laughter and lack of insight.

Physical and neurologic examinations were essentially negative. At the time this study was made the psychiatric status was still definitely as described.

Case 9.—Diagnosis: dementia praecox, hebephrenic type.

B. K., a woman, single, aged 28, admitted to the hospital Dec. 19, 1920, had a negative family history with the exception of epileptiform attacks in a brother and "nervous trouble" in one sister. The patient was considered normal mentally. She had graduated from a normal school. Since then, until the beginning of the present trouble, she taught school or was engaged in responsible work of a clerical nature. From an early age the patient had been reported as shy, particularly with reference to the opposite sex, somewhat seclusive and reticent about personal matters and subject to frequent episodes of depression. In June, 1920, she suffered a short period of depression for several days, after which she became noisy, excited and definitely hallucinated, with a prominent delusional trend. After about six weeks the patient was found to have become somewhat apathetic. After admission to the State Psychopathic Hospital Dec. 11, 1920, she was poorly accessible, indifferent and apathetic with reference to her surroundings. She refused food and was untidy in her personal appearance. She exhibited a definitely schizophrenic trend with marked delusions somewhat fantastic in type, hallucinations, ideas of reference and influence, unmotivated laughter and evidence of mannerisms.

Physical, neurologic and laboratory examinations were negative.

At the time this study was made the patient had become somewhat less agitated but otherwise there was no change in the initial condition.

Case 10.—Diagnosis: dementia praecox, catatonic type.

M. T., a woman, married, aged 34, admitted to the hospital July 13, 1921, had a negative family history. Her infancy and childhood were reported as essentially normal. She was fairly successful in school, having attained the sixth grade at the age of 12. She married at the age of 27 and had one child. She had complained of vague gastro-intestinal disturbance for some years and had never been really sturdy. About a year ago the patient had become somewhat exhausted physically, indifferent and apathetic, showing definite evidence of delusional trend and hallucinosis associated with episodes of acute excitement with vague paranoid trend and evidence of suicidal intent. Following admission to the State Psychopathic Hospital on July 13, 1921, the patient was extremely negativistic, resistive, mute and untidy. She refused food and frequently drooled. The patient was definitely autistic and assumed stereotyped postures.

Physical, neurologic and laboratory examinations were negative.

At the time this study was made the psychiatric status was definitely as described.

Case 15.—Diagnosis: Manic-depressive insanity; manic insanity, third attack.

E. O., a woman, married, aged 29, was admitted to the hospital May 31, 1921. Her maternal grandfather was reported to have had a "nervous breakdown" at 50, lasting six months. Her paternal grandmother was reported to have suffered a psychotic episode characterized by delusional trend, following confinement. The maternal line in general is reported as prone to "emotional weakness." Her personal history was negative with the exception of typhoid at the age of 16. She was married at 21 and had four children. She is reported to have been sociable, of pleasant disposition and to have had many personal friends. She suffered a mild attack of depression while at school at the age of 20, lasting two weeks. The second attack of depression was noted in 1920, following influenza complicated by sinusitis, during which she was committed to this hospital, having been discharged as improved on April 13, 1920. The present attack began about December, 1920, and was characterized by restlessness, instability of purpose and social overactivity. The patient was admitted to the State Psychopathic Hospital May 13, 1921, in a state typically characteristic of manic excitement, showing marked flight of ideas, very much increased psychomotor activity, extremely hypersthenic trend, distractibility and irritability on interference. She did not eat unless fed, was untidy about her personal appearance and slept little.

Physical, neurologic and laboratory examinations were negative.

At the time this study was made the psychiatric status was definitely as described.

DISCUSSION

The data secured in this study were tabulated as indicated in Table 2. It will be noted that there is sufficient agreement as respects the individual group cases to warrant the use of a composite graph for the purpose of securing more direct comparison.

On analysis it appears that in two of the normal subjects the reaction acme was reached at the end of thirty minutes, and in one at the end of one hour; in the case of the psychotic subjects, with one exception (Case 8), the reaction peak seems to have occurred at the end of one hour. Among the normal persons subsidence occurred in one case at the end of the second hour, but in the other two did not take place until after three and one-half hours, thus affording essential agreement with the observations of both Hamman and Hirschman and Cowie and Beaven. It should be noted, too, that in these normal cases the point of minimum glycemia or what might be termed the reaction pit is definitely below the individual fasting level and was noted in all three cases at the end of the three and one-half hour period, and that following this there is seen to be a somewhat gradual but definite return to the initial level which seems to have been practically reattained by the end of six and one-half hours. This drop below the fasting level or reaction pit with subsequent rebound, although partially indicated in the work of Hamman and Hirschman and of Cowie and Beaven, had not been specifically described by these authors.

As regards the response among the psychotic subjects, it will be noted that, although the general topography of the reaction curve

definitely resembles that noted in the controls, particularly through the first three and one-half hours, there are nevertheless certain definite points of difference. Thus it seems that in the excited and depressed phases of the manic-depressive group the point of maximum glycemia is below the acme level reached by the normal cases and the cases of dementia praecox. Also, and of somewhat more importance, it will be noted that the excited patients in the manic-depressive group seem to manifest clearly the control trend, presenting the characteristic subfasting level reaction pit described in this group followed by definite rebound to just above the initial level. In patients with

TABLE 2.—Chronologic Analysis of Epinephrin Glycemia (Percentage)

Case	Fasting	After ½ Hr.	After 1 Hr.	After 2 Hrs.	After 3½ Hrs	After 5 Hrs.	After 6½ Hrs.
Normal Subjects—							
1. W. A.	0.115	0.120	0.200	0.180	0.076	0.080	0.100
2. T. D.	0.120	0.205	0.192	0.156	0.095	0.105	0.115
3. A. N.	0.125	0.225	0.200	0.105	0.089	0.120	0.120
Average	0.120	0.183	0.198	0.147	0.086	0.101	0.111
Psychotic Subjects—							
Dementia Praecox:							
4. C. M.	0.095	0.105	0.120	0.110	0.100	0.080	0.100
5. L. H.	0.084	0.130	0.185	0.112	0.198	0.110	0.100
6. J. M.	0.116	0.172	0.215	0.165	0.096	0.114	0.117
7. H. B.	0.122	0.186	0.196	0.113	0.090	0.129	0.135
8. H. T.	0.074	0.180	0.166	0.070	0.172	0.082	0.071
9. B. K.	0.122	0.238	0.266	0.173	0.108	0.102	0.118
10. M. T.	0.094	0.239	0.279	0.266	0.135	.....	0.095
11. F. W.	0.085	0.182	0.222	0.112	0.072	0 076	0 098
12. N. S.	0.080	0.140	0.166	0.128	0.120	0.110	0.110
Average	0.095	0.174	0.201	0.137	0.110	0.100	0.104
Manic-Depressive Insanity:							
Excited type:							
13. R. W.	0.100	0.145	0.190	0.105	0.051	0.098	0.095
14. A. R.	0.094	0.125	0.125	0.120	0.115	0.120	0.090
15. E. O.	0.129	0.212	0.253	0.183	0.111	0.109	0.137
Average	0.107	0.160	0.189	0.136	0.092	0.109	0.106
Depressive type:							
16. R. R.	0.110	0.181	0.195	0.140	0.085	0.088	0.100
17. M. L.	0.120	0.180	0.200	0.125	0.092	0.092	0.084
18. M. P.	0.120	0.140	0.150	0.125	0.120	0.110	0.100
Average	0.116	0.167	0.181	0.130	0.099	0.096	0.094

dementia praecox and in the depressed phase of the manic-depressive psychosis, the drop at the three and one-half hour point is definitely less than that of the controls and of the excited manic patients, and instead of showing a rebound trend from this point, continues to drop gradually. In the depressed phase of manic-depressive psychosis there is no tendency to rebound, and in the dementia praecox cases practically none. In these groups the reaction pit is practically absent, and among the praecoxes the curve does not descend below the original fasting level. These departures may possibly be of significance from the point of view of specific metabolic difference, particularly so in view of the apparent deviation as already reported in such cases, in blood sugar

tolerance. Among the dementia praecox cases, so far as could be determined, there was no evidence of variant reaction dependent on subgrouping or type, although manifestly this series was too small to warrant legitimate deduction in this regard.

CONCLUSION

On the basis of the data secured in this study of three normal persons and fifteen psychotic subjects (dementia praecox and manic-depressive insanity), it appears that in normal persons the blood sugar rise following the intramuscular injection of 1 mg. of epinephrin is maximal in from thirty minutes to one hour with subsidence in three and one-half hours. This is in accord with the findings reported by Hamman and Hirschman and by Cowie and Beaven. The reaction pit or point of minimal glycemia is definitely below the initial fasting level following which there is a definite rebound to approximately this level. Further, it appears that among the psychotic subjects the general contour is essentially the same as among normal persons for the first three and one-half hours, following which, however, the depressed and dementia praecox cases become variant in that a further gradual drop is noted with slight or no indication of rebound, a deviation which conceivably may be of basic metabolic import.

THE DETERMINATION OF SODIUM, POTASSIUM, CALCIUM AND MAGNESIUM IN THE BLOOD AND SPINAL FLUID OF PATIENTS SUFFERING FROM MANIC-DEPRESSIVE INSANITY

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Ringer in a number of papers beginning in 1880 showed the necessity for a proper balance between sodium, potassium and calcium in the fluids of organisms. Loeb, in 1889, showed that electrolytes cause twitching of the muscles while nonelectrolytes have no such effect, and in many subsequent papers pointed out the necessity of physiologically balanced solutions. Howell, in 1898, emphasized the importance of calcium in relation to various activities of the organism. Weed and Wegeforth,[1] while studying the effects of irrigation of the subarachnoidian space in cats, noted a peculiar psychic disturbance following the use of sodium chlorid solution. They first used a modified Ringer's solution made up of sodium chlorid, 0.9 per cent.; calcium chlorid, 0.024 per cent., and potassium chlorid, 0.042 per cent. The subarachnoidian space from the vertex area or the cysterna magna to the lumbar area was irrigated with this fluid. The time required was one hour, and the irrigating solution was at a pressure of 400 mm. of water. The animals recovered from the anesthetic normally and remained well.

When a solution of pure sodium chlorid was used the results were very different. The authors mentioned state that while the saline is passing through the meninges frequent neuromuscular phenomena of irritation are shown. Animals not immediately dying from the irrigation usually exhibit extreme convulsions and maniacal attacks, the irritability enduring at times for several days. No essential difference in reaction was noted when solutions ranging from 0.7 to 1 per cent. of sodium chlorid in distilled water were used.

During the several days succeeding irrigation with the sodium chlorid solution "the clinical course was rather typical and was characterized by frequent convulsions and attacks of acute mania, during which there would be erection of the hair, bushing of the tail, dilatation of the eyes, aimless biting and an uncovering of the claws." In the protocol of Cat 22 it is stated: "Animal having marked convulsions. Is furiously insane and is biting itself. The next day the cat showed evidence of an acute mania."

1. Weed and Wegeforth: Jour. Pharmacol. & Exper. Therap. **13**:317, 1919.

Irrigation with solutions containing sodium and calcium had the same effect as irrigation with the modified Ringer's solution. Solutions of sodium and potassium were highly toxic and caused death before the completion of one hour's irrigation. The toxic effects were practically the same as those of pure sodium chlorid solutions.

It occurred to us that since an absence of calcium in the irrigating fluid was accompanied by such great irritability and even maniacal attacks in cats, that the maniacal activity of patients with manic-depressive insanity, though the symptoms are hardly comparable, might be associated with a deficiency of calcium in the blood or spinal fluid or both. An excess of calcium might be associated with the depressed phase of the same type of patient, and if such an association should exist, it would be demonstrable. Furthermore, if the association exists, restoration of the salt balance by the use of calcium in manic states and of sodium in the depressed states might be of therapeutic value. Several simple methods, recently reported, have made it possible to determine with a fair degree of accuracy the amounts of sodium, potassium, calcium and magnesium in small quantities of blood or spinal fluid.

The results of the usual routine examination of the blood and spinal fluid furnished the material, only frank cases being used. Both fluids were collected at the same time, in the morning before breakfast, and were examined at once. The technic employed was that of Kramer and Tisdall.[2] The blood was defibrinated as soon as drawn and centrifugalized. The clear serum was pipetted off and the analyses begun immediately. Eight cubic centimeters of serum and 12 c.c. of spinal fluid were required and were distributed as follows:

For Sodium	
2 c.c. serum	2 c.c. fluid
1 c.c. plus 1 c.c. sodium solution	1 c.c. fluid plus 1 c.c. sodium solution
2 c.c. sodium solution	
For Potassium	
1 c.c. serum	2 c.c. fluid
1 c.c. serum plus 1 c.c. potassium solution	1 c.c. fluid plus 1 c.c. potassium solution
2 c.c. potassium solution	
For Calcium and Magnesium	
2 c.c. serum	4 c.c. fluid
1 c.c. serum plus 1 c.c. each of calcium and magnesium solutions	2 c.c. fluid plus 1 c.c. each of calcium and magnesium solutions
1 c.c. calcium plus 1 c.c. magnesium solution	

The control solutions contained sodium, 2.5 mg. per c.c.; potassium, 0.2 mg. per c.c.; calcium, 1 mg. per c.c.; magnesium, 0.025 mg. per c.c.

The errors in analyses as checked by the controls were in no case over 3 per cent. and the average was 1 + per cent.

2. Kramer and Tisdall: Bull. Johns Hopkins Hosp. **32**:44, 1921; J. Biol. Chem. **46**:339, 472, 1921.

The potassium content of the spinal fluid as reported varies considerably. Mestrezat [3] found 20.8 mg. per 100 c.c., of 20 mixed normal spinal fluids. Myers [4] found an average of 19.2 mg. per 100 c.c. in fifteen cases of various psychoses, eleven of which were cases of paresis. He calls attention to the necessity of obtaining the fluid before death. Rosenbloom and Andrews [5] tabulated the estimations found in the literature. The amounts varied from 14.1 to 118.9 mg. per 100 c.c. These authors found amounts ranging from 14.1 to 111.9 mg. in a series of cases including three normal subjects, three cases of paresis, eight of cerebrospinal syphilis, five of dementia præcox, one each of tertiary spyhilis, typhoid fever, presenile dementia, chronic alcoholism, encephalitis and meningitis and two each of tuberculous meningitis, acute alcoholism and neurasthenia.

The sodium content is given by Mestrezat as 323 mg. per 100 c.c. and the magnesium as 3.0 mg. The calcium content is generally accepted as being between 4.5 and 6.0 mg. per 100 c.c.[6] The potassium content of serum as reported is more constant in amount. Schmidt [7] gives 31 and 33 mg. for two normal subjects, Macallum,[8] 19 to 21 mg., Myers and Short [9] rather less than 20 mg. These authors point out the necessity of obtaining the serum almost immediately from the clot and of obtaining the blood during life. Kramer and Tisdall [2] found 18 to 21 mg.: Simon,[10] 32.1 to 33.3 mg. Macallum points out that Schmidt's figures are rather high. This is true also of Simon's figures.

The sodium found in serum by Kramer and Tisdall [2] averaged 337 mg. per 100 c.c. in ten normal subjects, nine of whom were under 11 years of age, and one was an adult. Simon [10] gives 319 mg.; Schmidt, 344 mg., and Mestrezat, 255 mg. per 100 c.c.

The magnesium in serum found by Kramer and Tisdall in four normal adult males varied from 2.1 to 2.9 mg. and averaged 2.7 mg. per 100 c.c. Mestrezat gives 4.4 mg. as normal; Marriott and Haessler [11] 2.2 to 3.5 mg. and Denis,[12] 1.6 to 3.5 mg.

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3. Mestrezat: J. de pharm. et de chim. **29**:472, 1909.

4. Myers: J. Biol. Chem. **6**:115, 1909.

5. Rosenbloom and Andrews: Arch. Int. Med. **14**:536, 1914.

6. Halverson, Mohler and Bergeim: J. Biol. Chem. **30**:121, 1917; **29**:337, 1917; **32**:159, 1917. Denis and Minot: Ibid. **41**:359, 1920. Kramer and Howland: Ibid. **43**:35, 1920. Jones and Nye: Ibid. **47**:321, 1921. Marriott and Haessler: Ibid. **32**:233, 1917.

7. Schmidt, quoted by Myers and Short: J. Biol. Chem. **48**:83, 1921.

8. Macallum: Tr. College Phys., Philadelphia, Ser. 3, **39**:286, 1917.

9. Myers and Short: J. Biol. Chem. **48**:83, 1921.

10. Simon: Text Book of Physiological Chemistry, Ed. 3, Lea Brothers, 1907, p. 334.

11. Marriott and Haessler: J. Biol. Chem. **32**:233, 1917.

12. Denis: J. Biol. Chem. **41**:363, 1920.

The calcium content varies from 9 to 12 mg. per 100 c.c.

The tables include only those cases diagnosed as manic-depressive psychoses, manic or depressed phase. The Wassermann reaction, globulin tests and colloidal gold curve were negative in all cases.

TABLE 1.—Sodium, Potassium, Calcium and Magnesium in Blood and Spinal Fluid of Patients Suffering from the Manic Phase of Manic-Depressive Insanity

Case	Age	Duration		Sodium		Potassium		Calcium		Magnesium	
		Total	Attack	Blood, Mg.	Fluid, Mg.	Blood, Mg.	Fluid, Mg.	Blood, Mg.	Fluid, Mg.	Blood, Mg.	Fluid, Mg.
11361	18	4 yr.	6 mo.	322	325	21.2	12.9	11.2	5.0	2.3	2.4
11385	20	3 mo.	3 mo.	334	340	18.6	11.6	11.0	5.0	2.7	2.7
11301	22	6 mo.	6 mo.	330	330	20.6	13.0	10.5	5.1	2.3	2.3
11327	23	6 mo.	6 mo.	330	330	30.5	15.0	10.1	5.0	2.4	2.3
11249	24	3 mo.	3 mo.	334	331	19.5	14.0	9.8	5.0	2.4	2.1
11407	26	8 yr.	3 mo.	331	335	18.6	11.6	11.0	5.0	2.3	2.4
11808	26	6 yr.	6 mo.	333	331	20.5	12.6	10.0	5.0	2.1	2.4
11120	26	5 mo.	5 mo.	334	340	23.2	13.0	10.0	5.0	2.2	2.3
11340	26	5 mo.	5 mo.	329	330	20.0	14.0	10.0	5.0	2.4	2.3
11273	33	2 yr.	6 mo.	328	322	21.6	12.9	9.9	5.1	2.4	2.2
11083	35	1 yr.	1 mo.	322	324	20.6	13.2	10.0	5.1	2.3	2.3
11373	40	6 yr.	7 mo.	343	346	25.0	11.0	11.5	5.5	2.1	2.3
11344	52	4 yr.	2 mo.	337	337	23.0	12.0	12.0	5.5	2.3	2.3
8475	54	19 yr.	2 wk.	343	343	24.0	13.1	11.0	6.0	2.4	2.4
11322	54	18 yr.	2 mo.	325	327	23.0	13.5	10.0	5.2	2.4	2.4
11292	57	4 yr.	4 mo.	339	343	19.5	12.1	9.5	5.0	2.6	2.5
7322	60	12 yr.	1 mo.	329	329	19.0	12.4	10.0	5.0	2.3	2.3
Average				332	333	21.7	12.8	10.4	5.2	2.4	2.4
Maximum				343	346	30.5	14.0	12.0	6.0	2.7	2.7
Minimum				322	322	18.6	11.0	9.5	5.0	2.1	2.1

TABLE 2.—Sodium, Potassium, Calcium and Magnesium in Blood and Spinal Fluid of Patients Suffering from the Depressed Phase of Manic-Depressive Insanity

Case	Age	Duration		Sodium		Potassium		Calcium		Magnesium	
		Total	Attack	Blood, Mg.	Fluid, Mg.	Blood, Mg.	Fluid, Mg.	Blood, Mg.	Fluid, Mg.	Blood, Mg.	Fluid, Mg.
11358	18	4 mo.	4 mo.	297	303	20.0	12.1	9.0	5.0	2.7	2.7
11377	25	3 mo.	3 mo.	343	346	19.5	12.1	10.0	5.5	2.5	2.6
11422	30	5 mo.	5 mo.	334	328	19.2	12.1	9.0	5.1	2.4	2.7
11283	32	7 mo.	7 mo.	328	329	22.0	13.0	12.7	6.0	2.3	2.4
11083	35	1 yr.	2 wk.	339	341	21.5	13.0	12.0	6.0	2.3	2.3
11274	38	7 mo.	7 mo.	334	334	32.0	15.0	11.7	5.8	2.4	2.4
11081	38	1 yr.	1 yr.	328	314	23.1	11.6	10.0	5.0	2.7	2.7
11315	40	6 mo.	6 mo.	334	334	19.2	13.3	10.0	6.0	2.3	2.3
9200	41	10 yr.	2 yr.	334	340	20.7	12.1	10.1	5.0	2.4	2.4
11190	57	3 mo.	3 mo.	329	315	22.7	12.9	11.3	5.0	2.4	2.5
Average				330	328	22.0	12.7	10.6	5.4	2.4	2.5
Maximum				343	346	32.0	15.0	12.7	6.0	2.7	2.7
Minimum				297	303	19.2	11.6	9.0	5.0	2.3	2.3
Average, manics				330	328	22.0	12.7	10.6	5.4	2.4	2.5
Average, depressed				332	333	21.7	12.8	10.4	5.2	2.4	2.4

Seventeen cases of mania and ten of depression are recorded. The duration of the present attack varies from two weeks to seven months in patients suffering from the manic phase of manic-depressive psychosis and from two weeks to two years in those suffering from the depressed phase. The ages varied from 18 to 60 years.

It is quite evident that there is no variation of the calcium content from the normal in either mania or depression. There is distinctly less potassium in the fluid than has been reported by others in conditions other than manic-depressive insanity. A number of determinations, not included in the tables, were made with the fluid from patients with paresis, dementia præcox, epilepsy and primary lateral sclerosis. The findings were the same as those given in the tables. A sufficient number of observations on the sodium, potassium and magnesium content of normal spinal fluid have not been recorded to warrant any conclusions regarding the significance of the potassium findings in our cases.

SUMMARY

In order to determine whether the manic and depressed phases of manic-depressive insanity are associated with an alteration of the normal balance of sodium, potassium, calcium and magnesium in the blood and spinal fluid, analyses were made of these two fluids in seventeen cases of mania and in ten of depression. The average of these elements was practically the same in both states, and the individual variations from the average were small. The average sodium content of the blood and fluid in mania was 332 and 333 mg. and in depression, 330 and 328 mg. The results with potassium were also constant—mania, blood and fluid, 21.7 and 12.8 mg.; depression, 22 and 12.7 mg. The blood and fluid calcium in mania was 10.4 and 5.2 mg. and in depression, 10.6 and 5.4 mg. Magnesium in mania showed 2.4 mg. for the blood and the same amount for the fluid; in depression the figures were 2.4 and 2.5 mg. The normal calcium content of the blood and spinal fluid may be considered as having been established, but reports of the sodium, potassium and magnesium content of the blood and more especially of the spinal fluid are unfortunately few, and the results are conflicting. In the absence of any long series of analyses of normal blood and spinal fluid for the foregoing three elements, no conclusions regarding our findings can be drawn. With respect to calcium our results show that in the cases here recorded there was no variation from the normal in either blood or spinal fluid.

SUGAR TOLERANCE IN DEMENTIA PRAECOX AND OTHER MENTAL DISORDERS

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Normally during a fasting period the blood sugar maintains a fairly constant level. The figures for normal persons obtained by various investigators are: Bang,[1] 0.10 per cent.; Myers and Bailey[2] (500 cases), 0.09 to 0.11 per cent.; Williams and Humphrey[3] (thirty-nine cases), 0.11 per cent. and (seventy-four cases) 0.107 per cent.; Liefman and Stern,[4] 0.105 per cent. Weston,[5] in a series of mental cases, found a blood sugar content ranging from 0.085 to 0.122 per cent., figures well within normal limits.

The blood sugar content may vary from a variety of causes. Not only does diet affect the sugar concentration but, according to Lusk[6] and Strouse,[7] variations were seemingly associated with the season of the year. Emotional states are likewise associated with changes in blood sugar concentration. Such effects were demonstrated in some of our cases. This is in accord with the observation of glycosuria during excitement by Cannon[8] and by Bohm and Hoffman[9] following painful stimulation of animals.

We, therefore, decided to note the emotional state, to insist on a preparatory period of fasting for at least twelve hours, and to have the patient maintain a recumbent position in bed under conditions of comfortable room temperature.

A normal reaction following the feeding of 100 gm. of glucose is as follows: During the first one-half hour the blood sugar rises and attains its highest level between one-half and one hour after the feeding. This rise is rarely more than from 0.04 to 0.05 per cent. Following the rise

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1. Bang, I.: Der Blutzucker, Wiesbaden, 1913.
2. Myers and Bailey: J. Biol. Chem. **24**:152, 1916.
3. Williams, J. R., and Humphrey, E. M.: Arch. Int. Med. **23**:537, 1919.
4. Liefman and Stern: Biol. Chem. Ztschr. **1**:301, 1906.
5. Weston, Paul G.: Analyses of Blood of Insane Patients, Arch. Neurol. & Psychiat. **3**:147 (Feb.) 1920.
6. Lusk, G.: Elements of the Science of Nutrition, Ed. 2, Philadelphia, W. B. Saunders Company, 1910.
7. Strouse, S.: Observations on Alimentary Hyperglycemia, Arch. Int. Med. **26**:759 (Dec.) 1920.
8. Cannon, W. B.: Bodily Changes in Pain, Fear, Hunger and Rage, New York, D. Appleton & Co., 1920.
9. Bohm and Hoffman in Cannon: Bodily Changes in Pain, Fear, Hunger and Rage, New York, D. Appleton & Co., 1920.

during the first hour there is a gradual fall until the concentration reaches its initial level, usually in from two and one-half to three hours after the feeding.

The earlier investigations of sugar tolerance were made in diseases in which disturbance of carbohydrate metabolism is the chief manifestation. Patients with diabetes gave a decidedly abnormal response after a glucose meal. The blood sugar rose slowly but reached a high concentration between the first and second hour after feeding. The rise was far above the normal and the high concentration was maintained over a much longer period. The initial level was rarely approached at the end of the third hour. In some cases a high concentration was maintained from four to five hours.

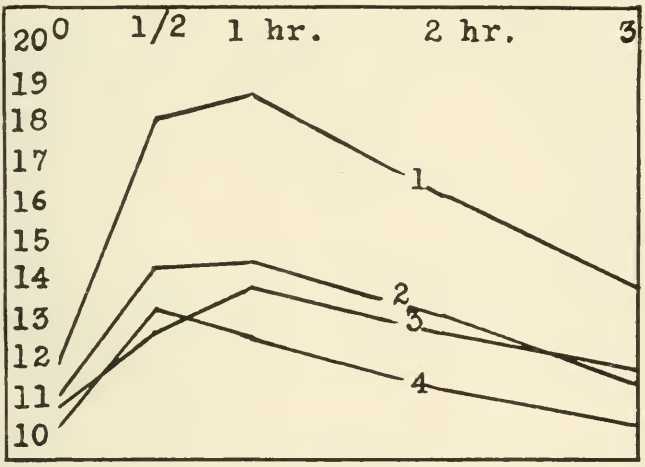

Chart 1.—The average curves of (1) catatonic patients, (2) hebephrenic patients, (3) patients with simple deteriorating praecox, and (4) patients with paresis.

Diabetes shows the highest blood sugar concentration in any disease so far reported and may reach 0.3 per cent.

A person with hyperthyroidism has also been shown to respond differently than a normal person, by Hamman and Hirschman,[10] Janney and Isaacson,[11] Geyelin,[12] Cummings and Pines,[13] Pemperton and Foster,[14] and others. In this condition the blood sugar following a sugar meal rises rapidly and reaches its highest concentration usually within the first hour; this high point averages above 0.2 per cent. During the succeeding two and one-half hours the blood sugar gradually

10. Hamman, L., and Hirschman, I. I.: Arch. Int. Med. **20**:176, 1917.
11. Janney, N. W., and Isaacson, V. I.: Arch. Int. Med. **22**:160, 1918.
12. Geyelin, H. R.: Arch. Int. Med. **16**:975, 1915.
13. Cummings, R. I., and Pines, G.: Arch. Int. Med. **19**:777, 1917.
14. Pemperton, R., and Foster, G. L.: Arch. Int. Med. **25**:243, 1920.

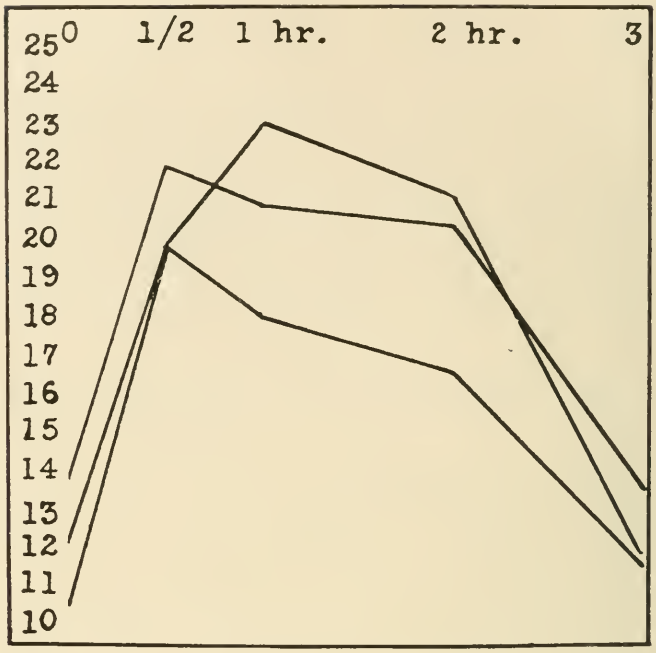

Chart 2 (Case C4).—This chart shows the similarity of response in one case of catatonia—three examinations at intervals of over four weeks.

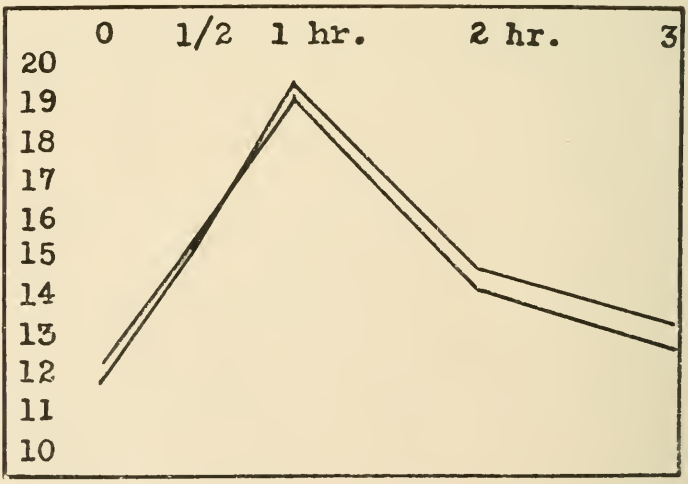

Chart 3 (Case C9, Catatonia).—Close parallelism in results of two examinations made at intervals of two weeks.

falls and approaches the initial level at the end of the third hour. These two types of response to sugar feeding are found in conditions of relatively low sugar tolerance; both show glycosuria after carbohydrate feeding. Patients with diseases of the pituitary gland and hypothyroid states show high sugar tolerance. The characteristic of this group is a reaction curve of less than normal as reported by Brock and Kaw,[15] Janney, Goodhart and Isaacson,[16] McCrudden and Sargent,[17] Knopfelmacher,[18] and others.

It may therefore be regarded as well established that certain endocrine disturbances are rather constantly associated with disturbance of carbohydrate metabolism; furthermore, that disturbance of carbohydrate metabolism can be demonstrated by tests of sugar tolerance, using as a method of investigation the hyperglycemia which follows a glucose meal.

The association of endocrine activity with mental development and mental states after maturity, the prominent rôle claimed for the endocrine glands in carbohydrate metabolism and the variations from normal reactions in clear endocrine dysfunctions, already quoted, suggested the use of this test to investigate internal gland disturbance in certain mental diseases.

Kooy, quoting W. F. Menzies,[19] reported that patients with melancholia show an abnormal response in the blood sugar for a two hour period following breakfast. Other than this we have found only an occasional case of mental disease, one paretic and several epileptic cases included among the cases reported by other investigators.

TECHNIC OF TEST

The work here reported began in November, 1920. A large series of blood examinations was made in which the method of Myers-Bailey[20] was compared with Benedict's modification[21] of the Lewis-Benedict method. It was decided to use the latter in our investigation.

Glucose was administered in 50 per cent. solution flavored with lemon juice and chilled with ice. The dose was 1.75 gm. per kilo of body weight. The feeding was given in the morning after fasting for from twelve to fourteen hours. All subjects were kept in bed

15. Brock, S., and Kaw, W. E.: Arch. Int. Med. **27**:1, 1921.

16. Janney, N. W.: Goodhart, S. P., and Isaacson, V. I.: Arch. Int. Med. **21**:188, 1917.

17. McCrudden, F. H., and Sargent, C. S.: Arch. Int. Med. **17**:465, 1916.

18. Knopfelmacher, W.: Wien. klin. Wchnschr. **17**:244, 1904.

19. Menzies, W. F.: J. Ment. Sc. **64**:275, 1920.

20. Myers and Bailey: J. Biol. Chem. **24**:147, 1916.

21. Benedict: Benedict's Modification of the Lewis and Benedict Method, J. Biol.Chem. **34**:203, 1918.

throughout the period of the test. Urine examinations were made on specimens voided during the three hours of observation. Approximately 3 to 4 c.c. of blood were taken from a vein and oxalated at once in a test tube. One sample was taken a few minutes before feeding the glucose. Subsequent samples were taken one-half hour, one, two and three hours after the glucose meal. Bedside notes were made on the emotional state, muscular activity, etc. The blood samples were all examined shortly after they were obtained, and the results are given in grams per cent.

TABLE 1.—Glucose Test in Cases of Dementia Praecox. Hebephrenic Type

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
D 1	0.094	0.125	0.145	0.122	0.12	0.051	1 hour
	0.102	0.136	0.158	0.140	0.11	0.056	1 hour
D 2	0.122	0.150	0.132	0.120	0.115	0.028	½ hour
D 3	0.110	0.146	0.115	0.115	0.102	0.036	½ hour
D 4	0.100	0.130	0.128	0.128	0.122	0.030	½ hour
D 5	0.100	0.126	0.138	0.130	0.121	0.038	1 hour
D 6	0.095	0.137	0.128	0.101	0.094	0.042	½ hour
D 7	0.126	0.155	0.145	0.136	0.129	0.029	½ hour
D 8	0.100	0.146	0.155	0.135	0.116	0.055	1 hour
D 9	0.105	0.110	0.128	0.120	0.110	0.023	1 hour
D10	0.100	0.147	0.140	0.114	0.099	0.047	½ hour
D11	0.110	0.149	0.141	0.139	0.110	0.039	½ hour
D12	0.095	0.160	0.150	0.100	0.100	0.065	½ hour
D13	0.125	0.130	0.148	0.144	0.140	0.023	1 hour
D14	0.108	0.116	0.108	0.120	0.104	0.018	2 hours
D15	0.112	0.120	0.151	0.140	0.120	0.039	1 hour
D16	0.100	0.165	0.150	0.125	0.102	0.055	½ hour
O17	0.100	0.148	0.134	0.122	0.103	0.048	½ hour
D18	0.105	0.130	0.125	0.110	0.105	0.025	½ hour
D19	0.110	0.128	0.147	0.160	0.110	0.040	2 hours
D20	0.135	0.163	0.142	0.120	0.131	0.028	½ hour
D21	0.124	0.146	0.183	0.180	0.146	0.059	1 hour
D22	0.127	0.136	0.160	0.175	0.120	0.052	2 hours
D23*	0.120	0.210	0.150	0.146	0.130	0.090	½ hour
D24*	0.100	0.160	0.175	0.145	0.085	0.075	1 hour
D25*	0.140	0.148	0.182	0.130	0.132	0.048	1 hour
Average	0.110	0.143	0.144	0.131	0.114	0.043	

* Females.

MATERIAL STUDIED

In all, 107 cases of mental disease were studied. Of this number, eighteen occurred in females. The mental diagnosis was made after a period of observation extending over several months. An effort was made to include cases that showed characteristic pictures. Of these 107 cases, 52 were diagnosed as dementia praecox, 17 as manic-depressive insanity, 7 as paresis and 3 as morphinism. The remaining 24 included feeblemindedness, epilepsy, alcoholism, involution melancholia, hyperthyroidism and a number of clinically obscure cases.

Our interest centered largely on the dementia praecox cases. The fifty-two cases in this group were subclassified into twenty-five hebephrenic, eleven catatonic, seven simple deteriorating and nine paranoid types.

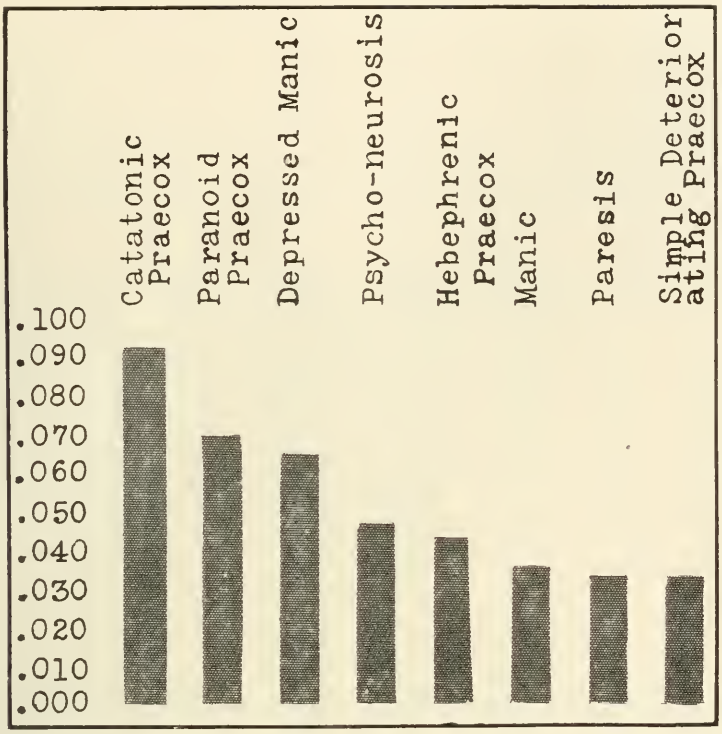

Chart 4.—Diagrammatic representation of average maximum rise of blood sugar in the various conditions noted. Horizontal line at .045 represents the average normal rise.

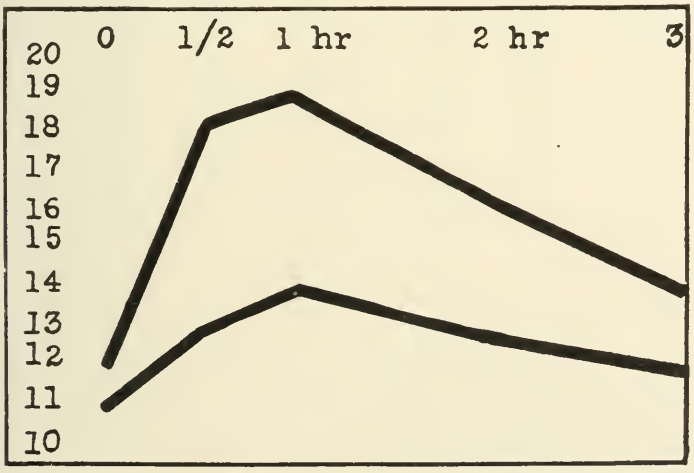

Chart 5.—The upper curve represents the average reaction in catatonic cases. The lower curve shows the average reaction in simple deteriorating dementia praecox.

DEMENTIA PRAECOX

The response to sugar feeding was practically normal in the hebephrenic type. The initial blood sugar concentration after a twelve hour fast was uniformly higher in the catatonic patients than in those with other forms of dementia praecox. The average initial level of the catatonic patients was 0.120 per cent. as compared to 0.110 per cent. for the hebephrenic patients and 0.108 per cent. for those with the simple

TABLE 2.—GLUCOSE TESTS IN CASES OF DEMENTIA PRAECOX, PARANOID TYPE

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
P D 1	0.130	0.183	0.165	0.145	0.130	0.053	½ hour
P D 2	0.150	0.215	0.185	0.180	0.175	0.065	½ hour
P D 3	0.125	0.150	0.125	0.126	0.128	0.025	½ hour
P D 4	0.130	0.210	0.165	0.138	0.136	0.080	½ hour
P D 5	0.160	0.212	0.163	0.160	0.150	0.052	½ hour
P D 6	0.105	0.150	0.126	0.125	0.115	0.045	½ hour
P D 7	0.12	0.182	0.165	0.134	0.125	0.062	½ hour
	0.145	0.165	0.210	0.186	0.144	0.065	1 hour
P D 8*	0.11	0.135	0.130	0.115	0.115	0.025	½ hour
P D 9*	0.131	0.190	0.316	0.250	0.145	0.185	1 hour
Average	0.130	0.179	0.175	0.155	0.136	0.065	

* Females.

TABLE 3.—GLUCOSE TESTS IN CASES OF CATATONIC DEMENTIA PRAECOX

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
C 1	0.118	0.218	0.140	0.130	0.121	0.100	½ hour
C 2	0.10	0.194	0.116	0.108	0.098	0.094	½ hour
	0.127	0.188	0.210	0.180	0.144	0.083	1 hour
C 3	0.095	0.166	0.131	0.121	0.100	0.071	½ hour
	0.12	0.185	0.245	0.252	0.24	0.132	2 hours
C 4	0.105	0.198	0.180	0.165	0.115	0.093	½ hour
	0.121	0.196	0.230	0.212	0.124	0.109	1 hour
	0.138	0.218	0.208	0.204	0.135	0.080	½ hour
C 5	0.108	0.166	0.214	0.165	0.106	0.106	1 hour
	0.142	0.215	0.230	0.185	0.170	0.088	1 hour
C 6	0.106	0.135	0.206	0.145	0.115	0.100	1 hour
	0.118	0.162	0.210	0.210	0.130	0.092	1 hour
C 7	0.140	0.265	0.220	0.165	0.142	0.125	½ hour
C 8	0.106	0.145	0.193	0.162	0.145	0 087	1 hour
C 9	0.118	0.152	0.195	0.146	0.134	0.077	1 hour
	0.121	0.152	0.192	0.140	0.126	0.071	1 hour
C10	0.120	0.160	0.135	0.125	0.115	0.040	½ hour
C11	0.110	0.140	0.13	0.12	0.12	0.030	½ hour
	0.130	0.160	0.255	0.224	0.15	0.125	1 hour
Average	0.118	0.179	0.191	0.166	0.133	0.089	

deteriorating type of disease. The average maximum rise of blood sugar following the glucose meal in the catatonic patients was over 0.20 per cent., in the hebephrenic 0.14 per cent. and in the simple deteriorating type 0.13 per cent. The increase of blood sugar for the catatonic patients averaged 0.094 per cent., while for the hebephrenic and simple deteriorating types the average was between 0.025 and 0.033 per cent.

The paranoid type, of which there were nine cases, also showed a reaction above normal. The average initial level was 0.130 per cent. The high point averaged 0.159 per cent., and the total increase above initial level averaged 0.046 per cent.

Of the dementia praecox group, therefore, the catatonic patients clearly showed an abnormal response that closely resembled the curve obtained in hyperthyroidism.

TABLE 4.—Glucose Tests in Cases of Dementia Praecox. Simple Deteriorating Type

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
S D 1	0.092	0.091	0.096	0.095	0.088	0.004	1 hour
	0.098	0.090	0.098	0.098	0.088	0.000	
S D 2	0.122	0.132	0.140	0.140	0.135	0.018	1 hour
S D 3	0.097	0.146	0.145	0.110	0.110	0.049	½ hour
S D 4	0.115	0.134	0.180	0.152	0.125	0.065	1 hour
S D 5	0.100	0.115	0.153	0.151	0.132	0.053	1 hour
S D 6	0.105	0.141	0.123	0.112	0.102	0.036	½ hour
S D 7	0.115	0.132	0.130	0.125	0.122	0.017	½ hour
Average	0.105	0.122	0.133	0.122	0.113	0.034	

TABLE 5.—Glucose Tests in Cases of Paresis

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
P 1	0.121	0.143	0.108	0.110	0.106	0.022	½ hour
P 2	0.094	0.105	0.130	0.105	0.10	0.036	1 hour
P 3	0.103	0.131	0.120	0.107	0.103	0.028	½ hour
P 4	0.086	0.127	0.130	0.110	0.093	0.044	1 hour
P 5	0.094	0.142	0.132	0.112	0.102	0.048	½ hour
P 6	0.113	0.151	0.130	0.117	0.111	0.038	½ hour
P 7	0.106	0.125	0.130	0.125	0.103	0.024	1 hour
Average	0.102	0.132	0.125	0.112	0.102	0.034	

PARESIS

Seven cases of paresis were included in this series. All responded in a strikingly similar manner, the uniformity of the curves being remarkable. The initial level in paresis was 0.101 per cent. The highest concentration after feeding varied from 0.110 to 0.151 per cent. The average for all cases was 0.132 per cent. At the end of the third hour in every case the blood sugar concentration closely approached the initial level. The increase above initial level averaged 0.033 per cent. The response in patients with paresis thus tends to be somewhat less than the normal.

MANIC-DEPRESSIVE INSANITY

Of this group, six males and four females were in a manic phase. The initial, fasting blood-sugar level ranged from 0.102 to 0.126 per cent. and averaged 0.111 per cent. The maximum rise occurred during the first hour and reached an average of 0.145 per cent. The increase above the initial level averaged 0.035 per cent. This response is less

than normal. The individual variation from the average response among these cases was not great.

Seven depressed cases were tested. The initial blood sugar level varied from 0.082 to 0.122 per cent., the average being 0.106 per cent. The maximum concentration after feeding occurred during the first hour and averaged 0.154 per cent. The increase was approximately 0.05 per cent., which is greater than the normal response. Our findings, therefore, tend to corroborate the observations reported by Kooy.[19]

TABLE 6.—Glucose Tests in Cases of Manic-Depressive Insanity, Manic Phase

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
				Males			
M 1	0.114	0.12	0.132	0.13	0.105	0.018	1 hour
M 2	0.10	0.14	0.132	0.105	0.092	0.04	½ hour
M 3	0.122	0.16	0.162	0.13	0.115	0.04	1 hour
M 4	0.112	0.158	0.14	0.132	0.12	0.040	½ hour
M 5	0.12	0.142	0.164	0.15	0.126	0.044	1 hour
M 6	0.104	0.13	0.15	0.125	0.112	0.046	1 hour
Average	0.112	0.141	0.146	0.128	0.111	0.039	
				Females			
M 7	0.11	0.133	0.144	0.13	0.112	0.034	1 hour
M 8	0.107	0.141	0.115	0.102	0.102	0.034	½ hour
M 9	0.102	0.142	0.135	0.115	0.096	0.04	½ hour
M10	0.126	0.157	0.153	0.136	0.128	0.031	½ hour
Average	0.111	0.143	0.136	0.120	0.109	0.034	

TABLE 7.—Glucose Tests in Cases of Manic-Depressive Insanity, Depressed Phase

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
M D 1	0.082	0.094	0.136	0.100	0.083	0.054	1 hour
M D 2	0.098	0.150	0.142	0.137	0.120	0.052	½ hour
M D 3	0.110	0.125	0.193	0.138	0.107	0.083	1 hour
M D 4	0.120	0.202	0.164	0.130	0.135	0.082	½ hour
M D 5	0.100	0.164	0.140	0.133	0.127	0.064	½ hour
M D 6	0.122	0.140	0.165	0.120	0.125	0.043	1 hour
M D 7	0.114	0.147	0.162	0.152	0.132	0.048	1 hour
Average	0.106	0.146	0.157	0.130	0.118	0.060	

PSYCHONEUROSIS

In this group there were five cases. The average initial blood sugar level was 0.108 per cent. The maximum concentration averaged 0.151 per cent. and the increase averaged 0.047 per cent. This response is approximately normal.

MORPHINISM

Three cases of morphinism are included in this series. The tests were made before drug withdrawal in two patients, T 1 and T 2, who had received one-half grain of morphin (0.03 gm.) on the evening previous

to the test. They were fairly comfortable in the morning and presented no withdrawal symptoms. These two patients responded to the sugar tests in a decidedly abnormal manner. The initial blood sugar concentration was 0.134 and 0.145 per cent. After the sugar meal the blood sugar concentration rose rapidly to a high level. At the one-half hour interval both showed a concentration well above 0.2 per cent. At the hour interval one patient showed 0.3 per cent. During the succeeding two hours the blood sugar fell rapidly but had not returned to its initial level at the end of the third hour. The increase above the initial level in case T 1 was 0.157 per cent. and in case T 2 0.093 per cent. The third case is of interest. At the time of the sugar meal this patient complained bitterly of withdrawal pains. No morphin was given. The initial blood sugar concentration was 0.175 per cent., which is extremely high. After the feeding the concentration did not change but maintained the initial high level for approximately two and one-half hours, and at the end of the third hour was slightly below it.

TABLE 8.—Glucose Tests in Cases of Psychoneuroses

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
P N 1	0.086	0.095	0.126	0.102	0.085	0.040	1 hour
P N 2	0.108	0.117	0.136	0.120	0.103	0.028	1 hour
P N 3	0.120	0.135	0.156	0.144	0.123	0.036	1 hour
P N 4	0.100	0.162	0.140	0.132	0.102	0.062	½ hour
P N 5	0.130	0.140	0.200	0.151	0.126	0.070	1 hour
Average	0.108	0.129	0.151	0.129	0.107	0.047	

TABLE 9.—Glucose Tests in Cases of Morphinism

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise
T 1	0.145	0.224	0.292	0.206	0.156	0.147	1 hour
T 2	0.134	0.215	0.227	0.215	0.194	0.093	1 hour
T 3	0.175	0.175	0.17	0.168	0.166	0.000	

UNCLASSIFIED AND OTHER MENTAL STATES

An additional twenty-five cases were included in our series. These comprised feeblemindedness, epilepsy, alcoholism, neurasthenia, psychasthenia and a number of clinically doubtful or undetermined cases. It is interesting that of the clinically doubtful cases, in three, in which catatonic dementia praecox was considered (U 11, U 14 and U 18), the response to the test resembled the curve obtained in the frankly catatonic cases, the increase in blood sugar being 0.075, 0.076 and 0.082 per cent., respectively.

DISCUSSION

A considerable number of our patients were tested on several occasions in the course of two or more months; in some cases three

tests were made. The curves obtained on repetition of the tests were strikingly similar. In several cases the parallelism was closely maintained throughout the entire period of three hours. In one case of catatonia, C 11, the first test showed the character of curve obtained in every catatonic case, with the exception of C 10. A second test on C 11, several months subsequent to the first, was practically normal. After the first test this patient improved very much, and at the time of

TABLE 10.—Glucose Test in Unclassified and Other Mental States

Case No.	Before Feeding	½ Hour Interval	1 Hour Interval	2 Hour Interval	3 Hour Interval	Total Rise	Period of Rise	Diagnosis and Remarks
U 1	0.128	0.144	0.152	0.131	0.126	0.024	1 hour	Constitutional inferiority
U 2	0.097	0.116	0.125	0.110	0.102	0.028	1 hour	Feebleminded
U 3	0.114	0.153	0.136	0.126	0.120	0.039	½ hour	Feebleminded
U 4	0.123	0.150	0.133	0.125	0.118	0.027	½ hour	Feebleminded
U 5	0.115	0.120	0.154	0.126	0.120	0.039	1 hour	Feebleminded epileptic
U 6	0.123	0.130	0.144	0.126	0.114	0.021	1 hour	Epileptic
U 7	0.125	0.080	0.118	0.148	0.100	0.023	2 hours	Epileptic
U 8	0.105	0.138	0.125	0.121	0.115	0.033	½ hour	Alcoholic deterioration
U 9	0.105	0.172	0.165	0.150	0.122	0.067	½ hour	Chronic alcoholism hallucinosis
U 10	0.106	0.173	0.125	0.111	0.108	0.067	½ hour	Chr. alcoholism paranoid
U 11	0.115	0.183	0.190	0.162	0.132	0.075	1 hour	Unclassified manic symptoms; catatonia suspected
U 12	0.140	0.163	0.212	0.165	0.135	0.072	1 hour	Atypical manic
U 13*	0.152	0.195	0.159	0.142	0.145	0.043	½ hour	Neurasthenia and hyperthyroidism
U 14	0.100	0.162	0.176	0.147	0.080	0.076	1 hour	Dementia praecox with manic symptoms, possibly catatonic
U 15	0.098	0.205	0.222	0.125	0.085	0.124	½ hour	Psychasthenia
	0.105	0.200	0.195	0.132	0.114	0.095	½ hour	
U 16	0.132	0.131	0.187	0.165	0.112	0.055	1 hour	Involution melancholia
U 17	0.125	0.173	0.135	0.126	0.118	0.048	½ hour	Unclassified, possibly depressive manic
U 18	0.124	0.140	0.206	0.140	0.132	0.082	1 hour	Dementia praecox, possibly catatonic
U 19	0.110	0.180	0.120	0.115	0.114	0.070	½ hour	Unclassified atypical manic
U 20	0.108	0.165	0.180	0.115	0.104	0.072	1 hour	Dementia praecox hebephrenic, doubtful
	0.110	0.176	0.180	0.120	0.115	0.070	1 hour	
U 21*	0.101	0.160	0.134	0.121	0.125	0.059	½ hour	Manic-depressive insanity, mixed type
U 22	0.124	0.135	0.176	0.160	0.111	0.052	1 hour	Unclassified questionable dementia praecox
U 23	0.112	0.166	0.121	0.115	0.106	0.054	½ hour	Dementia praecox hebephrenic questionable
	0.115	0.185	0.178	0.127	0.115	0.070	½ hour	
U 24	0.100	0.145	0.138	0.133	0.102	0.045	½ hour	Dementia praecox hebephrenic questionable
	0.104	0.152	0.176	0.155	0.118	0.072	1 hour	

* Females.

the second test was markedly better. He was up and about, talked quite readily, was interested in occupational work and expressed no false ideas, but he had no insight into his former condition.[22]

22. Raphael, T., and Parsons, I. P.: Blood Sugar Studies in Dementia Praecox and Manic-Depressive Insanity, Arch. Neurol. & Psychiat. **5**:687 (June) 1921. These authors reported, during the period of our investigations, conclusions similar to our own. They found an abnormal sugar tolerance curve in dementia praecox; the depressions gave a high curve and the manic excitements a low response. The number of cases studied by them did not permit conclusions as to types of reponse in the different subgroups of dementia praecox. The patient in Case 9 of their series gave a very high curve similar to that which we obtained in catatonia.

Owing to lack of cooperation, it was often difficult to collect specimens of urine. We were able, however, to obtain them in over 50 per cent. of our cases. Examinations for sugar were made on all of these specimens. The results were by no means uniform, and we were not able to prove the assertion that a blood sugar concentration of 0.17 per cent. is the threshold of elimination. Many of our patients had a blood concentration above 0.2 per cent. for periods of one hour and more and yet failed to show sugar in the urine.

Assuming that the curves noted in hyperthyroidism are directly the result of altered thyroid function or, secondarily, the expression of disturbance in the endocrine chain, the conclusion that endocrine imbalance exists in catatonia is warranted. Whether this manifestation is due to a primary disturbance of any member of the endocrine system or whether it is merely the expression of altered function due to some emotional state cannot be decided on this evidence.

One case strikingly demonstrates the effect of emotion during the application of the test. Case P. D. 9 was one of paranoid dementia praecox in which ideas of persecution, particularly of poison administration, the use of noxious gases and electricity, were dominant. Shortly after taking the sugar solution the patient expressed fear of a poisonous dose. Later, when the first blood sample was taken, he manifested marked fear; his face was very pale; there was profuse perspiration, rapid breathing and a general picture of great apprehension. In this case the blood sugar rose from an initial level of 0.132 to 0.195 per cent. within one-half hour after feeding and at the hour interval reached 0.318 per cent. Following this high concentration a rapid drop was noted. At the end of the second hour the blood sugar was 0.23 per cent. and at the end of three hours it was 0.145 per cent., only slightly above the initial level. This patient showed the highest response of any in our series. The case of morphinism, T 3, also bears on the effect of emotion on blood sugar. The feeding of glucose in this case caused no response in the blood sugar. In attempting to interpret the abnormal responses found in catatonic dementia praecox, one must hold in mind the possibility that emotional states may exist without being clearly evident. It, therefore, still leaves us in doubt. The possibility of the existence of considerable emotional tension in an active catatonic state with consequent sensitiveness of the suprarenals and thus the possibility of an oversupply of epinephrin and an upset of the endocrine balance, which might be manifested by abnormal reaction to sugar feeding, must be considered.

Another group of patients that tended to show a uniform character of response was that of the seven patients with cases diagnosed as dementia praecox—simple deteriorating type. This subgroup, as usually interpreted, includes cases in which general mental deterioration is

evident without strikingly bizarre ideas or attitudes. Three patients gave responses that clearly simulated the reactions obtained in patients with hypothyroidism and allied conditions of hypofunction. Case SD 1 showed, in two examinations, a blood sugar level that remained low throughout the test, the curve being almost a straight line. SD 2 and SD 7 gave slight responses, the maximum rise in blood sugar in each being less than 0.02 per cent. This group, taken as a whole, gave an average curve which is less than the normal response; the maximum rise was 0.025 per cent. In view of these findings one may suspect that, in some of these cases at least, there is an endocrine dysfunction.

CONCLUSIONS

1. Except in cases of active catatonia, certain cases of simple deteriorating dementia praecox and several cases in which evident emotional upsets existed at the time of the test, this investigation points to a blood sugar concentration in mental disease that is practically normal when the test is made while the patient is fasting, the average being 0.105 per cent.

2. The response of patients with mental cases, except the types mentioned in the foregoing, to sugar feeding is generally within normal range.

3. Patients with active cases of catatonic dementia praecox responded to glucose feeding with a hyperglycemia that resembles the response obtained in hyperthyroidism.

4. Several cases of simple deteriorating dementia praecox responded to glucose feeding in a manner that resembles the responses obtained in certain endocrine disturbances, such as dyspituitarism.

5. Patients with cases of manic-depressive insanity—depressed phase—responded to the sugar test with a curve higher than that found in normal subjects.

Abstracts from Current Literature

PHYSIOLOGY AND PATHOLOGY OF STEREOGNOSTIC AND SYMBOLIC PERCEPTION OF OBJECTS. G. Santangelo. Monatschr. f. Psychiat. u. Neurol. **49**:229 (April) 1921.

For a long time after Hoffman had introduced the term "stereognostic" into medical literature, the ability to recognize the form of objects was ascribed to a special sense called the stereognostic sense. It was later shown that no such special sense existed. Markowa pointed out that recognition of the shape of objects is a complex psychic act made up of peripheral and central components, so that instead of speaking of a stereognostic sense, we should speak of stereognostic perception.

Müller gives the following picture of the appreciation of form by touch: We receive certain impressions by touch and muscle sense; these awaken the memory of similar sensations, and call up a certain form which experience has taught us to associate with these sensations. This process is known as identification of the first order, between an immediate impression and the memory of a similar previous sensation. But Chretien points out that the process can go further. In addition to the identification of form, the sense perceptions can call up images whose elements are furnished from other sensory spheres—more especially the visual—and which give us all the characteristics of an object; in other words, we obtain the complete picture of the object, which permits us to recognize and name it. This process is called identification of the second order. We now use the term stereognostic perception for the tactile recognition of form, and symbolic perception for the tactile recognition of objects. Loss of these functions is termed astereognosis (failure of tactile recognition of form) and asymbolia (failure of tactile recognition of objects in spite of retention of adequate peripheral sensation).

There is considerable disagreement as to which modality of sensation is most important for the maintenance of stereognostic perception. There is still more disagreement regarding the mechanism of production of asymbolia. Wernicke, who was the first to call attention to asymbolia, believed that it results from the loss of tactile memory pictures. Later Flechsig and Monakow assumed an associative disturbance. According to them, asymbolia results from a break in the transcortical association paths between the true touch centers in the rolandic convolutions and the other sense centers, especially the visual. This would account for its frequent occurrence in parietal lobe lesions. According to Déjerine and his followers, symbolic disturbances cannot be explained by any such associative mechanism, but are the result of a summation of disturbances of peripheral sensation (always present, though slight) with general psychic disturbances, such as loss of attention, mental weakness, loss of memory, etc.

Recently Mochi has gone over all the cases in the literature. He verifies the associative nature of the disturbance and shows that it is localized generally along a line which connects the sensorimotor zone with the outer surface of the occipital lobe, about at the level of the middle third of the cerebral hemisphere.

The author has done experimental work in this field in several directions. First he attempted to determine the value of the various peripheral components which subserve the normal stereognostic function. His conclusions are:

Touch: Has scant significance in the appreciation of form.

Weber's Sense: (Compass test.) Important but not indispensable.

Temperature Sense: Loss of temperature sense disturbs to some extent the appreciation of form and the recognition of objects; its maintenance is of definite value in symbolic perception and of less value in perception of form.

Pain Sense: Little value.

Pressure Sense: Some importance.

The sense modalities described furnished no important contribution to stereognostic and symbolic perception. They give us more or less accurate data about the form of the surface; but neither one of them nor all together can enable us to recognize three dimensional forms and objects. The essential data for such recognition are furnished by muscle and joint sense, including sense of position, passive and active motion.

The author studied the stereognostic and symbolic functions of other parts of the body—sole, back, etc. With the sole he finds it possible to determine simple geometrical forms, but not to recognize objects. In the back conditions are similar but the response is slower. Whenever it is impossible to get an idea of the object in its entirety, symbolic recognition is impossible. He has attempted to use the stereognostic function for diagnostic purposes, more especially for accurate localization of cortical lesions of the rolandic zone. In such lesions we may find a loss of the stereognostic function of the hand, with retention of stereognostic function for the sole. A dissociation of this type can only occur in a lesion lying in, or immediately beneath, the rolandic cortex. In capsular or pericapsular lesions, owing to the crowding of the projection fibers, stereognostic function in hand and foot will be together.

Finally, the author points out that stereognostic perception is fully developed after the first year of life, and that physiologically there are no appreciable differences between right and left side in relation to perception of form and recognition of objects.

SELLING, Portland, Ore.

THE EFFERENT PATHWAYS OF THE EMINENTIA QUADRIGEMINA IN DOGS. A. BUSACCA, Ric. di morfol. **1**:261 (March) 1921.

Owing to the great discrepancies which still exist about the ascending projection tracts of the lamina quadrigemina, the author has undertaken special researches in mammals. In this paper he gives the results he obtained in dogs. Twenty-eight dogs were operated on by puncturing the lamina and killed from twenty to thirty days later. The central nervous system was then treated with the Marchi method. Protocols of nine cases in which the lesion was localized to the lamina quadrigemina are given. The remainder of the cases were omitted from the study, because the experimental lesion was not limited to the lamina alone. The author arrived at these conclusions:

In consequence of the lesion of the lamina quadrigemina in a dog, the following systems of fibers degenerate: tectospinal tract (crossed and uncrossed), tectoreticular fibers, commissural fibers between the superior colliculi, commissural fibers between the inferior colliculi and fibers in the brachium of the inferior colliculus.

The crossed tectospinal tract is constituted by a single bundle of fibers, whose cells of origin are situated in the various layers of the superior colliculi.

This tract circles around the central substance of the mesencephalon, passes through the fasciculus longitudinalis medialis and the red nucleus, and on the middle line crosses with the homologous tract of the opposite side along a line extending from the first roots of the oculomotor nerve to the caudal end of the red nucleus. Thence it goes to the mesencephalic half of the opposite side between the medial line, and the medial longitudinal fasciculus and the red nucleus. It bends caudally and after running before the medial longitudinal fasciculus reaches the rhombencephalon and the anterior portion of the anterior horn of the spinal cord. It may be followed as far as the cervical enlargement. This tract having its origin from the cells of the superior colliculi, must be considered as a reflex descending optic pathway intended to connect one of the primary optic centers to the underlying regions of the rhombencephalon and spinal cord.

The direct tectospinal tract is constituted by a single homolateral bundle which originates from the cells of the nucleus of the inferior colliculi and probably also from the cells of the other layers of this eminence. It runs first in the lateral lemniscus, then in the ventrolateral portion of the medulla oblongata and passes into the anterolateral portion of the anterior horn in the spinal cord (position of the olivospinal tract) where it can be followed as far as the level of the roots of the second pair of cervical nerves. This tract having its origin from the posterior eminence has the significance of a reflex descending acoustic pathway intended to connect one of the most conspicuous masses of gray substance, scattered along the course of the central acoustic pathway, with the underlying formations of the rhombencephalon and the spinal cord.

The anterior and posterior eminences are connected with the reticular formation of the mesencephalon by tectoreticular fibers which do not constitute a real bundle as it is maintained by some authors. These are disseminated fibers which go from the lamina quadrigemina to the reticular formation of the mesencephalon.

Between the anterior eminences, in their cephalic two-thirds, runs a system of fibers which cross posteriorly to the aqueduct of Sylvius and whose task it is to connect the two eminences. This system of fibers is in direct continuity with the posterior white commissure, which seems to receive also fibers from the superior colliculi. These fibers, however, do not reach the rhombencephalon.

The posterior eminences are interconnected by a system of fibers which is entirely independent from the one that unites the two anterior eminences. It also crosses behind the central gray substance of the aqueduct of Sylvius.

In the posterior eminences some fibers probably begin which, after entering the brachium of the inferior colliculus, go to the medial geniculate body. The author could not follow their degeneration beyond the nucleus of this geniculate body.

No degeneration was found in the brachium of the superior colliculus from a lesion of the superior colliculi. The author therefore is unable to confirm the existence of tectoretinal, tectothalamic and tecto-cortical fibers for Gudden's commissure admitted by some authors.

NACCARATI, New York.

RATING SCHEME FOR CONDUCT. JAMES S. PLANT. Am. J. Psychiat. **1**:547, 1922.

Plant presents an ingenious and interesting scheme for rating the conduct of mental patients. The field of inquiry is divided into physical and mental categories. Under the former are considered weight, sleep and physical exer-

cise, while under the latter is estimated attitude toward taking food, room and attire, reaction toward the nurses, care of self ("tidiness"), general knowledge as shown in conversation, emotional reaction, resourcefulness and ingenuity, rapidity of habit formation, span of attention, hallucinations, delusions, orientation, insight, recent memory, reaction to visitors, and judgment. The determinations are made by nurses who assign a rating value, usually from 1 to 10 in each subdivision. For instance, under "attention" a stuporous patient would be rated 1 while a patient who "plans and carries out a piece of work requiring a long period of time, as weaving a rug or making a piece of pottery," would be rated 10. Three calculations are made, constituting the average for the physical considerations, the average for the mental, and finally, the average for the standard deviation of the latter. The figures obtained are expressed graphically, and the status of the patient appears on the chart as a zone of varying width.

The author's idea possesses considerable merit. If further experience justifies the tentative conclusions that "where the average falls accompanied by a marked increase in the standard deviation" an ultimate recovery may be anticipated and where "a fall in the average accompanied by a marked diminution in the standard deviation" indicates chronicity, we will have a useful clinical prognostic guide. Again, the method calls for close observation and this in itself should exercise a favorable influence on the morale of the nursing force. In making deductions, there is necessarily a margin of error which must be borne in mind. This was reduced to a minimum in Plant's work largely because of his intimate and careful personal supervision. Failing this or some similar check, the usefulness of the plan would be seriously impaired, and it would be likely to degenerate into a more or less meaningless formula. Some clinicians may feel that the various categories should not be given equal weight. For instance, it might be pointed out that the affective far surpasses in importance most of the other reactions which are listed. However, practically it is true that it is impossible to deal with pure and separate subdivisions of conduct so that actually major symptoms give to minor ones their distinctive coloring and by enhancing their significance the proportionate balance of the rating value is maintained. This is particularly true of the emotional status so that in viewing the conduct from almost any angle we are perforce making some measurement of affect.

STRECKER, Philadelphia.

DISEASES OF PERIPHERAL NERVES. HARALD SIEVERT, Monatschr. f. Psychiat. u. Neurol. **49**:364 (June) 1921.

The author reports the results of a study of 393 cases of disease of the peripheral nerves. War injuries were excluded. The sciatic was the most frequently involved, 102 cases, or 26 per cent. of the total number. Bilateral involvement occurred in one case of severe sepsis. This fulfilled Heilbronner's dictum that a diagnosis of bilateral sciatica is justified only after complete recovery. The common causes mentioned are cold, alcohol and various infections. Gonorrhea was responsible for three cases. Pelvic sarcoma was responsible for four. By the time these four cases were recognized, the process was so advanced that the outlook was hopeless. In discussing therapy he emphasizes the use of hot air baths and hot sand bags in preference to moist heat. In severe cases epidural injection of a weak cocain solution in physiologic salt solution proved most valuable. "Vakzineurin" gave good results in the few cases of infectious origin in which it was tried. He states that in spite of

all skepticism, in spite of all search for other causative factors, we must still assign to "cold" a definite rôle in the etiology of sciatica.

Diseases of the trigeminal nerve were second in frequency. Involvement of the facial nerve is usually the result of "cold" or infection. A number of these cases, one of them bilateral, were syphilitic.

In musculospiral lesions (forty-three cases) alcohol and pressure paralysis (crutch paralysis) are important factors. Two cases in which the ulnar nerve was also involved resulted from the use of a tourniquet, and proved very resistant to treatment. Nicotin was responsible for one case, involving both musculospirals, the left median and the great occipital. Stopping tobacco resulted in relatively prompt recovery.

The ulnar nerve was involved in twenty-nine cases. In three it was bilateral, following pleurisy. He reports an interesting case of bilateral ulnar neuritis in typhus resulting in paresis and atrophy of the appropriate muscles and sensory loss. A week after discharge from the hospital, there had been no improvement. At this stage the patient developed typhoid fever and in the first phase of rising temperature there was marked improvement in function of the paretic ulnar muscles, accompanied by pain. After a week, the paresis dropped to its previous level, and the pain stopped. There was gradual recovery in the course of three months. In explaining this phenomenon the author suggests that the toxic materials liberated in the first week of the typhoid stimulated the diseased nerve fibers. He believes that the favorable action of "Vakzineurin" is attributable to the same cause. He emphasizes the favorable results which he has obtained by the use of "Vakzineurin," although he has apparently used it in relatively few cases. He recommends its further trial.

The author brings out a number of other points: That recovery in plexus lesions is slow; that true intercostal neuralgias are rare; that neuritis of the cutaneous femoris lateralis may occur in gout; that obturator neuritis may follow a severe cystitis. He reports three cases of neuralgia (?) of the glossopharyngeal nerve, all following angina. Symptoms consisted of severe, episodic pain in the pharynx and a cramp-like sensation there, and sensations radiating into the posterior portion of the tongue. The picture was identical in the three cases. He emphasizes the need of patience in these cases, on the part of both the physician and the patient.

SELLING, Portland, Ore.

STUDIES IN THE GROWTH AND DIFFERENTIATION OF THE TELENCEPHALON IN MAN. THE FISSURA HIPPOCAMPI. MARION HINES, J. Comp. Neurol. **34**:73 (Feb. 15) 1922.

This is a very complete study of the morphogenesis and histogenesis of the hippocampal formation in human embryos from 11.8 mm. to 43 mm., with some observations on older specimens up to 85 mm. Most of this material is in excellent preservation, and the study of the carefully made wax models is supplemented by more complete histologic examination than has hitherto been attempted. The fissures described in the cerebrum of human embryos by previous workers are in some cases artefacts, in some cases transitory fissures, and in other cases fissures whose history can be traced through to the definitive adult pattern. Of the latter type, the first to appear is the arcuate fissure of His (which has no relation to the fissura prima of His appearing somewhat later); that this is the embryonic hippocampal fissure is demonstrated both by its morphology and by its relation to the underlying tissue differentiation, both of which are followed in the series of embryos to practically adult relations.

The hippocampal region can be recognized histologically before the 11.8 mm. stage, and from this age onward its characteristic structure is always visible. The hippocampal (arcuate) fissure appears at about 16 mm. The fascia dentata first appears at about 20 mm. as a marginal group of cells at the ventral border of the sulcus limitans hippocampi. These cells migrate dorsalward close to the pial surface in the ventral lip of the shallow hippocampal fissure, and at 85 mm. they begin to condense into the characteristic adult form.

The comparative anatomy of the hippocampus is reviewed, and the conclusion is reached that the reptilian hippocampal formation contains no fascia dentata. The structure so named by several comparative anatomists is hippocampal cortex, and the fissura arcuata of Herrick in reptiles is the hippocampal fissure, the early human condition running very closely parallel with that of reptiles. It may be added that the author's success in analyzing the development of this very difficult region was materially assisted by her familiarity with its comparative anatomy, for many details which have been overlooked or incorrectly interpreted by previous workers are intelligible only in the light of relations in lower vertebrates which are presumably ancestral.

C. J. Herrick, Chicago.

ON THE TOPOGRAPHY AND SIGNIFICANCE OF SOME BROWN SPOTS ON THE ABDOMEN OBSERVED IN CASES OF LUMBAR MYELITIS FROM POTT'S DISEASE. L. De Lisi, Arch. gen di neurol. psichiat. e psicanal. **2**:2 (Dec.) 1921.

The author reports four cases of spastic paraplegia from Pott's lumbar meningomyelitis in which he found a brown spot on the abdomen having a peculiar constant topographic distribution. He calls attention to the fact that such a spot has not been found in other spinal cord and vertebral diseases. The lower border of the brown spot extended between the two flexures of the groin. Its external margins were on the anterior ascellar line. The upper border reached the sixth rib except in one case in which the limit did not go beyond the lower third of the xipho-umbilical line. The spot occupied, therefore, the skin which received its spinal sensory innervation from the roots of the dorsal nerves—the fifth, sixth, seventh, eighth, ninth, tenth and eleventh nerves—but it was limited externally by a line corresponding to the division between anterior and posterior diramations of the perforating branches of the same dorsal nerves. The spot was of Addisonian nature. Two of the patients died; in one of them tuberculosis of the suprarenal capsules was found. The other patients showed clinical signs of frustre Addisonian disease, but necropsy examination could not be performed on the other who died.

The particular topography of the spot, situated within the territory of the roots and of the dorsal nerves which contract relationship with the ganglions of the lateral chain and with the communicating branches of the splanchnic system, suggests that the limited zone of pigmentation is the expression of a particular disturbance of the splanchnic solar system, maintained by a nervous and an endocrino-biochemical factor. There is no topographic relationship between the myelitis, which is localized beneath the real and the apparent origin of the splanchnic nerves, and the eventual lesion of the celiac-splanchnic system. The limitation of the spot to only one portion of the dermatoma (part of the anterior section) does not contrast with the funda-

mental biologic laws which govern the segmentary disposition of the pigmentation of the vertebrates and in general terms the segmentary disposition of the cutaneous sympathetic.

From the clinical and semeiotic point of view the described spot should be included in the category of the partial melanodermas which are usually encountered in the frustre Addisonism and in forms of tuberculosis; but it possesses indications of affection of a definite section of the sympathetic system.

Considering its nature and the high mortality already experienced in this small number of cases, its presence has a serious prognostic significance.

NACCARATI, New York.

A CASE OF TUMOR OF THE SPLENIUM OF THE CORPUS CALLOSUM. G. G. GUILLAIN, Ann. de méd. **11**:33 (Jan.) 1922.

This is a contribution to the semeiologic study of tumors of the corpus callosum and is based on observation of one case and a review of the literature.

A patient aged 52, in February, 1920, began to complain of headache and to show marked disturbance of memory. Early in the month of August, 1920, he entered the hospital with these symptoms: violent headaches; vertigenous sensations; no paralysis of any of the extremities or of any of the cranial nerves; no apparent alterations of sensibility; abolition of the deep reflexes of the legs; absence of superficial reflexes; a positive Kernig's sign; transitory urinary retention; unequal pupils with feeble reactions to light and on accommodation; severe mental symptoms with disorientation; amnesia and apraxia; subsequent blindness. The blood urea showed 52 mg. per hundred cubic centimeters. A lumbar puncture in September, 1920, gave a clear spinal fluid containing 48 mg. of albumin (rachialbuminimeter of Sicard), 6 lymphocytes per cubic millimeter, a negative Wassermann and a negative benzoin colloidal reaction. In October, when a (third) spinal puncture was performed, there were 7 cells, the Wassermann reaction was again negative, the benzoin colloidal test was negative in the syphilitic zone, but presented a slight curve in the meningitic zone (0000020002220000). But in addition there was now present a zanthochromia and an increase in pressure of the fluid, measuring 90 cm. of water (manometer of Claude). It had been impossible to estimate intracranial pressure by fundal examination.

The first symptoms had shown themselves in February, 1920. The patient died in October, 1920, an evolution relatively rapid for cerebral tumors. Necropsy examination confirmed the diagnosis of tumor of the splenium.

The author believes that there is a special symptomatology of tumors of the splenium, and he enumerates the symptoms as follows:

1. Signs of intracranial hypertension, with vomiting, headache and sometimes pupillary stasis. These signs are often less accentuated than in the other cerebral tumors.

2. Mental symptoms characterized by amnesia, bizarre acts and attitudes, emotional indifference, disorientation, sometimes by mental confusion, by torpor interrupted by periods of agitation and absence of a systematized delirium. In the late stage there is a veritable dementia. The mental symptoms have sometimes multiple resemblances to those of general paresis.

3. Frequent presence of paralyses, contractures and bilateral hypertonias. These effects appear to be due to the propagation of the neoplasm to the pyramidal fibers or central gray nuclei.

4. Possibility of phenomena of apraxia.

5. Absence of aphasia.

6. Habitual absence of paralyses of the cranial nerves of the base.

Davis, New York.

THE ORIGIN OF THE OTIC AND OPTIC PRIMORDIA IN MAN. G. W. Bartelmez, J. Comp. Neurol. **34**:201 (April 15) 1922.

This paper reports a part of the results of an extensive study of human development during the early part of the period of somite formation. It is based on twelve well preserved normal embryos ranging between three and sixteen somites. The most striking result here reported is the very early appearance of the otic primordium in embryos of two to three somites. Man is the only vertebrate so far recorded in which the otic plate is differentiated before the optic primordium. The otic plate first appears as a diffuse thickening of ectoderm in the hindbrain region. At four somites the acousticofacial ganglion appears and is clearly derived from the definitive neural tube.

Isolated thickenings (growth centers) of the cranial neural folds appear at a stage of seven to eight somites, which promptly fuse to form a continuous ridge, the "optic-crest primordium." An associated ventricular sulcus in the forebrain levels of the ridge indicates the position of the optic anlage. This is the earliest stage of this anlage which has been recognized in a mammal. The nonoptic part of this primordium proliferates mesectoderm and a large part of the trigeminal ganglion. This demonstration of the formation of mesectoderm from the neural tube is in line with the somewhat similar findings of Platt, Landacre, Stone, and others in Amphibia, and opens an important chapter in the histogenesis of the human head, the details of which remain to be filled in.

C. J. Herrick, Chicago.

EARLY DIAGNOSIS AND TREATMENT OF DISSEMINATED SCLEROSIS. D. K. Adams, Brit. M. J. **2**:841 (Nov. 19) 1921.

This paper presents the findings of Adams and his collaborators, who studied a series of cases of disseminated sclerosis, clinically, serologically and experimentally. Clinically the author stresses the importance of transient disturbance of bladder function, of vision with diplopia and of fine nystagmoid movements as very early symptoms of the disease. Serologically he finds that the colloidal gold test is necessary in the diagnosis. Experimentally, fifteen rabbits were inoculated with spinal fluid from eight cases of multiple sclerosis and nine with blood from similar cases. Five of the first group and four of the latter developed definite nervous symptoms. Six additional rabbits were inoculated with brain and spinal cord emulsions from the rabbits showing nervous symptoms. Of these, two developed evidence of involvement of the nervous system. The author presents no definite conclusions as the results of these studies but seems rather to endeavor to confirm the hypothesis that multiple sclerosis is caused by bacteria. Adams advocates the administration of potassium iodid, mercury and arsenic in cases of dissemi-

nated sclerosis, the mercury to be given in the form of inunctions to toleration, the arsenic in the form of small repeated (up to twenty) doses of neoarsphenamin intravenously, and the potassium iodid to be given by mouth.

Potter, Mercer, Pa.

IRIDOCYCLITIS—PAROTITIS—POLYNEURITIS: A NEW CLINICAL SYNDROME. A. Feiling and G. Viner, J. Neurol. & Psychopath. **2**:353 (Feb.) 1922.

The main symptoms in the case history presented were: a prodromal stage of malaise with drowsiness and backache, right facial nerve palsy, two days later beginning iridocyclitis in the right eye and swelling, firm and painless, of the right parotid gland. About four days later the left facialis became weak; two days after this the left eye became involved, and swelling was observed in the left parotid.

When examined three weeks after the onset, a rash somewhat resembling an erythema nodosum was present on the anterior aspects of the legs and lower part of the thighs, leukopenia was present, the spinal fluid contained 15 lymphocytes per cubic millimeter, but there was no increase of globulin, and there was no fever. Cultural studies were negative. In addition to the swelling of the parotids, there were bilateral iridocyclitis and iridoplegia; both sides of the face were paralyzed, and there were signs of mild general polyneuritis.

During the next month the eye condition became worse and increased tension required repeated paracentesis. The paralyses and signs of polyneuritis gradually disappeared, and the parotitis cleared up. At the end of four months the patient had practically recovered.

Similar cases are adduced from the literature, and the authors, after discussing the relation to mumps, concluded that the syndrome is a clinical entity, distinct from mumps, but whether a specific infection or not is not known.

Singer, Chicago.

SUTURE OF SEVERED MEDIAN NERVE WITH RAPID RECOVERY OF FUNCTION. Edgar Wirth. Brit. M. J. **2**:900 (Nov. 26) 1921.

After accidental section of the median nerve with complete loss of power in all the muscles and loss of epicritic, protopathic and deep sensibility in the area supplied by this nerve, Wirth, after ligating the brachial artery and vein, performed an immediate end to end suture. Fine chromicized catgut was used to bring about an exact adaptation of the ends of the nerve. Two days after the operation there was better flexion of the wrist, much better pronation of the forearm, less impairment in opposing the thumb and less difficulty in abduction of the thumb. At the end of six weeks the normal muscular power was almost restored, and there was little impairment of sensation. Trophic changes were noted in the skin of the thumb, index and middle finger, consisting of an exfoliation of the outer layers of the skin. After nearly five months there was slight difficulty in flexion of the terminal phalanx of the index finger and thumb. Epicritic and protopathic sensation were absent over the index finger only.

This case demonstrates the rate of recovery of a sectioned median nerve under the most promising conditions except for the impairment of the circulation resulting from ligature of the brachial artery.

Potter, Mercer, Pa.

THE PHYLOGENETIC SIGNIFICANCE OF THE PLANTAR RESPONSE IN MAN. G. de M. Rudolf, J. Neurol. & Psychopath. **2**:337 (Feb.) 1922.

Observations of the movement of the big toe only in the plantar reflex in amphibia, reptilia, rodentia and carnivora gave either no response or a flexor one. In primates, including a chimpanzee, the responses were uniformly extensor. During the first two weeks of extra-uterine life many human infants gave a flexor response which usually became extensor a little later. One premature infant (30 weeks) gave no response. Some infants gave extensor responses within a few minutes of birth, and in some cases the adult flexor type of response appeared early.

The conclusion is drawn that, ontogentically, the plantar reflex in man passes through the phylogenetic stages of absent response, flexor, extensor and, finally, adult flexor response. This last stage is dependent on brain influence. In complete section of the cord a similar phylogenetic series is observed, absent response during the phase of spinal shock, flexor for a variable period and finally extensor. The adult flexion does not here reappear because brain control is not restored.

Singer, Chicago.

DYSPITUITARISM: REPORT OF A CASE OF POSTERIOR LOBE INSUFFICIENCY CONTROLLED BY ORGANOTHERAPY. Roger S. Morris and Hiram B. Weiss, J. A. M. A. **78**:1522 (May 20) 1922.

The author reports a case of dyspituitarism in which the patient presented the picture of obesity, drowsiness, headache, frequent nocturnal urination, loss of sexual power and impairment of memory. These symptoms have been relieved and controlled over a period of six years by use of posterior lobe extract. Anterior pituitary extracts caused no improvement, and he had previously been given thyroid tablets with no change of symptoms except a loss of weight. Five years after beginning treatment with posterior lobe extract the blood sugar was 0.133 mg. per hundred cubic centimeters. A glucose tolerance test was given, and two hours after receiving the glucose the blood sugar was 0.239 mg. per hundred cubic centimeters. After six years' treatment with posterior lobe extract the sugar tolerance still remained low.

Nixon, Minneapolis.

THE RESULTS OF GONORRHEAL INFECTION OF THE NERVOUS SYSTEM. E. O'Connor, Quart. J. Med. **15**:69 (Oct.) 1921.

An extensive review of the literature on this subject leads the author to conclude that gonorrhea has a tendency to produce slight psychic manifestations which may be due to a feeble toxemia; that toxic delirium due to the gonococcus is rare; that gonorrheal cerebrospinal meningitis has been established clinically and confirmed microscopically; that gonorrheal meningomyelitis is rare.

Potter, Mercer, Pa.

A COMPARATIVE STUDY OF THREE COLLOIDAL REACTIONS ON THE SPINAL FLUID. D. O. Riddel and R. M. Stewart, J. Neurol. & Psychopath. **2**:325 (Feb.) 1922.

Comparisons are here made between the results of tests with colloidal gold, gum mastic and benzoin solutions. In general paralysis the first and last gave

parallel results, the second did not agree so closely. Gold and mastic gave paretic curves with nonparetic fluids; benzoin did not. Syphilitic curves in nonsyphilitic cases were obtained with all three. Benzoin also often gave a slight precipitation in the middle tubes with normal fluids.

SINGER, Chicago.

EPILEPSY FROM THE PSYCHOLOGICAL STANDPOINT. A. CARVER, Brit. M. J. **2**:840 (Nov. 19) 1921.

This author believes that the epileptic syndrome results from a combination of psychologic, physiologic, anatomic and other factors. Carver says that each epileptic personality requires intensive individual study, that in the majority of cases the psychologic factors are by far the most important and an understanding of them is essential for therapeutic reasons.

POTTER, Mercer, Pa.

EXPERIMENTAL STUDIES ON THE HISTOGENESIS OF THE SYMPATHETIC NERVOUS SYSTEM. ALBERT KUNTZ, J. Comp. Neurol. **34**:1 (Feb. 15) 1922.

By operations performed on chick and frog embryos in stages preceding the differentiation of neuroblasts the neural crests were removed or the entire neural tube was removed for a number of postcephalic segments. In other cases, more or less of the ventral portion of the neural tube was destroyed, leaving the neural crests and the dorsal portion of the neural tube intact. In a fourth group an attempt was made to destroy the cells which give rise to the sensory ganglions of the vagi and the portions of the hindbrain from which the vagi arise. From the study of the sympathetic primordia of these operated embryos in later stages, it is concluded that the sympathetic primordia are made up of cells which arise from both the neural tube and the cerebrospinal ganglions. Those from the neural tube are far more numerous, and they arise in the intermediate portions of the walls of the tube, that is, in the region occupied by cell bodies of the preganglionic neurons of the adult. The fate of the cells which migrate into the sympathetic primordia from the neural crest was not determined. In the absence of spinal ganglions and dorsal nerve roots the efferent fibers of the spinal nerves are accompanied by cells of medullary origin, which are supposed to form neurilemma. The cells of the vagal sympathetic plexuses arise from the vagal ganglions and the walls of the hindbrain.

C. J. HERRICK, Chicago.

THE FREQUENCY OF MENTAL DISEASE BEFORE AND AFTER THE WAR. TOEPEL. Monatschr. f. Psychiat. u. Neurol. **49**:323 (June) 1921.

The author bases his conclusions on statistics furnished by the admissions to the Cologne Psychiatric Clinic in the year preceding the war (1913) and in the year following the war (1919). For statistical purposes he divides psychoses into exogenic, endogenic and psychogenic. Exogenic psychoses, which depend on damage to the body from without (traumas, toxins, bacteria) decrease or increase proportionately to the exciting cause. In the year following the war we would expect an increase of psychoses resulting from cranial

injuries and a decrease in the alcoholic psychoses. Endogenic psychoses, dependent on internal conditions and independent of external causes, should remain unchanged. Psychogenic disturbances which represent pathologic reactions to affective experiences should show a marked increase. The results of the statistical study are as follows: Cases of alcoholism markedly diminished; of schizophrenia moderately diminished; of epilepsy somewhat diminished; of mental deficiency, manic-depressive insanity and syphilitic psychoses, practically stationary; cases of hysterias, traumatic neuroses and psychopathic states greatly increased. The diminution in the number of cases of epilepsy coincides with Kluth's findings, and the author agrees with Kluth in attributing this diminution to the lessened alcohol consumption.

Selling, Portland, Ore.

THE EARLY DEVELOPMENT OF THE CEREBRAL HEMISPHERES IN AMBLYSTOMA. H. Saxton Burr, J. Comp. Neurol. **34**:277 (June 15) 1922.

Two themes are developed in this paper: 1. The fate of the neuropore is determined experimentally. In early larvae, before closure of the neuropore, a slight wound was made in its ventral lip and this was stained with Nile blue. The stained area could be followed throughout subsequent development, and it was found that the lamina terminalis is formed by the closure of the lateral lips of the neuropore, and the ventral lip of the latter becomes the terminal ridge of Johnston (locus of the future anterior commissure). Kingsbury's recent modification of the scheme of subdivision of the early neural tube proposed by His is confirmed. The floorplate of His ends in the fovea isthmi; the roofplate of His ends in the terminal ridge. Between these landmarks the lateral basal and alar laminae of His fuse in the midplane.

2. The method of evagination of the cerebral hemispheres is briefly described. It is concluded that the hemispheres are evaginated from alar laminae (of His) alone and in early stages show a tendency toward cephalocaudal lamination, on which in later stages is superposed the dorsoventral lamination described by Herrick in the adult.

C. J. Herrick, Chicago.

INFUNDIBULAR POLYURIA. Lhermitte, Ann. de méd. **11**:89 (Feb.) 1922.

In this extensive article which takes up the subject of diabetes insipidus and which is based on the study of a case with syphilitic etiology, Lhermitte reports that histologic study showed the existence of profound lesions which were confined to the infundibulum and tuber cinereum. The supra-optic, suprachiasmic and paraventricular nuclei were the nuclei of the latter which were so gravely concerned. In the infundibulum, nerve cell changes were associated with vasculomeningeal specific inflammation; but in the tuber cinereum, the lesion appeared purely cytologic.

Lhermitte stresses the point that the hypophysis was not the site of any histologic abnormality.

One main conclusion set forth affirms that diabetes insipidus does not rest on either a perversion or obliteration of an endocrinal secretion but is a disorder of renal secretion conditioned by central nervous system disease.

Davis, New York.

THE AUDITORY SENSE OF THE HONEY-BEE. N. E. McIndoo, J. Comp. Neurol. **34**:173 (April 15) 1922.

Bee keepers are agreed that bees can hear, yet they cannot prove it, and some critics still contend that it has never been experimentally proved that any insect can hear; nevertheless, within the last few years some good experimental results have been obtained. The author has examined all of the five organs of the honey-bee which have been alleged to serve this function, and he finds that none of them seem structurally adapted to serve as organs of hearing at all comparable with our own. In bees, some of these organs seem qualified to respond to vibrations, but in ways more nearly comparable with our organs of touch than with our organs of hearing.

C. J. Herrick, Chicago.

MAGNESIUM AS A SEDATIVE. Paul G. Weston, Am. J. Psychiat. **1**: 637, 1922.

Weston advocates magnesium sulphate as a sedative in disturbed mental states. Two hundred and fifty 1 to 2 c.c. injections of a 25 to 50 per cent. sterile solution of magnesium sulphate were administered to fifty patients, including a large number with agitated depressions. The usual result was relaxation and the production of sleep lasting from four to six hours. This method of chemical restraint is said to be devoid of danger, and in the event of untoward symptoms calcium chlorid (intravenously) will exert an immediate inhibitory effect.

Strecker, Philadelphia.

TASTE FIBERS AND THE CHORDA TYMPANI NERVE. J. M. D. Olmsted, J. Comp. Neurol. **34**:337 (June 15) 1922.

It has previously been shown that taste on the anterior part of the tongue is lost after severance of the chorda tympani and that taste buds of this region in the dog degenerate if the lingual nerve is cut distal to its junction with the chorda. To complete the demonstration of the course of these taste fibers, the chorda tympani and the lingual nerves were cut, in different dogs, proximal to their junction. In the first case, taste buds of the anterior part of the tongue degenerated; in the second case, the taste buds did not degenerate, thus confirming the central course of the taste fibers through the chorda rather than through the lingual branch of the fifth nerve.

C. J. Herrick, Chicago.

Society Transactions

PHILADELPHIA NEUROLOGICAL SOCIETY

March 24, 1922

N. S. Yawger, M.D., *President, Pro Tem.*

SYPHILITIC PATIENTS SHOWING UNUSUAL FEATURES. Dr. J. V Klauder.

A man, 38 years old, had had epileptiform seizures and crying spells. He was apprehensive, depressed and had memory and speech defects, pupillary abnormalities and exaggeration of the patellar reflexes. The blood Wassermann reaction was strongly positive and the spinal fluid typical of paresis. He also complained of precordial pain, palpitation and shortness of breath on slight exertion. Examination revealed aortic dilatation and insufficiency.

He was shown because he was an exception to the rule that patients with neurosyphilis rarely present clinical manifestations of tertiary syphilis elsewhere. Patients with a frank tertiary involvement of the skin, bones or viscera may present one or more neurologic abnormalities, but ordinarily the disease is expended in only one system of the body. The work of Warthin, however, indicates that this dogma is less true pathologically than it is clinically.

A man, aged 48, had had a chancre thirty years ago, but had not received treatment. He now has a cutaneous syphilid on the forehead, his only complaint. The pupils were unequal and irregular, and reacted sluggishly to light. The right knee jerk was feeble, the left absent. The blood Wassermann reaction was four plus; the spinal fluid showed 2 lymphocytes, a negative globulin reaction, colloidal gold 1110000000 and a negative Wassermann reaction in 1 c.c.

This patient, like the first, had tertiary syphilis with frank involvement of the nervous system, a normal spinal fluid and the absence of subjective symptoms of neurosyphilis. This type has been termed abortive, "burnt out" or imperfect tabes, and doubtless includes other forms of neurosyphilis. The presence of a normal spinal fluid in this class of patients, previously untreated, points to a spontaneous cessation of the underlying neurosyphilitic process. In these cases, the pupillary abnormality probably represents a "neurologic scar" of a former neuraxis involvement. It is generally believed, although not definitely established, that the spinal fluid is persistently positive for many years prior to the development of frank symptoms of neurosyphilis. Therefore, the presence of an isolated pupillary abnormality, in the type of case under discussion, together with a negative spinal fluid, does not warrant the belief that this objective symptom is a forerunner of tabes or some other neurosyphilitic process.

The statistics of Dreyfus are of importance in the discussion of such cases. He says that from 35 to 40 per cent. of patients with tertiary syphilis with isolated pupillary abnormalities have negative spinal fluids. Indeed, in his cases the spinal fluid remained negative after provocatory arsphenamin injections.

The significance of isolated pupillary abnormality in a syphilitic patient cannot be definitely stated until the spinal fluid is examined. This is important in the examination of syphilitic persons.

This woman, 31 years old, when three months pregnant, in April, 1920, suffered a complete right hemiplegia with aphasia and some impairment of audition. Her blood Wassermann reaction at that time was negative and the spinal fluid normal. Subsequent blood Wassermann tests showed moderately positive reactions. The spinal fluid remained normal.

Some years ago she gave birth to a dead infant. The placenta presented the appearance characteristic of syphilis, and the woman's blood Wassermann reaction at the time was four plus. She then received treatment with arsphenamin and mercury over a period of two years when the Wassermann reaction became negative, and several tests in the course of a few years were negative.

DISCUSSION

Dr. W. B. Cadwalader: Hemiplegia coming on during pregnancy or shortly after may be caused by embolism, quite independently of syphilitic infection. Dr. Ornsteen has recently reported such cases.

Dr. William G. Spiller: Hemiplegia developing in a syphilitic man should not be regarded as evidence of acute syphilis. Syphilis might leave the blood vessels highly diseased, and a rupture or thrombosis might occur later in a diseased vessel from other causes than acute syphilis.

Dr. Francis X. Dercum: I am firmly convinced of the existence of two strains of spirochetes. It is impossible to reconcile the symptoms of the exudative forms of syphilis with those of the parenchymatous form. It is a fact that in a large number of tabetic and paretic patients there is no history of an initial lesion or of a slight one. It may be asserted that sometimes the symptoms of both infections are present, and it is conceivable that infection with both strains of the spirochete may occur. The parenchymatous group, the so-called parasyphilitic group, occupies a place by itself. It is not at all unusual to obtain negative serologic findings in the parenchymatous group. They are cases which have immunized themselves for the time being. Any large clinic will present such patients as Dr. Klauder has shown. I regard changes in the pupil as the most important indication of syphilis. Slight irregularity, slight inequality or inequality in the reaction to light are indications that the pupils are developing into Argyll Robertson pupils.

THROMBOSIS OF THE ANTERIOR SPINAL ARTERY. Dr. A. M. Ornsteen.

Occlusion of the anterior spinal artery is not frequent and necropsies have been few. Spiller, in 1909, reported a case with softening from the fourth cervical to the second dorsal segment.

The anterior spinal artery, the last branch of the vertebral within the skull before it becomes the basilar, descends ventrad to the medulla and unites with its fellow of the opposite side at about the level of the foramen mangum, to form the anterior median spinal artery. The latter vessel descends the entire length of the cord in the anterior median fissure, being reenforced along its course by lateral branches entering through the intervertebral foramina from the vertebral, thoracic, lumbar and sacral vessels. The anterior spinal artery supplies the pyramids and the mesial fillet in the lower anterior portion of the bulb, and the upper few cervical segments of the cord through the first

portion of the anterior median spinal artery before the lateral anastomoses begin. In the cord, the gray matter and a portion of the anterolateral columns are nourished.

The syndrome to be expected from occlusion of these vessels is: spastic tetraplegia with disturbance of the sense of position and vibration because of pyramid and mesial fillet involvement. If the softening extends into the cervical segments, atrophy and fibrillary twitchings of segmental muscle groups occur in addition to the spastic tetraplegia. Disturbance in the recognition of pain and temperature may occur in a limited area from involvement of the central gray matter, or may be widespread below the lesion, unilateral or bilateral, depending on the amount of destruction of the anterolateral columns. I believe that the two cases herein reported are instances of thrombosis of the anterior spinal arteries.

The first patient, aged 54, a laborer, complained of stiffness in gait, weakness of the upper extremities and numbness in both hands and in the perineum. These symptoms began in November, 1921, when he suddenly felt his hands become numb; several hours later he experienced numbness in the lumbar region and left leg. On the next day, the numbness increased and was present in both arms and legs. On the third day others noticed that he was walking and bending peculiarly, and he felt increasing weakness and stiffness in both lower extremities. He continued to work for two days, but with great difficulty because of stiffness in arms and legs. On the fifth day while walking he fell to his knees, and with difficulty arose and managed to walk home. Improvement began about a week later. Three weeks after the onset he complained of numbness of both hands and forearms, of a feeling of warmth over the chest and abdomen, a sticking sensation around the genitals and perineum and infrequency and hesitancy of urination.

Examination showed a spastic gait with marked swaying in the Romberg position. The lower limbs were very hypertonic. The knee jerks were markedly exaggerated with bilateral patellar clonus. The ankle jerks were greatly increased; no clonus was present. There was a Babinski sign on the right. The abdominal reflexes were absent. The upper extremities were not notably hypertonic but the movements were slow and stiff, with fair power. The left biceps reflex was prompt, the right diminished; the triceps reflexes were greatly exaggerated. The right deltoid, suprascapular and infrascapular muscles were atrophied; the right triceps was not perceptibly atrophic but fibrillary twitchings were evident in this muscle and in the right biceps and deltoid. The sense of position was impaired in the toes of both feet, but not in the hands; vibration was not perceived in the feet, momentarily over the tibiae, and almost normally in the knees and hands. Tactile, pain and temperature sensations were undisturbed, although he made more mistakes in discerning temperature in the right forearm than in the other forms of sensation. Examination revealed atrophy of the left shoulder girdle with fibrillary twitchings in the infrascapular and triceps muscles.

The blood Wassermann reaction was negative. The blood pressure was: systolic, 160, diastolic, 90.

The second patient was a woman, 24 years of age, who on May 29, 1918, became tetraplegic in an hour and a half. For several weeks before the onset she complained of dull pain in the upper dorsal region. When walking upstairs, there was a stiff and drawing sensation in this area. Three days before the paralysis her neck felt heavy and stiff. On the morning of the day of onset she felt nothing unusual and in the afternoon she went out for a

walk. When she had walked about two blocks, a sudden sharp pain was felt in the cervico-thoracic spine radiating into the substernal region, accompanied by a numb sensation in both legs. She hurried home unaided, the numbness spreading to trunk and arms, especially the left. She was able to enter the house but had to be carried upstairs. Sharp sticking pains were felt throughout the entire body from the neck down; the fourth and fifth fingers of the left hand became spasmodically flexed; the lower extremities became stiff and in about an hour and a half she was completely paralyzed in all four extremities. The whole body felt numb; there was retention of urine for twenty-four hours. For eight weeks she had to be catheterized and there was obstipation. After three months power began to return in the right arm and then in the left, and in about eight months she was able to get about with the aid of two canes.

She now has marked spastic paraplegia, with adductor spasm, exaggerated patellar reflexes, double ankle clonus and a Babinski sign. The abdominal reflexes are absent. Motor power in the right upper extremity is fair; poor in the left. The small muscles of the left hand and those of the flexor surface of the left forearm are atrophied; the fourth and fifth fingers of this hand are contractured. The left supinator reflex is absent, but is active on the right. The biceps reflexes are prompt, more so on the right; the triceps reflexes are both exaggerated. No atrophy is seen above the elbows. The sense of position and vibration and stereognostic perception are normal in all extremities. Tactile sense is normal on the right and hyperesthetic on the left up to the eighth dorsal segment. Pain sense is notably diminished in the right leg and trunk up to the fourth dorsal segment and is normal in the upper extremities. Temperature sense is disturbed in both lower extremities, more marked in the right; cold causes a somewhat painful sensation in the left leg and is normal in each upper extremity. The pupils are normal. Serologic examinations and roentgenograms of the vertebrae are negative.

In this case the lesion appears to involve the anterior median artery to a rather low level in the cervical cord, seventh and eighth segments. There is no evidence of sympathetic paralysis. This patient was seen in the early days of her affliction by a number of eminent European neurologists; their diagnoses were as follows: Flatau and Goldflam of Warsaw and Fleishman of Kiev diagnosed the condition as "sclerosis" (of what character I do not know); the former gave her four injections of arsphenamin. Lapinsky of Kiev diagnosed a hemorrhage, whether hematomyelia or a subdural hemorrhage I cannot say. Cassirer of Berlin diagnosed hemotamyelia.

DISCUSSION

Dr. Daniel J. McCarthy: Could not a myelitis, meningomyelitis or hemorrhagic meningeal condition in the cervical cord itself explain these symptoms?

Dr. A. M. Ornsteen: A meningomyelitis with hemorrhage could explain all the symptoms, but the preservation of motor power for one and a half hours from the onset is against hemorrhage. In order to obtain a spastic upper motor neuron tetraplegia the lesion must be in the uppermost part of the cord in order to involve both pyramidal tracts. A hemorrhage usually produces paralysis suddenly, of a flaccid type at the onset; but here, at the time of the paralysis, the patient's limbs all became stiff. There was a contracture of the left hand and an extension stiffness of both of her extremities; an hour

and a half elapsing between the onset of the initial symptoms and complete paralysis is in favor of thrombosis, which might be secondary to meningomyelitis rather than hemorrhage into the gray matter of the cord. If the posterior spinal artery is affected the anterior horns are not involved.

THE THALAMIC SYNDROME. Dr. N. W. Winkelman.

This patient, 70 years old, was fairly well until fourteen months ago, when, as he was walking, things suddenly became black in front of him, and he fell to the ground. He was not unconscious, but was dazed and after a few minutes was able to walk a short distance to his home. He was in bed for a day or two. So far as could be determined, there was no aphasia or paralysis, though there was weakness on the right side of the body, including the face. About four or five months after this attack he began to have pain over the entire right side of the body; at first very mild, gradually increasing in intensity, until now he finds it almost unbearable. Sometimes it feels as if the entire right side were burning and at other times it feels very cold. On the right side there is a feeling as if a phonograph were playing.

Examination revealed a short, well developed, man, who was emotional, and cried easily. His teeth were in poor condition, and he had marked arteriosclerosis. His blood pressure was: systolic, 195; diastolic, 100; his heart was much enlarged; there was a loud mitral systolic murmur and marked edema of the ankles. When touched lightly on the right side he complained bitterly of pain. He walked rather stiffly and dragged the right leg a little, holding the right arm as if afraid to touch anything with it. Fine movements of the fingers were well performed on both sides. The pupils were small, slightly irregular but reacted normally, and the cranial nerves were normal. The reflexes were a little more prompt on the right and there was slight weakness on that side but no ankle clonus or Babinski sign. There was hypesthesia on the right, more marked distally. When touched on the right side with the point of a pin or with hot or cold tubes he complained of severe pain over the entire right side, but this also was more marked distally. There was distinct impairment of the vibratory sense and the sense of position in the right lower extremity. There was no astereognosis. There were no visual disturbances and no choreic or athetoid movements. He showed a senile type of mental change.

I would ask the question which Souques asked Lhermitte when the latter presented a case of thalamic disease at the Paris Neurological Society; namely, whether the thalamus is always at fault in a case of this kind or whether a lesion of the parietal region or of the fasciculus thalamocorticalis cannot produce the same syndrome.

DISCUSSION

Dr. Charles K. Mills: I have seen the same or a very similar syndrome, including even the dysesthesia supposed to be pathognomonic of thalamic disease, in a case of lesion of the parietal lobe between the thalamus and the cortex, demonstrated at necropsy. Such a lesion would of course involve the tracts of communication both from the thalamus to the cortex and from the cortex to the thalamus. It is probable that the nearer the lesion reaches the thalamic border the more likely will the symptomatology approach that of true thalamic disease. I am not sure also that we may not have a syndrome closely approximating that of Dr. Winkelman's case from a tegmental lesion below, but not far removed from the thalamic entrance zone.

Dr. F. X. Dercum: Dr. Mills' view that the lesion might be above the thalamus hardly applies in the present instance because of the absence of astereognosis. If the lesion were in the corticothalamic fibers, astereognosis in some degree would have to be present. I do not think that we can escape from the conclusion that in this case the lesion is in the thalamus.

Dr. W. G. Spiller: I should like to have satisfactory evidence that a lesion entirely below the optic thalamus may cause spontaneous pain in one half of the body. Gordon Holmes has spoken of central pain from lesions of the spinal cord, but I am unable to refer to any reliable case in which a lesion entirely subthalamic had caused intense unilateral pain, affecting both upper and lower limbs.

HISTOLOGIC CHANGES PRODUCED EXPERIMENTALLY IN THE CENTRAL NERVOUS SYSTEM OF MONKEYS BY MERCURY.

Drs. Baldwin Lucke and John A. Kolmer.

In previous papers on the histologic changes produced in rabbits and rats by arsphenamin, neo-arsphenamin and mercury we have reported certain lesions in the central nervous system which may be summarized as follows: Multiple doses of the arsenicals, in excess of the calculated therapeutic amounts, produced hyperemia, focal hemorrhages, some endothelial proliferation and frequently hyaline thrombosis. After multiple doses of the mercurials, the most striking findings in a considerable number of rabbits were perivascular and pial small round cell infiltration. This latter lesion had not been observed in the numerous control animals, nor in those treated with the arsenicals, and was therefore regarded as being induced by the mercurials used. We felt, however, that these experiments should be repeated, and we selected monkeys because of their closer phylogenetic relationship. An added reason for this selection was that spontaneous lesions in the various organs of the rabbit are of not infrequent occurrence.

Histopathologic study of the brains from three monkeys treated for a period of three months by intramuscular injection and inunction, respectively, of different mercurials revealed a number of distinct tissue changes which may be summarized as follows: 1. The pia arachnoid was locally thickened and cellular. This was most pronounced in the sulci and was chiefly due to fibroblastic hyperplasia. 2. The endothelium of many capillaries and of the small vessels in general was large and swollen and in a state of active proliferation. New vessel formation, as evidenced by capillary budding, was frequently observed. 3. Mild infiltration of the adventitial lymph spaces of the smallest vessels with lymphocytes, plasma cells and intermediate forms, was present. 4. There was a moderate proliferation of the cellular as well as of the fiber-forming neuroglia. The former was most distinct about proliferating capillaries, in the white matter and in the neighborhood of diseased ganglion cells; the latter was best seen in the subependymal and the marginal cortical layers. 5. A relatively small number of ganglion cells were in a state of acute degeneration. 6. The distribution of lesions mentioned was irregular, mainly local, and on the whole most pronounced in the basal portions of the brain.

Conclusions.—1. Mercury, administered over a period of three months in monkeys causes proliferative, degenerative and slight exudative changes in the central nervous system.

2. It is suggested that this investigation is applicable to the problem of human neurosyphilis.

DISCUSSION

Dr. D. J. McCarthy: In the early use of arsphenamin there were some cases of overdosing, more particularly in children. Some cases of lead poisoning both human and experimental were reported from the Pepper Laboratory showing encephalitis. It appears to me that the dose of mercury per kilo is markedly larger than that we give to human beings. I should be amazed to find that lesions of paresis were due to mercury.

Dr. F. X. Dercum: I think the impression left in our minds is that we should use the metals in the treatment of syphilis with caution. It opens up also the greater question, not yet settled, as to other effective methods of treating syphilis. A great many things can perhaps be developed by a more intensive study of the biology of the spirochete.

Dr. Sherman F. Gilpin: The practical fact in regard to paresis or tabes is that many of the patients do not know they have had syphilis, and have never received mercury or arsenic. The animals used in these experiments did not have syphilis. The person who is nonsyphilitic and who takes mercury in a very small dose soon has marked local manifestations in the mouth and intestines. I do not see how we can judge the effect of mercury or arsenic on syphilitic persons by the effect of mercury or arsenic on nonsyphilitic animals

Dr. Alfred Gordon: The statements of Drs. Lucke and Kolmer appear to be revolutionary. How will they explain cases with removal of acute symptoms after mercurial treatment? It would be very interesting to hear Dr. Kolmer explain this apparent paradox. It is discouraging to witness a condemnation of the well tried drug. How long did the treatment of monkeys continue, and what was the amount of mercury given in comparison with similar treatment in man?

Dr. W. B. Cadwalader: I have occasionally noted diminution of vigor in syphilitic patients after unusually prolonged and intensive treatment with mercury and arsenic; a depression of vital functions which might have been caused by the drugs, not by syphilis. Has Dr. Lucke, in his experimental animals, observed anything that might correspond to this condition?

Dr. John A. Kolmer: The dose of mercuric salicylate administered to these animals by intramuscular injection corresponded to 1 grain (0.06 gm.) per 60 kilos of body weight. The inunctions were administered in the form of blue ointment in doses of 1 dram (3.9 gm.) per 60 kilos. Theses amounts correspond to those ordinarily administered to human beings in the treatment of syphilis.

Both Dr. Lucke and myself desire to say that we do not regard these histologic changes of sufficient degree to influence unfavorably the treatment of syphilis with mercury. The changes were largely intravascular and well within the range of repair. Therefore, while they may occur in the human brain in cases of syphilis intensively treated with mercury, they probably do not produce permanent injury or symptoms. However, answering Dr. Cadwalader, our animals lost considerably in weight and showed the effects of mercurialization.

Dr. Lucke and myself do not regard these lesions as likely to be mistaken for the histologic changes found in paresis; we simply believe that we have data showing that the administration of mercury to lower animals may produce lesions which are somewhat similar to some of the changes in paresis. *Spirochaeta pallida* induces lymphocytic infiltration in practically all tissues in which it may be located, and we believe that it is interesting to learn that the

administration of mercury may result in the production of areas of lymphocytic infiltration and endothelial changes of a similar kind and probably caused by the deposition of mercury in these tissues.

Dr. Baldwin Lucke: Treatments for three months with any drug in therapeutic doses cannot produce the same lesions as disease that has lasted for many years. This ought to be understood. If I had treated these animals for three years, or ten years, the story might have been entirely different. I know that relatively small quantities of any of the metallic salts will produce profound changes in the liver and kidneys and elsewhere; there is no reason to expect that the brain would be exempt. We are not asserting that mercury causes paresis or tabes; we are simply stating that in these monkeys, treated for a relatively short time, there occurred certain changes in the nervous system that simulated in part the early changes in paresis.

THE DIAGNOSIS OF BRAIN TUMORS BY THE BÁRÁNY TEST, WITH REPORTS OF CASES PROVED BY OPERATION OR NECROPSY. Dr. Lewis Fisher.

(This paper was published in full in the J. A. M. A. **78**:1515 [May 20] 1922.)

CONCLUSIONS

1. In cases of cerebellopontile angle lesion the Bárány tests are absolute. By means of them these lesions can be definitely located or excluded long before the appearance of the ordinary clinical findings.

2. Lesions of the posterior fossa generally give fairly constant findings in the Bárány tests. I believe that they are of great value in the differential diagnosis between a subtentorial or supratentorial lesion.

3. The Bárány tests are also helpful to a lesser degree in lesions in the middle or anterior fossa.

DISCUSSION

Dr. J. Hendrie Lloyd: The most satisfactory experience I have had with the Bárány tests has been in syphilis of the eighth nerve. Dr. Fisher made some of these examinations for me, and it was very interesting to observe the abolition of the nystagmoid movements and of the vertigo. The Bárány tests are intended simply to test the functions of the vestibular nerve. That is all they can do. In some of these cases in which there is paralysis of the eighth nerve, together with paralysis of the sixth and seventh nerves, there are good reasons for making a diagnosis without the Bárány tests, and in these cases we should not give too much credit to the Bárány test in making a diagnosis. But there are other cases. Two weeks ago I was present at a brain operation. The patient had been taken with very severe headaches following trauma, with very rapid onset of papilledema, progressing rapidly to blindness. There were practically no localizing symptoms. The woman was not deaf, she had no involvement of any cranial nerve except the second. She had an unsteady gait, not marked. The ophthalmologist and I thought she had a right lateral homonymous hemianopsia. There was such a high grade of papilledema that neither of us wished to attach too much importance to the changes in the visual field. She had also slight astereognosis of the right hand. The Bárány tests were made, and a lesion of the right cerebellum, in the right semilunar lobe, was diagnosed. The surgeon performed an exploratory and decompressive operation at that point, but found nothing. I believe that we shall be thrown off the track if we are not extremely careful. The trouble is that in some of

these examinations the otologist goes too far. He attempts to make a diagnosis. He hands it out to us and expects us to accept it. We do not do this in the case of any other cranial nerve, not even the optic nerves; why, then, should we attach such diagnostic importance to the vestibular nerve? In the case mentioned, the hemianopia and astereognosis probably indicated a lesion of the left parieto-occipital region.

Dr. William G. Spiller: Dr. Fisher has been of much assistance to me in the diagnosis of tumor of the cerebellopontile angle by means of the Bárány tests. In two cases I did not consider the findings sufficient for a diagnosis of this condition, and yet Dr. Fisher had concluded from these tests that the tumor was situated in the angle, and he was correct. I have come to place much reliance on the diagnostic findings by the Bárány tests as related to angle tumors. I am not prepared to make any statement regarding the use of these tests in the diagnosis of tumors elsewhere.

It is surprising that the symptoms of angle tumor may be obscure, but cases occur in which the diagnosis of such a tumor from the clinical findings is extremely difficult, even when the tumor is of considerable size. It is therefore of the greatest importance that the Bárány tests are valuable in such cases.

Dr. Lewis Fisher: I think Dr. Lloyd's criticism timely and justifiable. I do not know who the otologist was in this case, but if he had had much experience in this work he would not have been so positive of the tumor in the semilunar lobe. Unfortunately this sort of diagnosis is made only too frequently by the inexperienced who have not seen a sufficiently large number of cases to have learned to evaluate certain things. It is no more than natural that this kind of hasty and unjustifiable diagnosis should work a great deal of harm in the development of this work. Up to the present state of our knowledge, I feel that the only lesion in which we are justified in making a positive diagnosis is one in the cerebellopontile angle. These tests should be only corroborative and suggestive, but never positive of lesions elsewhere.

I fear that I am unable to answer the question as to the percentage of failures. These were more frequent years ago when we thought we knew a great deal about this work but in reality knew very little. I do not recall a single failure in the case of a cerebellopontile angle tumor within the last five years. The results in operative cases are frequently misleading. For instance, in a case examined recently in a western city, I made a diagnosis of a cerebellopontile angle tumor. The doctor at whose request I saw the patient wrote me a week later that at operation, in spite of a big exposure, digital exploration failed to show the tumor. Because of free bleeding the operation had to be discontinued. I received another letter from him a week later, stating that the patient died and necropsy revealed a large tumor in the angle. I have come to regard, therefore, an operative finding as conclusive only where it is positive.

PHILADELPHIA PSYCHIATRIC SOCIETY

Stated Meeting, May 12, 1922

Albert C. Buckley, M.D., *President*

THE ORIGIN OF SPIRITUALISM. Dr. Charles W. Burr.

Long before recorded history, long before man could write, it was possible though unprovable that spiritualism existed. Its vogue in savage races of today is proof that it is a belief which would be sympathetic to the primitive

mind, unless one accepted the hypothesis that all savage races of today are degenerate descendants of higher ancestors. While this might be true of a few races, for example, in certain African tribes, it is not true of all. Some are simply races whose protoplasm has been able to ascend only to a certain stage, and then has stood still. At all events, in every savage race today in Africa, Australasia, Asia, South America and the land of the Esquimaux, spiritism exists. Among the savages it has been accepted by the whole tribe; there are no skeptics. It is only in civilized man that we find any, let alone a majority, who refuse to accept it. If truth were proved by majorities contrary to fact, then spiritualism was proved to be true milleniums ago.

Dr. Burr summed up the facts about primitive man: Assume that he had developed so far as to live as a family. He was a herding animal, and it was only thousands of years later that he lived in tribes. He and his woman and offspring lived together permanently. The era of casual breeding had passed. He had learned that he must fight for his existence by cunning because many of his enemies exceeded him in strength. He had learned that sticks and stones were useful weapons; he had even learned that certain stones by flaking made better arms. Tools, with the exception of flints, he had none, nor did he need them except in the making of his flints. He had not become a cultivator of the ground. He might have become a fisherman. It would have been detrimental to him if he had, because he was overfed and lazy, and the hunter could easily beat him in any combat. He lived a precarious life, sometimes gorged, sometimes starved. Probably already infectious diseases had begun to take their toll. He was strong and hard-muscled; we have the proof of that in the big ridges on his bones where the muscles were inserted. He was not very tall. His jaws were strong, his teeth large, and his brows beetling. He was not beautiful to look at, but he was healthy. There were no weaklings, for it was probable that the diseases which lead to degeneracy had not arisen, and because a kindly nature, not restrained by the brutal sentimentalism of civilization, killed off all the accidentally unfit. He had inherited epilepsy from his mammalian ancestors, and probably mania from the anthropoids. Mentally, his memory was well developed, and his senses, especially sight and hearing, were acute. Taste and smell were probably little developed, or rather smell may have begun to decrease even in his anthropoid ancestors. Taste was of little value to him, because food was eaten not to tickle the palate but to feed the fires of his engine. His sense of physical pain was not acute. Sensations were developing into emotions. He already had a somewhat higher feeling toward his woman than had the ape. He had no sense of awe, no real esthetic pleasure. Fear was his great emotion.

Can we form a mental picture of primitive man, showing what his mental state was and decide whether or not he could have and would have developed ideas concerning communication with the dead?

First, Dr. Burr said, he wished to give an hypothesis concerning which mental qualities man inherited from his animal ancestors and which, if any, were peculiar to him. Dr. Burr, of course, accepted the theory of evolution, that is, the theory that there is an unbroken family line from man to the earliest form of living matter, whatever might be the method of introduction of anatomic and functional change in the formation of new species. For our purpose we are interested only in the mental side of racial inheritance. Which mental faculties did early man inherit from his ancestors? All of them. But the power of reasoning—that is, the ability, given any premise, to form a

judgment as to the consequences—was present in even the highest animals in only fragmentary form. Man's emotional nature, on the contrary, found almost its counterpart in many animals. Fear, pain, pleasure, love of a kind, man received from his humbler relatives. Memory also came from the same source.

His vocabulary was small because the subjects of his thoughts were few. Fear was his greatest emotion. The unknown and the unexpected terrorized him. Thunder and lightning, the avalanche, fire, great rivers, especially when in flood, and all the wondrous things, caused in him not awe and admiration, but abject terror.

He, during centuries or milleniums, developed mentally, and finally there arose what we today call the spirit of inquiry—he wanted to know the causes of things. He now had acquired the sense of awe. He dreamed, and being logical but having no education, no scientific tradition to help him, interpreted his dreams as being the adventures of himself outside his body. Long before this he had learned that he had a personality, was a thing apart, just as children today reach a moment when they realize that they are persons. This thing which was himself which wandered in dreams he called his soul. Soon he gave soul to all things and thus arose animism—the first of all the religions this world had seen and the seed from which all others have sprung.

But he reasoned, and he was logical. If the soul left the body in sleep, did it not also leave it at death? Hence the belief in immortality. There was only a step further to the dead talking to the living. This was the origin and source of spiritualism. But in present day savages, in early history, and probably in primitive man, this talking by the dead to the living was not a thing longed for but dreaded. The dead gave messages, not from loving sons, but of another kind.

It was interesting that spiritualism and occultism in general seemed to have been widespread in the first century after Christ, and certainly waxed fat and grew in revolutionary France, in England after the Crimean War, after our Civil War and after the World War. Why? Because such times are times of intellectual anarchy, emotionalism and moral breakdown. Today the world is sick and many men when sick become like children. Such men cast off rationalism and revert to slavery of the emotions. Man was a feeling, not a thinking, animal at best, and today a large number of people have thrown off the most recently acquired characteristic, reason, and are obeying the emotional will to believe. When, if ever, the pendulum ceases to swing, we shall all agree that there are many things concerning which it is wise to be agnostic, and some things that we cannot know. When intellect rules we shall study only phenomena, we shall not try to know realities, for reason is modest and knows its limitations.

FOLIE A DEUX. Dr. John H. W. Rhein.

Dr. Rhein reported three instances of folie à deux, a well recognized but comparatively rare form of insanity. In the first instance, a man, in apparently good health and of normal mentality, a short time after his wife developed paranoid delusions, ideas of reference and visual and auditory hallucinations, developed the same type of psychosis. In these patients there was present a paranoid state with ideas of reference and hallucinations of hearing and sight in persons who previously had not been psychotic, occurring in the presenile period in both instances. The patients had the same delusions, occur-

ring first in the wife, whose personality was the dominating one, neither exhibiting deterioration, disorientation or marked changes in personality, judgment or affectivity or pronounced changes in the arterial system; no physical basis could be found to explain a possible toxic origin of the symptoms. The cases illustrated the type of case described by the French as folie imposée.

The second illustration of this disease was the case of two sisters living intimately under the same condition, that of cook and maid, for twenty years, who had developed similar psychoses of paranoid type, the primary psychosis occurring in the stronger personality and imposing on the sister a similar secondary psychosis of the folie imposée type.

The third illustration of this disease was its occurrence in a woman 43 years of age, who developed a psychosis characterized by paranoid ideas, ideas of reference and auditory hallucinations. She had slept in the same room as her mother and sister for sixteen years. Six weeks after the first symptoms of her psychosis, the mother became insane, showing paranoid ideas, visual hallucinations and grandiose ideas which terminated shortly in cerebral hemorrhage. A second daughter contracted a similar train of symptoms as those presented by her sister. A third daughter, after a period of confusion of two months' duration, fell out the window while walking in her sleep. In this group of cases, the insanity of the mother was regarded as an instance of folie simultanée, while the secondary psychosis in the sister illustrated the type of psychosis described as folie imposée.

Folie à deux, to which the first reference in literature by Hoffman dates back to 1846, was described by the French as consisting of three types, namely, folie imposée, folie simultanée and folie communiquée.

1. La folie imposée is one in which one individual affected with a psychosis transmits to another with whom he is living intimately and in secluded association a similar psychosis in which, when the two subjects are separated, the latter recovers.

2. By folie simultanée is meant that psychosis in which two subjects are simultaneously affected by the same psychosis arising from the same external factors, in which, therefore, transmission plays no part.

3. Folie communiquée represents a psychosis in which the mental symptoms of the primary subject become firmly rooted in the second subject, but in both cases new elements arise, and a true independent psychosis occurs, which persists and progresses even after separation from the active factor.

References to the literature were cited, illustrating the various types of this psychosis, also the rôle played by heredity and contagion. Illustrations of this disease are found occurring in mother and daughter, husband and wife, brothers and sisters and also in persons closely associated but not related. Instances of folie gemillaire which may take the form of folie à deux also are cited, though in most instances this type is an example of a psychosis of different origin.

Dr. Rhein concludes that it is apparent that there are several types of insanities which occur simultaneously in two persons who have been closely associated. In twins induced insanity may be observed, as well as a coincidental occurrence of insanity, instances of which are familiar as occurring in families in which predisposition and similar exciting environmental influences play important etiologic parts. Dr. Rhein also gave instances of insanity occurring simultaneously in two persons intimately associated, which may be viewed as examples of insanity of independent etiology. Insanities also occur in two persons living together in close association in which the secondary

psychosis resembles exactly the primary one, which appears to be the direct result of contagion or suggestion without any apparent hereditary basis, and which assumes in most instances a paranoid state in which the prognosis for the secondary psychosis is good.

CHRONIC PSYCHOPATHIC INFERIORS—A DIAGNOSTIC PROBLEM.

Dr. Alice E. Johnson.

Dr. Johnson said that this group was not well-defined and in reality was undiagnosed. An effort was made to analyze a large number of patients placed in this group, with reference to the cause of their inadjustability; the difficulty of all such cases lay in the personality of the patients. The test of normality was the degree of adjustability to ordinary circumstances. Adjustability was determined by the patient's fear reaction or ability to remember pain. Moral impression ability was a good working name for the quality. The group studied showed that people have either too much or too little fear reaction; hence there are two opposite reasons for failure to make an adjustment. This is true regardless of the intellectual ability of the patient. Diagnosis should be made on this basis, and it would be found that the patients in this group suffered from two very different conditions. To those with deficient moral impressionability the name constitutional psychopathic inferior should be applied exclusively. The others are psychoneurotics. Exact diagnosis is the only basis for effective treatment. True constitutional psychopathic inferiors are incurable, and a problem for the state. There is some hope for the psychoneurotics if clinical technic is properly developed. Dr. Johnson said she thought that there is great need for a closer and more extensive study of this large class of social misfits.

Book Reviews

DER ANETHISCHE SYMPTOMENKOMPLEX. EINE STUDIE ZUR PSYCHOPATHOLOGIE DER HANDLUNG. Von Dr. Othmar Albrecht. Abhandlungen aus der Neurologie, Psychiatrie, Psychologie und ihren Grenzgebeiten. No. 12, pp. 107. Berlin: S. Karger.

In a semiphilosophical and semipsychologic general discussion of thirty-five pages, Albrecht arrives at the formulation of anethical action as the expression of a "disorder of orientation in the ethical space." He then takes up the symptoms as dependent on special mood disorders, such as exaggerations of the instinctive life and of the ego feeling, and the negativistic reactions. He summarizes the symptoms in forty cases which are given in full on pages 65 to 100, and offers the following conclusion:

"The disorientation in the social space which shows in the form of pathologically anethical activity can in a large number of cases be traced to morbid disorders of the course of reactions of the total personality. The most essential ones of these disorders can be formulated as the anethical symptom complex: The alteration of mood and emotion, the exaggeration of the instinctive life, of the self-feeling and the negativistic reaction."

The concept does not serve as a real diagnosis, any more than does "moral insanity." (See the article in Baldwin's "Dictionary of Philosophy and Psychology.") Albrecht's contribution does not clear the horizon. In the main, the characterization of the concrete plain facts entering into the individual cases and the discussions by Healy, Campbell and others, on a frankly pragmatic basis, give more satisfaction than the efforts to get light from general discussions. The records are certainly not overloaded by intelligence tests; on the other hand, one also misses the pragmatic trying out of the cases in the light of efforts at their disposal.

UEBER DIE ENTSTEHUNG DER NEGRISCHEN KORPERCHEN. Von Dr. Ladislaus Benedek und Dr. Franz Oskar Porsche. Abhandlungen aus der Neurologie, Psychiatrie, Psychologie und ihren Grenzgebeiten; Beiheft zur Monatschrift für Psychiatrie und Neurologie, herausgegeben von K. Bonhoeffer. No. 14. Pp. 86. Berlin: S. Karger, 1921.

In a study of the Negri bodies of street rabies and experimental rabies the authors have developed three methods which give a remarkably distinctive differentiation of the acidophilous parts of the structure. The descriptions and the analysis of the literature led them to make the assertion that the typical forms of the Negri bodies can be derived from the structural changes of the nucleoli. They found increased immigration of nucleoli into the cell bodies. The small homogeneous inclusions found in the Negri bodies are probably derived from the acidophilous and basophilous lumps (Schollen) suspended in the nuclear substance. The immigration of the nucleolus is promptly followed by the formation of a new nucleolus. The process of this replacement appears to be accelerated in rabies. Ten plates, most of them colored, furnish the documentary evidence. An interesting bibliography of great value to those studying cell alterations and the formation of "parasites" is appended.

OSSERVAZIONI NEUROLOGICHE SU LESIONI DEL SISTEMA NERVOSO DA TRAUMI DI GUERRA. Prof. Ottorino Rossi. Pp. 1-224. Sassari, 1921.

Prof. Ottorino Rossi in an evidently privately printed review of his war material gives, in 224 pages, a most valuable and interesting survey of casuistics—with 164 figures in the text—partly lesions of the forebrain (frontal, parietal, temporal, occipital, callosal), partly of the cerebellum, and various cerebral syndromes. The second part of the work is principally devoted to lesions of the spinal cord and spinal roots, reflex disorders, sensibility paths, etc. The individual studies are well presented. Unfortunately, there is no index, and there are no summaries which would render in a concise form the deductions from this casuistic treasure house. Those working up war material should not omit a careful study of this well reported material.

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VISUAL DEFECTS CAUSED BY OCCIPITAL LOBE LESIONS

REPORT OF THIRTEEN CASES *

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LOS ANGELES

Unusual opportunities are afforded by war injuries for the observation of disturbances of the visual functions in their relation to more or less circumscribed lesions of the brain, and several important contributions to this subject have been published in foreign journals since the beginning of the world war. In 1916, Holmes and Lister [1] reported their observations on a large series of cases of this type and deduced the following conclusions:

1. The upper and lower halves of each retina are represented in the upper and lower halves of each visual area, respectively.

2. The center for macular vision lies in the posterior part of the visual area, probably on the margins and lateral surfaces of each occipital pole. The macula has not a bilateral representation.

3. The center for vision subserved by the periphery of the retina is situated in the anterior part of the visual area, and serial concentric zones of the retina from the macula to the periphery are represented in this order, from behind forward in the visual cortex.

4. Those parts of the retinas adjoining their vertical axes are probably represented in the dorsal and ventral margins of the visual areas along the mesial surfaces of the occipital lobe, while the retina in the neighborhood of its horizontal axis is projected onto the walls and floor of the calcarine fissures.

5. Severe lesions of the visual cortex produce complete blindness in corresponding parts of the visual fields or, if incomplete, an

* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, May, 1922, Washington, D. C.

1. Holmes and Lister: Disturbance of Vision from Cerebral Lesions, Brain **39**:34, 1916.

amblyopia, color vision being generally lost and white objects appearing indistinct, or only more potent stimuli, as abruptly moving objects, may excite sensations.

6. Defects of vision in the two eyes are always congruous and superimposable, provided no abnormalities of the peripheral visual apparatus exist.

7. Lesions of the lateral surface of the hemispheres, especially of the posterior parietal regions, may cause certain disturbances of the higher perceptual functions with intact visual orientation, and localization in space; disturbance of the perception of depth and distance; loss of visual attention and agnosia.

Again in 1918, Holmes [2] called attention to the various types of hemianopsias, quadrant defects, multiple, paracentral and central scotomas that resulted, depending on the location of the lesion and the amount of tissue destroyed. Visual charts were presented describing these defects, with explanations as to the probable site of the lesion. In a few instances postmortem findings were also given.

In the same year, Holmes [3] contributed an article on the "Disturbance of Visual Orientation," grouping the symptoms of the condition under two main headings: (*a*) the disturbance of orientation and localization in space by sight; (*b*) the disturbance of movement of the eyes and ocular reflexes.

In 1917 Riddock [4] published a paper on dissociations of visual perceptions due to occipital injuries and referred especially to the appreciation of movement in the blind field and its prognostic value, and to the types of dissociation being analogous to the dissociation of general somatic sense impressions as occurring in cerebral injuries. He corroborated the findings of Lister and Holmes in regard to cerebral localization of the macula, etc.

A year later Moreau,[5] studying occipital injuries from a slightly different angle, divided the retina from the periphery centrally into three zones of perception, distinction and fixation. He said that it was necessary to study from a physiologic standpoint the reason why central vision was so often intact in cases of lateral and even bilateral hemianopsia, as publications had been too much concerned with the lost areas of peripheral vision. He thought complementary studies of central vision were more important, especially the physiologic and

2. Holmes: Disturbances of Vision by Cerebral Lesions, Brit. J. Ophth. **2**:353, 1918.

3. Holmes: Disturbance of Visual Orientation, Brit. M. J. **2**:449. 506, 1918.

4. Riddock: Dissociations of Visual Perceptions Due to Occipital Injuries, with Especial Reference to Appreciation of Movement, Brain **40**:15, 1917.

5. Moreau: Sur les troubles de la vision maculaire produit par les lesions traumatique de la region occipitale, Ann. D'Oculistique **155**:357, 1918.

auto-examinations; and that these should precede the clinical, as the physiologic point of view is important in discussing the independent existence of foveal and macular fibers, whether crossed, direct or mixed.

Morax [6] said he had never found fixation affected in hemianopic scotomas due to a unilateral occipital lesion, but he had found it lost when both occipital lobes were affected. He made a distinction between the periphery of the macular area and the fixation point.

Referring to a previous article by Morax, Moreau and Castelain,[7] he said that they had found the same alterations in the periphery of the macula as in the peripheral field properly speaking; that is, either a quadrant, complete or irregular hemianopsia. This may occur either in conjunction with the peripheral field alterations or not, thus presupposing two centers, one for the macula and one for the periphery.

Concerning the state of vision at the point of fixation in cases of macular and peripheral hemianopsias or scotomas, they never found it altered. Morax says it is necessary to admit of a small zone at the point of fixation, of probably 1 degree in extent, which possesses very complex connections. His conclusions are practically the same as those of Holmes, but he states more clearly that the preservation of normal acuity of vision is compatible with the destruction of one macular center, that is, either the right or left occipital lobe.

Wilbrand and Sanger [8] evidently accept the view that the macula, or at least the center of it, has bilateral cortical connections. They cite cases, however, in which hemianopic fields are blind to the fixation point, without loss of acuity of central vision.

The patients forming the basis of this report were under observation in General Hospital No. 11 at Cape May in 1919, and in each case had received a wound of the head which involved one or both occipital lobes. In each of three cases (1, 5 and 7) a foreign body had traversed the brain for a considerable distance, in two instances (1 and 7) passing from one hemisphere to the other across the median line. In Cases 5 and 7 the roentgen ray revealed projectiles in the substance of the brain near the opposite side of the cranium from the points of entrance. In Case 1 there was evidence that a projectile had been removed by early operation at a distance from the wound of entry. In several cases small fragments of bone were revealed within the cranial cavity near the defect in the skull.

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6. Morax: Discussion des hypothesis faites sur les connexions corticales des faisceau maculaires, Ann. D'Oculistique **156**:25, 1919.

7. Morax, Moreau and Castelain: Les differents types d'alterations de la vision maculair dans les lesions traumatique occipital, Ann. D'Oculistique **156**: 1, 1919.

8. Wilbrand and Sanger: Neurologie des Auges, 1917.

While none of the patients in this series came to necropsy and it was impossible to determine with accuracy the extent of the brain injuries, it is of some interest to observe the correlation of the visual defects and the brain lesions.

In charting the fields a self registering perimeter was used to determine the peripheral fields and an improvised screen similar to the Bjerrum screen for the purpose of mapping more accurately the visual defects of the central areas. Using an object 5 mm. square, and with the patient at a distance of 1 meter from the screen, defects in the central areas may be recorded with a margin of error of less than 1 degree.

The illustrations showing the position of cranial defects and of foreign bodies are based on tracings from radiographs. Conventional diagrams of the cranium, that of the lateral aspect modified from Marie and Foix,[9] and of the posterior aspect from Wilbrand and Sanger,[8] are utilized, depicting the bony landmarks in relation to those of the cerebral cortex. The close approximation of the posterior poles of the occipital lobes to the external occipital protuberance is particularly to be noted.

REPORT OF CASES

Case 1.—P. B., 26 years of age, was wounded Sept. 27, 1918, in the left occipital region, after which he was unconscious for several hours. There was an early operation the details of which are unknown. Following this he was paralyzed in the left arm and leg for two or three months. He was admitted to Hospital No. 11, March 13, 1919. Roentgen-ray examination revealed a cranial defect in the left occipitoparietal region (Fig. 1), a small metallic fragment near the midline intracranially, trephine holes and the outlines of a bone flap in the right parietal bone. There was a trace of a residual left hemiplegia and a right homonymous hemianopsia. Eye movements, pupils and fundi were normal. Fixation was retained. Visual acuity: right eye 20/15, left eye 20/20. The field charts (Fig. 1) show the blind areas extending to within less than 1 degree of the fixation point, and about the same distance from the midlines in the upper halves of the fields. In this case evidence justifies the conclusion that a projectile entered the left occipital region at the site of the cranial defect, passing upward, forward and to the right, and lodged in the right parietal region from whence it was removed by an early operation.

Case 2.—W. C., a man aged 25, had been wounded Sept. 29, 1918, by a shell fragment in the left posterior parietal region near the midline. He was unconscious for about five minutes, and there is no record of an early operation. He was admitted to Hospital No. 11, March 10, 1919, with an unhealed wound. Roentgen-ray examination showed a cranial defect 2 cm. in diameter near the posterior superior angle of the left parietal bone (Fig. 2), also numerous small bone fragments near the margins of the defect and a small metallic foreign body 2 cm. downward from the inner table. Homonymous hemianopsia constituted the only focal symptom of cerebral injury. Ocular movements, pupils

9. Marie, Pierre and Foix, C.: Les aphasies de guerre, Rev. neurol., February, 1917.

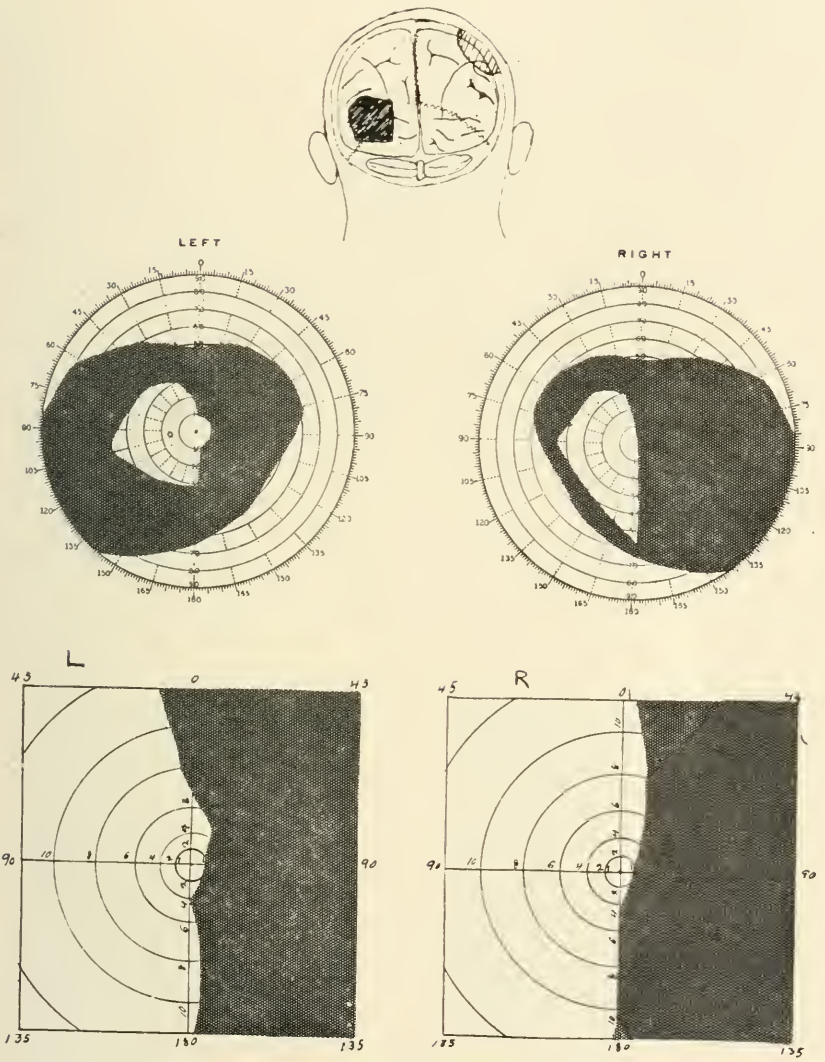

Fig. 1 (Case 1, P. B.).—Left parieto-occipital wound and cranial defect; right parietal bone flap; right homonymous hemianopsia. Perimeter charts.

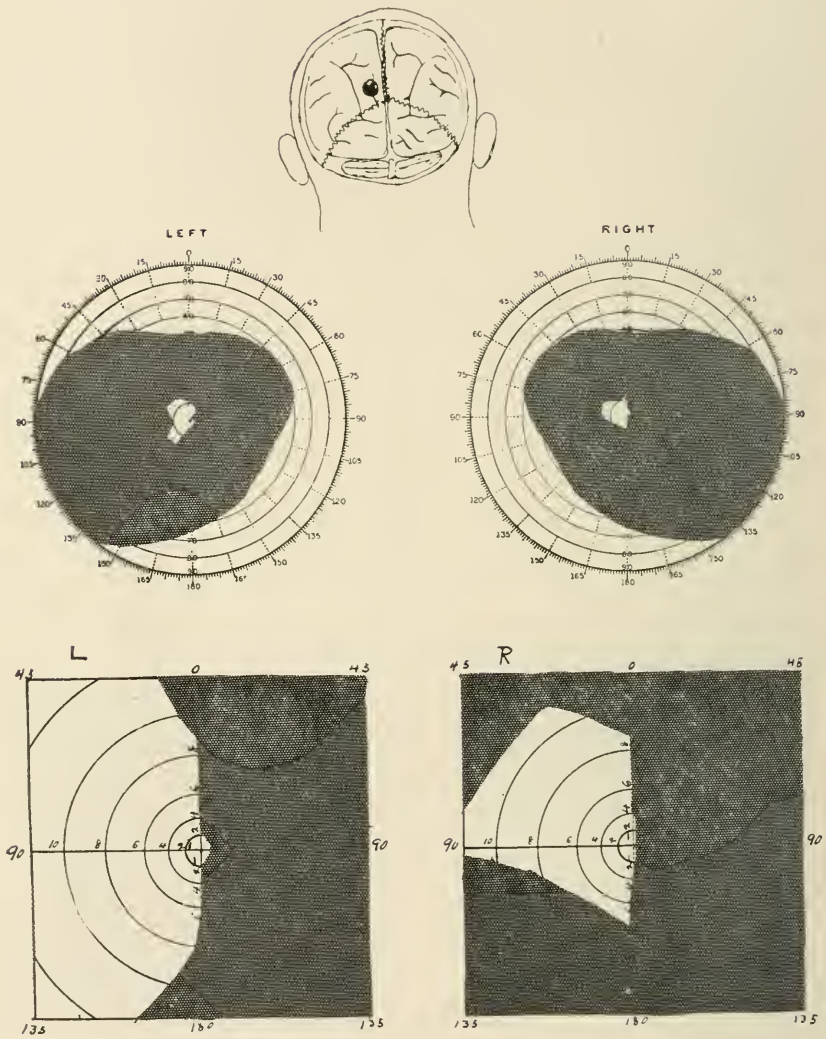

Fig. 2 (Case 2, W. C.).—Wound and cranial defect in left posterior superior parietal region; incomplete right homonymous hemianopsia. Perimeter charts.

and fundi were normal, and fixation was retained. Visual acuity: right eye 20/20, left eye 20/20. Field charts made with a 5 mm. test object showed homonymous hemianopsia extending to within 0.5 degree of fixation points. Tests made with bright lights and large moving objects revealed a slight degree of retained vision throughout the affected fields. From the location of the cranial defect and the relative position of the metallic and bone fragments, it is apparent that the cerebral lesion involved the left occipital lobe near the upper margin at a considerable distance from the occipital pole. The destructive effect of the wound was evidently downward, toward the optic radiations of Gratiolet.

Case 3.—F. C. B., aged 23, was wounded Nov. 1, 1918, in the right occipital region, after which he was unconscious for one half hour. There was no record of an early operation. The wound healed in February, 1919, and he was admitted to Hospital No. 11 a month later. A roentgenogram proved that there was a cranial defect 5 cm. in diameter involving the right occipitoparietal suture (Fig. 3). There were numerous small bone fragments in the vicinity of the defect. A left homonymous hemianopsia was the only focal cerebral symptom observed. Ocular movements and pupils were normal; both fundi showed slightly blurred disk margins. Visual acuity: right eye 20/20, left eye 20/20. Fixation was retained. The charts show hemianopic fields extending to within 0.25 degree of the fixation points (Fig. 3).

Case 4.—J. B., aged 24 years, received multiple wounds in the shoulder and back from a bursting shell on June 13, 1918, and was wounded a second time on Nov. 3, 1918, a piece of metal passing through the right orbit and lodging in the right temporal muscle without penetrating the cranium. The right eye was enucleated, but there was no record of an occipital wound. This patient was admitted to Hospital No. 11, Feb. 20, 1919. Roentgen-ray examination showed: (*a*) a metallic foreign body, 1.5 cm. in diameter, in the right temporal muscle above the zygoma; (*b*) a cranial defect 2 cm. in diameter in the occipital bone 1 cm. to the right and 1 cm. above the external occipital protuberance. The field chart shows a left hemianopsia extending practically to the fixation point. The visual acuity was 20/30. Although the patient was unaware of the occipital wound, and the history contained no record of it, circumstances indicate that it occurred at the time he received the wound on the back and shoulder. If that surmise is correct, this soldier returned to duty with an unrecognized homonymous hemianopsia.

Case 5.—G. C., aged 31 years, a man, received a wound Nov. 3, 1918, in the left occipital region near the external occipital protuberance. He was transferred to Hospital No. 11, Dec. 28, 1918, for observation. On admission the following conditions were present: marked right hemiplegia, complete aphasia and right homonymous hemianopsia. The hemiplegia gradually receded to a slight residual remnant. Speech and the comprehension of spoken language were in large measure regained; but almost complete alexia persisted. The hemianopsia, however, was complete and permanent. Roentgen-ray findings were: (*a*) a cranial defect, 1 by 0.75 cm., 1 cm. above the inion, bordering the midline; (*b*) a metallic foreign body in the frontal region close to the midline, about 3 cm. under the coronal suture (Fig. 5). Ocular movements and pupils were normal, and the fundi were negative with the exception that the left disk margin was blurred. Fixation was retained and visual acuity was: right eye 20/20, left eye 20/20. Charts of the macular areas show the blind fields extending to within 0.66 of a degree of the fixation point.

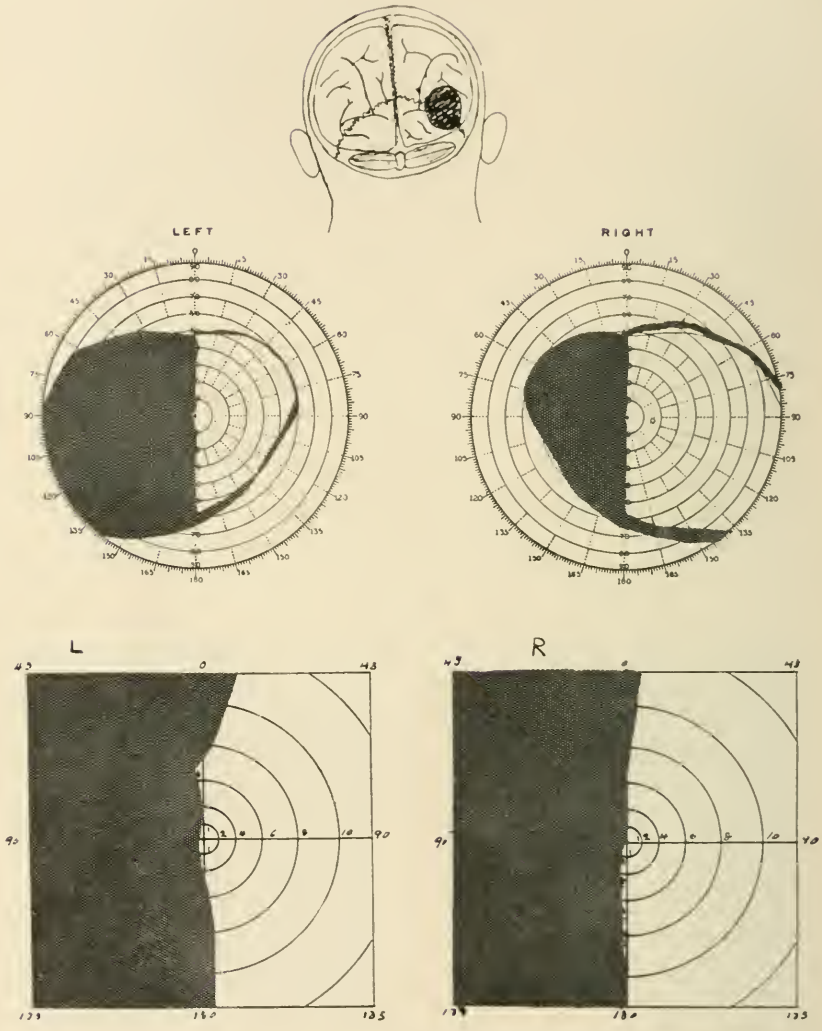

Fig. 3 (Case 3, F. C. B.).—Wound and defect in right parieto-occipital region; left hemianopsia. Perimeter charts.

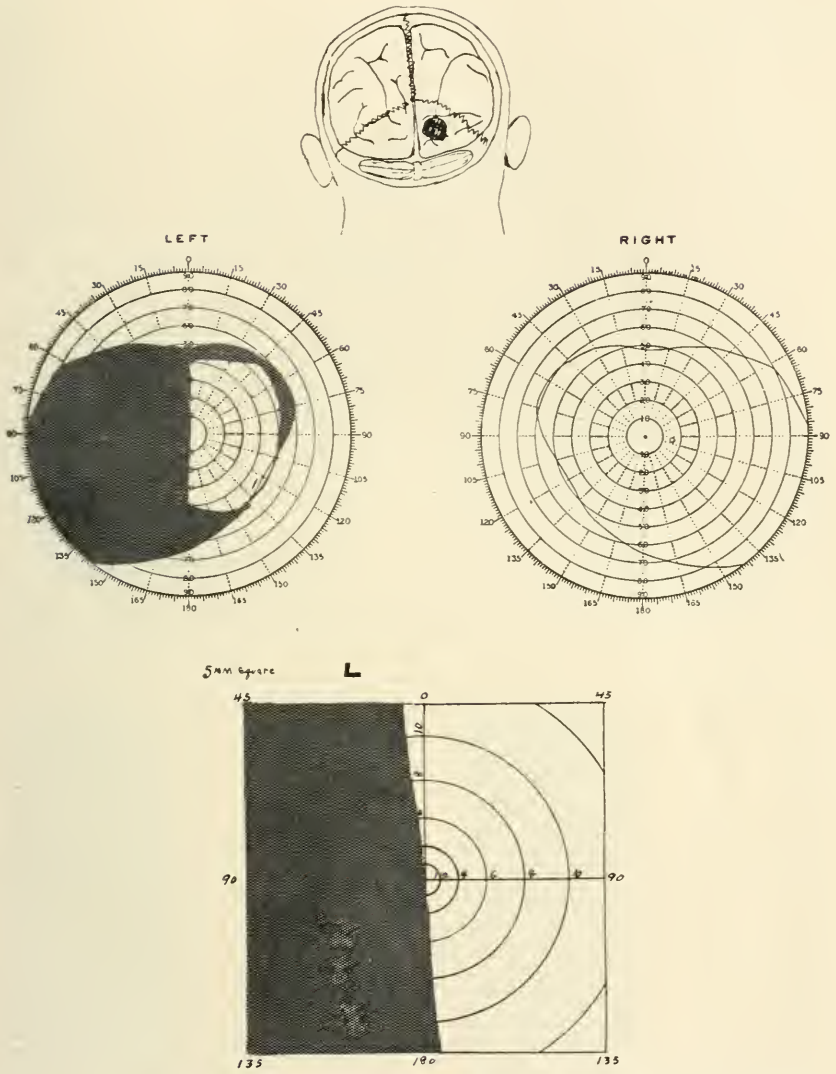

Fig. 4 (Case 4, J. B.).—Right occipital wound and defect; left hemianopsia. Perimeter charts.

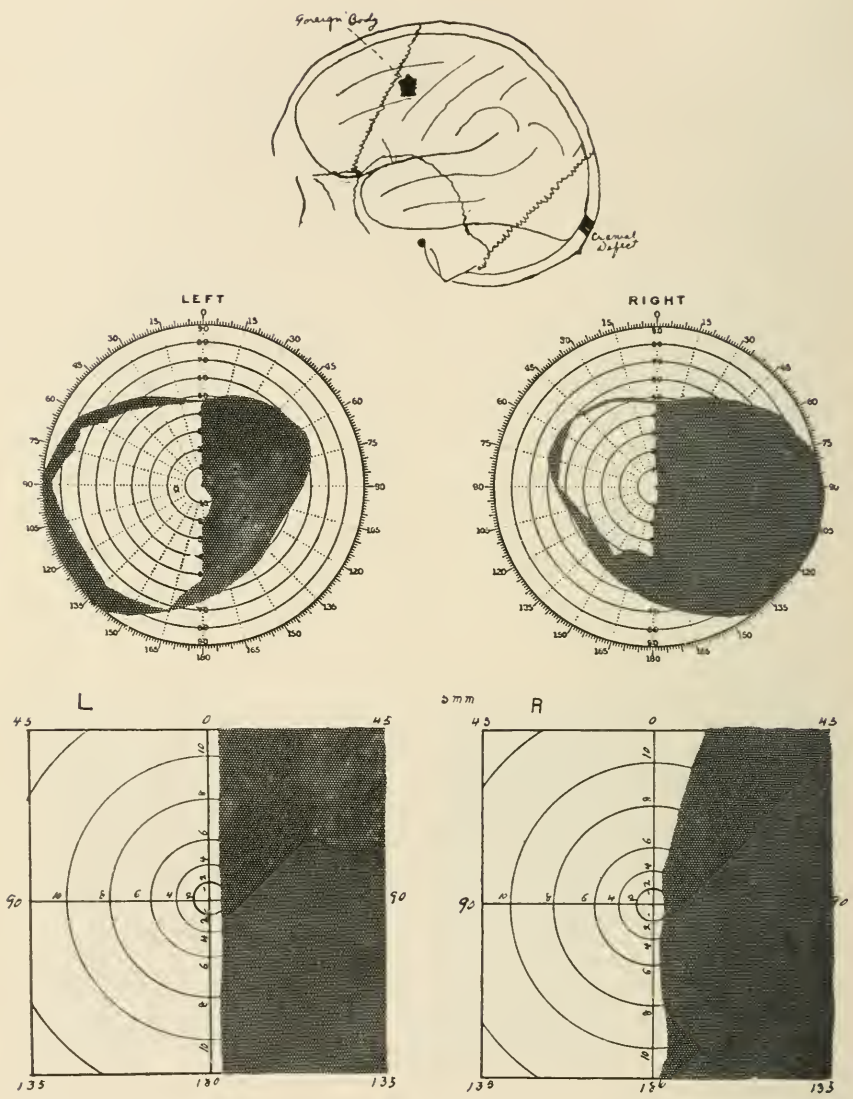

Fig. 5 (Case 5, G. C.).—Left occipital wound and defect near inion. Metallic foreign body in frontal region close to midline; right hemianopsia, alexia; transient right hemiplegia and complete aphasia. Perimeter charts.

Case 6.—No details of the early history of A. D., aged 25 years, were available. A roentgenogram revealed a large irregular cranial defect, 4 by 8 cm., involving the left occipital and parietal bones, and bordering on the midline (Fig. 6). The ocular movements, pupils and fundi were normal, and slight haziness of the lens of the right eye was present. Visual acuity was: right eye 20/100, left eye 20/15. A right homonymous hemianopsia extended to the fixation point (Fig. 6).

Case 7.—Early records of M. D., aged 24, were not available, and he was unable to give details on account of memory defect. He was ambulatory with evidences of a slight residual left hemiparesis, mentally confused and amnesic and gross intelligence defect was present. He had difficulty at first in finding his bed, and was frequently lost in the corridors of the hospital. Roentgen-ray findings were: (*a*) cranial defect 3 cm. in diameter in the right frontal region; (*b*) metallic foreign body about the size and shape of a machine-gun bullet in the left occipital region 2 cm. from the inner plate of the occipital bone, 3 cm. to the left of the midline and 1 cm. above the level of the inion. Ocular movements, pupils and fundi were normal. Visual acuity was: right eye 20/50, left eye 20/50. There was a left homonymous hemianopsia present extending to within 5 degrees of the fixation point. From the roentgen-ray evidence the foreign body was apparently lodged just posterior to the posterior horn of the left lateral ventricle. Its probable course may be assumed to extend from the frontal defect downward, backward and to the left across the midline. The right corona radiata was traversed, as was the posterior part of the corpus callosum. The optic radiations of the left occipital lobe were also somewhat involved.

Case 8.—F. D., 26 years, was wounded Oct. 28, 1918, in the right occipital region. He was unconscious for ten hours, and on waking "everything seemed blurred." In an early operation, under local anesthesia, bone fragments and pulped brain tissue were removed, but no foreign body was found. He was admitted to Hospital No. 11, April 3, 1919, ambulatory. A roentgenogram showed a cranial defect 3 by 4 cm. in occipital bone bordering the right lambdoidal suture and several small bone fragments down and in from the defect. The ocular movements were normal, and the pupils were equal. The reflexes were present, the left being a little sluggish; vessels of both fundi were tortuous, disks sharply defined; the physiologic cup was obliterated on the right and small on the left. Visual acuity: right eye 20/15, left eye 20/15. Left homonymous hemianopsia extended to the fixation points.

Case 9.—L. S., a man aged 29, was wounded Oct. 12, 1918, in the left occipital region. An early operation having been performed, he was admitted to Hospital No. 11, Jan. 4, 1919, remaining under observation for six months. A roentgenogram showed a defect 5 by 6 cm. in the left occipital region bordering the midline. An operation for the repair of the cranial defect was performed, March 15, 1919. A cone-shaped, fluid filled cavity was encountered, the apex of which communicated with the posterior horn of the left lateral ventricle, the base coinciding with the margins of the cranial defect. A considerable quantity of cerebrospinal fluid escaped, and the roentgenogram taken immediately after the operation showed the outline of the air-filled lateral ventricle (Fig. 9). The ocular movements were normal; however, slight convergence of the right eye was present. The pupils were equal, reflexes present, media clear, and there were no significant fundus changes. Visual acuity was: right eye 20/50, left eye 20/30. There was a complete right homonymous hemi-

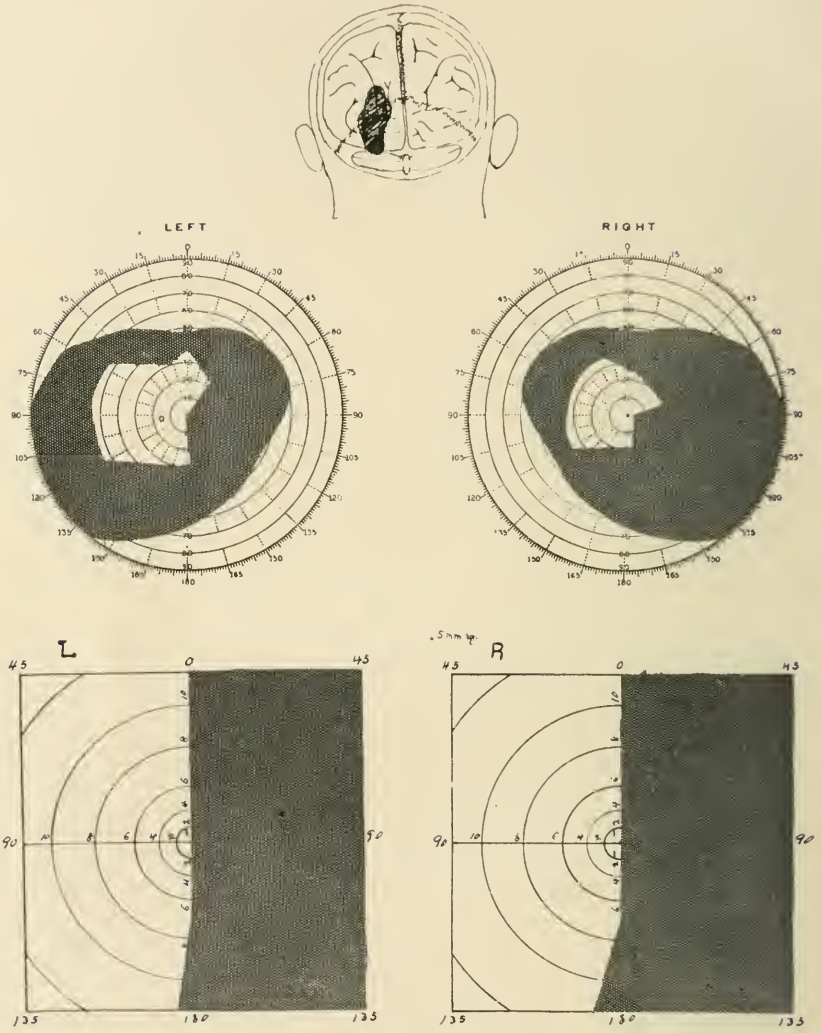

Fig. 6 (Case 6, A. D.).—Left parieto-occipital wound and defect; right hemianopsia. Perimeter charts.

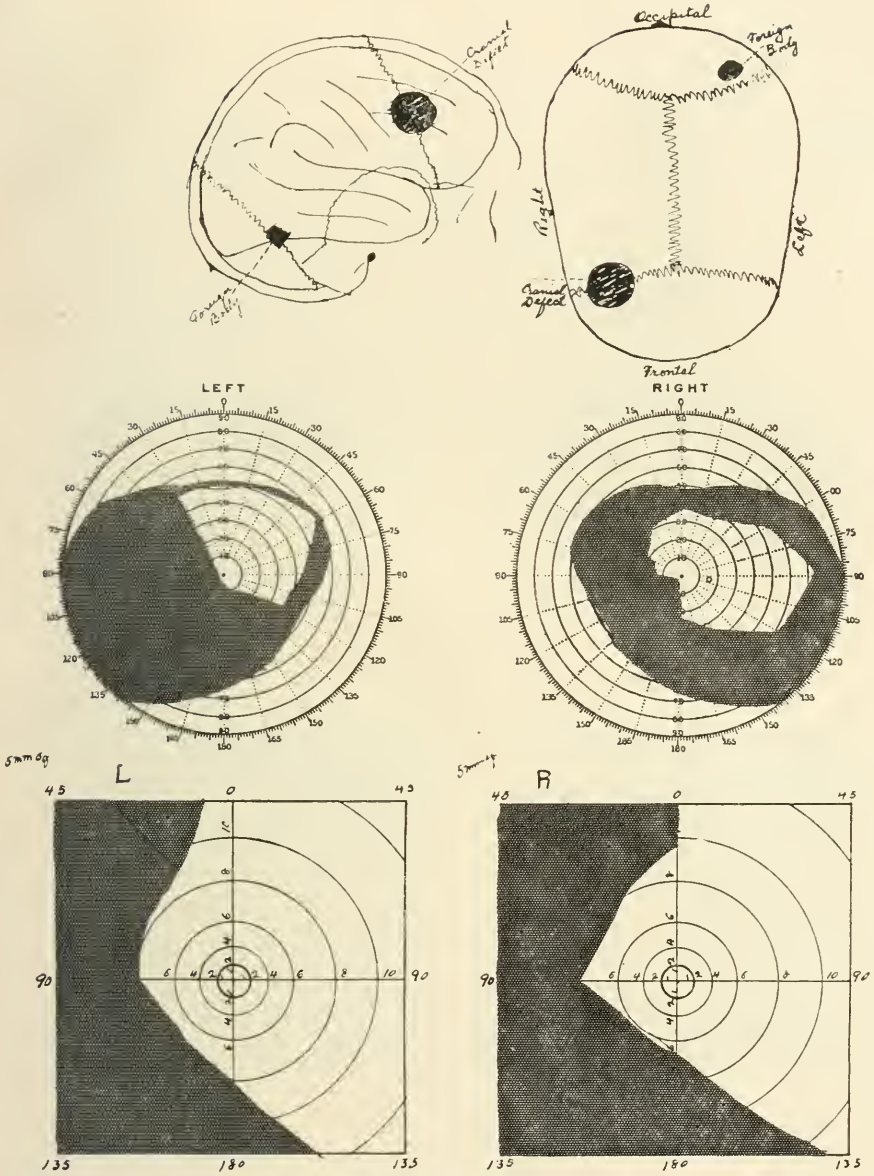

Fig. 7 (Case 7, M. D.).—Right frontoparietal wound and defect. Foreign body in left occipital lobe; right hemianopsia; dementia. Perimeter charts.

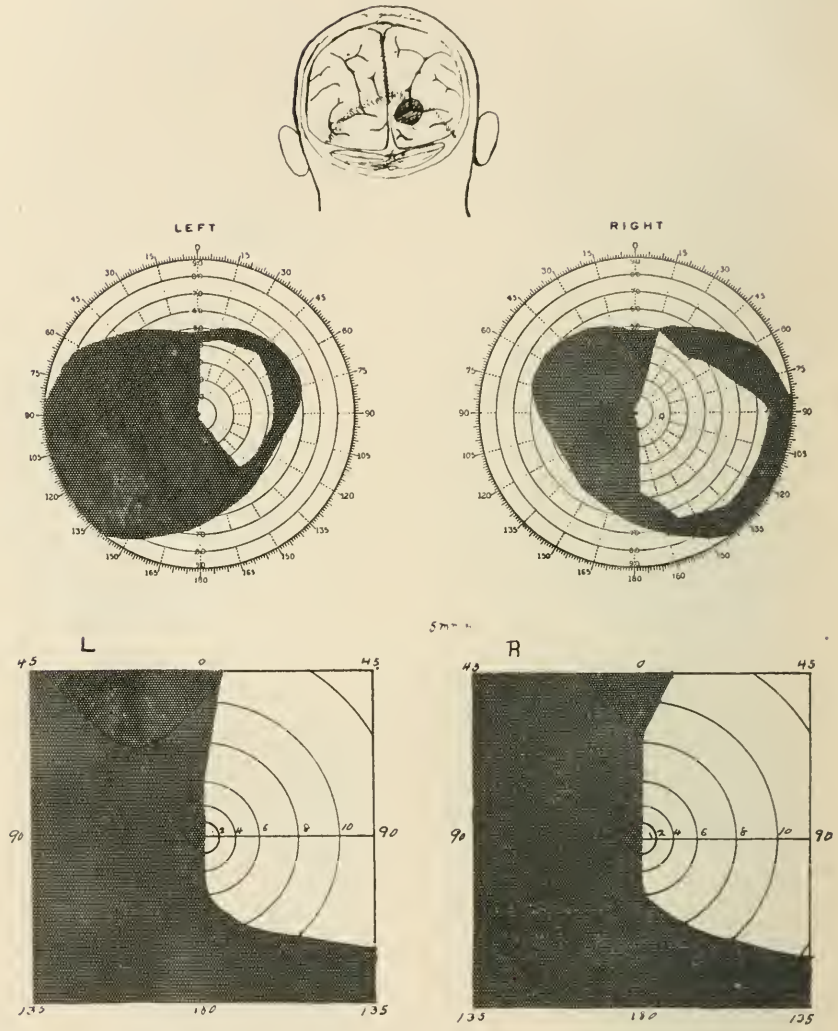

Fig. 8 (Charts 8, F. D.).—Right occipital wound and defect; left hemianopsia. Perimeter charts.

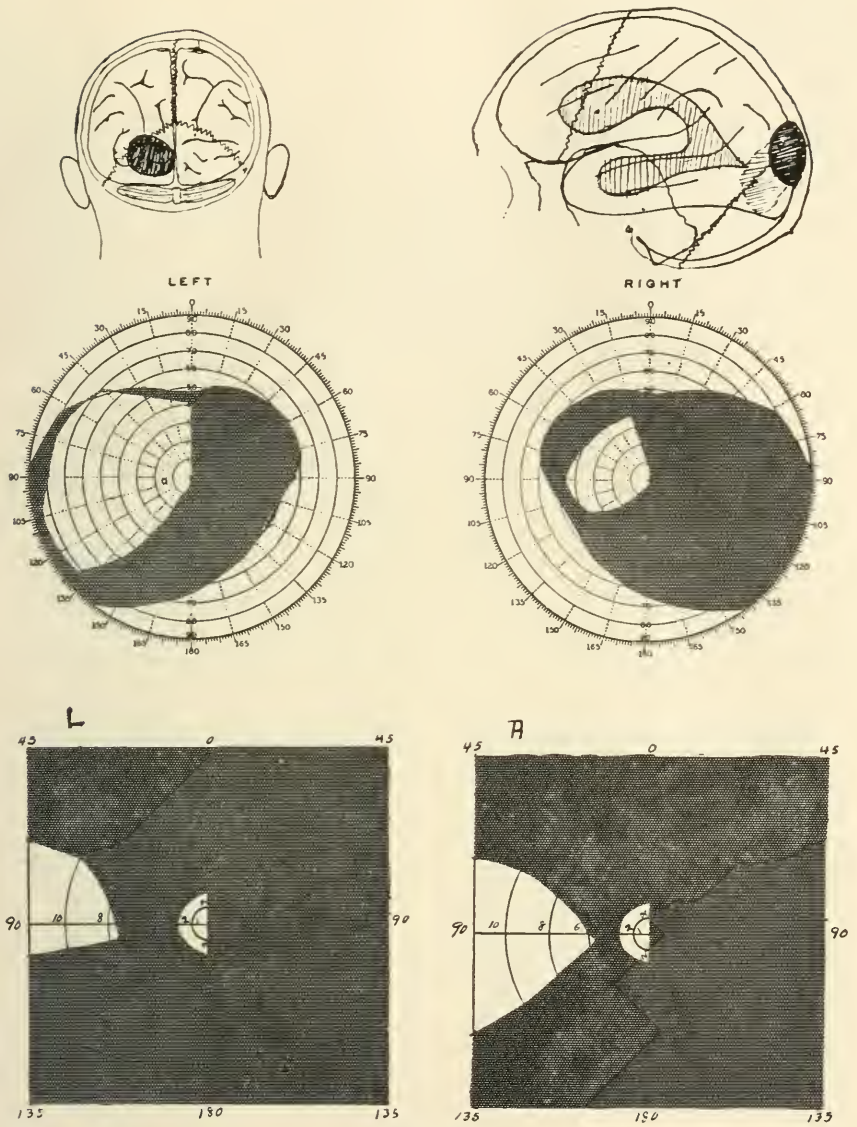

Fig. 9 (Case 9, L. S.).—Left occipital wound and defect; right hemianopsia and impairment of the left fields. Lateral aspect showing outlines of cyst cavity and air filled lateral ventricle. Perimeter charts.

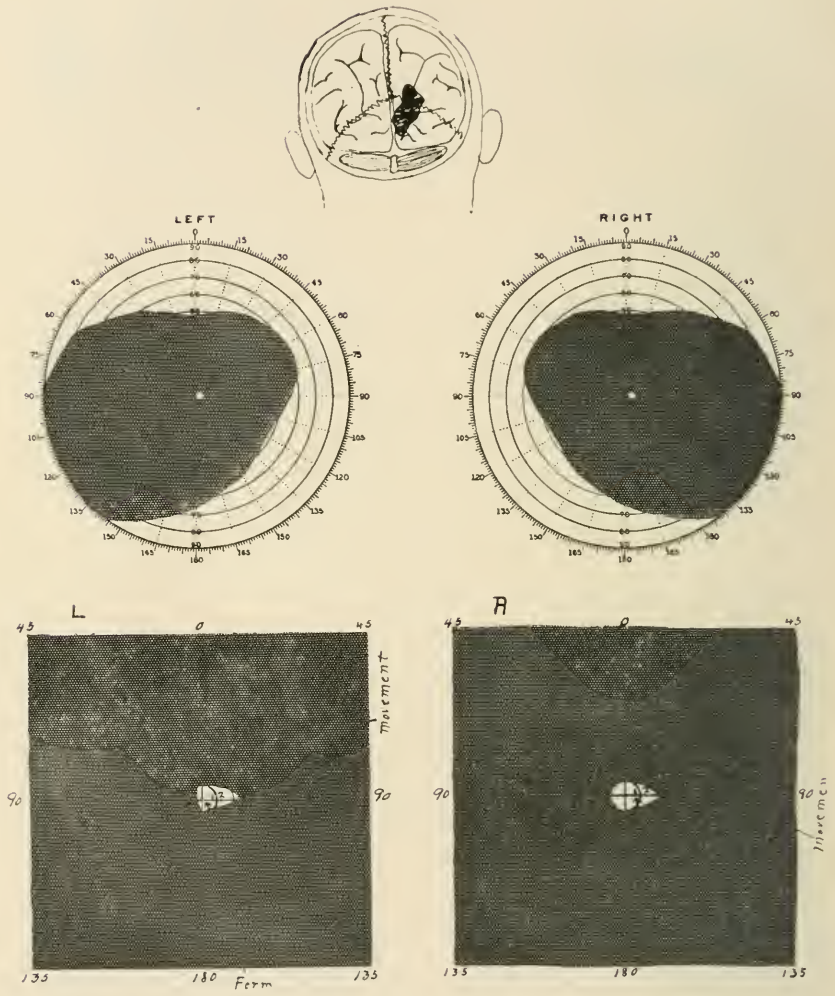

Fig. 10 (Case 10, B. H.).—Right occipitoparietal wound and defect. Complete left hemianopsia; incomplete right hemianopsia. Perimeter charts.

anopsia, and also defective left fields (Fig. 9). Macular vision was preserved in a semicircular area extending from a vertical line through the fixation point into the left fields 1.5 degrees. Roughly symmetrical islands of retained vision were present in the left fields but distinctly separated from the maculae. In order to study the hemianopsia in relation to the fixation points tests were made at a distance of 5 meters from the patient with a white object 5 mm. in diameter. At this distance and with steady fixation the object was seen only when it approached within 1 cm. on the right side of the fixation point on testing the right eye, and within less than 2 cm. when testing the left eye. These tests were repeated on several occasions, and the results were always definite and consistent.

Case 10.—B. H., was wounded, Oct. 4, 1918, in the right occipitoparietal region, after which he was unconscious for two weeks. He was admitted to Hospital No. 11, Dec. 22, 1918, the wound being unhealed. Roentgen-ray examination revealed a large cranial defect, 4 by 8 cm., involving the right side of

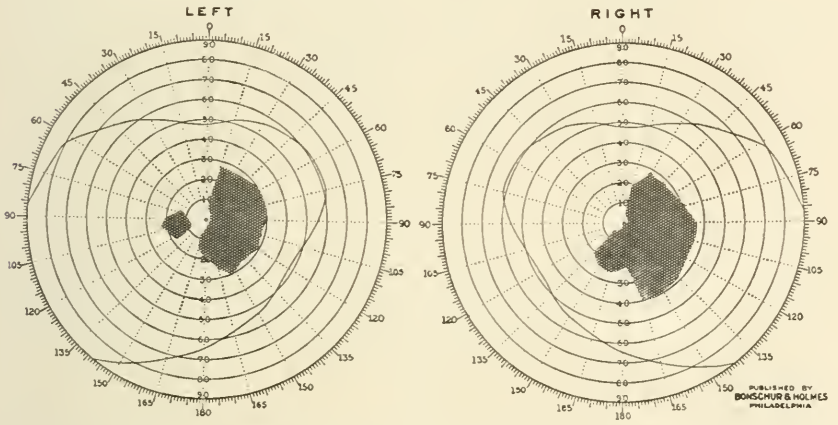

Fig. 11 (Case 11, V. M.).—Transverse tangential wound just below the inion. Irregular scotomas in right fields, but extending slightly into lower left fields.

the occipital lobe, and the right parietal bones (Fig. 10). The ocular movements, pupils, media and fundi were normal. Fixation was retained, and visual acuity was: right eye 20/40, left eye 20/40. Macular vision only was preserved, with the exception of the perception of bright light and large moving objects in part of the right fields. The retained macular areas were roughly cone shaped and symmetrical, extending from a semicircular line through the 1 degree point on the left of the fixation point of the right eye and the 0.25 degree point of the left eye toward the right for about 2 degrees.

Case 11.—On Oct. 14, 1918, the patient received a transverse tangential wound just below the inion. Immediately after the injury "everything looked white," but within one week the patient was able to distinguish objects. He was admitted to Hospital No. 11 in January, 1919. The pupils and fundi were normal, and there was a thin superficial opacity of the left cornea. Charts of the visual fields showed practically symmetrical scotomas of irregular outline, situated for the most part in the right fields, but extending to the left below the fixation point (Fig. 11). The macular areas were invaded to the fixation point, and central vision was reduced: right eye 20/70, left eye 20/100. The

left physiologic blind spot was abnormally large. The peripheral limits of both fields were approximately normal. The case is of interest, however, in correlating the scotomas with what was apparently a small cerebral lesion. From the fact that the acuity of central vision was reduced it is probable that neither occipital lobe remained entirely intact, the major portion of the scotomas occupying the right fields, and a minor portion the left fields, indicating a

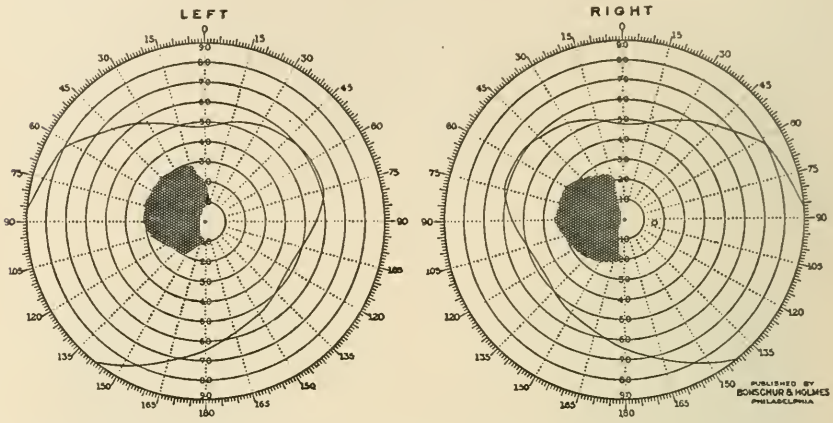

Fig. 12 (Case 12, F. E. G.).—Wound right occipital region. Symmetrical scotomas in left fields.

lesion of both occipital lobes, the left being affected to a greater extent than the right. Since complete hemianopsia was not present, neither occipital lobe was extensively involved. From the character and location of the wound it seems certain that any injury to the cerebrum must have been limited to the immediate vicinity of the occipital poles.

Case 12.—F. E. G. received wounds July 18, 1918, in the right occipital region. Early operation was performed in which bone fragments were removed.

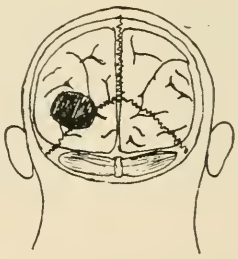

Fig. 13 (Case 13, T. C.).—Left parieto-occipital wound and defect. Homonymous lower right quadrant visual defect.

The patient was admitted to Hospital No. 11 on Nov. 6, 1918. On examination symmetrical scotomas were found in the left fields (Fig. 12) with normal fixation and visual acuity: right eye 20/20, left eye 20/20.

Case 13.—T. C. was wounded on Oct. 3, 1918, in the left occipitoparietal region. A roentgenogram showed a defect, 4 by 5 cm., involving the occipital and parietal bones (Fig. 13), and a linear fracture extending across the

parietal eminence from the defect. The charts of the fields of this case were lost, but it is recorded that both visual fields were defective in the lower right quadrants. The patient was right handed, and was able to read intelligently.

COMMENT

From the data obtained from the observation of this series of cases attention may be called to these points:

1. Fixation of vision and normal visual acuity (20/20 or better) are commonly retained when lesions of the occipital lobe have caused a complete homonymous hemianopsia (Cases 1, 3, 5, 6 and 8). In no case was there any indication that a unilateral occipital lesion caused a loss of fixation or of visual acuity, with the possible exception of Case 4 in which vision of the left eye was 20/30 (right eye enucleated). Error of refraction was not excluded as a cause of imperfect vision in this case. In all of the cases in which the character of the wounds indicated that both occipital lobes were injured, visual acuity was reduced in both eyes (Cases 7, 9, 10 and 11). No disturbance of fixation was demonstrated even in these cases.

2. The hemianopic fields commonly approached to within a fraction of 1 degree of the fixation point.

3. Evidence that macular vision is represented in the apex of the occipital lobe is furnished by Case 11.

4. Defects of the visual fields, scotomas or hemianopsias, resulting from lesions of the occipital lobes, are roughly symmetrical but not exactly superimposable.

5. Greatly reduced visual perception in homonymous fields (incomplete hemianopsia) may exist as a permanent residual result of occipital injury (Cases 2 and 10). In such cases bright lights and large moving objects can be discerned in fields which are blind to the usual tests for form and color.

In comparing the conclusions of Holmes and Lister with those of Morax, Moreau and others, it will be noticed that there are apparent contradictions in regard to the cortical representations of the macula. Holmes and Lister definitely state that the macula has not a bilateral representation, while Morax says that it is necessary to admit of a small zone at the point of fixation, probably 1 degree in extent, which possesses complex connections, since he has never found fixation affected in unilateral lesions. Visual acuity was not specifically mentioned by Holmes and Lister, but the observations of Morax and those of the authors show that central vision is commonly normal in cases of hemianopsia from occipital lesions, even when the blind areas extend to the fixation point. Morax makes a distinction between the "fixation point" and other parts of the macula, and uses the designations "area of precision" and "periphery of the macular area," from which it is clear that he conceives the macula as an area of high visual acuity, and

the fixation point as its center. If this conception be accepted, the charts of various observers indicate that half of the macular area is included in the hemianopic field; the median vertical boundary of the hemianopic field bisects the macula as well as the peripheral portions of the field. From this it may be concluded that each macular "area," as a whole, has bilateral connections in the cortex, the right half of each macula being represented in the right occipital lobe, and the left half in the left lobe.

Concerning the question of an overlapping of the retinal areas in relation to the right and left occipital lobes, respectively, certain evidence and analogies may be considered: 1. Fixation was never lost in unilateral occipital lesions. 2. In the cases most carefully charted it was constantly observed that vision was retained a fraction of a degree to the blind side of the fixation point. If the "fixation point" is a *fixed point,* a small overlap of innervation is indicated. 3. The well known overlapping of the sensory end-organs of the skin in adjoining peripheral nerve areas and spinal segment areas, and especially the sensory overlap along the entire midline of the body, each half of which is in relation with the opposite cerebral hemisphere, may be taken for analogies for an overlap of the retinal innervation. It appears plausible, therefore, that a very small overlapping innervation of the retina exists along the entire line of division between its lateral halves, and that the fixation point, situated on this line, actually possesses bilateral cortical representation as do all other points along the same line. This conception is apparently consistent with all of the phenomena observed in this series of cases, and with those of other observers.

CONCLUSIONS

1. Unilateral occipital lesions commonly result in homonymous hemianopsia, the blind field of each eye being limited by an approximately vertical line passing close to the fixation point.

2. Unilateral occipital lesions do not result in a loss of fixation nor a reduction of acuity of central vision of either eye.

3. Central vision is represented in the apexes of the occipital lobes.

4. Unilateral lesions at a distance from the occipital pole may result in approximately symmetrical paracentral scotomas.

5. Visual defects caused by lesions of the occipital lobes are approximately symmetrical but not exactly superimposable.

6. The macula is a central area of high visual acuity, not sharply circumscribed, extending a short distance in all directions from the fixation point which probably represents less than 1 degree in the arc of the visual field.

7. The hypothesis is suggested that a minute overlap of innervation exists along the entire vertical line separating the retinal halves. Each

half of the macula is thus in relation with the corresponding occipital cortex, and the fixation point, situated on the line of division, possesses bilateral cortical connections.

DISCUSSION

Dr. M. Allen Starr, New York: I should like to ask whether these fields of vision were symmetrical or whether there was very marked deviation in the limitation of the fields in the two eyes?

Dr. Charles W. Mills, Philadelphia: I think I was the first to point out that there may be a macular hemianopsia without a general peripheral hemianopsia. It seems unfortunate that in addition to the mere study of these fields, macular and peripheral, there was not also in the same cases a careful investigation of full and half vision for words, letters and special objects. This could readily have been done by a study of barrel or tubular vision.

There are probably lower and higher macular center fields in the cortex, the lower in some portion, probably in the posterior part of the calcarine region, and the higher in the lateral occipital lobe, probably in the angular region where Ferrier first placed them.

Dr. Edward A. Sharp, Buffalo: In using a plain dark screen, it is difficult for the patient to fix on it. Ten or fifteen feet back, the point of fixation is small. We use a long steel fishing rod end to carry the disk; but it is difficult at times to fix the object at the center. With the perimeter, we get closer to the object than with a screen. It seems to me that there is a chance for error in the fixation at a distance. Our difficulty has been in keeping the central point fixed at that distance.

Dr. M. Allen Starr, New York: The determination of the general visual field should be made differently from that of the field of vision of the macula, and the only satisfactory way of determining the latter is by having the patient look through a small tube which concentrates his actual fixation on a very bright point in the distance and then introduce the object at the end of the tube. In this manner, confusion, which comes from a large field, is eliminated.

Dr. Adolf Meyer, Baltimore: The perimeter examinations are probably the most difficult examinations that anybody can undertake with any patient. It seems to me that we must keep our minds and our eyes open to the relativity and to knowing to what extent we have the cooperation of the patient. In the studies that I have had an opportunity to make from the anatomic point of view, I have often deplored the fact that there could not have been some forethought by which points of anatomic interest might have been checked physiologically. The conclusion that I reached was that it was putting both the patient and the physician to the most difficult task to secure accurate perimeter examinations. The first thing is to get the closest estimate possible and then if there is any indication at all for more detailed examination, such measures as Dr. Starr mentioned, and other precautions, will have to exclude the distraction and the fatigability on the part of the patient and the physician.

Dr. Ingham, Los Angeles, in closing: In regard to the symmetry of scotomas and the defects in the visual fields, we found them to be quite consistent; that is, symmetry was present, not in the degree in which the one could be exactly superimposed on the other, but with a very close approximation. For instance, if the dividing line was at a slight angle, instead of being perfectly vertical,

the angle was similar in right and left fields. Gross cuts in the visual field were duplicated on both sides; but there was not a complete accuracy or perfect symmetry of the blind areas.

In reply to Dr. Starr's question, the size of the test object was, routinely, 5 mm., and the distance of the test 1 meter. A small white spot in the center of this screen served for fixation. The color fields, as well as the form fields, were charted and other methods were used, such as bright lights and large moving objects; but we found that for routine examination a white test object was most satisfactory.

Dr. Mills' reference to a hemianopsia of the macula is of interest, and we had one case in which this was demonstrated. There was a bilateral lesion, one visual cortex being completely destroyed and the other incompletely destroyed. Central vision was retained as well as a dim perception of large moving objects in a part of one field. Accurately charting the small central fields of vision revealed the characteristics of a bilateral hemianopsia of the macula. In other words, this patient had only macular vision in which was a hemianopsia.

Regarding the question of the higher and lower centers, the integrative functions in respect to vision came up for consideration. There was "word blindness" and "word deafness" in one of the cases and aphasic symptoms in others. These problems are not presented in this paper. We did not find any cases similar to those to which Holmes and Riddock referred, in which there was a loss of the stereoscopic vision without loss of visual perception.

The difficulties of fixation are quite a matter for consideration in the examination of patients. The perfectly black screen without any relief from the monotony does not enable some patients to maintain fixation. There are many cases in which fixation is difficult, especially when there is a degree of amaurosis of the central field. There was but little trouble in that connection in the cases here reported.

With reference to the quadrant defects, we had some examples of the quadrant blindness which were roughly symmetrical; and there was one case in which there was only little more than a quadrant of vision remaining in each field, a complete hemianopsia on one side, and a quadrant on the other side. Then there were scotomas, one paracentral scotoma, and another scotoma involving the macular area. These scotomas were also symmetrical in their situation and form but not exactly superimposable.

The difficulty of charting defects of the visual fields is very similar to the difficulty of charting areas of loss of sensation on the skin; the fatigue phenomena, the psychology of the patient and the psychology of the examiner must all be considered. All these points enter into the problem and should be checked carefully in making the record.

ELECTROMYOGRAPHIC STUDIES OF PARALYSIS AGITANS *

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For many years graphic records of various tremors have been made by means of tambours and levers. Only recently has the string galvanometer been employed to make such records, with obvious advantages. Not only is greater accuracy possible, but the recording of the action-currents gives an indication of the physiologic activity within the muscle during the periods when the muscle is mechanically quiescent. This accuracy, moreover, emphasizes the remarkable constancy of the periodic phenomena of tremor, and draws our attention to the principles which must underlie these neuromuscular rhythms.

Electromyography, or the study of the action-currents of the skeletal muscles, was first described from the physiologic standpoint by Piper,[1] the interpretations being later modified by Forbes and Rappleye.[2] A short description of the method as applied to the study of paralysis agitans may be inserted here.

In order to record the electrical changes in a contracting muscle a continuous circuit must be established through that muscle and the string of the galvanometer; thus there must be two electrodes on the body surface, one connected with each end of the string. One of these is applied to the skin over the belly of the muscle to be studied, and the other is placed over some nearby skin area beneath which there is no muscular contraction. In studying the tremor of paralysis agitans, the muscle usually recorded was the flexor carpi radialis because of its frequent involvement in the tremor and its convenient location for the application of electrodes. One of these is placed directly over the belly of this muscle, the other (the "indifferent" electrode) may be placed on any other part of the body, but in order to avoid action-currents from the heart it is best to have it on the same limb; and in order to avoid action-currents from other contracting muscles it should be placed over tendons or over some completely inactive muscle. The flexor surface of the wrist is a good place, but if the tremor is

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1. Piper, H.: "Elektrophysiologie menschlicher Muskeln," Berlin, 1912.
2. Forbes and Rappleye: Am. J. Physiol. **42**:228, 1917.

marked there will be movement of the electrode and mechanical shifting of its position on the skin, causing long waves in the record (Plate 4, Fig. 1). It is therefore often better to rest the elbow and weight of the arm on a table; with the biceps and triceps thus relaxed the "indifferent" electrode may be placed on the outer surface of the lower arm. This completes the circuit through body and galvanometer, and the record as nearly as possible represents the action-currents set up by the contractions of one muscle—in this case the flexor carpi radialis. It must be remembered, however, that in the tremor of paralysis agitans many muscles are involved and may be contracting at different times; even from a distance these may give lesser action-currents to complicate the picture.

The apparatus employed in these studies was the string galvanometer designed by Dr. H. B. Williams and manufactured by C. F. Hindle & Co. For electromyographic studies a galvanometer and recording camera such as are used for cardiographic work are perfectly satisfactory. Most of our records were obtained with the regular electrocardiographic equipment of the hospital. We were able to use this apparatus by simply increasing the speed of the falling plate and by supplying our own special electrodes. The camera generally used was of the type manufactured by the Cambridge Scientific Instrument Company, the speed of the plate being increased from the 3 cm. per second used to take electrocardiograms to 5 or even 10 cm. per second; the most satisfactory speed for this work being between 5 and 6 cm. per second. A few of the cases were studied at the Harvard Medical School in the laboratory of Dr. Alexander Forbes, where there is a camera of special design [3] which uses moving picture film and gives high rates of speed with remarkable uniformity.

At the hospital I used small German silver electrodes, one with a surface area of 100 sq. cm., the other of 50 sq. cm. Beneath these were placed pads moistened in hot physiologic sodium chlorid; electrode and pad were then firmly bandaged to the limb. In Dr. Forbes' laboratory we used nonpolarizable zinc-sulphate electrodes.[4] These are more difficult to apply to the patient, but they keep a more uniform moisture and resistance and seem to give better definition to the small action-currents, especially when a high-speed film is employed for recording.

With the patient in position the electrodes are firmly fastened to the appropriate spots. The galvanometer is then set with the string at such a tension that 1 millivolt causes a deflection of 1 cm. on the

3. Forbes and Thacher: Am. J. Physiol. **52**:409 (July) 1920.

4. Cobb, S.: Bull. Johns Hopkins Hosp. **29**:247 (Nov.) 1918. Also foot notes 1 and 2.

record. The connections are made with the patient; the resistance of the patient is measured and compensated, and the camera and lights are arranged for the making of the record.

OBSERVATIONS

By this method eighteen cases of tremor were studied. All of these showed features of the paralysis agitans syndrome, and in all the tremor was of the coarse type found in that condition, but only eleven of the cases were typical Parkinson's disease or the senile form of paralysis agitans. Case 17 is probably a case of early Parkinson's disease, not yet definite enough to be diagnosed; the patients in Cases 2, 5 and 9 almost certainly had basal ganglion lesions and they had tremors of the paralysis agitans type, but their clinical pictures were confusing, Case 5 being more of an athetoid chorea with tremor. Cases 10 and 12 were definitely examples of the paralysis agitans syndrome following lethargic encephalitis, while Case 14 may have been postencephalitic.

REPORT OF CASES

Case 1.—C. A., a woman, aged 59, was seen Oct. 15, 1919. Three years before her right ankle was injured. In May of this year (five months before) she first noticed shaking of her right arm and of the right side of her face, with a peculiar weak feeling in her knees. Examination revealed the fact that the right arm was so stiff and weak that she could hardly raise it to her mouth. Walking was difficult only in getting started; when she was once "under way" there was no further trouble. There was constant tremor of the head and of the right arm. Occasionally this tremor was noticed in the left hand. Any excitement increased this tremor, which was of the parkinsonian type. There was rigidity of the muscles of the right arm. The knee reflexes were hyperactive. Mental examination showed marked depression.

The patient died in July, 1920.

Diagnosis: Paralysis agitans.

Case 2.—J. B., a woman, aged 33, seen in May, 1919, for six weeks had had aches in her left wrist. There was tenderness over the styloid process of the radius and she said that a year ago she had had acute swelling in this location as well as in the left leg. For six months there had been increasing tremor of the left hand. The knee reflexes were exaggerated. There was some atrophy of the muscles of the left hand and the tremor, which seemed to be in this hand only, was exaggerated by putting the muscles on slight tension; for example, pressing a little against the fingers of the extended hand brought it out conspicuously. In this respect it resembled a clonus, but the spontaneous tremor seen when she tried to hold a glass of water was of practically the same rate. There was slight weakness of the left side of the face and marked enlargement of the thyroid. In September, 1921, the tremor was present in both hands and both legs. There was some rigidity of the muscles and pain in the left knee. The blood Wassermann reaction was negative.

Diagnosis: Tremor resembling that of paralysis agitans in a patient with arthritis, who later developed a more typical paralysis agitans picture.

Case 3.—A. B., a man, aged 60, was seen July 11, 1921. Four years before the left thumb showed slight tremor which gradually increased and progressed until the hand and arm were involved. Any motion increased this tremor. After two years the same kind of tremor began to develop in the right leg, and one year ago stiffness of the muscles of the right arm was noticed, while rigidity of the legs appeared six months ago. At the time of the first examination, the patient showed the typical parkinsonian attitude and gait with "pill rolling" tremor, more marked on the right. The face was masklike and the eyes staring. There was slight propulsion. In October, 1921, examination revealed in addition weakness of the left arm with a slightly flexed position of the fingers and weakness of the left leg. The patient has been treated (Table 2) for about seven months and at present (April, 1922) shows less rigidity and considers himself more comfortable, but otherwise he shows no evidence of change. The Wassermann reaction was negative.

Diagnosis: Paralysis agitans.

Case 4.—J. S. B., a negro, aged 48, was seen Dec. 30, 1919. The first symptom was stiffness of the right arm and hand in May, 1919. In September tremor of the right hand and both sides of the face developed. There were periods when the whole body seemed stiff, particularly noticeable in the legs. On admission the patient showed marked speech defect, a masklike face with drooping of the right side; the right hand had a conspicuous coarse tremor which was increased when he was excited but practically stopped when he was distracted. He could control this tremor sufficiently to write or draw straight lines on a blackboard. In April, 1920, he showed more speech defect, otherwise the condition was the same. In March, 1922, there was no change except that the right side of the face was more conspicuously drooping and the tremor was, if anything, greater. The blood Wassermann reaction and lumbar puncture were negative.

Diagnosis: Paralysis agitans.

Case 5.—A. C., an Italian girl, aged 12, was seen March 15, 1917. For some years she had had a skin ulceration diagnosed as tuberculous. In the middle of the winter of 1917 she developed chorea. At this time she had a spasmodic jerking motion of the left hand and arm that was somewhat rhythmic, the rhythm interrupted by an occasional slashing motion of the left arm of a choreic type. The left leg was spastic, and she walked with a hemiplegic gait. One year later she showed considerable improvement in the tremor in the right arm, but it was still easily elicitable by asking her to put the arm on slight tension. There was also fine tremor of the tongue and occasionally athetoid movements of the left arm and leg. Speech was staccato. The tendon reflexes were slightly exaggerated. There was a Babinski sign on the left. The Wassermann reaction was negative.

Diagnosis: Athetoid-chorea with parkinsonian tremor.

Case 6.—C. C., a woman, aged 51, was seen Nov. 14, 1919. In 1916, she noticed difficulty in using the right hand and a tendency to carry the right arm partly flexed. There was also a dull ache in the right shoulder and breast. About a year and a half after the onset of these symptoms the right arm and leg began to tremble. Examination revealed continuous coarse tremor of the right arm and leg; anything which caused increased muscular tension increased the tremor. On account of the pain and stiffness in the right shoulder she

was unable to raise her right arm high enough to comb her hair. "It is exactly half of my body which is affected." The blood Wassermann reaction was negative.

Diagnosis: Paralysis agitans.

Case 7.—K. C., a woman, aged 58, was seen May 29, 1919. For six months this patient had had tremor of the right hand and arm. She could use her hand very well, and there was no stiffness. The knee reflexes were present. In July, 1919, there was little change, but in January, 1920, a year later, the facial expression was somewhat masklike and the right side of the face looked flatter. The tremor consisted of pronation and supination of the right hand, with little if any flexion and extension of the fingers. The right leg and the whole left side were unaffected. In walking the right hand showed tremor, the arm was slightly flexed at the elbow and swung slightly but distinctly less than the left one. In January, 1920, the tremor was more marked, but there was no masklike expression. The face burned, but there were no other sensory symptoms except that the left hand sometimes felt as if "asleep." The blood Wassermann reaction was negative. The blood calcium was 8.5 mg. per 100 c.c. plasma.

Diagnosis: Paralysis agitans.

Case 8.—M. D., a woman, aged 60, was seen Oct. 7, 1919. She had noticed coarse tremor of the right arm suddenly in April, 1917. She had had eighteen children. She had always been nervous, but since having the influenza the preceding winter she had been more unstable than ever. Examination revealed widely dilated pupils and exaggerated tendon reflexes. There was slight tremor of the right arm, most marked in the flexor and extensor muscles of the wrist and fingers. The blood Wassermann reaction was negative.

Diagnosis: Paralysis agitans.

Case 9.—M. A. D., a girl, aged 14, was seen March 13, 1915. One year before she first complained of shaking of the left hand and inability to grasp objects properly. Examination on admission revealed ptosis of the left lid, slight enlargement of the thyroid, wide pupils, exaggerated tendon reflexes and marked tremor of the left arm and hand. Tonsillectomy was performed, and she was discharged. She returned in October, 1918. She reported that the tremor in the left arm had gradually become worse, with numbness in both the left arm and leg. Occasionally there was pain in the left side. The left arm and leg were somewhat weak and her gait slightly hemiplegic. In October, 1919, the condition was similar but somewhat worse, with more pain and more tremor. The blood Wassermann reaction was negative. The basal metabolism was two plus.

Diagnosis: Parkinsonian tremor with atypical syndrome.

Case 10.—E. E., a man, aged 18, was seen March 4, 1922. Two years before, after recovering from pneumonia, he noticed slight difficulty in speech. This became more marked following an accident in which a can of red lead was said to have fallen and struck him on the back of the neck. A few days later he noted twitching movements in the arms and legs which gradually increased until, four months later, he gave up work on account of lack of control of his hands. This passed off in about four months. Thirteen months after the injury (seven months ago) he began to feel pain in the back of the neck radiating down to the shoulder blades. Six months ago his legs began to be rigid and his gait unsteady. With the development of these symptoms tremor

in the left arm was noticed, and the facial expression became masklike. More recently his fingers have become numb. At present he is bedridden and lethargic, but when aroused shows good memory and intelligence. The Wassermann reaction was negative on the blood and spinal fluid. The spinal fluid pressure was 285 mm. of water; otherwise negative. Four determinations of the basal metabolism were: plus 15.5, plus 21, plus 5 and plus 27.

Diagnosis: Lethargic encephalitis.

Case 11.—M. P. G., a man, aged 56, was seen in June, 1919. Four years before he noticed slight trembling in both hands, but more on the right. He was unable to write as well as formerly, and it was hard to bring a fork to his mouth. Physical examination showed a masklike face, loss of associated movements of the arms and legs in walking, the typical parkinsonian attitude in standing and coarse tremor of both hands. This tremor was somewhat more marked on the right. In both legs a slight tremor was palpable, and he complained of muscular cramps. The blood Wassermann reaction was negative.

Diagnosis: Paralysis agitans.

Case 12.—T. I., a boy, aged 8, was seen April 12, 1922. The past history was negative. In February, 1920, the patient had a croupy cold, after which he became sleepless, talkative and hyperactive, with twitchings of the arms, legs and head. He complained of diplopia. Two or three months after recovering from the acute symptoms, he had two convulsions and began to show rigidity and tremor, more marked on the right. The facial expression became masklike, the speech monotonous and tremulous. After this he improved; the tremor and twitchings became less marked. Three months ago he became worse; he lost the use of the right arm and leg to some extent and the tremor on the right side grew worse. He became very unruly. His head was usually held to the right, the right leg was spastic, and he walked on the toes of the right foot, planting it heavily. The deep reflexes were decreased on the right, normal on the left. The picture was one of masklike facies, propulsion, parkinsonian attitude, tremor, rigidity of the arms and rigidity of the legs without tremor, more marked on the right side.

Diagnosis: Paralysis agitans syndrome following lethargic encephalitis.

Case 13.—M. K., a man, aged 39, was seen in July, 1907. The patient was referred to us because of tremor of the right hand. In 1919 he reported back and said that during the last twelve years this shaking had been increasing gradually until the right hand could be stopped only by grasping it with the left. Occasionally there was also a tremor in the left arm and a quivering of the face around the mouth, and the protruded tongue. The face was masklike and speech slow. Tendon reflexes were exaggerated. The blood Wassermann reaction was negative.

Diagnosis: Paralysis agitans.

Case 14.—Mary K., a woman, aged 43, was seen Feb. 11, 1920. For a year and a half she had noticed slight trembling in the left leg and for four months in the left arm. During the last few days the head had begun to feel tremulous. Physical examination revealed slight edema of the left leg and of the left arm, with an area on the skin over the triceps that felt as if the skin were thickened and infiltrated. There was no rigidity of the muscles, and the facial expression was normal. The left hand had a slight tremor of parkinsonian type. The left leg also, when balanced on the ball of the foot, showed tremor. The blood Wassermann reaction was negative.

Diagnosis: There is a possibility that this case represents a residuum from lethargic encephalitis because an indefinite history of a period of coryza and somnolence was obtained, but it appears more probable that it was an incipient case of paralysis agitans.

Case 15.—G. H. M., a man, aged 56, was seen Jan. 6, 1920. Three years before tremor started in the left hand and one year later in the left leg. This was accompanied by a dull ache in the neck. Examination revealed coarse tremor of the left arm and left leg when the muscles were put on slight tension. The muscles of the trunk were also slightly involved on the left; for example, there was a tremor in the pectoralis major and the latissimus dorsi. The tendon reflexes were somewhat exaggerated. The muscles of the left arm showed slight rigidity, with a "cogwheel" feeling on passive motion. The left side of the face appeared somewhat flattened and expressionless. The blood Wassermann reaction was negative.

Diagnosis: Paralysis agitans.

Case 16.—R. M., a woman, aged 42, was seen Dec. 20, 1918. Two years before she noticed shaking in the left arm, but the onset was insidious. A few months afterward, the left leg was affected in the same way when she put her weight on it. The left leg and arm were weaker than the right, and the tendon reflexes on this side seemed to be somewhat more lively. There was marked tremor of the left hand and arm and of the protruded tongue. The right hand showed a fine tremor. The skin of the left hand was distinctly smooth and shiny. The left leg showed no skin changes, but a marked tremor when the weight of this extremity was balanced on the ball of the foot. The left side of the face was slightly flattened and less expressive than the right. The blood Wassermann reaction was negative. The spinal fluid showed 8 cells, but was otherwise negative.

Diagnosis: Paralysis agitans.

Case 17.—M. V. S., a woman, aged 43, was seen July 26, 1919. In May of this year she noticed a prickling sensation in her left forefinger. This later spread to the thumb and the third finger. She showed slight tremor of the right hand when extended and of the left hand when at rest, but this was stopped by voluntary motion. There had been some numbness of both legs, more marked on the right. All four extremities were stiff. The blood Wassermann reaction was negative.

Diagnosis: Tremor of the parkinsonian type in a neurotic person.

Case 18.—J. T., a man, aged 57, was seen April 15, 1920. Six years before he had been jammed against the side of a door by a horse and had received a minor injury of the right shoulder with difficulty in walking. Six months after this there was marked trembling of both legs when he attempted to walk. Four years ago the right hand started trembling and a few months after that the left hand. The face showed the typical masklike appearance, and the voice was monotonous. There was coarse tremor of both hands with the "pill rolling" motion, numbness in the legs and arms—more marked on the right—and loss of association of the movements of the arms and legs in locomotion. The blood Wassermann reaction was negative. The basal metabolism, in two determinations was plus 23 per cent. and minus 2 per cent.

Diagnosis: Paralysis agitans.

In Table 1 the cases are arranged in alphabetic order and the data of each category are entered in the appropriate column. It will be

TABLE 1.—Findings in Author's Cases

Case Number	Initials of Patient	Date of Observations	Rate of Tremor per Second	Frequency of Action-Currents of Tremor-Contractions per Second	Frequency of Action-Currents Between Tremor-Contractions per Second	Muscle from Which Action-Currents Were Recorded	Approximate Length of Muscle in Centimeters	Heart Rate	Age	Sex
1	C. A.	10/22/19	5.6	45	65	Extensor pollicis brevis	17	..	59	F
2	J. B.	8/ 4/19	5.1	60	80(?)	Extensor carpi ulnaris	22	..	33	F
		10/ 2/19	5.4	55	75	Extensor carpi ulnaris	22	..	33	F
3	A. B.	3/29/22	5.2	40	65	Flexor carpi radialis	27	82	61	M
4	J. S. B.	12/30/19	4.9	50	75	Extensor communis digitorum	42	70	48	M
		12/30/19	4.9	..	90	Flexor carpi radialis	31	70	48	M
5	A. C.	7/ 7/19	4.8	..	90	Flexor carpi radialis	26	..	14	F
		7/14/19	5.0	55	80	Flexor carpi radialis	26	..	14	F
6	C. C.	11/14/19	6.4	40	70	Gastrocnemius	35	..	51	F
7	K. C.	1/29/20	5.8	50	75	Flexor carpi radialis	28	..	58	F
8	M. D.	9/30/19	5.4	50	75	Extensor communis digitorum	37	..	60	F
		10/ 7/19	5.1	..	..	Extensor communis digitorum	37	..	60	F
9	M. A. D.	10/16/19	4.7	..	60	Flexor carpi radialis	28	90	18	F
		10/20/19	5.0	50	75	Extensor communis digitorum	38	..	18	F
10	E. E.	3/ 4/22	5.6	..	..	Triceps	36	78	18	M
		3/20/22	5.5	25	53	Triceps	36	90	18	M
		3/20/22	5.4	40	55	Triceps	36	90	18	M
11	M. G.	6/20/19	6.5	55	80(?)	Abductor pollicis brevis	7	..	56	M
12	T. I.	4/12/22	9.0	50	105(?)	Extensor communis digitorum	26	130	8	M
13	M. K.	1/29/20	6.4	30	60	Flexor carpi radialis	30	..	52	M
		11/16/21	6.5	40	65	Flexor carpi radialis	30	100	53	M
		12/ 5/21	6.0	..	..	Flexor carpi radialis	30	98	53	M
14	M. K.	2/11/20	6.6	..	..	Gastrocnemius	35	..	43	F
		2/11/20	6.6	..	..	Gastrocnemius	35	..	43	F
15	G. H. M.	1/ 6/20	6.1	45	70	Flexor carpi radialis	29	..	56	M
		1/ 6/20	5.7	..	..	Gastrocnemius	36	..	56	M
16	R. M.	10/ 2/19	5.8	60	90	Gastrocnemius	35	73	43	F
		11/ 4/19	6.2	60	95	Gastrocnemius	35	73	43	F
17	M. V. S.	7/26/19	6.1	40	85	Flexor carpi radialis	27	..	43	F
18	J. T.	7/31/20	6.0	..	..	Flexor carpi radialis	29	..	57	M
Average..	.....	.....	5.8	46	73					

seen that two kinds of measurement were made from each record and their different natures must be clearly distinguished: first, the rate of tremore indicates the number of short, clonic contractions per second made by the muscle involved. A tremor of this kind consists of a series of muscular contractions following each other at a rapid and more or less constant rate; each of these contractions we call a tremor-contraction. Now, all biologic activity is accompanied by changes in electrical potential which set up action-currents: it is these action-currents which are recorded by the string galvanometer, and when led off from a muscle they make an electromyogram. If such a record is compared with a mechanical myogram it is found that the action-currents of any given contraction occur just previous to and with the beginning of the mechanical contraction of the muscle.[5] Therefore the electromyogram may be used to record the time relations of muscular contractions. In examining these electromyograms of the tremor of paralysis agitans it is seen that with each tremor-contraction there are one or more large diphasic action-currents; the usual number is from two to four. After this group of action-currents the string is less active, but in this disease is rarely at rest. In other words, between the tremor-contractions there is some muscular activity in progress which is represented in the electromyogram by a series of small, rapid waves, whereas the waves of the tremor-contraction group are larger and slower. Thus in Table 1 there are two columns for action-current frequencies, one the frequency of action-currents of the tremor-contraction per second, and the other the frequency of action-currents between the tremor-contractions per second. It is possible that these different forms of action-currents represent different physiologic processes, and the fact that the frequency of action-currents between the tremor-contractions is constantly higher than that of the action-currents of the tremor-contractions is in favor of this view, the average for the former (the sixth column of Table 1) being 73 per second and for the action-currents of the tremor-contraction (fifth column) being 46. Such a distinction immediately brings to mind the double symptomatology of paralysis agitans—tremor and rigidity—and one is tempted to say that the electromyogram depicts these two phenomena by these two types of action-currents. But before stating such a theory much more investigation should be made of the nature of rigidity. Electromyograms of decerebrate rigidity[6] in cats show fine rapid action-currents at a frequency of 70 to 90 per second comparable to those seen in our records between the tremor-contractions. This analogy may be significant, but

5. Salomonson, J. K. A. W.: Brain **43**:369, 1920.

6. Buytendyk, F. J. J.: Ztschr. f. Biol. **59**:36, 1912. Einthoven, W.: Arch. Neerland. de Physiol. **2**:489, 1918.

there are so many unsettled questions concerning rigidity, spasticity and tonic contraction that I do not wish to go into the discussion of tonus and tonic innervation. There is much conflicting information on the subject and new evidence must be collected before these most important phenomena are understood. For example, Salomonson [5] says that muscle contractions may be classified in three different groups: (*a*) the simple twitch which gives a single diphasic action-current; (*b*) the voluntary contraction with its tetanic alternating action-currents at the rate of about 50 per second, and (*c*) the tonic muscular contractions in which "we may observe strong muscle spasms and also notable changes of the muscle tension without any electric action-current."

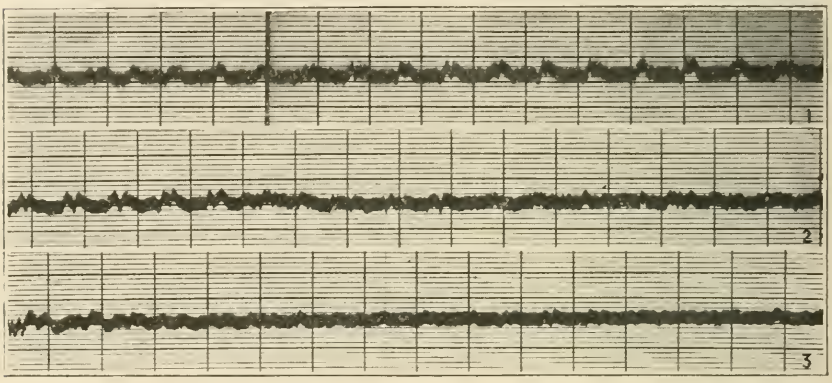

PLATE 1

Paralysis agitans syndrome following encephalitis, Case 10. Time marker, 1/5 of a second. The patient showed a slight inconstant tremor and marked rigidity.

Fig. 1.—Electromyogram from triceps of right arm showing tremor at rate of 5.4.

Fig. 2.—Triceps as in Figure 1. At the beginning there is tremor which ceases, leaving rigidity. Action-currents at frequency of 53 per second.

Fig. 3.—Electromyogram of triceps at rest with no tremor, but marked rigidity. Main waves at frequency of about 45 per second.

The first two groups are well substantiated by physiologic and clinical studies with the string galvanometer since the original researches of Piper.[1] But the nature of tonic muscular contraction cannot be disposed of so summarily. As noted in the foregoing, Salomonson considers that these tonic contractions are accompanied by no action-currents, whereas Hoffmann [7] believes that tonus is a weak tetanus. He is corroborated by Rehn,[8] who made electromyograms of spastic

7. Hoffmann, P.: Arch. f. Physiol., 1913, p. 23.

8. Rehn, E.: Deutsch. Ztschr. f. Chir. **162**:155, 1921.

muscles before and after operations. This raises the question as to whether the decerebrate rigidity of experimental animals [9] is comparable to the extensor rigidity seen clinically in man. Walshe [10] considers these practically identical, and we have the evidence quoted that both give rapid tetanic action-currents, although Salomonson holds that spastic and rigid phenomena in the human are tonic phenomena and produce no action-currents, stating [11] that he finds great muscle spasm in diseases of the corpus striatum and regio subthalamicus which do not show any action-currents.

Case 10 of our series may be taken as evidence on this point. The patient showed great rigidity of the arms and occasional periods of coarse tremor, especially marked at the elbow. The electromyograms were made from the triceps (Plate 1). Figure 1 shows a typical paralysis agitans tremor at the rate of 5.4 per second. Figure 2 shows the tremor for one second, and then a period of two seconds in which the tremor fades out and disappears, leaving a tetanic series of action-currents at a frequency of 53 per second. In Figure 3 we see no evidence of the regular tremor, merely a series of small waves at a frequency of 45 or 50 per second. All of these records were made from the triceps, the electrodes being unchanged during the series. The arm was at rest, the patient being supine with shoulder, elbow and wrist supported on pillows. Electromyograms of normal muscles thus put at rest show no electrical activity when studied with this apparatus.

Although these observations may seem to indicate that the rigidity of paralysis agitans is accompanied by a tetanic series of action-currents, we must remember that certain artefacts possibly account for the electrical variation. First, distant muscles other than the triceps might be contracting and transmitting action-currents to the electrodes. It is impossible to lead off the action-currents from one part of the body alone. Second, oscillations of large amplitude would render slightly more difficult the detection of small superimposed waves. Moreover, many of the records were not made rapidly enough and with accurate enough focus to give definition to their fine waves. But enough have been measured and placed in the sixth column of the tables to indicate that on the average this rate is 59 per cent. more rapid than the action-currents of the tremor-contractions.

The best example of this contrast between tremor-contraction and rigidity is seen in Case 13 (Plate 2, Fig. 2). Here the large tremor-contraction waves are definite and slow at a frequency of 38 per second, whereas the small waves between are equally distinct, but at

9. Sherrington, C. S.: Brain **38**:191 (Nov.) 1915.
10. Walshe, F. M. R.: Brain **42**:1 (April) 1919.
11. Salomonson, J. K. A. W.: Brain **42**:372, 1919.

a frequency of 70 per second. Plate 2, Figures 1 (Case 3) and 3 (Case 12) show the same thing registered on a more rapidly moving film.

The tremor of paralysis agitans, as recorded by this method, shows some interesting points. In the first place, the tremor appears to be due to periodic, short muscular contractions, each one of which is accompanied by a series of from two to six or eight relatively large action-currents (Plate 2, Figs. 1, 2, 3, 4, 5). That is to say, each one may be looked on as a short tetanic contraction unlike the contraction

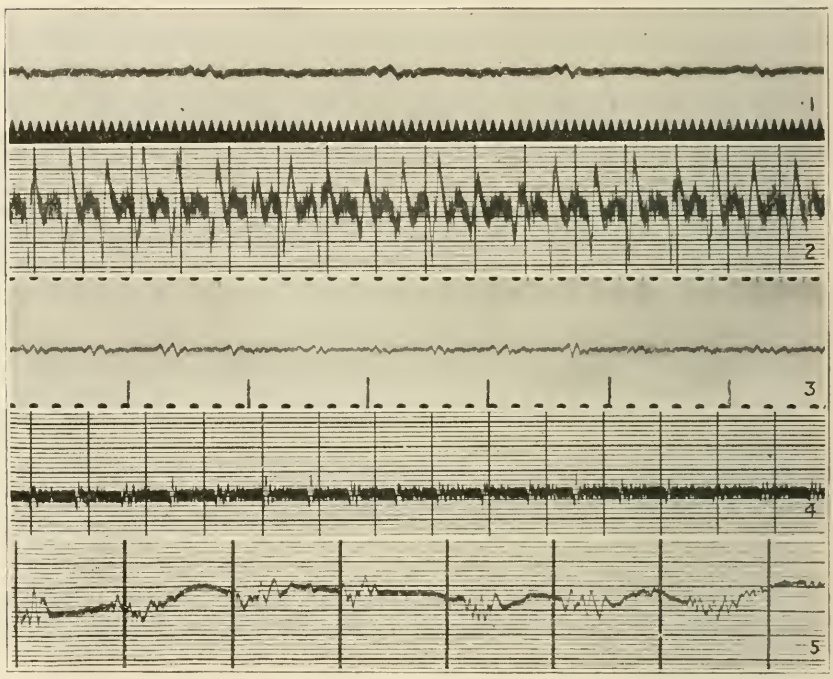

PLATE 2

Types of electromyograms in paralysis agitans.

Fig. 1 (Case 3).—(Dr. Forbes' apparatus, greater speed and tuning fork at 1/100 of a second). Between large waves (at frequency of 47 per second) which precede each tremor-contraction are smaller waves (at frequency of 86 per second); tremor rate 5.1.

Fig. 2 (Case 13).—For comparison with Figure 1. Frequency of main waves of tremor-contractions about 38 per second; frequency of main waves between tremor-contractions 70 per second; rate of tremor 6.2.

Fig. 3 (Case 12).—(With Dr. Forbes' apparatus.) Showing rapid rate of tremor in a child; rate, 9 per second. Twin marker, 1/5 second.

Fig. 4 (Case 16).—Typical myogram for paralysis agitans.

Fig. 5 (Case 5).—A typical curve of mixed chorea-tremor case

TABLE 2.—Data from Case 3—Patient A. B.—Over a Period of Five Months Under Varying Conditions and from Five Different Muscles

Date of Observations	Rate of Tremor per Second	Frequency of Action-Currents of Tremor-Contractions per Second	Frequency of Action-Currents Between Tremor-Contractions per Second	Muscle from Which Action-Currents Were Recorded	Approximate Length of Muscle in Cm.	Heart Rate	Age of Patient	Special Conditions
10/28/21	5.3	50	75	Extensor pollicis brevis	18	80	60	Sodium cacodylate, 12 grains four times a day
10/28/21	5.2	35	60	Extensor pollicis brevis	18	80	60	Sodium cacodylate, 12 grains four times a day
11/ 9/21	5.1	50	75	Abductor pollicis brevis	7	104	60	
11/ 9/21	5.2	40	60	Gastrocnemius	36	104	60	
12/ 7/21	5.3	40	60	Flexor carpi radialis	28	...	60	No medication for 7 preceding days
12/22/21	5.8	..	..	Flexor carpi radialis	28	...	60	No medication for 3 preceding weeks
12/22/21	5.5	40	60	Flexor carpi radialis	28	...	60	1½ hours after scopolamin hydrobromid 1/100 grain by mouth
1/25/22	5.7	35	65	Flexor carpi radialis	28	88	61	Scopolamin hydrobromid 1/100 grain three times a day from December 22 to January 21
1/25/22	5.4	..	70	Flexor carpi radialis	28	88	61	
1/25/22	5.3	35	60	Flexor carpi radialis	28	88	61	½ hour after fluid extract gelsemium, 7 drops by mouth
2/ 8/22	5.6	35	60	Flexor carpi radialis	28	...	61	Fluid extract gelsemium, 4 drops three times a day from January 25 to February 8
3/29/22	5.2	40	65	Flexor carpi radialis	28	76	61	No medication
3/29/22	0	0	55	Flexor carpi radialis	28	82	61	5 minutes after scopolamin hydrobromid, 1/250 grain intravenously
3/29/22	0	0	45	Flexor carpi radialis	28	...	61	10 minutes after scopolamin as above
Average.....	.....	.....	62					

of a simple reflex such as the knee jerk,[4] which shows a single diphasic action-current. It is, however, quite similar to the contraction of clonus [12] except for the fact that between contractions there is a series of small waves (discussed in the foregoing) which possibly are due to the steady muscular rigidity.

Then there is the fact of the remarkable regularity of this tremor. In any one case the periods between tremor-contractions vary only a few hundredths of a second, and over long periods the tremor rates remain quite constant. For example, Case 3 (Table 2) had records made from the flexor carpi radialis in four successive months. On December 7 the rate of tremor was 5.3 per second; on December 22 it was 5.5; on January 25, 5.4; on February 8, 5.6, and on March 29, 5.2. Another patient (Case 13) on January 29, 1920, showed a rate of tremor in the flexor carpi radialis of 6.4 per second; twenty-two months later the rate was 6.5, and a month after this 6 per second. Other examples of regularity over varying periods may be found in Table 1. In fact it is difficult to vary the rate by any experimental or therapeutic procedures, although minor spontaneous changes occur within a few minutes. Drugs, for example, seem to have little effect on the tremor rate, although they may decrease the amplitude of the tremor and even cause its disappearance. Case 3 (Table 2) was studied from this point of view: In October, while in the wards of the hospital, the patient was given sodium cacodylate in large doses intramuscularly. This seemed to relieve the pain in his shoulder and decreased the muscular rigidity slightly,[13] but had no effect on the rate of tremor. Medication was then omitted until December 22 when scopolamin hydrobromid, $^1/_{100}$ grains, was given by mouth. This perhaps reduced the rate from 5.8 to 5.5, but the psychologic factor of waiting for the effect of the drug for one and one-half hours in a quiet room must not be forgotten. On March 29 the rate was 5.2 and the excursion ample (Plate 3, Fig. 1); five minutes after the intravenous administration of $^1/_{250}$ of a grain of scopolamin hydrobromid the electromyogram shows no trace of the tremor (Plate 3, Fig. 2), and clinically it appeared to have ceased. Five minutes later (Plate 3, Fig. 3) the tremor was still absent, and although slight tremor of the thumb was observed within half an hour, the patient said that he was comfortable and practically free from the "shaking" for eight hours.

The long waves so conspicuous in Plate 3, Figure 1, are not due to action-currents, but to shifting of the electrode on the skin of the patient, thus causing a change of the base line in the myogram. This

12. Footnotes 4 and 5.

13. Rodriguez, M. B.: Rev. neurol. **28**:699, 1921. Mella, H.: A Preliminary Report on the Treatment of Paralysis Agitans, Arch. Neurol. & Psychiat. **7**: 137 (Jan.) 1922.

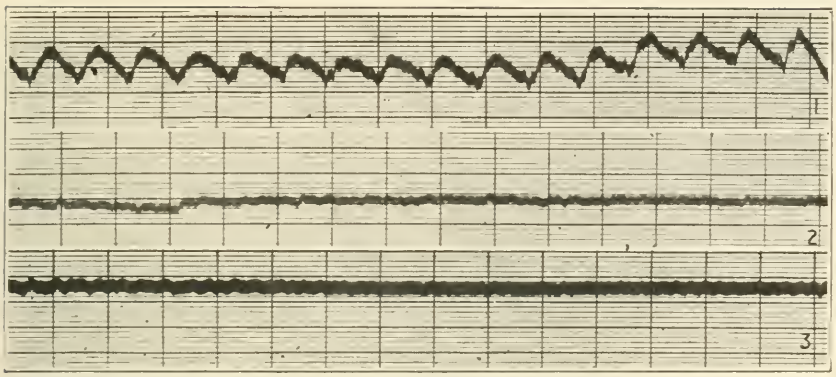

PLATE 3

Paralysis agitans, Case 3. Time marker, 1/5 of a second.

Fig. 1.—Myogram before medication. Rate, 5.2; marked tremor. The hand is unrestrained and there is shifting of the leads on the skin.

Fig. 2.—Five minutes after scopolamin hydrobromid, grains 1/250 intravenously. No tremor visible clinically.

Fig. 3.—About ten minutes after medication; no tremor visible. Twenty minutes after the medication slight intermittent tremor appeared, but the patient reports that he was practically free until eight hours later.

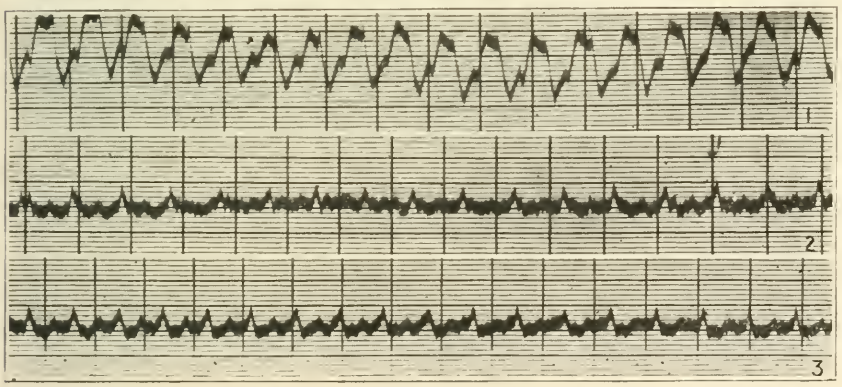

PLATE 4

Paralysis agitans. Case 3. Time marker, 1/5 of a second.

Fig. 1.—One-half hour after 7 drops of fluid extract of gelsemium had been administered. The motion of the hand was unrestricted so that there is marked shifting of the leads on the skin; rate, 5.7.

Fig. 2.—Same as Figure 1 but with restriction of the tremor by lightly restraining the wrist and hand; rate, 5.4.

Fig. 3.—After taking fluid extract of gelsemium, 4 drops three times a day, for two weeks; rate, 5.6.

is well illustrated in Plate 4, in which Figure 1 shows conspicuously the shifts in the base line; but Plate 4, Figure 2, after restriction of the mechanical fling of the hand caused by the tremor, shows no such shifting of the base line because the electrodes are stopped from shifting their positions on the skin. The tremor, however, continues to register through the electrical activity in the periodically contracting muscle.

Fluid extract of gelsemium seemed to have no effect on the myograms either when given over a long period (Plate 4, Fig. 3) or by making records immediately after a larger dose, as on January 25, 1922, in Case 3 (Table 2).

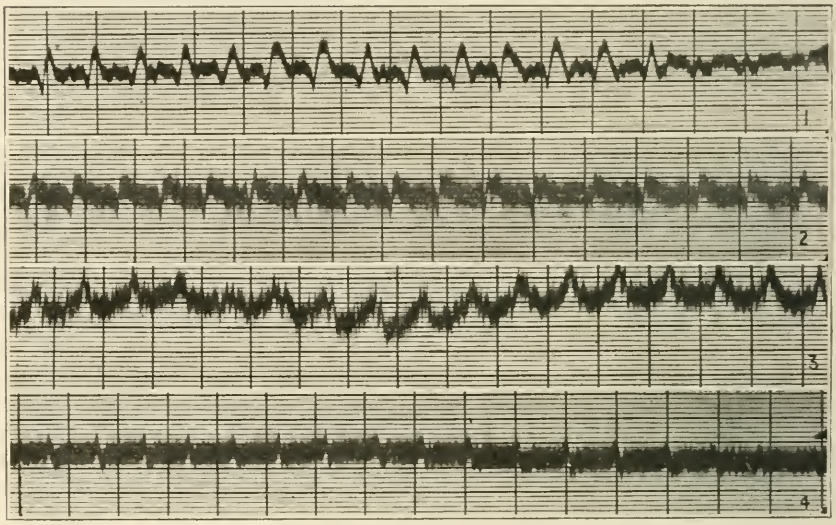

PLATE 5

Paralysis agitans, Case 3. Time marker, 1/5 of a second.

Fig. 1.—Forearm flexors; Dec. 7, 1921; rate, 5.3.
Fig. 2.—Gastrocnemius; Nov. 9, 1921; rate, 5.2.
Fig. 3.—Abductor pollicis brevis; Nov. 9, 1921; rate, 5.1.
Fig. 4.—Extensor pollicis brevis; Oct. 29, 1921; rate, 5.2.

A study of the data obtained from Case 3 indicates that the rate of tremor is practically the same in different muscles (Plate 5). In the beginning of this work we expected that short muscles might show a more rapid rate than long muscles, but the observations seem to prove conclusively that the rate of tremor is not a function of the length of the muscle. For example, Case 3 shows a rate of 5.1 in the abductor pollicis brevis (Plate 5, Fig. 3), a muscle approximately 7 cm. in length, whereas the gastrocnemius in the same patient on the same date had a rate of 5.2 per second (Plate 5, Fig. 2). The gastrocnemius is

approximately five times as long as the abductor pollicis brevis. Other muscles are shown in this same table with their approximate lengths and rates of tremor.

What, then, is the physiologic process that controls this so regular rate of periodic muscular contraction? It seems that a neuromuscular rhythm of such constancy must depend on some fundamental bodily condition. To obtain evidence on this point the heart rate in many of the patients was recorded at the same time that the myogram was made, but no correlation could be made out between these two rates, except the generalization that in young people in whom the heart rate (and the metabolic processes) are more rapid, the rate of the tremor is more rapid (Case 12, Table 1). This seems also to be true of clonus [12] and continues the interesting comparison between the two conditions.

The average rate of tremor for all the adult cases was found to be 5.8, whereas the boy of 8 (Case 12) had a much greater rate of 9 per second. Case 5 is not included because an Italian girl of 12 may be considered (metabolically speaking) on the borderline between childhood and adult life. The typical parkinsonian cases had an average rate of 5.9, whereas the atypical cases averaged 5.7. The males averaged 5.76 in rate and the females 5.77.

The basal metabolism was studied in Cases 9, 10 and 18. All were above normal, but this may be due to the muscular activity of the tremor. The question as to whether the rigidity of the muscles causes an increase in metabolism takes us again into the study of muscle tone and the various points touched on in the foregoing. Roaf [14] has found no increase in metabolism in a cat made rigid by decerebration.

If then this rate of tremor is so constant, and is independent of muscle length, it would seem to be a rhythmic discharge of the central nervous system. The fact that children show a more rapid tremor than adults indicates that general metabolism controls the rate. It is hoped that further research will elucidate these relationships, possibly explaining nervous discharge of this sort in some such way as Lucas and Adrian [15] have explained nerve conduction.

CONCLUSIONS

1. The tremor of paralysis agitans gives a characteristic electromyogram, with large, slow waves at the time of muscular contraction, and smaller, more frequent waves between these tremor-contractions.

2. The rate of the tremor of paralysis agitans is remarkably constant, the average being 5.8 per second. Little variation is observed in any one case when reexamined months later.

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14. Roaf, H. E.: Quart. J. Exper. Physiol. **5**:31, 1912.

15. Lucas and Adrian: The Conduction of the Nervous Impulse, London, 1917.

3. In children the rate of the tremor may be much more rapid (9 per second in Case 12).

4. Scopolamin may stop the tremor, but does not seem to slow the rate when acting less completely.

5. Various muscles in the same person show practically the same rate of tremor.

A CONSIDERATION OF THE DERMAL VERSUS THE EPIDERMAL CHOLESTEATOMAS HAVING THEIR ATTACHMENT IN THE CEREBRAL ENVELOPES *

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In a series of approximately 750 verified brain tumors from the clinic of Dr. Harvey Cushing, there have occurred seven examples of true intracranial cholesteatomas. In 1920, Bailey [1] reported two of these, representing the nonhair-containing variety, and since the publication of this article there has been one further example of the same type. The other three tumors have contained hair, and therefore come under the heading of dermoids, or hair-containing cholesteatomas. It is with the latter three cases that this paper proposes to deal.

NOMENCLATURE

A word should be said regarding the terminology used in the description of the tumors under discussion. By the term "intracranial cholesteatomas" is understood the definite but rare class of tumors of the intracranial cavity ordinarily referred to as "cholesteatomas" and qualified as "hair-containing" or as "pearly tumors." Twenty-five years ago Bostroem [2] (1897) gave an admirable description of these growths under the caption of "pial epidermoids and dermoids, and dural dermoids," using these terms because they represented what he believed to be their supporting tissue.

The term "pearly tumor" describes only a limited class of cholesteatomas, meaning merely that some tumors of this general group exhibit a definite pearly luster owing to the highly refractile quality of their delicate covering. This name has been applied heretofore to the nonhair-containing epidermoid variety, because it is that type which shows this peculiarity most strikingly, the visibility and pearly sheen usually being dependent on whether only the upper, and not the lower or dermal layer was included in the tissue of origin. That this distinction is not always true is shown by Bostroem's second case and by one

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* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, May, 1922, Washington, D. C.

1. Bailey: Cruveillier's tumeurs perlées, Surg., Gynec. & Obst. **31**:390-401 (Oct.) 1920.

2. Bostroem: Ueber die pialen Epidermoide, Dermoide und Lipome, und duralen Dermoide, Centralbl. f. allg. Path. u. path. Anat. **8**:1-98, 1897.

of the cases reported here, in which although the growths were in appearance "pearly tumors," nevertheless they contained hair. So far as can be learned, these are the only examples of such a finding, and bear out the almost certain general relationship of these tumors. That deeper layers may be involved, or at least that the cell inclusions may have even further potentiality, is shown by the occasional reports of certain intracranial teratomas, which are unquestionably only a step further and quite analogous to the growths under discussion (Kato).[3] Indeed one of our cases, as will be shown later, contained a small osteoid fragment and therefore might almost come under the latter designation.

Tumors of the hypophysis, arising from the remains of Rathke's pouch, sometimes reported as intracranial cholesteatomas because they contain cholesterin crystals, should not be included in our use of the term. They are not analogous tumors, either in respect to their tissue of origin or their general content. Likewise I do not consider the so-called "middle-ear cholesteatomas," since it is still a mooted question as to whether they are originally meningeal growths which have broken down and made their way to the surface, or whether they result simply from collections of the products of inflammation due to a chronic otitis media. A recent discussion of this subject was published by Crone,[4] in 1917, in which he reported six cases of "dermoid fistula of the temporal bone." That true intracranial cholesteatomas may occasionally occur in this situation and resemble the more commonly reported otitic collections is probably true. Grossman,[5] in 1903, found one or possibly two examples of this variety of tumor out of 578 cases of cholesteatomas from the Berlin Königlichen Ohrenklinik.

HISTORICAL NOTE

The story of meningeal cholesteatomas has been recited by almost every one who has reported tumors of this type, partly because their rarity and striking physical characteristics have warranted something more than a brief description of their pathology, and partly also because the confusion over the designation of their name has needed an historical explanation. The dermoid variety was described much earlier in the literature than the epidermoid. As noted by Bostroem, such a tumor was mentioned by Verattus[6] in 1745, which is sixty-two years

3. Kato: Ein kasuistischer Beitrag zur Kenntnis von teratoiden Geschwulsten in Kleinhirnbrückenwinkel, Jahrb. f. Psychiat. **35**:43, 1914.

4. Crone: Die Dermoid fisteln über dem Steissbein, München. med. Wchnschr. **16**:521, 1917.

5. Grossman: Ein ungewöhnlichen Befund bei Cholesteatom und Sinusthrombose, Deutsch. med. Wchnschr., 1903, No. 24.

6. Verattus: De Bononiensi scientiarum et artium instituto atque academia commentarii **2**: Pt. 1, 184, 1745.

prior to Dumeril's case[7] of the nonhair-containing type, reported in 1807, and depicted in 1829 by Cruveillier.[8] The latter investigator introduced the term "tumeur perlée," but in 1838 Johannes Müller,[9] referring to these cases of Cruveillier, in a treatise in which he also described two similar tumors which he had himself observed, called them cholesteatomas because they were found to contain cholesterin crystals.

The next important landmark in their history was the reversion to Cruveillier's terminology by Virchow,[10] in 1855, in his studies "Ueber Perlgeschwülste." As cholesterin could not be demonstrated in all cases of undoubted pearly tumors, the broadly descriptive term seemed more accurate. It was not until 1897 that an attempt was made to supply histologically exact designations for meningeal growths hitherto referred to as pearly tumors or cholesteatomas. In this year Bostroem, as mentioned previously, reported both a hair-containing and a nonhair-containing tumor of the type under consideration. By a most careful examination of the gross relationship to the cerebral membranes of the tumors which he reported, and further by exhaustive microscopic studies, Bostroem showed their definite attachment to the pia mater. In the dermoid which he presented, serial sections of the tumor's point of attachment demonstrated that its intrinsic elements, connective tissue, elastic fibers, blood vessels, etc., were continuous with those of the pia, and that its blood supply came from vessels which formed the direct supply of this membrane, with which they were continuous. As a result of these studies, he furnished the new appellations of "pial dermoids and epidermoids, and dural dermoids." These terms, however, are cumbersome, and have not gained recognition by subsequent writers, so that at the present time the most useful name, and the one which seems to be most universally associated with this variety of tumor, is cholesteatoma. If we now modify this very general term, and refer to tumors of this group as meningeal cholesteatomas, there can be no mistaking the kind of growth to which reference is made, as this designation immediately eliminates the group of tumors containing cholesterin crystals which arise from pituitary rests, and also does away with any confusion of association with those of the middle-ear cholesteatomas, which have not had a primary meningeal attachment. The occurrence of cholesteatomas, either hair-containing or otherwise,

7. Dumeril: Bull. Soc. Faculté de méd., Feb. 19, 1807.

8. Cruveillier: Anatomie pathologique du corps humaine **1**: book 2, plate 6.

9. Müller: Ueber den feineren Bau und die Formen der krankhaften Geschwülste, 1838.

10. Virchow: Ueber Perlgeschwülste, Arch. f. path. Anat. **8**:371-418, 1855.

within any of the cerebral envelopes, from the scalp inward, has of course long been recognized. Some of these tumors, although not present in the meninges, may still be intracranial, as shown by a recent case from this clinic reported by Dr. Cushing.[11] Our use of the term meningeal cholesteatomas refers simply to a particular subgroup in the general class, in order to distinguish them from tumors which are not analogous.

INCIDENCE

Examples of the dermoid variety have been less commonly reported than those of the epidermoid. In Bostroem's exhaustive article in 1897 only eighteen reports of the former could be collected, while since that date we have found five further cases in an extensive search of the literature. These are contained in the articles of Tannenhain [12] (1897); Trachtenberg [13] (1898); Schulgin [14] (1911); Teutschlaender [15] (1914); and Stanojevits [16] (1918). Trachtenberg's case is of especial interest as it represents a rare example of multiple tumors, one of which was in the spinal canal, while the others were intracranial.

The eighteen cases found by Bostroem, together with the five just noted, make twenty-three cases reported up to the present time. These, with the three which I shall cite, make a total of twenty-six. Of the epidermoids, Bailey accounted for sixty-two in 1920, making that type appear to be more than twice as common. This relationship, however, is not borne out in the Brigham series, where, of 750 verified intracranial tumors, there have occurred three tumors each of the dermoid and epidermoid variety. This makes either type represent 0.4 per cent. of all intracranial growths.

LOCATION

The favorite situations of the dermal and epidermal cholesteatomas are very similar, their most frequent sites being somewhere near the midline at the base of the brain, or in the region of the fourth ventricle,

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11. Cushing, H.: A Large Epidermal Cholesteatoma of the Parieto-Temporal Region Deforming the Left Hemisphere Without Cerebral Symptoms, Surg., Gynec. & Obst. **34**:557-566, 1922.

12. Tannenhain: Dermoid Cyste des dritten Gehirnventrikels, Wien. klin. Wchnschr., 1897, p. 494.

13. Trachtenberg: Ein Beitrag zur Lehre von den arachnoidealen Epidermoiden und Dermoiden des Hirns und Rückenmarks, Arch. f. path. Anat. **154**:274-291, 1898.

14. Schulgin: Zwei Fälle von Cholesteatom des 4 Ventrikels, Sowrem. Psichiat., Moscow, 1911, No. 1, p. 143.

15. Teutschlaender: Zwei seltenere tumorartige Bildungen der Gehirnbasis, Arch. f. path. Anat. **218**:224-248, 1914.

16. Stanojevits, L.: Mannfaustgrosses, lange Zeit hindurch ohne objective Symptome bestehendes und plötzlich zum Tode führendes Klein hirnteratom, Neurol. Centralbl. **37**:784, 1918.

though in addition the dermoids have a strong predilection to push into one or other of the cerebral hemispheres, where they are usually much larger than the epidermal variety. The one striking point of difference, however, is that the cerebellopontile angle is one of the most common places for the nonhair-containing tumors, whereas no dermoids have been reported in this location.

Of the three cases from this clinic, one occurred in the middle fossa, compressing the temporal lobe. This situation has been reported only twice previously, and in each of these instances, as was true also in our case, the tumors were composed of two portions, like an hour-glass, as shown by the illustrations from the original articles. A summary of each of these reports is of interest.

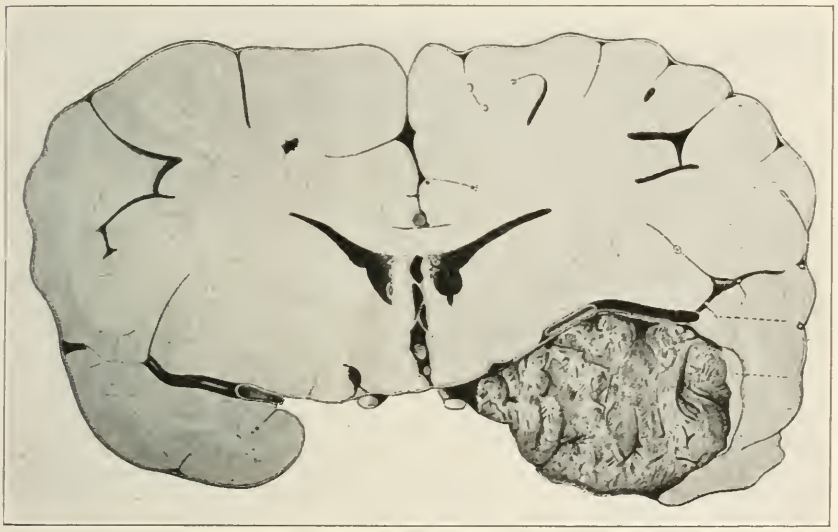


Fig. 1 (Bostroem's Case).—Transverse section of brain, showing tumor compressing left temporal lobe.

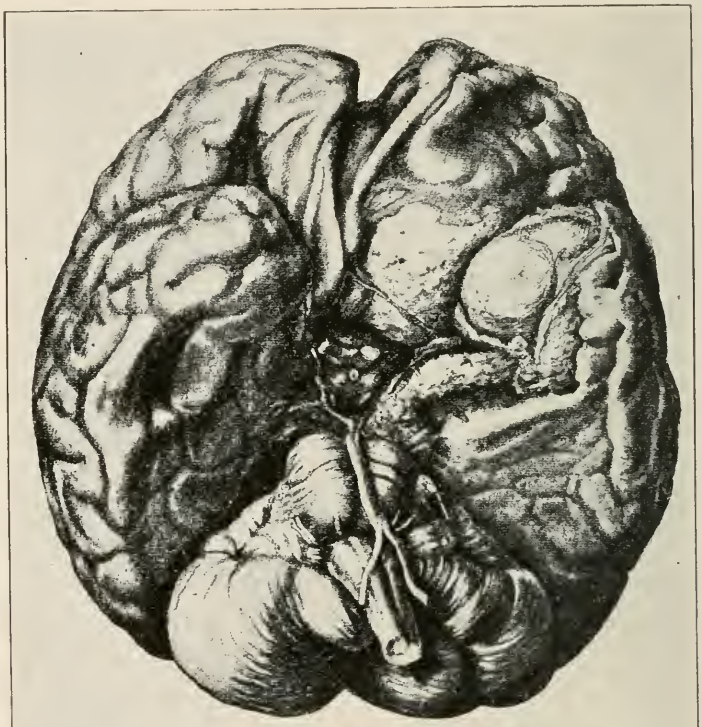
CASES IN THE LITERATURE

Bostroem's Case.—A man, aged 20, died in the workhouse, April 13, 1894, of extensive lung tuberculosis. While an inmate of the institution he had been lazy, obstinate and aggressive. His mental attainments were limited, and he complained frequently of sleeplessness. His left eye was reddened and swollen.

Necropsy revealed a tumor in the left fossa of Sylvius, compressing the temporal lobe (Fig. 1). The tumor was of a cloudy, opaque, dry consistency, yellowish green in color, with an exquisite pearl-like sheen over its surface. It measured 4.4 by 3.3 cm. in two diameters. It was covered by a delicate membrane which was continuous with the arachnoid. The tumor was further seen to consist of two portions, a larger lateral portion, and a smaller medial portion, the part between being compressed by the left ala orbitalis.

Section of the tumor showed a lumpy, yellowish-white, cloudy, opaque mass, with a firmer framework visible below. Shining white, pearly masses were present throughout the section, and between these were mingled large and small collections of soft, sebaceous material of a cloudy yellow color in which were many fine, short hairs, arranged in groups, mostly in the middle part of the tumor.

Sections of the tumor, both fresh and after embedding, showed a covering of epidermal cells, not so typically and plainly formed as in epidermoids. The contents consisted of thin, transparent, polygonal cells, most of them without nuclei. Between these cells there were masses of free, shining fat, and in the midst of this were many short, yellowish hairs and some cholesterin crystals.



Textfig. 3. Dermoid der Gehirnbasis, Ansicht von unten. 2 : 1.

Fig. 2 (Teutschlaender's Case).—Basal view, showing situation of tumor.

Teutschlaender's Case.—A 50-year old inmate of an insane asylum, a well educated man, had been subject to epileptic seizures for many years. During the last few months of life he was troubled with disorientation and periods of confusion. He became untidy. Death occurred Jan. 13, 1912.

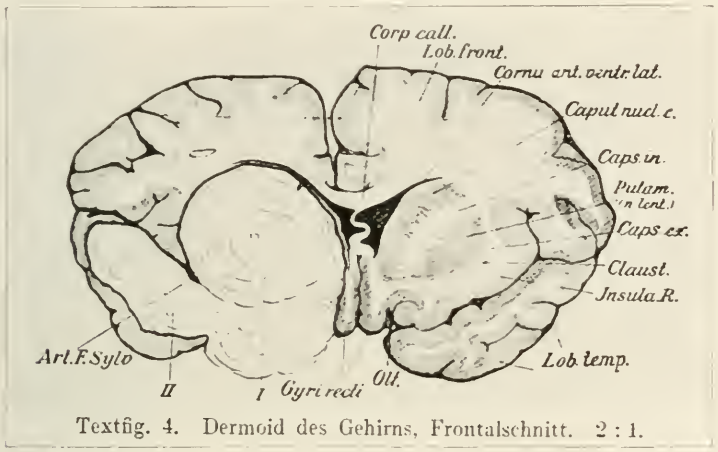
At the base of the left cerebral hemisphere, in the region of the fossa of Sylvius and the neighboring portion of the frontal and temporal lobes, there was found, at necropsy, a sebaceous, yellowish white, soft mass, the size of a goose egg, partly free and partly buried in brain substance (Fig. 2). The mass was separated from the brain by the pia-arachnoid. It consisted of two

portions, joined by a connecting bridge of tumor tissue. The larger medial portion was situated in the frontal lobe, and the smaller, lateral extension was in the temporal lobe (Fig. 3).

Gross transverse section showed crescentic layers of sebaceous material. The medial portion of the tumor contained macroscopic hairs. Chemical examination showed cholesterin.

Microscopic study demonstrated pavement epithelial covering, and on the inside fatlike material, hairs like lanugo hairs, and sebaceous glands.

These two findings are almost the exact counterparts of those in the first case which I shall report, and if a localizing diagnosis could have been made, they would have been surgically accessible. They illustrate, however, that only too frequent class of patients, who, for



Textfig. 4. Dermoid des Gehirns, Frontalschnitt. 2 : 1.

Fig. 3 (Teutschlaender's Case).—Transverse section, showing the large deeper portion and the small lateral extension of the growth.

one reason or another, because of ill-explained mental symptoms, become stranded in institutions for the insane, where necropsy reveals the cause of their disorder.

REPORT OF CASES

CASE 1.—*Hair-containing cholesteatoma of left temporal lobe disclosed by shadow in roentgenogram. Operation: extirpation of tumor. Recovery.*

History.—D. M. D., a man, aged 23 years, an army officer, was admitted Jan. 17, 1921, referred by Dr. Charles D. Humes of Indianapolis. He complained of headaches and convulsions. His family history was unimportant. He had had chorea in 1907; tuberculous adenitis in 1916, with excision of the glands in the left cervical region in 1917; a nervous breakdown in 1918; meningitis in 1919, and four operations for removal of the tonsils, the last one in 1918. In 1915, while running on an indoor track, he fell and struck his head on a post. He was dazed, and had a large scalp wound of the left frontal region.

Present Illness.—After an illness called a "nervous breakdown," in 1918, the patient dragged his left leg for about a month. He recovered from this and was in active service with the United States Army in France from July to November, 1919. In December, 1919, he had a peculiar seizure in a hotel. He was seated at a table, when quite unaccountably, he began to act peculiarly, and upset a glass of water in an awkward fashion. He did not answer questions. He excused himself from the table, and while in the hotel lobby became dazed and then had a general convulsion with vomiting. He was unconscious a large part of the time for two days, and had fever up to 103 F. for four days. A diagnosis of influenzal meningitis was made. For three weeks after this seizure the patient had difficulty in speaking. He could not think of the words he wished to say and would have to stop in the middle of a sentence because he could not remember the proper word. He was disoriented and felt dull. He was up and about after three weeks, but for the next five months he had a good deal of pain in the back.

In January, 1920, he had an attack of vomiting, and fainted. In July, 1920, he had another convulsion with loss of consciousness lasting two hours. Roentgenograms of the skull taken after this seizure showed calcium deposits in the left temporal region. The spinal fluid examination was negative.

From this time until admitted to the Peter Bent Brigham Hospital, the patient had one convulsion, in September, 1920. He felt weak and without ambition, and became extremely tired on the slightest exertion.

Headaches localized in the left frontal region and associated with dizziness were present every day or two. During these attacks his pulse rate was very slow, sometimes less than 50 per minute.

Physical Examination.—Physical examination revealed almost nothing of significance. The left patellar reflex was somewhat greater than the right. Ophthalmoscopic examination of both fundi revealed rather full vessels, otherwise the eyegrounds were normal. There was slight fulness and tenderness over the left temporal region, and the vessels over this area pulsated more fully than on the right side. The visual fields were normal even to very small visual angles.

A convulsive seizure was witnessed on Jan. 18, 1921. This was preceded by a short period of mental dulness, amnesia and speech difficulty, especially inability to name objects. The convulsion itself consisted in an initial drawing of the head to the right, followed by twitchings of both sides of the face, and finally by clonic jerkings of first the right arm and right leg, and then of the entire musculature on both sides of body.

Stereoscopic plates of the skull in a left lateral position showed a thin, crescent-shaped shadow of increased density, apparently above and to the left of the sella turcica (Fig. 4). The Wassermann test of the blood and spinal fluid were negative. Blood pressure, blood count, blood smears and urine were normal.

Operation.—Feb. 3, 1921, Dr. Cushing made an osteoplastic exploration of the left hemisphere. A temporal lobe cyst was extirpated. Ether anesthesia was used.

An osteoplastic flap was turned down with its base low in the left temporal region. The bone flap showed evidence of pressure erosion, the dura was quite tense and a subtemporal bone defect was made.

The dura was opened over the temporal lobe which protruded markedly, palpation showing what was unmistakably a cyst. An incision through the

second temporal was carried down to the wall of the cyst, and its upper pole was fixed with pledgets of Zenker's solution until it was stiff enough to handle. A small needle was then inserted into the cyst, but through this nothing could be withdrawn by suction. The usual brain needle was then inserted and a curious, grumous, dirty fluid was removed, immediate examination of which showed fatty cells. The remainder of the fluid as it adhered to the tube became

Fig. 4.—Crescentic shadow above the sella turcica, shown by the roentgenogram in Case 1.

stiffened, much like the cooling of melted fat. The fluid was thick and brownish, and about 40 c.c. were collected, although the cyst probably contained twice that amount as much of it was lost and the rest evacuated subsequently.

The cyst when emptied was found to have a delicate vascularized lining membrane. A curious fragment of tissue, quite loose, saucer shaped, about 1 cm. in diameter and 0.5 cm. in thickness, was lifted out of the cavity, the source of this fragment not being apparent. The cyst wall was carefully fixed

with Zenker's fluid until it became stiffened and puckered, then by filling the cavity full of cotton, it was possible by slow dissection to remove the entire cyst wall, though in the process it was somewhat shredded. The bone flap was then replaced.

Microscopic Examination.—The cyst contained a dirty, brownish fluid which had the appearance of thin gravy, but which felt like machine oil, owing to the large amount of fat. Microscopically, the field was covered with fat droplets which stained with scharlach r. There were also a moderate number of large, pale cells containing lipoid, and rare red blood cells.

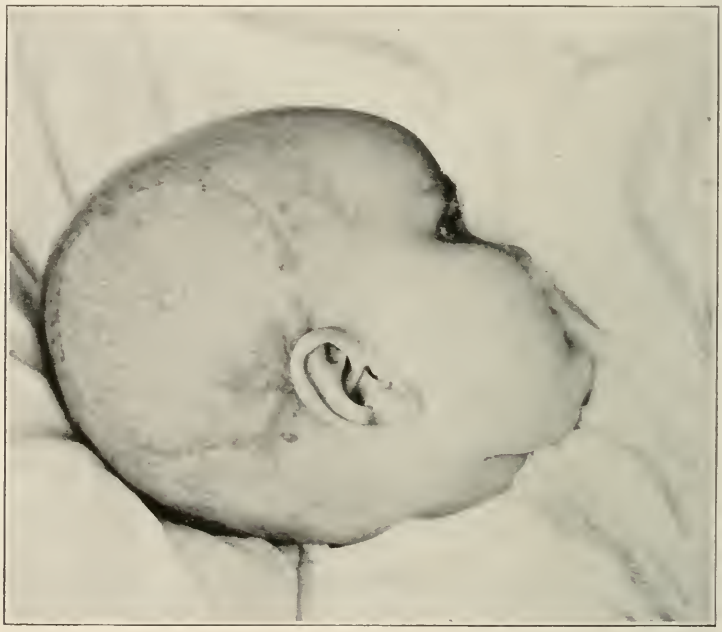


Fig. 5 (Case 2).—Patient at time of discharge from hospital.

Sections of the cyst wall showed that it was lined with a low, stratified epithelium, usually about 3 cells in thickness, but in places from 4 to 6 cells. Beneath this was a loose tissue in which were a moderate number of thin-walled blood vessels.

A section of the free body in the cyst cavity showed that it consisted of necrotic tissue débris in which were a great many fat crystals. A rare group of from ten to fifteen bodies which suggested epithelial scales was also seen, and rarely what was apparently a piece of hair cut transversely.

Diagnosis: Obscure cyst—cause unexplained.

Postoperative Notes.—Contrary to expectation, the patient did not do well. He remained drowsy and listless, and he complained frequently of headache. On February 25 his eyegrounds showed bilateral choked disks of 2 diopters,

whereas they had previously been normal. On several occasions he had a feeling of numbness in the right hand and arm.

On February 26, stereoscopic roentgenograms of the skull showed in addition to the operative defect the same crescentic shadow of increased density which was previously described.

On March 4, he had a generalized convulsion, and for the next ten days was drowsy with slowed pulse and respiration. The decompression area became full and tense, and on March 18 the elevation of the optic disks had risen to 3 diopters. It was evident that there was something wrong, and a reexploration of the wound was deemed advisable, particularly in view of the fact that the supposedly calcareous wall of the cyst had not been removed as the roentgen ray had demonstrated.

Second Operation.—March 21, 1921, Dr. Cushing made a subtemporal exploration through the previous operative site. He punctured the lateral ventricle. The second cyst, containing hair and débris, was evacuated.

A vertical linear incision was made through the temporal region, and the bone defect of the former operation enlarged. The dura was incised, disclosing an adherent temporal lobe which was protruding slightly. A needle was inserted into the ventricle, and 50 c.c. of clear fluid were secured.

In the lower portion of the temporal lobe there was disclosed the slightly fluctuant wall of what was taken to be a portion of the original cyst which had escaped notice at the primary operation. The enucleation of this was therefore undertaken, but during this operation an underlying cyst containing a considerable amount of granular, purulent material was encountered. The cystic cavity proved to be quite large and extended to the inner portion of the temporal lobe. In addition to the thick fluid evacuated, it contained much granular débris, in which were numerous soft, delicate hairs. Lining the cavity, moreover, there was a calcareous shell, which had evidently produced the shadow seen repeatedly in roentgenograms.

The wall of the cyst was cleaned and washed out with a weak formaldehyd solution; the wound was then closed, leaving a single drain into the depth of the cavity.

Pathology.—A considerable mass of the thick, granular contents of the cyst was hardened in Zenker's fluid. Sections of the contents showed numerous masses of epithelial scales, many minute pieces of hair, much fat and many polymorphonuclear leukocytes.

Diagnosis: An infected dermoid cyst.

After this procedure the patient made an uneventful and complete recovery. The drains were permanently removed twelve days after operation, and the wound was healed one week later. The choked disk receded to normal, and all of the patient's previous symptoms cleared up quickly. Further stereoscopic roentgenograms of the skull showed no shadow in the temporal region. The patient was discharged April 30, 1921, and in January, 1922, he reported that he was in excellent health.

Comment.—So extremely insignificant was the evidence of organic intracranial lesion in this patient that an exploratory operation was undertaken with great misgivings. The man had become a little dull and listless, three or four convulsions had taken place, and a roentgenogram examination of the skull had shown a faint shadow above the sella

turcica in the left hemisphere. In favor of a left-sided lesion was the history of transient speech disturbances and the location of his headaches to the left frontal region. On the contrary, he had had a period during which he dragged his left leg, and objectively the left knee reflex was greater than the right. Chief credit should be given to the patient's family physician for strongly urging an exploration. The tumor was evidently of the hour-glass variety, the more external portion of which, showing no definite dermal elements in the wall, was encountered and removed at the primary operation; the mesial portion, containing the calcareous shell and dermal contents, was disclosed and extirpated only after the patient's unsatisfactory convalescence had made a second operative exploration seem advisable.

Fig. 6 (Case 2).—External surface of tumor.

Case 2.—*Infected dermoid cyst of right temporal lobe. Two previous operations with disclosure of a small extradural abscess containing hair. Exploratory craniotomy. Removal of a thick-walled cyst from right temporal lobe. Temporary recovery. Death three and one-half months later.*

History.—M. L. W. was referred by Dr. St. Clair of Johnson City, Tenn., with a diagnosis of brain tumor. The patient, a child, 3½ years of age, was admitted to the hospital May 28, 1909. The family history was unimportant. The child was born at full term by normal labor. She was healthy and breast fed. At the age of 4 months she had evidently had an otitis media, with a discharge of pus from one of her ears. It could not be ascertained which ear was involved. She recovered quickly from this illness. When 8 months old she had "intestinal indigestion" lasting several months during the summer, and she had never been entirely well after this trouble.

Present Illness.—In September, 1908, the child was ill with a sore throat, and one month later an abscess on the right side of her neck was evacuated. About this time she began to have pain in the head, and a slight weakness of the left side of the face was noted. In December, 1908, a reddened, swollen area behind the right ear was incised, but no pus was obtained. Five days later

it was again incised and considerable pus evacuated. In January, 1909, the same area was incised and the bone curetted. By the end of January the child had developed weakness of the whole left side. The area behind her right ear was again opened, and this time an abscess containing hairs was disclosed between the bone and dura. The condition cleared up temporarily, but on February 26 it was again found to be necessary to open the wound, and again pus and hairs were disclosed between the bone and dura. Once more the symptoms cleared up for a time, but shortly before admission to the Johns Hopkins Hospital she had a left-sided convulsion, accompanied by headaches and vomiting.

Neurologic Examination.—The child was pale, irritable and restless. Percussion of the head elicited definite "cracked-pot" resonance. Her pupils were unequal, the right being slightly larger than the left. The right fundus showed a typical choked disk with an elevation of 2 diopters, while the left fundus

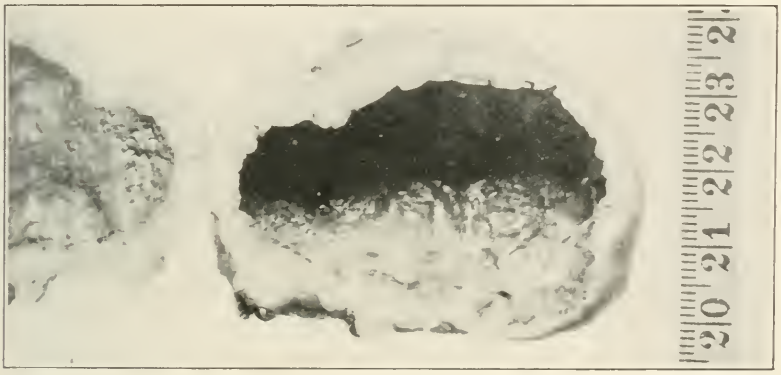


Fig. 7 (Case 2).—Inside of tumor.

was normal. There was slight weakness of the left leg, and the deep reflexes were more active on the left side. Ankle clonus was present on both sides. There was a tender, reddened area behind the right ear, with a discharging sinus.

Operation.—May 31, 1909, Dr. Cushing made an exploratory craniotomy and lumbar puncture disclosing a large cyst of the right temporal lobe. The cyst was extirpated and the child recovered.

A bone flap was turned down over the right temporal region, disclosing a tense dura which was adherent at the site of the previous operations. The dura was opened over the lower portion of the field, and there was considerable bulging of the brain through the opening, necessitating lumbar puncture. The appearance of the cortex suggested an underlying cyst; therefore an incision was made in the first temporal convolution, disclosing a cyst wall. This wall was dissected free from the surrounding brain and removed entirely, though in doing so it was necessary to open the cyst and evacuate its contents. The cavity contained a thick, greenish purulent material, cultures from which showed a pure strain of streptococcus.

The dura was closed as far as possible, the bone flap replaced and the wound sutured, leaving a single drain into the cavity from which the cyst had been extirpated.

Postoperative Notes.—The child made a good primary recovery, but there were wound complications which necessitated prolonged hospital care, and though discharged apparently well (Fig. 5), she died three and a half months after the operation.

Pathology.—Gross Appearance of Tumor: The tumor was roughly elliptical, about the size of a hen's egg, measuring 5.5 by 4 by 3 cm. in its three diameters. The surface was fairly smooth, but with irregular elevations and depressions (Fig. 6). A longitudinal section dividing the tumor from one end to the other showed that it was entirely cystic, with a tough, fibrous wall which varied from 3 mm. to 7 mm. in thickness. The entire inner surface of the cyst wall was trabeculated with interlacing cords, which in some places stood out as isolated bands but in other places merged into the general structure of the wall (Fig. 7).

Microscopic Description of Cyst Wall: The tissue consisted of a cyst wall, such as is seen in epithelial cysts, especially those of the dermoid variety, that is, a wall made up of fibrous tissue abundant in collagen. The cyst lining was made up wholly of granulation tissue in which were many large cells with small nuclei which contained fat vacuoles. They were evidently phagocytic cells of the endothelial variety. There was also a considerable infiltration of polymorphonuclear leukocytes and lymphoid cells. No hair follicles were discernible.

Diagnosis: Probable dermoid cyst (infected).

Comment.—The patient had been operated on two or three times previously, incisions having been made over the postauricular region into what was at first supposed to be a superficial abscess. At one of these sessions a trephine opening had been made in the skull, and subsequently, on another occasion, through this opening was disclosed what was taken to be an extradural abscess, but in this abscess an abundance of short yellow hairs were demonstrated. Finally, a thick-walled cyst from the temporal lobe was removed beneath the region which had heretofore been superficially dealt with. The cyst contents had become infected, and at the time of extirpation no hairs could be demonstrated, but studies of the pathology of the wall of the cyst, and also the fact that hairs had been found in its infected contents previously, left no reasonable doubt as to its dermoid character.

Case 3.—*Extreme grade of internal hydrocephalus with intracranial pressure symptoms. Operation without disclosure of tumor. Necropsy: hair-containing cholesteatoma of undersurface of cerebellum, giving mother-of-pearl appearance.*

History.—E. C., a white, female child 2 years of age, admitted Jan. 31, 1920, was referred by Dr. Z. L. Shaw of Manchester, N. H. The complaint was: "Large head." The family history was unimportant. The child was born at full term without instruments. Her appearance at birth was normal, and she developed normally in every way up to the age of 1 year. When 15 months old she fell out of her carriage to the sidewalk, striking the back of her head. She cried and vomited once after this fall, but seemed to suffer no immediate effects otherwise.

Present Illness.—At the age of 1 year the mother had to increase the size of the child's bonnets more than usual, and she also thought that her head was a little larger. At 17 months projectile vomiting began, which continued until two months before admission. The size of her head increased rapidly after the age of 17 months. At the age of 23 months she started to decline, having "spasms" with opisthotonos and loss of consciousness. She had not been able to sit up for one month. There was an increase in the size of the head of 4 inches (10.16 cm.) from July, 1919, to January, 1920.

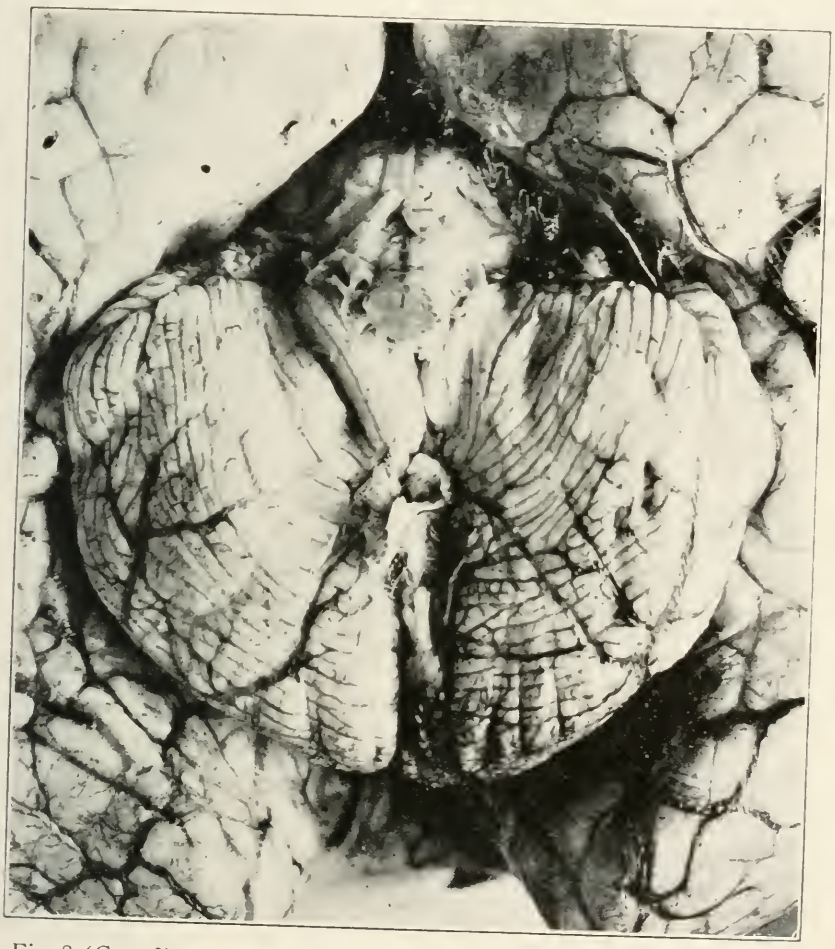


Fig. 8 (Case 3).—Inferior surface of cerebellum, showing, between the hemispheres, the area of thickened arachnoid membrane overlying the dermoid growth.

Physical Examination.—The patient was a well developed and well nourished child with evident hydrocephalus. The circumference of the head was 28 inches or 71.1 cm. There was marked separation of all sutures of the skull and great dilatation of the superficial veins over the scalp, with a marked bulging of the frontal region, and exophthalmos. The suboccipital region was full, especially on the right. She had a persistent lateral nystagmus to the right and left, and

also upward. There was definite incoordination of the hands. There was a large patch of craniotabes in the occipital region. In the midoccipital region, about at the torcular, there was a deep follicle from which several hairs grew like a pilonidal sinus. There was a huge median vein, 1 cm. in breadth, coming from the torcular. Examination of the fundi showed bilateral early choked disks of low elevation.

Operation.—On Feb. 3, 1920, Dr. Cushing made a suboccipital exploration for possible tumor of the cerebellum producing hydrocephalus.

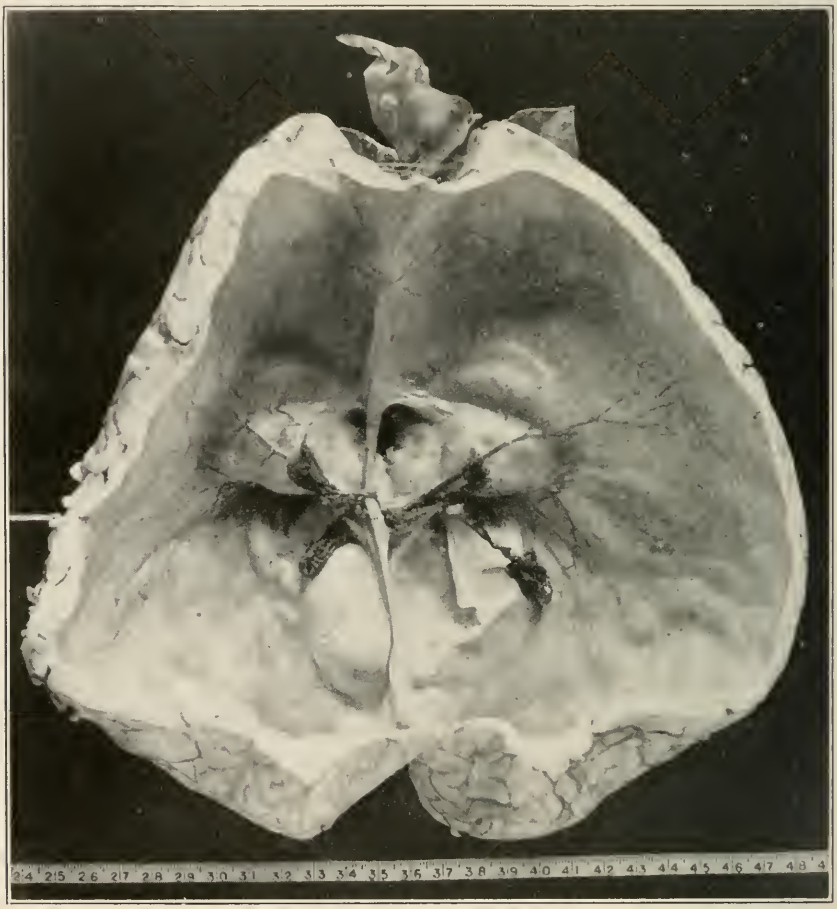


Fig. 9 (Case 3).—Interior of brain, showing extreme degree of internal hydrocephalus.

The suboccipital region was exposed by reflecting the skin and muscle flaps after the usual "crossbow" incision. Just above the operative area there was a tangle of dilated veins, radiating like a caput medusae from the torcular.

The occipital bone was exposed without great difficulty. It was not especially thin, nor was there any protruding of the suboccipital region. The dura, on exposure, was found to be tense, and a lumbar puncture needle was inserted

Fig. 10 (Case 3).—Longitudinal section of the tumor dividing the cerebellar hemispheres. Many long hairs may be seen growing into the tumor from the stalk at its posterior end.

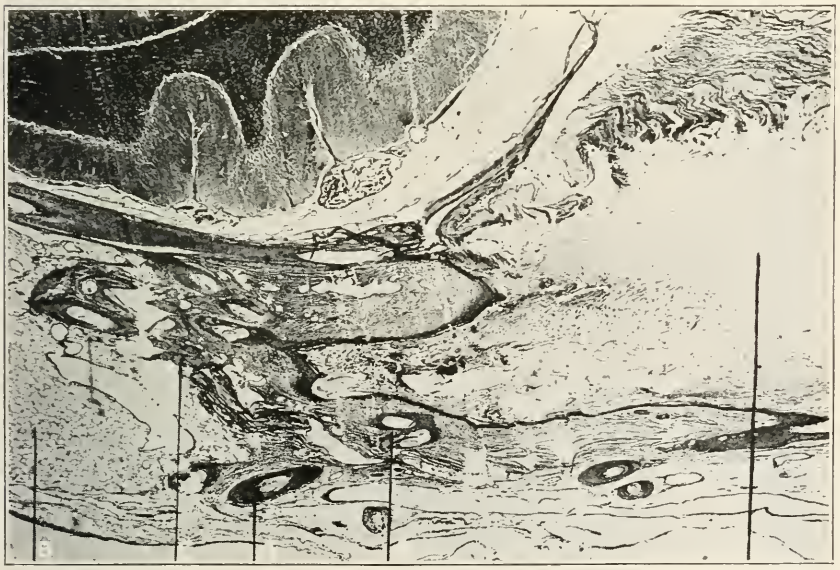


Fig. 11 (Case 3).—Photomicrograph taken through stalk of tumor, at point shown in Figure 14; *A*, hairs and hair follicles; *B*, fat cells; *C*, sebaceous gland cells; *D*, interior of the dermoid; $\times 25$.

into each hemisphere in the hope of encountering a gliomatous cyst. Clear cerebrospinal fluid under tension was disclosed, and without opening the dura the operation was abandoned.

The child died six days after the operation of bronchopneumonia.

Necropsy.—The brain was fixed by injection of liquor formaldehydi through the carotids. The brain was enormous with extreme dilatation of the ventricles. The cortex was thin, measuring in some places only 3 mm., and was only about 6 mm. in its thickest portions. The dura was extremely delicate and thin. The cerebellum as compared with the rest of the brain was very small, measuring 9 cm. in its transverse diameter. Between the two cerebellar hemispheres there was thickened arachnoid overlying a small congenital tumor of the cholesteatomatous variety (Fig. 8). No other abnormalities were found except an extreme degree of internal hydrocephalus (Fig. 9) for which the small tumor to be described could in no definite way account.

Gross Description of Tumor.—Underneath the somewhat thickened arachnoid, between the inferior surfaces of the two cerebellar hemispheres a small oval tumor was disclosed, measuring 2.4 by 1 by 0.8 cm. in three diameters. It lay between the arachnoid and the pia, being everywhere separated from cerebellar substance by the latter membrane. The surface of the tumor was smooth and its wall translucent, showing plainly the white contents of the tumor, and giving much the same "mother-of-pearl" luster which has been used to describe the external appearance of the epidermoid cholesteatomas.

On longitudinal section, the tumor was seen to be surrounded by a thin, milky-white membrane which constituted its wall. This was slightly thicker than ordinary tissue paper and was fairly tough. The tumor was entirely filled with a white, rather granular substance, which had somewhat the appearance of cottage cheese. In this substance were numerous, fine, light-brown hairs, varying in length from 0.5 to 2 cm., and apparently growing into the white material from many places on the wall of the tumor (Fig. 10). There was one point at the posterior end of the tumor which seemed to represent its stalk, or spot of attachment apparently to the pia, and from this point hairs grew in greater abundance than at any other place.

Microscopic Description.[17]—The wall of the tumor was a thin membrane composed of two layers. The outer layer consisted of several strands of connective tissue, sometimes compact and sometimes loosely separated, in the meshes of which were occasional blood vessels, and in several places hairs. The inner layer was composed of cuboidal epithelium, in most places 1 or 2 cells deep, but in other places widening out to a depth of 8 or 10 cells.

At the posterior end of the tumor, the outer connective tissue layer of the wall was enormously widened into what appeared to be the stalk of the tumor where it had its attachment. In this stalk were numerous blood vessels, a great many hair follicles and many sebaceous gland cells surrounded by fat (Fig. 11). Most of the hair follicles pointed directly toward the interior of the tumor, evidently to discharge their hairs within it, although in addition to the hairs seen in cross section, inside the tumor there were others which had been cut across as they lay in the wall. At one point in the outer connective tissue layer a small area of osteoid tissue was present (Fig. 12).

17. For areas in tumor where microphotographs were taken, compare Figure 14.

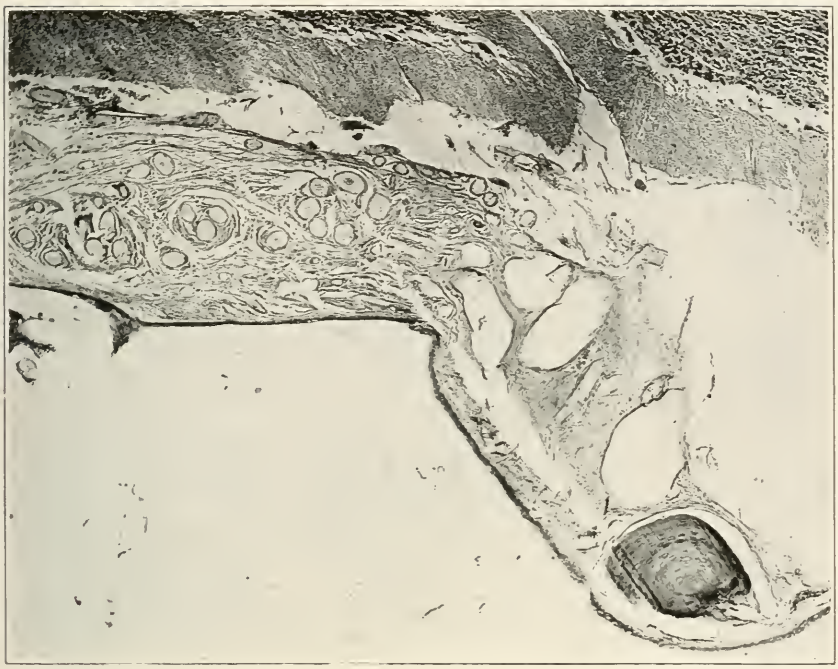


Fig. 12 (Case 3). — Photomicrograph taken at point shown in Figure 14. Osteoid tissue and hairs shown in wall of tumor; × 70.

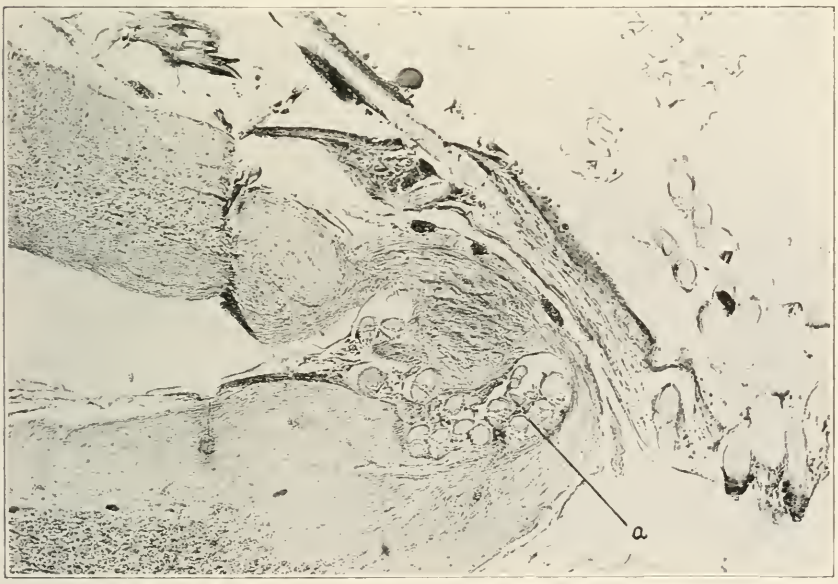


Fig. 13 (Case 3).—Photomicrograph taken at point shown in Figure 14, illustrating the hairs which have grown out into cerebellar substance at *a*; × 70.

The contents of the tumor could also be divided into two layers, the outer of which was represented by lines of homogeneous material without structure and without distinguishable cell boundaries. Below this layer, and making up the bulk of the tumor contents, was a mass of broken up, apparently disintegrating, polyhedral cells, the outlines of which were sometimes quite distinct, and whose nuclei could often be seen plainly.

In addition to the hairs seen in the tumor and within its walls, there were other groups of hairs cut transversely, which were entirely outside the tumor wall, lying in cerebellar substance (Fig. 13). The only explanation of the situation of these hairs appeared to be that they had grown out through the wall of the tumor, like "ingrowing hairs" in the skin, since the inside of the tumor would represent the outside of the skin.

Chemical analysis of the contents of the cyst disclosed the presence of cholesterin in considerable quantity, although no crystals could be demonstrated.

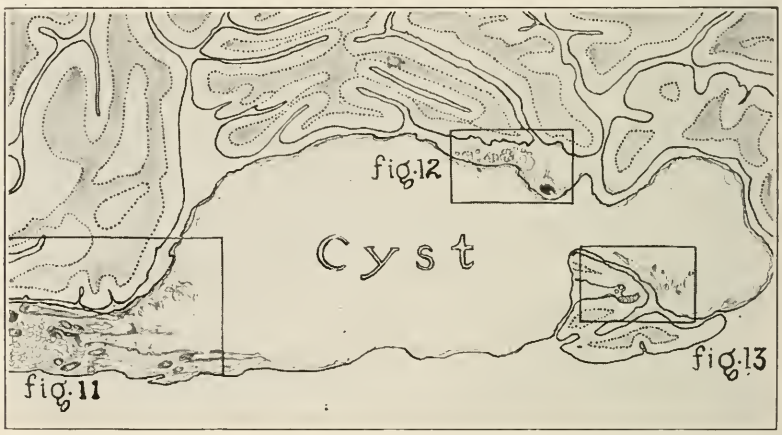


Fig. 14 (Case 3).—Diagram of tumor to illustrate areas from which photomicrographs were taken.

Comment.—From a pathologic and histogenetic point of view the tumor in this third case was undoubtedly the most interesting of the three here reported. It was, in effect, a pearly tumor, attached to the pia mater, its soft, white contents being somewhat similar to those of epidermoids, but with the addition of hair, while in the wall were hair follicles, sebaceous gland cells, fat and osteoid tissue. Its wall was, to be sure, somewhat thicker than in the nonhair-containing variety, since it probably represented an inclusion of deeper cell layers, but the wall was translucent, and there was a definite pearly sheen. Its median position at the base of the brain corresponded to one of the usual locations of intracranial cholesteatomas.

These striking points of similarity of a true dermoid to the nonhair-containing tumors of this class form a strong argument in favor of the congenital origin of the latter from superficial epiblastic cells which do

not have the potentiality of the lower layers. This bears out Bostroem's contention for the general relationship of this group of tumors, and further supports the views of others who have argued in favor of an epithelial origin for the nonhair-containing cholesteatomas.

SUMMARY

There is a group of rare tumors of the intracranial cavity which represent fetal epiblastic inclusions, sometimes of the epidermal layer alone, and sometimes including also the dermal layer.

These tumors may or may not contain hair and other tissue elements, according to the depth of the cell layer represented in the inclusion.

It is convenient to group all these tumors under the term cholesteatomas, either hair-containing or nonhair-containing.

Three examples of the hair-containing variety, or intracranial dermoids, are presented for consideration, and in two of the patients the tumors were removed by operation, in one of them with apparent success.

EPIDEMIC (LETHARGIC) ENCEPHALITIS

CULTURAL AND EXPERIMENTAL STUDIES. SECOND COMMUNICATION *

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MILWAUKEE

The results of some experimental and cultural studies of epidemic encephalitis were reported in a preliminary communication [1] and were believed to confirm the demonstration by Loewe and Strauss [2] of a minute, filtrable organism as the cause of this disease. Additional material has been studied, and similar results have been obtained and are presented in this report.

Investigations by Levaditi and Harvier [3] and by McIntosh and Turnbull,[4] were referred to in the previous article.[1] Further studies by these investigators and reports by others, also confirming the experiments of Loewe and Strauss, have since been published, and it is of interest to review briefly some of this literature.

McIntosh [5] reported successful transmission from his original monkey to another, and to a rabbit. A monkey kept as a control with the inoculated monkey developed a spontaneous infection, with symptoms of epidemic encephalitis and characteristic brain lesions.

Levaditi, Harvier and their co-workers [6] have added more experimental evidence of the filtrability of the virus of epidemic encephalitis which is present in the central nervous system of fatal cases. They found it pathogenic for guinea-pigs and rabbits, but less so for monkeys. Animals were infected by inoculating them intracranially, intra-ocularly,

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* From the Laboratories of Columbia Hospital.

1. Thalhimer, W.: Epidemic (Lethargic) Encephalitis, Arch. Neurol. & Psychiat. **5**:113 (Feb.) 1921.

2. Loewe, L.; Hirshfeld, S., and Strauss, I.: Studies in Epidemic Encephalitis (Encephalitis Lethargica), J. Infect. Dis. **25**:378 (Nov.) 1919; New York M. J. **19**:772, 1919. Loewe, L., and Strauss, I.: Etiology of Epidemic (Lethargic) Encephalitis, J. A. M. A. **73**:1056 (Oct. 4) 1919; The Diagnosis of Epidemic Encephalitis, ibid. **74**:1373 (May 15) 1920; Proceedings of the New York Path. Soc. **20**:18, 1920; Studies in Epidemic (Lethargic) Encephalitis, Cultural Studies, J. Infect. Dis. **27**:250, 1920.

3. Levaditi, C., and Harvier, P.: Compt. rend. Soc. de biol., **83**:354, 1920; Bull. et mém. Soc. méd. d. hôp. de Paris **64**:179, 1920.

4. McIntosh, J., and Turnbull, H. M.: Experimental Transmission of Encephalitis Lethargica to a Monkey, Brit. J. Exper. Pathol. **1**:89, 1920.

5. McIntosh, J., and Turnbull, H. M.: The Experimental Transmission of Experimental Encephalitis Lethargica in Series in Monkeys and Rabbits, with Notes on a Spontaneous Infection in a Monkey, Brit. J. Exper. Path. **1**:257, 1920.

6. Levaditi, C., and Harvier, P.: Etude experimentale de l'encephalite dite lethargique, Ann. de l'Inst. Pasteur **34**:911, 1920.

into the peripheral nerves and intranasally after scarifying the nasal mucous membrane. They also found the virus in the cerebrospinal fluid and nasal washings of cases of this disease. Their attempts to cultivate an organism from the virus, with the methods perfected by Noguchi, were unsuccessful. The virus, however, remained alive in Noguchi medium for from seven to eight days and in tissue cultures, after the method of Carrel, for fifteen days.

Maggiore and Sindoni [7] isolated from the blood and spinal fluid of cases of epidemic encephalitis an organism resembling that isolated by Flexner and Noguchi [8] from cases of poliomyelitis. They produced the disease in rabbits by intracranial injection of a patient's spinal fluid and intravenous injection of a culture of the organism. Repeated passages through animals produced invariably the characteristic clinical picture and pathologic lesions. They concluded that poliomyelitis and epidemic encephalitis are identical. In a recent communication they report further cultural and clinical evidence which strengthens their belief that epidemic encephalitis and poliomyelitis are the same disease. (The presence of the virus in spinal fluid and the susceptibility of rabbits to the disease differentiate it from poliomyelitis.)

Ottolenghi, Antona and Tonietti [9] found the virus in the blood, nasal washings and spinal fluid of cases of epidemic encephalitis. The virus is filtrable. Guinea-pigs were infected by intracranial and intraperitoneal inoculation and by instillation of nasopharyngeal washings into the nostrils. In rabbits the nasal mucous membrane had first to be scarified for successful inoculation. Brains of cats, experimentally infected, were virulent for guinea-pigs. Two strains of virus were successfully passed through eight and twelve series of animals. The experimental disease lasted from five to thirty-five days and proved fatal in all but thirteen of the 215 guinea-pigs inoculated.

Bastai,[10] working in the clinic of Micheli, found a filtrable virus in the central nervous system, obtained at necropsy, from cases of epidemic encephalitis. Subdural injection of this caused a fatal illness in rabbits, dogs, cats, guinea-pigs and rats, which was very similar to the disease in man. Characteristic microscopic cerebral lesions were present in the animals. The disease could be communicated indefinitely from animal to animal. With tissue-ascitic fluid medium, an extremely minute,

7. Maggiore, S., and Sindoni, M.: Etiology of Epidemic Encephalitis, Pediatria, Naples **28**:985, 1920. Epidemic Encephalitis, ibid. **29**:682, 1921.

8. Flexner, Simon, and Noguchi, Hideyo: Experiments on the Cultivation of the Micro-Organisms Causing Epidemic Poliomyelitis, Tr. Assn. Am. Physicians, Philadelphia **28**:55-68, 1913.

9. Ottolenghi, D.; d'Antona, S., and Tonietti, F.: Etiology of Lethargic Encephalitis, Policlinico, Rome **27**:1075, 1920.

10. Bastai, P.: Ricerche batteriologiche sperimentali intorno alla etiologia della encefalite epidemica, Sperimentale **76**:1, 1920.

filtrable organism was cultivated from Berkefeld filtrates of the original brain material obtained from cases of epidemic encephalitis and from the brains of the animals which succumbed to the experimental disease. Cultures of this organism, injected subdurally, produced in animals the same disease and the characteristic pathologic lesions already mentioned. Micheli,[11] says that he is convinced of the accuracy and correctness of the investigation of Bastai, which was performed in his clinic.

Kling, Davide and Liljenquist [12] recently reported confirmation of their previous findings [13] that the virus of epidemic encephalitis appears

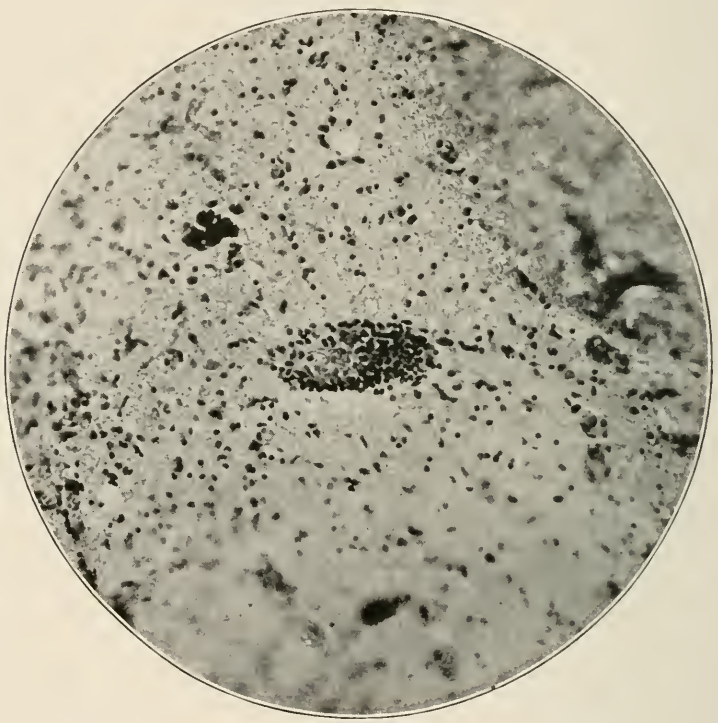

Fig. 1.—Midbrain region of a case of epidemic encephalitis, myoclonic type.

to be glycerol resistant, filtrable and uncultivatable. Their recent report was based on the inoculation of rabbits with spinal fluid from a case of epidemic encephalitis. Four rabbits were originally inoculated and were killed in from thirty-eight to forty days. The brains of two showed characteristic lesions. Five rabbits were inoculated with brain material

11. Micheli, F.: Intorno all'etiologia dell'encefalite Epidemica, Riforma méd. **37**:9, 1921.

12. Kling, C.; Davide, H., and Liljenquist, F.: Virus of Epidemic Encephalitis in the Cerebrospinal Fluid, Hygiea, Stockholm **83**:566 (Sept. 16) 1921.

13. Kling, C., and Liljenquist, F.: Compt. rend Soc. de biol. **84**:521, 1921.

from these. Two animals of this series were killed and the brains also showed characteristic lesions. They emphasize the possibility of employing inoculation of spinal fluid into rabbits as a diagnostic method. Netter, Cesari and Durand [14] have reported communication of the disease to rabbits by inoculation of nervous tissue from a man who died fifteen months after the onset of the disease. They were able to transfer the virus from animal to animal by inoculation of extract of the salivary glands. They found that the virus remained virulent in 50 per cent. of glycerol for at least thirty-two days.

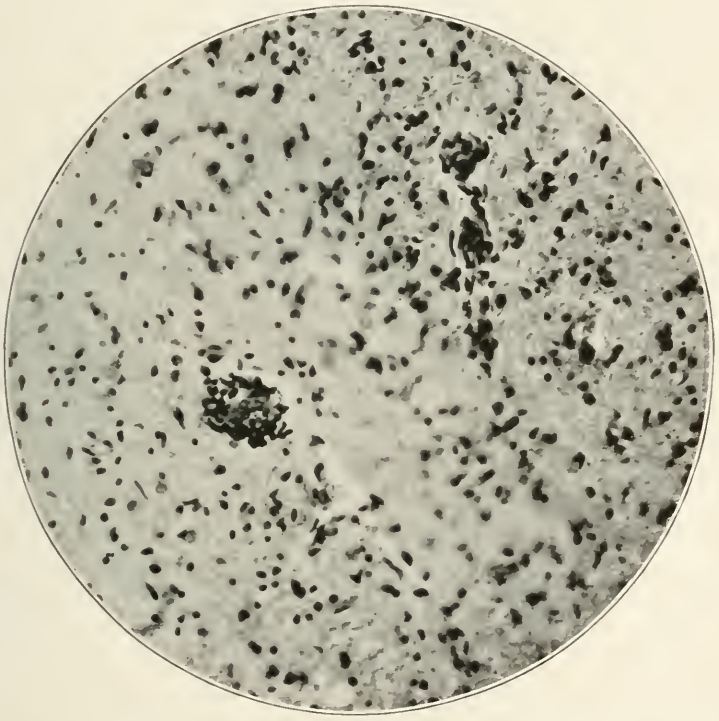

Fig. 2.—Midbrain region of a case of epidemic encephalitis, myoclonic type.

Amoss [15] found that serum from convalescing cases of epidemic encephalitis did not protect monkeys from poliomyelitis virus, whereas serum from convalescent poliomyelitis cases does protect monkeys from this virus. This immunologic difference is contrary to Maggiore and Sindoni's belief in the identity of poliomyelitis and epidemic encephalitis

14. Netter, A.; Cesari, E., and Durand, H.: Demonstration de l'activité du virus dans les centres nerveux 15 mois apres le debut. Presence de ce virus daus les glandes salivaires, Compt. rend Soc. de biol. **84**:854, 1921.

15. Amoss, H. L.: Immunological Distinctions of Encephalitis and Poliomyelitis, J. Exper. Med. **33**:187, 1921.

and is further verification that these two diseases are separate entities caused by viruses which biologically are closely related.

Several other communications are of interest, although their exact significance cannot be determined. Doerr and Schnabel,[16] and Blanc and Caminopetros[17] found a filtrable virus in the plasma of herpes febrilis which caused herpetic keratitis when injected into the cornea of rabbits. This condition can be transferred from animal to animal. This virus, when injected subdurally

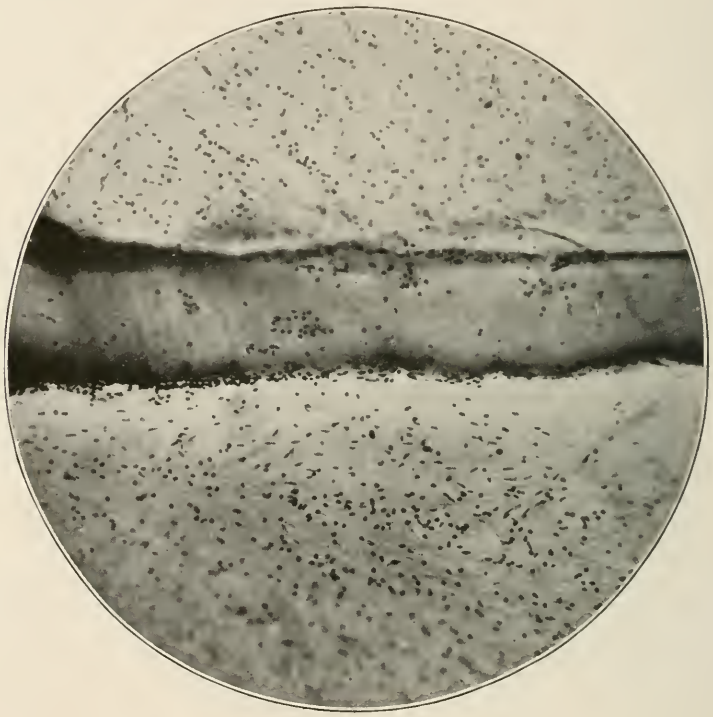

Fig. 3.—Subcortical region of a case of epidemic encephalitis, fulminating type.

into rabbits, is said to produce clinical and pathologic manifestations identical with those produced by virus from cases of epidemic encephalitis. They believe these two viruses are closely related. Luger and Lauda[18] report finding

16. Doerr, R., and Schnabel, A.: Das Virus des Herpes febrilis and seine Beziehungen zum Virus der Encephalitis epidemica (lethargica), Schweiz. med. Wchnschr. **51**:469 (May 19) 1921. Weitere experimentelle Beitrage zur Aetiologie und Verbreitungsart des Herpes febrilis beim Menschen, ibid. p. 562.

17. Blanc, G., and Caminopetros, J.: Recherches experimentales sur l'herpes, Compt. rend. Soc. de biol. **84**:629-630, 767-770, 859-860, 1921.

18. Luger, A., and Lauda, E.: Zur Aetiologie des Herpes Febrilis, Ztschr. f. d. ges. exper. Med. **24**:19, 1921.

a filtrable virus in the fluid of the vesicles of herpes febrilis which on injection produced herpes in the cornea of animals. This condition can be transmitted indefinitely from animal to animal.

MATERIAL AND METHODS

The experimental and cultural methods used throughout this investigation were the same as those described in the preliminary communication [1] and identical with those previously described by Loewe and Strauss.[2]

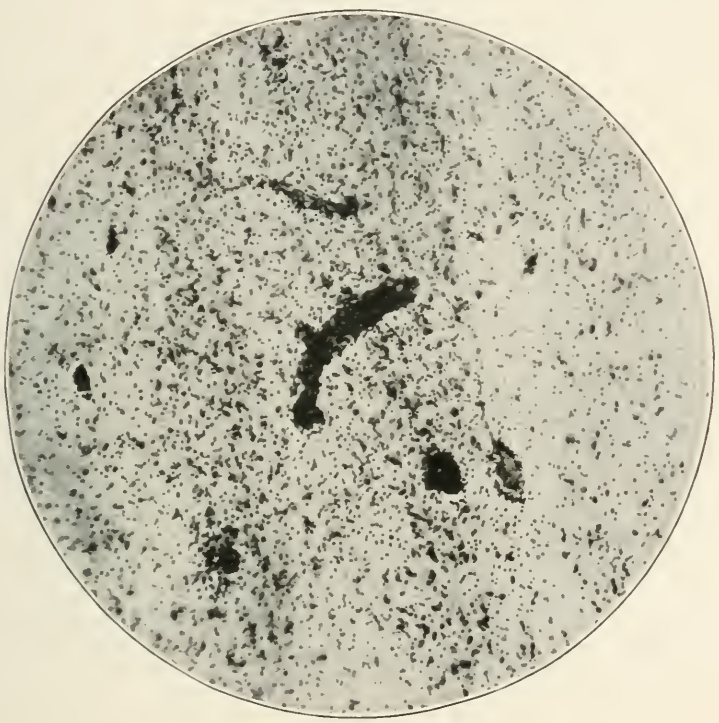

Fig. 4.—Brain of a rabbit inoculated intracranially with virus which had been passed through another rabbit.

The material and experiments are collected in the table. Animal inoculations referred to as positive are those in which microscopic brain lesions were found, identical with those present in fatal human cases. The inoculations were made intracranially. Positive cultures indicate recovery in the tissue-ascites medium, perfected by Noguchi, of a minute filtrable organism having the same morphologic, cultural and biologic characteristics as those recovered by Loewe and Strauss.[2]

The cases which came to necropsy ran typical clinical courses and varied from a fulminating case, with death eighteen hours after the first symptoms, to one of lethargic type which lasted eighteen months with remissions and relapses.

The brains in all these cases showed characteristic lesions; that is, perivascular round cell infiltration and focalized areas of degeneration and round cell infiltration, most numerous in the pons and midbrain region. In the two fulminating cases the lesions were definite but few in number. This is of importance since, in the cases studied by McIntosh and Turnbull, no lesions were found. Some of the brains from rabbits, which in the present study succumbed after inoculation, showed no lesions even though the virus was present, as was proved by culture and by transmission to other rabbits.

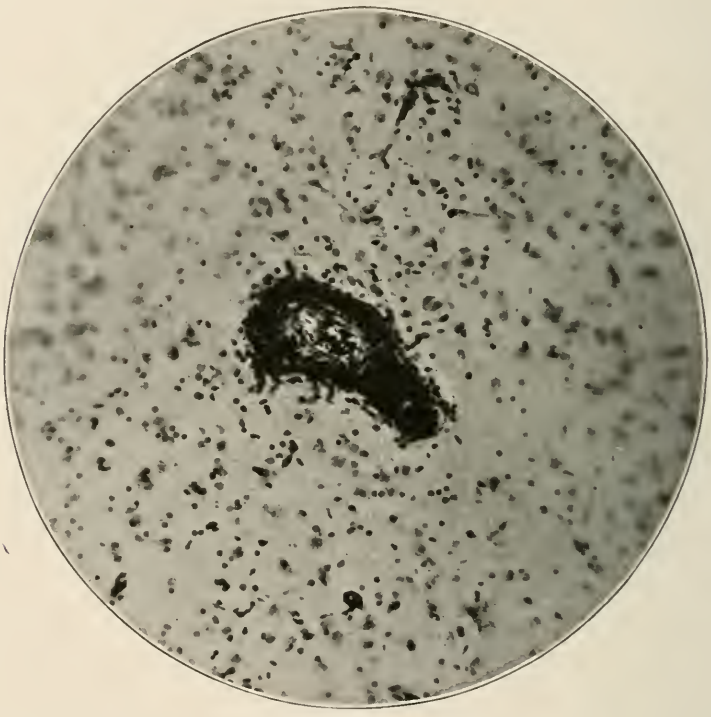

Fig. 5.—Brain of a rabbit inoculated intracranially with virus which had been passed through three other rabbits.

Necropsies were performed on seven cases of epidemic encephalitis. Filtrates (through Mandler clay filters tested to hold back *B. prodigiosus*) from five brains yielded positive animal inoculations and cultures. One brain filtrate yielded only positive cultures and one brain only positive animal inoculation, but from these animals the minute filtrable organism was recovered. Positive results, including both cultures and animal inoculation, were obtained in 100 per cent. of the seven brains studied.

The number of spinal fluids investigated was forty-five, secured from thirty-five cases. Positive cultures were obtained from spinal fluid from twenty-four cases, which is 70 per cent. of the cases and 53 per cent. of the spinal fluids examined. Positive animal inoculation was secured with spinal fluid from twenty-two cases, which is 65 per cent. of the cases and 49 per cent. of the spinal fluids studied. With spinal fluids from five (15 per cent.) of the cases animal inoculations were positive, although cultures were negative. Positive cultures were

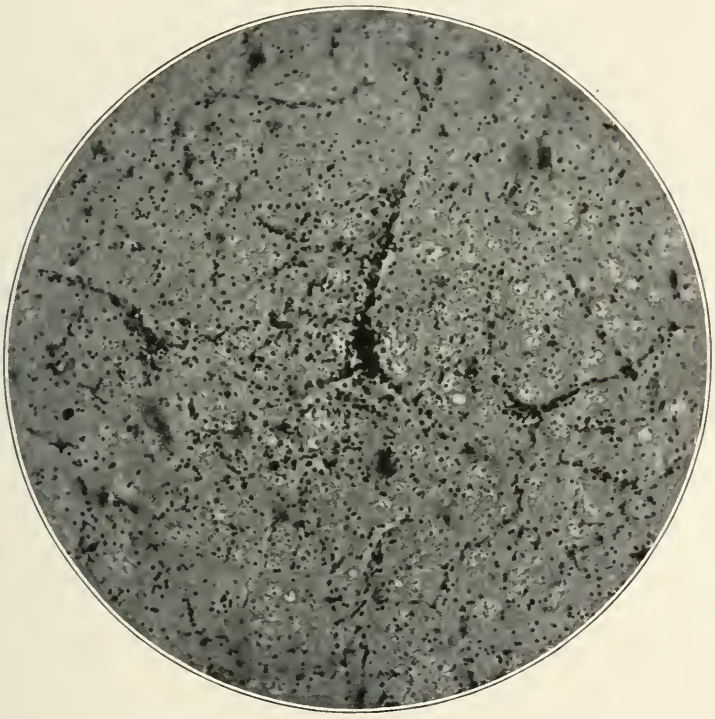

Fig. 6.—Rabbit inoculated intracranially with culture of the minute organism in its third generation.

obtained from spinal fluids obtained on two different days from three cases. In two other instances the first spinal fluid, obtained when the patient was acutely ill, yielded positive cultures while subsequently, during convalescence, negative results were obtained from specimens of spinal fluid. In two cases, spinal fluid obtained three and five months after onset of this disease yielded positive cultures. The total of positive results, by both cultures and animal inoculations, was obtained with spinal fluids from 85 per cent. of the cases studied.

Nasopharyngeal washings were similarly tested from five cases; positive animal inoculation was obtained in all five, positive cultures in four. The combined results were positive in 100 per cent. in this series.

The total number of rabbits inoculated intracranially with either original material or filtrates of the brain of animals which succumbed was 295. Of these 167 died; 108, or 65 per cent., showed characteristic

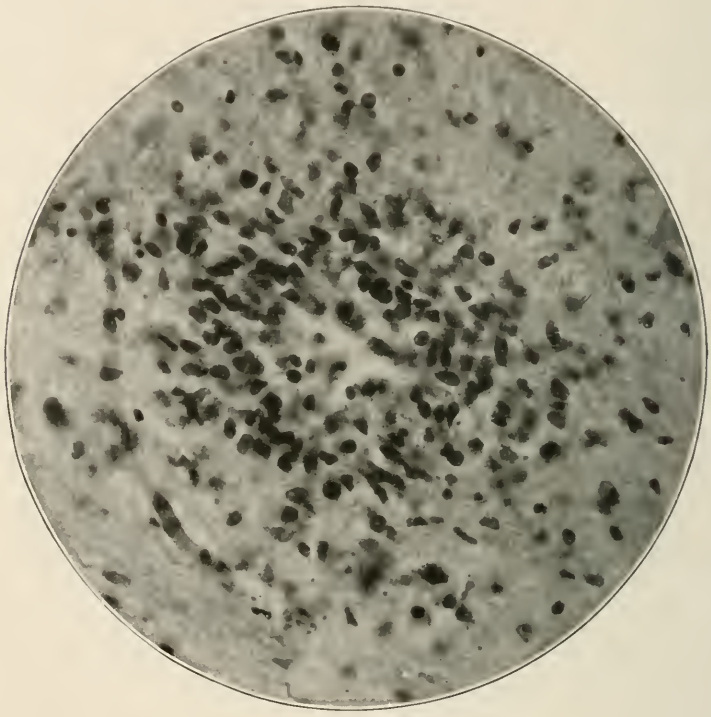

Fig. 7.—Rabbit inoculated intracranially with culture of the minute organism in its third generation.

lesions of epidemic encephalitis (only two rabbits died from acute meningitis). Most of the strains of virus were passed through only one or two series of animals, but passage of a few strains was made through twelve, five, five and four series.

The animals generally died in from two to eight weeks after inoculation, and this is considered to be the incubation period after intracranial inoculation. A few rabbits died in from one to two days. Death after this short interval was believed to be caused by some factor other than the development of the disease, as cerebral lesions were not present. Nevertheless, in a number of instances when the

animal, inoculated intracranially with a potent virus, succumbed after a day, cultures of brain filtrate and transmission experiments were positive.

Viruses of different origins were inoculated intracranially into fifty-two guinea-pigs; thirty-five died, and twenty-one, or 60 per cent., showed characteristic brain lesions (three guinea-pigs died from acute meningitis).

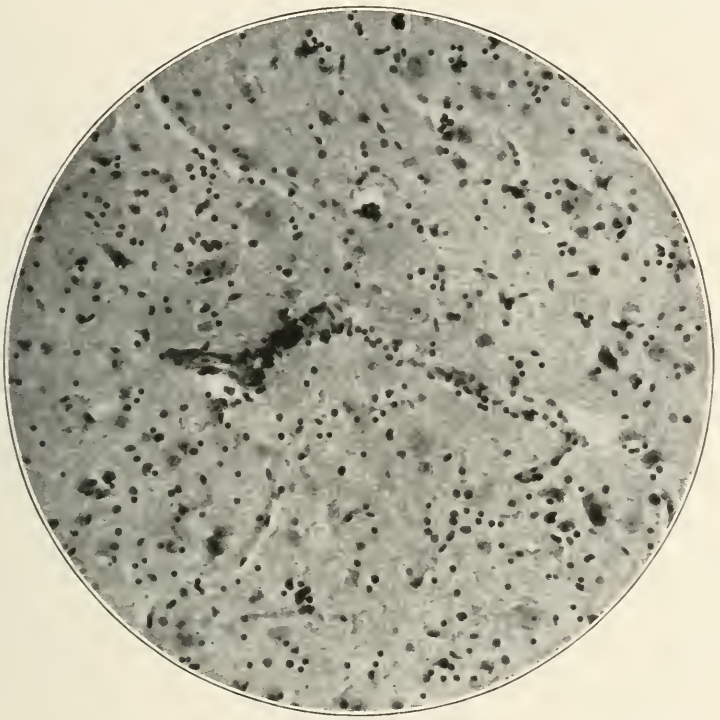

Fig. 8.—Rabbit inoculated intracranially with culture of the minute organism in its third generation.

Cultures in the third, fifth and fifteenth generations were inoculated intracranially into rabbits with the same percentage of positive results as with injections of virus, and the minute organism was again recovered from the brain filtrate of the animals that died.

Some of the cultures were carried through twenty-two generations. Cultures were repeatedly filtered and the minute organism recovered from the filtrate.

Spinal fluid from the following control cases and brain filtrates from all but the last two were inoculated intracranially into thirty rabbits with negative results: three cases of glioma of brain, one case each of

tuberculous meningitis (verified at necropsy), Hodgkin's disease, poliomyelitis, staphylococcus bacteremia, tubercle of cord (verified microscopically) and diabetes.

Cultures on ordinary mediums of these spinal fluids and brain filtrates yielded no growth. Most of the spinal fluids, brain filtrates and filtered nasopharyngeal washings were similarly cultivated and showed no growth, except an occasional spinal fluid from which an obvious contamination was recovered. Filtrates from the rabbit brains yielded no growth.

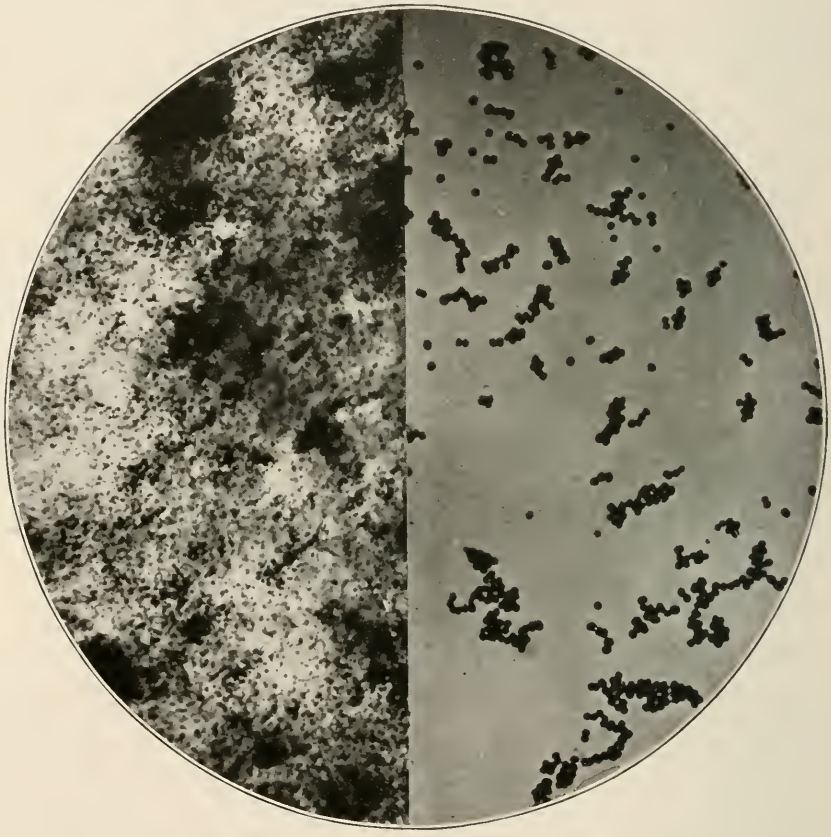

Fig. 9.—This illustration shows the comparative size of *Staphylococcus aureus* and the minute filtrable organism cultivated in Noguchi medium from the brain filtrate of a case of epidemic encephalitis; × 1200.

Although the human brains were not removed aseptically at necropsy, nevertheless two brains were cultivated on ordinary mediums (including blood agar) and in deep tubes (which had been autoclaved) of glucose bouillon containing a piece of sheep brain. The surface of the brain was seared and pieces were removed aseptically from the cere-

brum and midbrain. Seven rabbit brains, removed aseptically, were similarly cultivated. Most of the tubes inoculated with the human brains showed growths of saprophytic bacteria. Only an occasional tube inoculated with rabbit brain yielded growth, usually *Staphylococcus aureus*. Streptococci (hemolytic or anhemolytic) were never recovered from these blocks of brain, brain filtrates (human and animal), spinal fluids or filtered nasopharyngeal washings. Sections from the brains of five cases and from numerous rabbit brains showing characteristic lesions were stained by the Gram-Weigert method and no cocci or other organisms were found.

Results of Experiments

	Number of Cases	Number of Specimens	Number of Positive Animal Inoculations	Number of Positive Cultures	Negative Cultures but Positive Animal Inoculations	Total Number of Results, Both Cultures and Animal Inoculations
Brain filtrate (necropsy material)	7	7	6 (Case 5 was negative)	6 (Case 6 was negative)	..	100%
Spinal fluid	34 Including 7 mild cases and 8 convalescing cases	45	22 65% of cases 49% of spinal fluids	24 70% of cases 53% of spinal fluids	5 15% of cases	85%
Nasopharyngeal washings	..	5	5 100% of specimens	4 80% of specimens	1 20% of specimens	100%

Control, uninoculated rabbits were sacrificed from time to time from different groups of animals. The animals were secured in lots of one or two dozen from different stocks and dealers. None of the brains from these animals showed gross or microscopic lesions. Some of the inoculated animals which died after several weeks, or remained alive, developed snuffles. Two animals which developed snuffles were sacrificed and the brains found normal, grossly and microscopically. Of those which died after inoculation and which had developed snuffles some showed lesions characteristic of epidemic encephalitis and some did not. It is, therefore, not believed that snuffles in rabbits can account for the microscopic brain lesions characteristic of epidemic encephalitis found in the animals used in this investigation.

SUMMARY

The investigations of epidemic encephalitis by Loewe and Strauss, which antedate other similar studies, seem to indicate that a filtrable, living agent, or virus, is regularly associated with this disease. This

virus causes a disease in animals which is similar to, and in many animals identical with, epidemic encephalitis. The microscopic cerebral lesions in the animals are the same as those which have been found to be characteristic of this disease. From this virus, an extremely minute filtrable organism was grown in the ascites-tissue culture medium perfected by Noguchi. Cultures of this organism likewise produced the characteristic disease and lesions in animals.

The study reported confirms the findings of Loewe and Strauss [2] in their entirety. Their animal experiments with the filtrable virus have been confirmed also by McIntosh and Turnbull,[4] Levaditi and Harvier,[6] Maggiore and Sindoni,[7] Ottolenghi, d' Antona and Tonietti,[9] Bastai,[10] Kling, Davide and Liljenquist,[12,13] and by Netter, Cesari and Durand; [14] and their cultural experiments, by Maggiore and Sindoni [7] and by Bastai.[10]

Abstracts from Current Literature

A GENERAL CONSIDERATION OF ENCEPHALITIS (MORPHOLOGY AND PATHOGENESIS). C. von Monakow, Schweizer Arch. f. Neurol. u. Psychiat. **10**:3, 1922.

The present article serves not so much to review the subject of encephalitis from an historical standpoint or to summarize the recent histopathologic work, but to express, in a more general way, the point of view gained by thirty years of study of encephalitis from the morphogenic and pathophysiologic standpoints. Among the causes of encephalitis may be enumerated trauma, compression, toxic factors, particularly the encephalitis of erosion, and most frequently infection.

Both the pathologic and the clinical picture may be exceedingly varied; the lesion may be focal or diffuse, with or without involvement of the meninges, suppurative or nonsuppurative, at times localized to the cortex, at times to the ventricle or the choroid plexus, sometimes parenchymatous, at other times mesodermal and with indirect injury to the nervous structures.

The present article deals with the infectious, nonsuppurative type. Among the causes are various types of cocci, bacilli, spirochetes, spirilli, ultrafiltrable organisms, etc. In addition to the acute hemorrhagic poliencephalitis of Wernicke, the encephalitis of syphilis and diphtheria, all of which have been known for a longer period of time, there have been added the encephalitis associated with Heine-Medin's disease, influenza, scarlet fever, chorea, rabies, chlorosis, herpes, and a variety of other conditions. Progressive paralysis and multiple sclerosis are essentially encephalitic in nature. Of outstanding interest at the present time is epidemic encephalitis. The difficulty of distinguishing toxic from infectious types is shown in the newly described guanidin encephalitis of Fuchs and Pollack.

The manner of invasion of these types, whether through the nasopharynx, the tonsils, the upper respiratory tract, the intestinal canal, the lymph or the blood stream has not yet been fully clarified.

The brain, probably more than any other organ, is protected by numerous structures and mechanisms. Nonsuppurative encephalitis represents that type of morphologic reaction in the brain in which the inflammatory process takes place almost entirely within the ectomesodermal barrier. Two great types can be distinguished: The first is essentially parenchymatous. It is characterized by a rather diffuse involvement, notably of the floor of the ventricles and of the brain stem, the cortex remaining relatively intact. If the latter is involved, it is not in the domain of special arteries, but takes place in an irregular manner, particularly in the gray substance. Microscopically, it is characterized by scattered, fairly sharply circumscribed areas of liquefaction. There is edema of the entire nerve structure, especially in the oblongata and the pons, venous stasis, a relatively uninvolved pia, slight changes in consistency of the brain substance, and here and there punctate extravasations of blood. The ventricles are only moderately filled with a clear fluid, although the choroid plexuses are swollen and hyperemic. The vena magna galleni and the veins of the stem are engorged. To this general type belong some cases of influenzal encephalitis, the encephalitis of chorea, rabies, typhus, scarlet

fever, herpes and epidemic encephalitis. Whether or not the epidemic variety is to be identified with the encephalitis of influenza cannot be determined, although Economo insists that they are etiologically quite different.

Of this infectious, nonsuppurative, parenchymatous type one can distinguish two subdivisions. In one, the brain substance directly suffers a diffuse involvement; in the other, involvement is indirect and through the blood vessels. The manifest pathologic process takes place chiefly in the floors of the ventricles, the gray matter about the aqueduct of Sylvius, the thalamus and the striate regions; in other words, in the district most intimately related to the choroid plexus. The microscopic picture includes exudation, infiltration of vessel walls with lymphoid elements, abban products of nerve cells and fibers, red blood cells, in the acute cases, neuronophagia, rosette formation, atrophy, degeneration, various stages of necrosis of nerve cells, distention of His' space, rarefication of structures under the pia. These findings are also noted in progressive paralysis, multiple sclerosis, rabies, chorea, herpes and a variety of other types of encephalitis.

Von Monakow then reviews briefly his theory of the nutritive functions of cerebrospinal fluid. The transportation of metabolic waste products, he thinks, takes place along two channels; one in which the cerebrospinal fluid carries off dissolved substances through the space of His, and from there to the subarachnoid space, the other in which insoluble products are carried through the agency of cells, through the perivascular space of Virchow-Robin, and thence in part through lymph spaces of the pia into the venous system, in part through the lymphatic glands of the head and neck.

Focal encephalitis, "Herdencephalitis," constitutes the second form and may be seen typically in influenzal encephalitis. In this type there is a more extensive involvement of the blood vessels and the formation of fairly well defined areas of softening and hemorrhages, variously located, but especially to be found in the white matter of the brain, the internal capsule, the pons, and the cerebellum. As opposed to the epidemic variety, the localization is in poorly vascularized areas. This type is found in poliomyelitis, in the encephalitis complicating ulcerative endocarditis, diphtheria, scarlet fever, syphilis, hemorrhagic encephalitis of Wernicke, and one type of influenzal encephalitis. According to Monakow, the arteriothrombotic basis of this form is well established. This does, however, not exclude an associated, diffuse parenchymatous degeneration of brain substance through the agency of toxins. The formation of thrombi explains the intermittent progression which is here so characteristic a feature. These thrombi are grayish white, attached to eroded endothelial surfaces, and characterized by a coraloid structure. As a rule, the lumen becomes entirely obliterated at this point, although the thrombus may be absorbed or give rise to emboli. Usually several days are required for its formation. The brain tissue thus deprived of blood behaves as in arteriosclerosis. It is possible that this thrombus formation is an expression of a defense mechanism on the part of nervous parenchyma against toxins circulating in the blood, and represents an effort to eliminate these from the supplied tissues. To be sure, this protection by means of thrombi can take place only at the expense of nerve tissue supplied by the vessel in question. This pathologic process was familiar to Monakow for twenty years, but was not, however, described previously. An accompanying photograph illustrates this point very well. The section is from the occipital lobe, evidently stained by the Weigert method. At one place is seen an old scar in the region supplied by the posterior cerebral artery. This is evidently the oldest lesion. At another place is an area of softening which

is fairly well advanced, evidently later in appearance than the one previously described. At a third place in the section is an area of early softening, of three days' duration. Recent thrombi are also shown in branches of the sylvian artery.

Clinically two varieties can be distinguished. In the first the course is strikingly intermittent and is characterized by apoplectiform seizures; this variety corresponds to the section just described. The second form is usually ushered in by a light apoplectiform attack and progresses continuously for a period of one or two years. The progression may be evidenced by vertigenous attacks, periodic disorientation, slowly progressive aphasic, agnostic or apractic symptoms. It may resemble progressive paralysis, however, with the distinction that in the latter the focal lesions are more pronounced, and the typical psychic picture is missing.

In encephalitis we deal with every combination of such processes. The more mechanical and focal lesions, caused by interruption of the continuity of nerve structures, expresses itself largely through reflex and coordination disturbances, localized cramps and convulsive movements, coarse choreic and athetoid phenomena and relatively insignificant disorientation in space and time after the initial stage. Disorientation in regard to personality, as a rule, is not an expression of this more grossly focal or mechanical type of lesion. Quite different is the clinical expression of a diffuse toxic reaction. Here one finds delirium, soporous conditions, pains and abnormal sensations in the extremities, hallucinations, personal, spatial, and temporal disorientation, manic and depressive changes and apathy; in short, exceedingly varied disturbances in the psychic field. These split-off fragments many times do not fit, and compensation and adjustments are unusual.

Summarizing, Monakow would classify the nonsuppurative, infectious types as follows:

1. Diffuse, active, but eventually chronic parenchymatous type. In this type there are rarely missing focal lesions such as evidenced by ocular palsies; prominent in the symptomatology are soporose states, temporary periods of disorientation, delirium with hallucinations, depressive, manic, and schizophrenic episodes, pains, general weakness and a febrile course. These symptoms are particularly prominent in the initial stage; they may disappear without leaving a trace.

2. Focal Encephalitis: In this condition we are dealing largely with involvement of the mesodermal structures, that is, thrombosis, embolism and granulation limited to definite vascular territories, located particularly in the cerebrum. The brain parenchyma is involved secondarily. The expressions of disease are of more grossly localized character. This form is dominated, at the conclusion of the initial symptoms, by hemiplegic, paralytic or irritation phenomena. It is the type seen typically in influenzal encephalitis and a part of the ordinary cerebral palsy of childhood.

3. A type characterized by multiple, disseminated, usually well demarcated lesions of generally unknown, but probably infectious etiology. An example of this type is multiple sclerosis. The course is usually protracted and subject to marked fluctuations.

4. A chronic progressive type with diffuse involvement. This is almost certainly infectious in origin and includes progressive paralysis and the spirochetal types of encephalitis, such as trypanosomiasis.

Woltman, Rochester, Minn.

PICTURES OF PARALYSIS AGITANS AND TETANY WITHIN THE SCOPE OF ARTERIOSCLEROSIS. P. Martini and A. Isserlin, Klin. Wchnschr. **1**:510 (March 11) 1922.

The authors report an interesting case of arteriosclerosis in which the signs of a paralysis agitans and of tetany occurred.

The patient, a female, was brought to the hospital, March 11, 1920. For four years prior to admission she had had periods of mental confusion. On examination she was found to be emaciated. The blood pressure was: systolic, 180; diastolic, 110. The face was masklike; there was stiffness of the lower limbs; and a rhythmic tremor of the head and upper limbs was noted both at rest and when in movement. The head was held forward, the pupils were small, and the nerve trunks tender. There was no Babinski sign. Mentally she was disoriented for time and place. In taking the blood pressure, it was noted that a typical Trousseau phenomena developed.

The dementia gradually progressed. The Trousseau sign persisted, but no other evidence of a latent tetany was found. On March 29, epileptiform attacks occurred, and on the following day aphasia developed. During the following two months the dementia lessened, the Trousseau phenomena disappeared, and the parkinsonian attitude became more marked. Death occurred on June 22, 1920.

At postmortem a marked peripheral and central arteriosclerosis was found. The blood vessels of the convexities and especially of the base of the brain showed severe sclerotic changes. In the region of the right praecuneus there was a recent hemorrhagic softening. The lateral ventricle was somewhat dilated. In the left lenticular nucleus there was a fissured softening extending into the internal capsule. The cerebellum and the temporal regions were essentially negative.

The interest in the case lay in the association of the three syndromes—cerebral arteriosclerosis, paralysis agitans and tetany, with the possibility of a similar underlying pathologic condition. Wilson, Lewy, and Forster have found lenticular lesions in paralysis agitans. MacCallum, on the other hand, considers the subcortical centers as a possible site of the pathologic condition in tetany. In the present case the parathyroid glands unfortunately were not studied microscopically, but grossly no changes were noted. The authors do not wish to place too much weight on the findings noted in this case as a possible solution of the problem.

The presence of paralysis agitans, an amyostatic disease, in conjunction with the tetany, brings the possibility of their relation closer together. The gait of the dog or cat in which the parathyroids have been removed is not unlike that obtained by Sherrington in cases of decerebrated rigidity. E. Frank has called attention to the vegetative nervous system in cases of amyostatic disturbances, and to vegetative disturbances in tetany. The authors feel that although nothing has been proved by this patient, attention should at least be called to the relationship between the diseases.

Moersch, Rochester, Minn.

MICROPTIC HALLUCINATIONS. Raoul Leroy, l'Encephale **16**:504 (Nov.) 1921.

In general literature diminutive human beings are frequently mentioned. Perhaps the most famous description is in Swift's "Gulliver's Travels," in which Gulliver makes a voyage to Lilliput. In medical literature microptic

hallucinations (in the French "hallucinations lilliputiennes" and in the German "winzige Männchen") have been little mentioned. The author quotes from various sources descriptions of a peculiar sort of visual hallucination occurring in hypnogogic states, narcoses, cerebral arteriosclerosis, skull injuries, in toxic and febrile states, and associated with epilepsy as a psychic form of aura.

In these hallucinations the subject sees small human beings fantastically and brilliantly costumed and engaged in all sorts of activities. It is worthy of note that actual objects seen by the subject of these hallucinations are perceived as of normal size and color. Thus the state in which microptic hallucinations occur differs from the state of complete micropsia in which objective stimuli are all perceived on a diminutive scale. A characteristic of this type of hallucinations is that their emotional content is almost invariably agreeable.

Leroy regards these hallucinations as of importance in that they show clearly the relation between cortical centers and activities of the psyche. The former he regards as stimulated by a toxin which, at the same time, depresses consciousness. According to Theobald Smith, the reveries of children are occupied almost exclusively with play activities and fairy tales; many authors have described dreams of goblins and sprites and Lilliputian-sized landscapes. These things Leroy believes throw light on the source of microptic hallucinations. He regards them as produced by the subconscious or the unconscious, which is active, due to these toxins which at the same time depress normal consciousness but irritate cortical centers.

The pleasant emotional character of the hallucinations may be partly accounted for because the visions themselves are small and harmless, but particularly because the subject himself subconsciously believes in a world peopled by small beings who occupy themselves with agreeable pastimes. This principle explaining the agreeable emotional tone holds true also in the rare instances in which the hallucinations have as their content small demons and horrible activities which evoke terror because the subject has himself believed in such things.

The author does not mention the possibility of the peripheral visual apparatus participating in the production of these hallucinations.

Hyslop, New York.

SPINA BIFIDA OCCULTA AND SCIATICA. Hermann Weskott, Klin Wchnschr. **1**:625 (March 25) 1922.

During the past few years much attention has been devoted to spina bifida Under the head of myelodysplasia, Fuchs correlated spina bifida occulta with such conditions as enuresis, club foot, prolapsed uterus and other malformations. Recently the association of sciatica with spina bifida has been considered by several authors. Gudzent has noted in numerous cases of sciatica, spina bifida occulta of the last lumbar or first sacral vertebra, and he is of the opinion that in older people the presence of a vertebral deformity may play some part in the causation of sciatica.

Peritz has tried to show that this type of sciatica can be differentiated from others by the presence of signs of myelodysplasia, such as club foot, enuresis, numbness and lancinating pains. The author states that in a series of 260 cases of sciatica, six cases showed spina bifida occulta. The cases all occurred in otherwise healthy men of middle age. The case reports are briefly included.

The histories in all six cases were essentially the same—insidious pain in the back and down one leg, gradually becoming more severe and extremely

chronic and resisting all treatment. In the author's series there was no history of early enuresis, there was no hypertrichosis, sensory disturbance or claw foot. Judging from his own experience, he is not at all certain that the presence of a spina bifida occulta is to be considered the cause of sciatica. It is, however, possible, that this acts as a locus minoris resistentiae. In some cases operative measures have been instituted, and deformities of the nerve roots have been noted; however the relationship between these findings and the sciatica is not clear. The majority of the author's cases responded poorly to treatment, and he suggests that in all chronic cases which are resistive to treatment the possibility of an occult spina bifida be considered. Whether operative procedure should be instituted in these chronic cases is still quite uncertain, and the writer does not feel that he is in a position to make any definite recommendations from his limited experience.

Moersch, Rochester, Minn.

SOME FACTS IN THE DEVELOPMENT OF THE AMPHIBIAN NERVOUS SYSTEM. C. Judson Herrick, Anat. Rec. **23**:291, 1922.

The author discusses three factors which, among others, may be recognized in the embryologic development of the brain: (1) ancient palingenetic hereditary influences, such as primitive metamerism; (2) hereditary factors of more recent origin obviously of an adaptive nature, such as the reflex patterns and their neuromotor apparatus, and (3) the immediate effect of active function on the progress of individual development.

Until recently attention has been confined largely to the first of these factors, but the demand now is for a coordinated attack on the problems of development on all these frontiers. In order to learn the rôle of functional adaptations of the second and third types it is obviously first necessary to determine what these adaptations are. For the study of the development of functional localization and functional inter-relationships of parts, the amphibian nervous system is more suitable than the human brain, because it is less complex, more readily submits itself to the methods of experimental embryology and begins to function in response to external stimulation at a surprisingly early stage of development. A summary of the more recent work on the nervous system of amblystoma is given.

The author says that one of the first desiderata is a series of normal tables of the nervous system, based on the sequence of both structural and functional development. The object of the investigation is to correlate the changes in external form with corresponding changes in behavior and pattern and a histologic differentiation internally. For the consummation of this program more detailed studies of the development of reflex patterns from early larval stages are necessary.

Nixon, Minneapolis.

DISORDERS OF SENSATION IN PARALYSES OF THE FACIAL NERVE. J.-R. Pierre, Presse méd. **30**:488 (June 7) 1922.

In certain cases of advanced cerebellopontile angle tumor, ageusia of the anterior two thirds of the tongue was demonstrated, opposing the classical theory that taste disorders were found only when the lesion lay between the geniculate ganglion and the origin of the chorda tympani.

In refrigeration palsies, diminution in the sense of taste varied directly with the degree of paralysis, but ageusia was the more persistent of the two symp-

toms. The anterior two thirds of the tongue frequently showed thermal hypesthesia in addition, which disappeared sooner than the gustatory hypesthesia.

Hypesthesia of the concha auriculae, earlier associated with the facial nerve in herpetic cases, was here found in several cases without herpes. This tended to clear up by the fourth to the sixth day. It is announced that Truffert has demonstrated fibers in an anatomic preparation which are identified as the terminal sensory branches of the seventh nerve to this area.

Classic painful hyperacusis at the onset of a refrigeration palsy was found in only 6 per cent. of the cases studied. Lachrymal, buccal and sweat secretions were rarely, and then only slightly, affected.

HUDDLESON, New York.

THE DIAGNOSIS OF HYSTERIA. HENRY HEAD, Brit. M. J. **1**:827 (May 27) 1922.

Head regards hysteria clinically as definitely characterized by the positive nature of its morbid phenomena. For instance, an hysterical paralysis is the expression of the conviction "I cannot move" in the mind of the patient. Likewise, other deficit symptoms and signs, such as anesthesia, result from the refusal to accept impressions. The basic mental factors are proneness to autosuggestion, a negative attitude to orders from without and a tendency to disassociation. Hysteria is essentially an irrational answer to a mental conflict. Head's therapeutic advice is well worth repetition. "It must never be forgotten that in a large number of cases, especially in civil life, removal of hysterical symptoms is only a prelude to the discovery of an anxiety neurosis. The causes for the suppressed emotion must be investigated, or the patient may be left in an even worse condition than that in which you found him."

STRECKER, Philadelphia.

THE RADICULAR DISTRIBUTION OF NEVI AND VITILIGO. M. KLIPPEL and M. P. WEIL, Presse méd. **30**:388 (May 6) 1922.

The two disorders are considered together, with arguments for their common origin. Several cuts illustrate the root distribution of areas of vitiligo.

Nevi are divided into (1) those due to a peripheral lesion, in the vessel walls, which may occur early embryologically, and (2) those due to central lesions, in the brain or cord, that can occur effectively only late in fetal life when the nervous system is in trophic connection with the integument.

Certain nevi and leukodermic patches are apparently due to lesions in the peripheral nerves, but it is claimed that the majority are dependent on central nervous lesions. The latter are located in the posterior commissure of the spinal cord. Vitiligo is said to be frequently accompanied by an excess of globulin and even of cells in the spinal fluid, though not necessarily syphilitic.

HUDDLESON, New York.

THE SEMEIOLOGY OF INVOLUNTARY RHYTHMIC MOVEMENTS IN EPIDEMIC ENCEPHALITIS. M. E. KREBS, Progrès méd., April, 1922, No. 13, p. 145.

This paper describes unusual and abnormal forms of movement in epidemic encephalitis. Krebs reports seven cases. He is particularly interested in scoliosis. He quotes a previous paper on this subject in the *Revue*

neurologique, March, 1922, written with Babinski and Plichet. Other movements of the extremities are reported. Many of these are fragments of decerebrate rigidity. He emphasizes the great effect of emotion in exaggerating the extent not only of the trunk abnormalities, but also of the movements of the extremities. Finally, emphasis is laid on the similarity of the movements in epidemic encephalitis to those of athetosis, chorea and those cases designated torsion spasm by Ziehen and dysbasia lordotica progressiva by Oppenheim.

KRAUS, New York.

THE INFLUENCE OF THE LATERAL LINE SYSTEM ON THE PERIPHERAL OSSEOUS ELEMENTS OF FISHES AND AMPHIBIA. ROY L. MOODIE, J. Comp. Neurol. **34**:319 (June 15) 1922.

The lateral line sense organs are not trophic for the head skeleton. The association of lateral line canals with certain definite peripheral osseous elements has been a constant feature in the organization of fishes and Amphibia from Devonian times to the present. The nature of the influence of the lateral line canals on the formation of bone is mechanical, because it furnishes an inactive substance in the form of the dense connective tissue of which the canals are composed. Attention is called to some analogous processes of calcification in human neuropathology.

C. J. HERRICK, Chicago.

FURTHER COMPARATIVE STUDIES IN OTHER FISHES OF CELLS THAT ARE HOMOLOGOUS TO THE LARGE IRREGULAR GLANDULAR CELLS IN THE SPINAL CORD OF THE SKATES. CARL CASKEY SPEIDEL, J. Comp. Neurol. **34**:303 (June 15) 1922.

Dahlgren has described, in the spinal cord of the skate, enormous cells of nervous origin, but apparently of glandular function. Examination shows that homologous cells are found in the spinal cords of most (but not all) groups of fishes. Many gradations are described between cells which in size and internal structure resemble ordinary neurons and the large and peculiar cells of skates and flounders.

C. J. HERRICK, Chicago.

CLINICAL CHARACTERISTICS OF MUSCULAR TWITCHINGS IN EPIDEMIC ENCEPHALITIS. THE RELATIONSHIP OF ACTUALLY OBSERVED MYOCLONIAS TO SOME PREVIOUSLY KNOWN SYNDROMES. RHYTHMIC SPASMODIC MOVEMENTS IN ENCEPHALITIS. M. E. KREBS, Bull. et mém. Soc. méd. d. hôp. de Paris. March 24, 1922.

Krebs emphasizes the difference between rhythmic and arrhythmic myoclonic movements. He says that both types exist in epidemic encephalitis. The arrhythmic type recalls the contractions of the paramyoclonus of Friedreich. The rhythmic type differs from the arrhythmic in that it moves the limbs. Scoliosis and various movements of the extremities are produced in the rhythmic type.

KRAUS, New York.

CYTOLOGY OF THE LARGE NERVE CELLS OF THE CRAYFISH (CAMBARUS). L. S. ROSS, J. Comp. Neurol. **34**:37 (Feb. 15) 1922.

The neurofibrillae of the axons of these cells take a remarkable course within the cell body, spreading widely throughout the cytoplasm and enveloping the

nucleus. These fibrillae are not related to trophospongium of Holmgren, internal reticular apparatus of Golgi, or mitochondria.

C. J. Herrick, Chicago.

THE MOTOR NUCLEI OF THE CEREBRAL NERVES IN PHYLOGENY. A STUDY OF THE PHENOMENA OF NEUROBIOTAXIS. Davidson Black, J. Comp. Neurol. **34**:233 (April 15) 1922.

This is the fourth of a series of studies, of which the preceding parts have appeared at intervals during the past five years. The motor nuclear pattern of birds is on the whole fundamentally similar in all the forms examined and characteristically different from that of any other vertebrate group. The special features of the motor nuclei of several avian types are described in correlation with the structural peculiarities and modes of life of these species.

C. J. Herrick, Chicago.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY

Regular Meeting, April 4, 1922

Foster Kennedy, M.D., *President, in the Chair*

PATHOLOGIC FINDINGS IN THE HEART IN PROGRESSIVE MUSCULAR DYSTROPHY. Dr. Joseph H. Globus.

This paper and discussion will appear in full in a future issue of this journal.

A NEUROPSYCHIATRIC PILGRIMAGE. Illustrated by lantern slides. Dr. Smith Ely Jelliffe.

In May of 1921, I had the privilege of visiting many of my old European haunts, and it is of this journey I wish to speak.

France lost at least three of its greatest neurologists during the war. Its sister state, Belgium, also suffered an irreparable loss. They were all older men, and each had done his life work. Each stood preeminent in his sphere. Déjerine was perhaps the greatest figure of them all. I need not remind this audience what he means to neurologic science. His early "Famille Neuropathique," his "Familial Myopathy," are milestones in neurologic progress. With Thomas, his "Maladies de la Moelle" is a classic; his "Anatomie," written in conjunction with Mme. Déjerine, and his final large volume on "Semeiologie"—these are only a few of his standard performances which have enriched neurologic science. I would like to speak of his personal charm, his bonhomie, his rare skill and tact in handling neurotic patients according to his view of their disturbed emotional conditions.

Another lost leader, a native of Bordeaux, who has been one of the dominating figures in French psychiatry for many years is Régis. His name is familiar to many of the older men in psychiatry. He was a fearless and strong man. He was one of the first to be interested in psychanalysis, and with his pupil, now his successor, Hésnard, in Bordeaux, gave us their well-known criticism of the freudian principles.

In the early years of the war the death of Van Gehuchten made all who had known this gentle soul, mourn. His life work in Louvain had been destroyed in that mad rush of war and he himself could not survive it.

Our next immortal, Grasset, was a remarkable neurologist, and the younger men here may profit from Grasset and Rauzier's "Traité de Neurologie," a large book, crowded with data and quite the equal in many respects to Oppenheim's classic.

Having paid short respects to the dead, let us return to the primary object of my visit, namely, the annual reunion of the Paris Neurological Society—1920 had seen the first general reassemblage of that body since 1914.

This leads our steps to that great Mecca of French Neurology, the "Salpetrière." Here for many generations neurology and psychiatry have

drunk deep of knowledge, reaching an acme in the genius of Charcot. Raymond, his successor, carried on, feebly perhaps, in view of his predecessor's brilliancy, followed later by Déjerine. At his death in 1918, Pierre Marie followed him and it is owing to his courtesy that I am able to show you an intimate glimpse of the Charcot library and collections housed in the building in which the clinical work is carried on. Pierre Marie, the present professor of neurology, is remarkable for his facile and intelligent interest in all things neurologic, especially his quick vision to grasp the significance of small variations in structure and function. A striking trait is his great courtesy to American students; the enthusiasm that he can arouse in his students makes him at present the most dominant figure in French neurology.

The nomination of Claude to the chair of mental medicine of the University of Paris has met with approval by his colleagues and confrères. In the field of neurology he has gathered ample harvests. In psychiatry it cannot be said that Claude has made, as yet, any striking contribution, but the solid foundations on which he has reared his knowledge of the action of human beings leaves little doubt that in this field he has much to contribute.

Henri Claude was made intern of the hospitals during the year of 1893, intern of the gold medal in 1896, doctor of the hospitals in 1901, fellow (agrégé) in neurology in 1903, and assistant at the Clinic of Nervous Diseases; under this title he was frequently in charge of the course at the Salpetrière, where he directed the service for nonresident psychopathic patients.

Claude has frequently been laureate of the Faculty of Medicine, of the Academy of Medicine and of the Academy of Sciences; he is a member of the societies of biology, psychiatry and legal medicine, as well as neurology, of which he has been president. For the last fifteen years he has been expert of the tribunals where association with him is particularly appreciated by both judges and physicians.

He has published a number of studies in *L'Encephale*, of which he is a director. It would be unjust to forget the services which he rendered during the war as chief of important neuropsychiatric centers and a director of commissions. It is impossible to give an exact idea of Henri Claude's works in the limited space of this talk. His publications touch on the broader problems of medicine, neuropsychiatry, endocrinology and experimental pathology. His studies on the pluriglandular syndromes, on the method of glandular tests and on the relations of the glands of internal secretion to disorders of the nervous system are known to most present. His book on the semeiology of division of peripheral nerves, enriched with valuable personal documents, was very useful in the study of injuries of nerves in the war. Serous meningitis and the syndrome of intracranial hypertension constitutes one of the most important works in neurology. His researches in cerebral tumors, epidemic encephalitis atrophy of the cerebellum, tumors of the protuberance, spinal disorders, sections of the spinal cord and other conditions are also valuable.

In psychiatry, his reports at conferences on epilepsy, the nature of hysteria, the rôle of the emotions in the psychoneuroses, apraxia, mental disturbances in epidemic encephalitis, dementia praecox and senile dementia made him an authority. If the moment has come when psychiatry is able to comprehend more than subtle classifications; if it can perhaps be impregnated with ideas of internal pathology, general pathology, neurology and endocrinology; then we may hope that Henri Claude, aided by the disciples he has already made and by others who may attach themselves to his school, will contribute powerfully to the renovation of this science.

Taking up the work of the Congress itself, Dr. Jelliffe spoke briefly of the reports by Souques on paralysis agitans, the functions of the paleostriatum and neostriatum; the substantia nigra; encephalitis and its lessons; and the lack of real understanding of what is meant by emotional factors. Roussy's brilliant work on the thalamus and many others were rapidly alluded to.

He then sketched the personalities of, and work done by, Leri, Bouttier, Guillain, Crouzon, Sainton, Vurpas, Bourguignon, Behague, Sicard, Foix, Laignel Lavastine and other representatives of present day Paris neurology. Mme. Déjerine and Ceillier's work in the osteo-arthropathies and Thomas' work on the pilomotor reflexes were shown by lantern slides.

Dr. Jelliffe then took his auditors to Switzerland, stopping with Dr. Robert Bing at Basel; and then to von Monakow's collections in Zurich, giving illustrations of von Monakow's ideas of the integration of bodily function, the choroid plexus and its relations to mental and nervous disease. A rapid visit was made to Bürgholgli Hospital and to Prof. Bleuler, and the present tendencies of psychanalytic applications to psychiatry were touched on.

He next turned to the Neurological Institute of Vienna, and Marburg, Pollak and Spiegel. Particular attention was given to Spiegel's recent work on the vegetative nervous system, to the work of von Economo and of Wagner, von Jauregg and the malarial treatment of paresis. The technic and the patients whom he had seen were described. Allusions were also made to later discussions at Braunschweig with Weygandt, Nonne and others whose results were encouraging.

The speaker then took his hearers to Kraepelin's clinic at Munich. He spoke of the death of Alzheimer, Nissl and Brodmann and gave short accounts of these workers. Kraepelin himself was seen in Italy; his energies are now directed toward building up his Research Institute; in this work he has an able ally in Rudin. The scientific work in the clinic is as active as ever. Spielmeyer and Spatz are carrying on the Alzheimer traditions and enlarging the scope of their investigations beyond purely cellular alterations.

Berlin was rapidly visited, and a brief résumé given of the work of Rothmann, Lewandowsky, Oppenheim and Erb. A visit to the Vogts was described and the extension work of the Vogts and Bielschowsky outlined. Vogt's program for work to be done on the cortex was briefly discussed and the work on the striatum outlined.

Dr. Jelliffe then gave a rapid summary of the Braunschweig meeting of the Deutsche Nervenerzte. Strümpell's amyostatic syndrome was the subject, and comparisons were drawn between the work at Paris and Braunschweig on the physiopathology of the region of the striatum.

Dr. Jelliffe dwelt for a moment on the fascinating work of Lewy on experimental studies of metabolic pathways of vegetative function. Lewy, with Brugsch and Dresel have commenced a direct attack on the neurology of metabolism and have shown the importance of mesencephalic structures for the integration of visceral functioning.

Dr. Jelliffe then took his auditors to London and the Queen Square Hospital. He reviewed rapidly Head's aspects of the problem of aphasia and spoke of the Head-Riddoch work on the mass reflex, bringing the latter into coordination with the studies of Lhermitte on the cord, and of André Thomas on the pilomotor reflexes.

He spoke of the death of Henry Maudsley, almost the only representative of English psychiatry who spoke in the language of dynamic psychology, and of his contributions to psychiatry. Only with the great war did English

psychiatry awake from an inertia that was difficult to understand. Stoddard, among the older group, alone seemed to comprehend the real situations as Maudsley had seen them. Mercier's crabbed satire had seemed to cramp psychiatry in England almost as effectually as he himself had been cramped by his venom and his rigid "logic," both of which he used to ridicule his adversaries.

That English psychiatry had begun to awaken was evident and was illustrated by Sir Frederick Mott's work on the gonadal changes in dementia praecox. Almost every endocrine organ has been indicted by different investigators. Undoubtedly the most radical alterations were to be expected in spermatogenesis and ovogenesis, and even in the cells of Leydig—all of which Mott found gravely altered. Whereas Mott argued chiefly for these gonadal changes as of primary significance, Dr. Jelliffe emphasized his belief that they were results and not causes. When, to use Southard's phrase, a fourth dimensional psychiatry becomes thinkable, the life movement of the organism as a whole must occupy the focus of attention. This dynamic urge, like time, forces the individual along lines of behavior, metabolic or social, and has a definite entelechy. The continuance of life is life's chief function. This has been written into every cell of the body and is of the essence of its expression. Naturally the gonadal system, more perhaps than any other structures, must record this push.

Nature's great aim may be conceived to be the development of adult psychosexual persons. Practically all mankind is struggling along this pathway and halting at various levels of psychosexual evolution. The chief criteria to determine the stage of this development in any individual case are found in the unconscious. The psychanalytic technic alone can determine this. All previously orthodox criteria of so-called group logic are usually camouflage, substitute products. In the study of unconscious processes one may be able, in a manner analogous to that used by the paleontologist, to determine a geologic horizon, to discover just what stage the individual has reached in his psychosexual evolution. His dynamic strivings bear a direct relationship to this grade of development, and his constitutional diseases, speaking in general, develop in definite associations with his dynamic strivings.

Dr. Jelliffe then discussed the work of S. A. K. Wilson and the striatum syndromes, bringing this author's contributions in line with the Paris Neurological Conference to which Wilson himself had contributed, and to the Braunschweig meeting where the same subject was discussed.

Three Hundred and Ninety-Seventh Regular Meeting, June 6, 1922

E. G. Zabriskie, M.D., *Vice President, in the Chair*

THE STATESTHETIC AND KINESTHETIC COMPONENTS OF THE AFFERENT SYSTEM. Dr. J. Ramsay Hunt.

The whole efferent nervous system, cerebrospinal and vegetative, consists of two components which are physiologically and anatomically distinct. One is the static system which regulates posture; the other is the kinetic system controlling movement itself. In muscle, the kinetic system innervates the

anisotropic contractile mechanism and the static system the isotropic sarcoplasm. The function of the sarcostyles is movement. The function of sarcoplasm is postural fixation, posture following movement like a shadow.

The efferent system, phylogenetically considered, consists of three great physiological divisions, which I term archeokinetic, paleokinetic and neokinetic. The segmental nervous system contains the archeokinetic and archeostatic components of motility, representing reflex movement and reflex posture (archeokinesis).

The paleokinetic and neokinetic mechanisms for the regulation of higher types of movement are found in the suprasegmental nervous system. The paleokinetic mechanism consists of the corpus striatum, its subordinate spinal systems (extrapyramidal tracts), and cortical connections through the optic thalamus (corticopaleokinetic system). This system controls movements of the automatic-associated type (paleokinesis). The neokinetic mechanism consists of the rolandic area and its corticospinal system (pyramidal tracts). The neokinetic system is concerned with isolated-synergic types of movement (neokinesis).

I regard the cerebellum as the essential suprasegmental structure for the regulation of postural function. Both neostatic (isolated-synergic) and paleostatic (automatic-associated) types of posture are represented. The neostatic function is related to the hemispheric system and the paleostatic to the vermian system of the cerebellum.

In peripheral nerves and voluntary muscle the myokinetic system is represented by medullated nerves and the sarcostyles of the muscle fiber, the myostatic system by nonmedullated nerve fibers and sarcoplasm. Each system has its special form of tonus, a contractile tonus, referable to the kinetic mechanism (kinetotonus) and a plastic tonus referable to the static system (statotonus).

The static and kinetic components of the vegetative nervous system for the control of unstriped muscle are represented in the sympathetic and parasympathetic systems respectively. These two systems control the postural function and primitive motility of the blood vessels, glands and viscera. Both systems differ essentially in their physiologic manifestations and pharmacologic reactions. Anatomically, the parasympathetic system (midbrain, bulbar and sacral autonomic outflow) consists of medullated nerve fibers, while the sympathetic proper is composed of nonmedullated nerves. Unstriped muscle, like striated muscle, is composed of fibrillae and sarcoplasm. The fibrillae pass from one cell to another forming a contractile network, and subserve the function of primitive movement. The sarcoplasm is concerned with primitive posture which permits the adaptation of blood vessels and hollow organs to their contents (capacity-posture).

According to my conception, both the cerebrospinal and vegetative nervous systems, as well as striped and unstriped muscle, present evidences of static and kinetic systems underlying the functions of motility.

In the phylogenesis of movement the contractile cell passes by gradual stages from the nonstriated to the striated type, heart muscle representing a transition form between the two. Posture is the dominant function of involuntary muscle which coincides with the predominance of sarcoplasm. In voluntary muscles, movement is the dominant function, and there is a corresponding differentiation of the contractile mechanism.

In both voluntary and involuntary muscles various types of muscle fiber may be recognized, representing transitions from lower to higher forms. These differences in muscle structure are in harmony with the phylogenesis of the

efferent nervous system—archeokinetic, paleokinetic and neokinetic—for the "effector" end organs which express the contractile function must also undergo changes in evolution in order to fulfil the demands of a more highly organized central nervous system.

These two systems also have important relations to symptomatology. Symptoms referable to both the kinetic and static systems may be released by the dissociations of disease. A lesion of the kinetic system causes a disorder of movement and of the static system a disorder of tonus or of posture. This principle holds for both the splanchnic and somatic systems.

The kinetic mechanisms of the somatic system may give rise to various types of convulsive manifestation, namely: kinetic types of epileptic seizures (tetanic and clonic); also chorea, athetosis, dystonia, the tremor of paralysis agitans; paramyoclonus, myokymia and fibrillary twitchings.

Related to the static mechanism are sudden postural relaxations of epilepsy, partial or general (static seizures); all forms of myotonia: cerebral, cerebellar, spinal and peripheral; also cerebellar symptoms—asynergia, dysmetria, adiadokokinesis and intention tremor.

Even in the psychic sphere evidences of a dual representation are manifest in the hyperkineses of psychic origin (convulsions, chorea, tic convulsive) and in certain postural disorders (catatonia, catalepsy). A similar interpretation may also be given to active and passive perseveration.

In the vegetative nervous system, disorders of movement are related to the kinetic system (parasympathetic). This may be expressed by hyperkinesis, for example, gastric and intestinal hypermotility.

Related to the static system or sympathetic are disorders of postural tone—conditions of atony and dilatation of the blood vessels and the hollow viscera. This conception implies, therefore, a parallelism of structure and function of the kinetic and static systems throughout the whole efferent mechanism, from its lowest to its highest levels—a duality of function which is revealed in many different fields of investigations, and which is manifested in the symptomatology of the nervous system.

Kinesthetic and Statesthetic Systems.—The sense of movement and the sense of posture are well recognized components of deep sensibility. Both of these forms of bathyesthesia are composed of sensory impressions derived from various sources, chiefly from the muscles, but also from the joints, tendons and fascia. The vestibular mechanism, as was pointed out by Sherrington, is also closely related to the proprioceptive system and plays an important rôle in the regulation of postural tone. And it is interesting to note that recent investigators (Magnus and Kleijn; Randall; Hunter) recognize the existence of a kinetic as well as of a static labyrinth in which the semicircular canals yield kinetic impulses and the otoliths static impressions. And it is not unlikely that the labyrinth has a statesthetic and kinesthetic function quite separate and distinct from one another, subserving respectively the sensory aspects of posture and of motion.

In the conception of a statesthetic and kinesthetic function I have reference more particularly to muscle sensibility (myesthesia) and its relation to the dual functions of motility. For if it be true that the efferent nervous system from its earliest development in the vegetative mechanism to its highest expression in the cerebral cortex shows evidence of a static and a kinetic mechanism, the existence of a similar division of function in the afferent sphere is a necessary corollary. For the efferent system is only one limb of the reflex arc, and where two separate physiologic systems exist subserving the function

of motility, so different in the nature of their contractile function, there must also be corresponding differences in the function and morphology of their afferent mechanisms.

One may postulate, therefore, in both skeletal and visceral muscle, the existence of special afferent systems for the transmission of sensations of movement and of posture to the central nervous mechanism. One is the kinesthetic component of muscle sensibility conveying impulses of movement (kinesthesia); the other is the statesthetic component conveying impulses underlying postural tone (statesthesia).

Anatomic Considerations.—As already mentioned, striated muscle fiber has two types of motor nerve endings, which are probably related to the kinetic and static systems of motility. One is the motor end plate which is the terminal of a medullated nerve fiber (myokinetic effector); the other is a sympathetic type of nerve ending, the terminal of a nonmedullated nerve fiber (myostatic effector). Both of these terminals are beneath the sarcolemma (hypolemmal) and therefore in direct relation with the contractile content of the muscle fiber.

In addition to these motor types of nerve endings, the investigations of Huber, Crevetin and Dogiel have shown the existence of other terminals of a sensory character in relation to the muscle fiber. These are the nerve endings of both medullated and nonmedullated nerves, and are situated outside the sarcolemma. They are found on the outer surface of the muscle fiber, the tendon and musculotendinous junction, as well as in the intermuscular connective tissue, and are evidently sensory in their function.

Dogiel, who used the methylene blue method and whose investigations were carried out on the ocular muscles (recti) of man and mammals, reached the conclusion that there are two kinds of sensory nerve endings for each muscle fiber. These are the terminals of both medullated and nonmedullated types of nerve fibers. In one form the nerve ending entwines the muscle fiber, frequently throughout its whole length. The other surrounds the end of the muscle fiber in the form of a palisade, the fiber fitting snugly into this end apparatus. Between these two typical types of sensory nerve endings of muscle fibers there are various transition forms. It is evident from these investigations that muscle fibers are well supplied with sensory nerves and nerve endings of both medullated and nonmedullated types.

It would be premature to attempt any correlation between these histologic studies and a possible kinesthetic and statesthetic function. As, however, in the effector sphere there is already considerable evidence showing that kinetic function is controlled by a medullated nerve fiber and static function by a nonmedullated nerve fiber, it is possible that a similar morphologic difference and correlation may hold for the affectors and the afferent system. For the greatest evolution and highest differentiation of motility is in the kinetic sphere, and it is therefore possible that posture function, which is automatic and secondary, is subserved in both the afferent and efferent sphere by nerve fibers of primitive nonmedullated character.

The statesthetic and kinesthetic components of muscle sensibility unite with fibers from other structures subserving the sense of movement and of posture and pass together in the spinal cord, the brain stem and the thalamocortical pathway. In conditions of disease, because of their proximity, both of these components of the proprioceptive system are usually associated with loss of the sense of movement.

Within the spinal cord, the kinesthetic and statesthetic systems pass together in the columns of Goll and Burdach to the nuclei of the posterior columns.

From these nuclei, secondary pathways pass in the corpora restiforme to the cerebellum in the interest of postural function while other fibers, both kinesthetic and statesthetic, are continued in the brain stem to their secondary terminations in the optic thalamus. The ventral and dorsal direct cerebellar tracts pass directly to the vermis cerebelli from their primary stations in the gray matter of the spinal cord.

From the optic thalamus kinesthetic and statesthetic impulses are conveyed by its commisural system to the corpus striatum for the regulation of automatic-associated movement (paleokinesis). From the optic thalamus, the kinesthetic and statesthetic systems are continued in their tertiary and final pathway to the parietal lobe of the cerebral cortex.

In addition, therefore, to these sensory structures which participate in the reflex postural and kinetic functions of the segmental nervous system, three great stations representing posture-motion groupings may be recognized; namely, in the myelencephalon (nuclei of Goll and Burdach), the diencephalon (optic thalamus) and the neoencephalon (parietal lobe).

I believe that these two sensory systems play an important rôle in the reflex production of the phenomena of reciprocal innervation, which is so striking a feature of muscular activity, namely: concomitant relaxation of the static or posture mechanism of antagonistic muscles with contraction of the agonists.

Relation of the Statesthetic and Kinesthetic Systems to Symptomatology.—A disorder of the kinesthetic system would produce a loss of the sense of movement or kinetic ataxia. A disorder of the statesthetic system would produce a loss of postural sensibility or static ataxia.

The statesthetic system is the sensory component underlying plastic tonus (statotonus), the "lengthening and shortening reactions" of muscles and other manifestations of postural tone—reflexes of posture. The kinesthetic system is the sensory component underlying the "twitch," the contractile tonus (kinetotonus) and reflexes of movement.

These two functions of the proprioceptive system are usually involved together and frequently in the same degree. In some cases, as in tabes, a more selective involvement may occur, causing kinetic ataxia, loss of tendon reflexes, with little or no loss of postural tone; on the other hand, there may be well marked hypotonia without ataxia or loss of tendon reflexes.

Involvement of the corpus restiforme by cutting off statesthetic or postural stimuli to the cerebellum will produce static ataxia. This is a pure ataxic disorder due to loss of the postural synergy of the cerebellum and is not associated with other disturbances of deep sensibility. Kinetic ataxia, on the other hand, is an incoordination of movement dependent on a loss of the afferent systems conveying kinesthetic impulses to the efferent mechanism.

ON THE OCCURRENCE OF STATIC SEIZURES IN EPILEPSY. Dr. J. Ramsay Hunt.

By "static seizures" I mean a form of epileptic seizure characterized by sudden losses of postural control. This type of epileptic manifestation I believe is related to the static system of motility, and would differentiate it from the convulsive or kinetic type of seizure which gives the characteristic imprint to the clinical picture of epilepsy. I have observed a number of patients with static seizures. The kinetic type of seizure is the common one and may result from a variety of causes, toxic, organic and emotional. The static type of seizure I have observed only in idiopathic epilepsy. It is characterized by a

sudden loss of postural control and may occur alone, as a dissociated manifestation of epilepsy. The loss of postural control is sudden and shocklike, the patient falling to the ground with abrupt violence in response to gravity. This sudden plunge or drop is characteristic and is not infrequently the cause of serious injury, especially to the face and head. It is quite different from the usual fall of the epileptic in the convulsive attacks. In one case, both patellae had been severely injured by frequent and severe drop-seizures. While the drop is sudden the postural relaxation is of short duration, the patient rising almost immediately from the ground without assistance. The fall is usually associated with transitory loss of consciousness, which may, however, be slight. In not a few instances there is scarcely any appreciable obstruction of consciousness. The fall is usually forward and is associated with sudden relaxation or "giving way" of the lower extremities. As a rule there are no convulsive manifestations, although the two varieties of attack may be combined. The postural relaxation is more or less general, the patient falling in a heap from complete loss of postural control.

Contrasted with these more or less general types of postural relaxation, these patients often show a more limited or local form of postural relaxation, which may be quite circumscribed in character and distribution, and associated with myoclonic jerks or starts. Such myoclonic manifestations are not uncommon in the early morning in cases of epilepsy, particularly on arising, and are often relieved or lessened by the recumbent posture. They are characterized by sudden muscular jerks or starts, often bilateral, which may affect the arms, trunk, head or legs. Usually there is only a single muscular contraction, although these may follow one another in rapid succession. Patients during the period of myoclonia are liable to drop objects held in the hand and typical general static seizures in this group of cases, from a more general postural relaxation, are not uncommon.

While in the present state of our knowledge one cannot assert positively that these myoclonic manifestations are exclusively related to the static system, it is my belief that a close relationship exists, and that the myoclonic jerk or start is often only a secondary or compensatory kinetic manifestation in response to sudden localized relaxation in the posture sphere. From experimental evidence, some posture relaxation precedes or accompanies nearly every form of cortical movement, so it is possible that both of these elements may play a rôle in these minor motor manifestations of epilepsy. The typical drop-seizures are by no means common, and up to the present time my experience is limited to ten cases. When these attacks are present they tend to recur with a certain degree of regularity and persistence.

A few months ago, under the title "Dyssynergia cerebellaris myoclonica," I reported a group of cases in which the patients had symptoms of cerebellar disease associated with myoclonus epilepsy. In several of these patients typical static or drop-seizures were observed. In one case examination of the central nervous system revealed a primary atrophy of the cells of the dentate nucleus and its efferent system in the superior cerebellar peduncles. This lesion causes a break in the static or posture system and may have some relation to the myoclonia.

The neostatic system, I believe, arises in close relation to the neokinetic area of the rolandic region. It then descends in the anterior limb of the internal capsule, the mesial portion of the crus cerebri to the pons, where it terminates in relation to the ventral nuclei of the pons varolii. This corresponds to the frontopontile tract of neuro-anatomy. From the pons the fibers cross to the

opposite cerebellar hemisphere and then descend by way of the dentate rubrospinal and other systems to the sarcoplasm of muscle, the function of which is fixation of the muscle fiber in terms of posture. The static seizure, I believe, is related to a disorder of this mechanism.

Hering and Sherrington showed clearly that postural inhibition and muscular contraction could be elicited by electrical excitation of the cerebral cortex and that there exists a form of coordinate innervation in which the relaxation of one group of muscles occurs as an accompaniment of the active contraction of another set.

The experiments of Sherrington were carried out on cats and monkeys. He was able to show that stimulation of the appropriate center, e. g., that presiding over extension of the elbow, produced an immediate relaxation of the biceps, together with active contraction of the triceps. As soon as the stimulation is discontinued the arm returns to its previous posture of flexion. By weakening the faradic current, relaxation can in many instances be induced without any obvious contraction of the opposed muscles. The relaxation seems to occur quite synchronously with or sometimes a little prior to the contraction of the opposite group. The points of cerebral cortex from which relaxation and contraction of a particular muscle, e. g., the biceps brachii, can be evoked respectively are distinct from one another, and often even in a small monkey lie more than a centimeter apart. Besides, therefore, a localization for muscles according to their contraction, there is also a cortical localization different in scheme and capable of demarcation by observations with relaxations as index. It is interesting to note that Sherrington also obtained relaxation of certain muscles by stimulation of various points on the cross section of the internal capsule.

Sherrington also confirmed these results by cortical stimulation in decerebrate rigidity. After ablation of one cerebral hemisphere a homonymous extensor rigidity develops which presents an opportunity for examination of the sphere of excitation of the cortex on the extensor muscles of the crossed elbow and knee. He found in the rolandic region of the monkeys a cortical area which gives markedly and forthwith inhibition of the contraction of the extensors of the elbow, and another cortical area which similarly when excited inhibits the contraction of the extensor of the knee.

Weed, in an elaborate study of decerebrate rigidity, has still further clarified this subject. Weed found that inhibition of the extensor spasm of decerebrate rigidity could be obtained from the motor cortex of the rolandic area, from the mesial anterior portion of the internal capsule, from the mesial one-sixth of the crus cerebri, from the pons and from the anterior portion of the superior vermis.

In a later study Cobb, Bailey and Holtz also investigated the genesis and inhibition of extensor rigidity in cats. They found that electrical stimulation of the cortex of the anterior lobe of the cerebellum produced an inhibition of the rigidity in the ipsolateral muscles. Finally the anterior lobe was removed exposing the dentate rubral tracts, stimulation of which produced an even more marked inhibition of the extensor rigidity.

Therefore, on the basis of clinical observation and experimental data, I would postulate the existence of a type of epileptic manifestation characterized by sudden losses of postural control. I believe that these are referable to a loss of static control and may be regarded as static seizure, in contrast to the convulsive manifestations which are essentially kinetic in origin.

DISCUSSION

Dr. L. Pierce Clark: Since knowing Dr. Hunt's view relative to static seizures in epilepsy, I have been keen to find them, but I have not seen such attacks. The report of a pure static seizure without slight preceding tonic spasm I believe is due to faulty observation. We all know, however, that the tonic, clonic and simple paralytic phases of an epileptic seizure are subject to wide fluctuations in their proportional relations in a given seizure and in different persons. While any particular seizure may be preponderantly static in type, I believe in the dictum of Hughlings Jackson that some degree of muscular spasm invariably occurs in every epileptic attack and that if studied closely the tonic element will be disclosed at the inception of supposedly pure static seizures.

Dr. Smith Ely Jelliffe: I think Dr. Hunt is right in the possibility of the static type of loss of function. He can call it epilepsy if he cares to do so. There is a sudden failure of the geotropic mechanism. Whether his analysis of the pathways is valid or not, I cannot say. Dr. Hunt speaks of the function of the otoliths. I think that the inertia stimulus is an important factor. We must have some function of inertia. The planet we are on is being whirled in space at an enormous speed and we and our whole system are carried at a tremendous rate, so that inertia becomes an important force. The recent work of Magnus, Winkler, Kleijn and the whole Dutch school has emphasized the function of vestibular mechanism as handling inertia and geotropic stimuli.

Dr. C. L. Dana: I have somehow a feeling that the phenomena of mental and neural function cannot be altogether explained by a system of more and more complicated and integrated mechanisms. There must be an explanation of what balances the integrations and how the machines still work when most of the machine is gone, as in people without any labyrinth and little cerebellum and no cervical sympathetic system to speak of.

In regard to the static epileptic seizures I think Dr. Hunt is right. Some years ago I reported such a case which seemed to correspond with the old term of "falling sickness." My patient, a boy, would "crumple up" in the street or at home with instantaneous relaxation of all his muscles. There might have been an unobservable period of muscular tonus first, but I could not see it. The boy simply dropped and arose immediately. The case was reported as true "falling sickness." I have seen several others since, and Dr. Hunt has described the characteristic phenomena correctly.

Dr. I. Abrahamson: We must be careful in assuming that agonist and antagonist always act in the manner described. In encephalitis I have seen several cases in which the biceps and triceps contracted at the same instant. We should first show static seizures in jacksonian epilepsy. The crumpling up may be an expression of more or less sudden and complete loss of consciousness. Gyratory, propulsive or retropulsive seizures, falling to either side or forward and backward like a falling tree, would be more suggestive of static attacks than a mere crumpling up.

Dr. Ramsay Hunt (closing): I agree with Dr. Clark that in some cases of sudden postural relaxation (static seizures) it is difficult to say positively that there is not some perturbation of function in the kinetic sphere. That, however, does not invalidate the essential features of my hypothesis. It is a refinement of diagnosis and has more of a physiologic than practical interest. It reopens the question of postural relaxation in reciprocal innervation, a question which Sherrington initiated several years ago.

THE NATURE OF ESSENTIAL EPILEPSY. Dr. L. Pierce Clark.

The epilepsies, when stripped of all their organic and symptomatic types, leave a large group of epileptic patients who, apparently, in spite of any obvious cause, still have periodic convulsions, and to this group is applied the term essential epilepsy. It has been found that every such person possesses a primary defect in the instinctive life, called the epileptic constitution. The glaring clinical manifestation of such a personality is its crude form of egotism, possessing a correlate of extreme supersensitiveness and an emotional poverty as a part of the defective developing character. We then postulate that social and life adaptations in such persons cannot be met without enormous stress, and the varied life issues entailing the latter precipitate epileptic reactions. We therefore look on the convulsion as a break in the life demand for adaptation, and the nature of the convulsion as a protective and regressive phenomenon. The more severe and frequent it is, the deeper the regression. We have thoroughly detailed clinical material to substantiate this thesis, namely, that essential epilepsy is really based on the defective primary endowment, the epileptic constitution.

DISCUSSION

Dr. Smith Ely Jelliffe: I see no contradiction between the terms functional and organic. Every function has to work through an organ, so that to separate functional and organic in the deep philosophic sense is impossible. Where does Dr. Clark put the separation of functional types from organic types? He says he has pushed out every case that can be explained, such as those caused by bony spiculae, inflammation, tumor, etc., and that leaves a residue of cases that he calls essential epilepsy. In these cases he finds a certain type of constitution which, he says, is based on defective development. What does he mean by defective development? If he takes up psychogenic epilepsy, does he mean that the development is mental? Are "psychogenic" and "mental" synonymous terms? He has not made clear what he means by defective development. If he means by "psychogenic" the function of handling symbols, I can understand what he means by an essential epilepsy. The symbol functions at a high energy potential. When captured by the body it must be transformed and the energy redelivered. Symbolic delivery is the most essential and dynamic in the behavior mechanism. A psychogenic epilepsy, then, is one in which the symbolic functioning is defective.

Dr. Bernard Sachs: Dr. Clark has used a number of relatively new terms and expressions, but I should like to inquire in an entirely friendly way whether in his own mind he has gone beyond the old postulate that the epileptic patient has a predisposition to this special form of disease; or that his brain is subject to these peculiar discharges and anything going wrong in his body will aggravate them.

Dr. M. Osnato: I believe that Dr. Clark stated that the delirium in petit mal was of the functional type because its content dealt with the everyday life experience of the individual. I do not think that is any criterion. All delirial productions deal with ordinary life experiences, with what is in the consciousness. Therefore this does not prove that the delirium in petit mal is functional and not organic. I think there is danger in laying too much stress on the makeup and personality as determining the mental disease from which the patient suffers. The three points which Dr. Clark emphasizes—egocentricity, emotional poverty and hypersensitiveness—are not different from those found in the personality of patients with dementia praecox. The type of reaction is

influenced by the makeup but not by the disease itself. Dr. Clark said that a tyro can pick out the epilepsy makeup but that the epileptic patient may have minor degrees of the same attributes and that only the carefully trained physician can bring these out. The same qualities that are supposed to belong to the epileptic makeup are found in the characters of many people. Why should the mechanism be different in epilepsy if it is of psychogenic origin? Why should the psychologic mechanism work differently in epilepsy and express itself in convulsive manifestations which are objectively and by various chemical and other means so readily differentiated from the convulsive manifestations of hysteria?

Dr. I. J. Sands: Many points mentioned by Dr. Clark do not agree with my experience. In the first place, I take issue with him when he says that there is a primary defect in the instinctive life of the epileptic patient. When one thinks of the instinctive life of a person as ordinarily described by such men as Woodworth, McDougall, or Watson, representatives of the different recognized schools of psychology, it is difficult to find any real defect in the instinctive reaction of the epileptic. In fact, the instincts are well developed in him. In the elaboration of this theoretical defect in the instinctive life of the epileptic patient, Dr. Clark mentions the egotism, supersensitiveness and emotional poverty of the epileptic. It is true that one encounters these characteristics in epileptic patients, but their genesis is not to be found in instinctive defects. They are to be best explained as resulting from defensive mechanisms induced by an inferiority complex. The epileptic patient is fully aware of his handicap in life. This induces in him a feeling of inferiority. He is quick to sense any danger. He is very sensitive, or supersensitive, in order to detect any danger in the environment that may mean destruction to him. He is quick to detect any menacing situation that may come up in his sphere of activity. Such a personality is very unpleasant and is not conducive toward a frank and open relationship with one's neighbors. The epileptic patient becomes more or less of a social outcast, and for this state of affairs he does not seek an explanation in his own personality but in those of the people with whom he comes in contact. This in turn tends to make him egotistical as he is constantly finding imaginary faults in those with whom he comes in contact in his effort at rationalizing his exclusion from social organizations. The emotional poverty is partly explained as a result of the traumas caused by the convulsions, and partly as a sequence to the supersensitiveness and egotism of the person. Furthermore, we must not lose sight of the fact that there are quite a few epileptic patients who are very meek, altruistic and tolerant, and this too as a result of their inferiority complex, hoping to counteract their handicap by assuming such attitudes in their dealings with their fellowmen.

In the second place, I never could fully understand Dr. Clark's contention that the seizure is a mode of escape from an unpleasant situation. There is nothing more unpleasant and more serious that occurs in the life cycle of the epileptic patient than the convulsion. Each seizure leaves an indellible mark on the personality.

In the third place, I beg to take issue with Dr. Clark on his characterization of the epileptic delirium as a psychogenic delirium. At Bellevue, we are in a most favorable position to study the various forms of delirium. There is no doubt in my mind that the delirium associated with epilepsy is of organic nature. It resembles most closely the delirium resulting from cerebral

trauma; in fact, I believe that they are identical. I can never differentiate the two except from the history of the case. I believe that epilepsy is the resultant of some cerebral insult, gross or molecular structural alteration in the brains of the person, which is escaping detection through the present methods of investigations. The convulsions are responses to stimuli, endogenous, exogenous or psychogenic, sent to the highly sensitive brain of the patient. If the assumption that there are either gross or molecular changes in the brains of the epileptic patient be true, one might expect to find the type of epileptic patient described by Dr. Hunt. Clinically I have seen such a type coming into the psychopathic wards of Bellevue. It is difficult to prophesy where the locus for the ultimate solution of the genesis of epilepsy lies. More facts are needed to evaluate the effect of disease in the mother on the brain of the developing fetus. Furthermore, we need more data in regard to the influence of mild infections on the developing and growing brain during infancy.

Lastly, I cannot understand why Dr. Clark persistently asserts that phenobarbital has a detrimental effect on the patient, asserting that it causes deterioration. This is entirely different from the statements made in reports that are now swelling the literature. I have used phenobarbital extensively, not only in the sane epileptic patient but also in the psychotic one. I have never had any untoward results. Not only has it failed to cause deterioration, using the word in its restricted psychiatric sense, but it has helped to clear the psychotic episode and has prevented deterioration. In only one case have I seen bad results from phenobarbital, and that was in a young epileptic patient who had been receiving 5 grains (0.32 gm.) of phenobarbital three times a day over a period of ten weeks. That patient finally presented the typical signs of so-called "barbital poisoning." This was not the fault of the drug but of the physician who had used it improperly.

Dr. J. Ramsay Hunt: I should like to ask Dr. Clark his reasons for assuming that all cases of idiopathic epilepsy are psychogenetic. Epilepsy is a symptomatic manifestation which has definite associations with organic disease and intoxication of various kinds.

It is only in recent years that the pathology of paralysis agitans has been placed on a fairly firm basis. Before this many theories were advanced which are now no longer seriously considered. It seems that we are still in this period with regard to epilepsy. Let us hope that before many years have elapsed the epilepsies will also be placed on a more secure pathologic foundation, and then many of the theories which now engage investigators will have only an historical interest.

Dr. Israel Strauss: Let us suppose a boy 5 years of age has a history of convulsive seizures. We examine him and find nothing wrong organically. The metabolic, endocrinological and focal infection studies reveal nothing unusual. Such a case, according to Dr. Clark, is idiopathic. We must then seek for the attributes of the epileptic constitution which, as Dr. Osnato has pointed out, are present in a good many of us. This makeup has led to a conflict in adaptation and as a result of it the patient has developed epileptic convulsions. This would not appear to be a satisfactory and pleasurable solution for most persons. If now we find no organic cause for the epilepsy in this boy and no evidence of the epileptic constitution, what form of epilepsy has he? Some years ago Dr. Clark would have found the explanation in the attempt of the child to go back to the uterus of the mother, this leading it to assume the fetal position in the tonic state of the convulsion. I cannot see

the rationale of this. In seeking the solution of the problem of epilepsy we shall have to deal with fundamental processes in the life of the organism. We cannot solve it by studying the human being. I believe we must study lower forms of life from the point of cell metabolism and activity, for there lies the secret of what produces this tremendous change in the human brain.

Dr. C. P. Oberndorff: I have seen one interesting case of the "crumpling up" type of epilepsy mentioned by Dr. Hunt, in a young man of 26, 6 feet 2 inches (187.96 cm.) tall, with a prominent chin but no other signs of acromegaly. He was playing golf when he suddenly dropped. Since then he has had three or four attacks; in one he was cut severely by striking his face. In addition, he has shown a tendency to somnolence. He falls asleep in the train or even while talking or dancing. He is at present confronted with an emotional conflict in that he is Protestant and the girl he wants to marry is Catholic. On leaving the girl's house he has an attack of epilepsy or somnolence, so that he does not know what he is doing. While asleep he walked through a glass door and was badly cut. I did not wish to use psychanalysis in this case but hypnotized him with great facility. He tells me the mental state in hypnosis is different from that in the epileptic form attacks. He has a normal sella turcica, no increased sugar tolerance, or acidosity; but I think he has pituitary disturbance. Two views have been taken of his disorder: it is glandular or psychogenic. I thought it pituitary.

Dr. P. R. Lehrman: The difference in the views expressed impresses me as due to the difference in the mode of approach to this problem. The organic approach has so far yielded little. I have closely followed Dr. Clark's studies and in several instances have been convinced of the truth of his observations. I know of one man, aged 35, a Seventh Day Adventist minister, who has petit mal attacks, whose case was diagnosed as essential epilepsy after careful study at the Vanderbilt Clinic. Phenobarbital did not help him. I became interested in his utterances while he had an attack. He would then invariably repeat a Catholic prayer. This was a reversion to early training. The patient became a convert at the age of 17 out of protest at his tyrannical father. The relationship of such a personality reaction to religious conversion is significant. I believe that the more we study the problem of epilepsy from the point of view of personality and are willing to hear what the patient says, voluntarily and while associating, the quicker we shall be able to evaluate properly the method that Dr. Clark is using in his studies.

Dr. L. Pierce Clark (closing): I believe that essential epilepsy is at the bottom organic, or better, constitutional. The defect at inception of the disorder is not that form of brain lesion which should properly be classed as the symptomatic pathology. This primary defect is now and perhaps may always remain nondemonstrable by our present methods of study. The defect is shown in the imperfect development of the instincts of the epileptic person as a whole and not in any one of his special functions of brain structure. My method of approach may seemingly be a regressive one and not in accord with what we may term the mechanistic studies of the immediate past. It, however, really rests on the method perhaps first inaugurated by Hippocratic studies in epilepsy. It is essentially the psychobiologic one, which includes the inheritance, the present makeup, and the environmental factor. It may seemingly neglect the meticulous exactness of individual study of special parts of the brain because it maintains that we may not wrench such a function from its cooperative functioning with all other parts of the brain and the whole body as well.

My fundamental postulate is that epilepsy in its entirety is a life reaction disorder and must be studied on this basis. It is basically a dynamic approach to the evaluation of the essential defects of the whole organism. It has its specific mechanistic defects in brain structure cells, tracts and neural envelops; it has metabolic and katabolic disorders in the bodily tissues. These are all but correlates of the fundamental defects of the whole epileptic person. One may say, if we take a summation of all the isolated disordered functions of the whole brain, may we not build up a comprehensive picture of epilepsy? No. The dilemma then may be illustrated by MacCurdy's example in chemistry: Sodium and chlorin when united produce common table salt whose qualities can in no wise be postulated from a consideration of the single elements before their chemical union. So there comes into being a something unpredictable from the summation of the several organs and functions of the body. The biologic study of different disease processes, such as epilepsy, is absolutely essential to get at the broad fact of the dynamic etiology of the disorder. This manner of approach by modern scientific principles is relatively new and has far to go before neuropsychiatric problems will yield final and satisfactory results. What I have so far brought forward in my studies is really not radically new in any one of its tenets. It is the grouping and the more exact study of the formerly loose designation of predisposition that brings a seeming novelty to the formulation, and the great importance I place on the dynamics of the makeup in determining the disease as such. In regard to the study of epileptic delirium, one perhaps may not designate whether it is really psychogenic in character, from the content alone, but if one is able to show by after-analysis that the conflict revealed in delirium is removable by psychologic efforts it shows for practical purposes that the factors at work are probably psychogenic. If phenobarbital really did anything more than repress the fit and cause the patient to live at a lower level of life adaptation, Dr. Strauss' remarks on this part of our subject would be more pertinent. Sedatives alone can only work harm in the disease process as a whole in the long run. Even studies on the epileptic personality and makeup are not final, exclusive and inclusive; but we are on the right road and such studies properly correlated, with coincident changes in all bodily tissues, will give us new understanding of the disease process of epilepsy. The line of study is not dissimilar to many others in the more advanced study of the psychoses. The need of united mechanistic and psychobiologic study of our problem is obvious and each will make its value felt in the final solution.

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY *

Regular Monthly Meeting, April 20, 1922

Dr. F. H. Packard, *President, in the Chair*

SOME OBSERVATIONS ON THE CHEMISTRY OF EPINEPHRIN. Dr. J. C. Whitehorn (by invitation).

1. Epinephrin in strong concentrations gives a violaceous red color with the reagents customarily employed in testing for tryptophan or its derivatives; that is, concentrated sulphuric acid and glyoxylic acid, vanillin or formaldehyd.

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* Communications from members of the staff of McLean Hospital, Waverley, Mass.

This suggests a possible metabolic relation between epinephrin and tryptophan, and therefore makes desirable epinephrin studies in such conditions as pellagra.

2. Neutral formaldehyd, which inactivates epinephrin physiologically, has the chemical effect of almost, if not quite, destroying the basic character of epinephrin.

3. A new oxidative color reaction by means of silver peroxid has been found to be several times as delicate as the Ewins reaction. The silver peroxid is prepared by mixing equal volumes of one hundredth normal silver nitrate and 2 per cent. potassium persulphate. When 0.25 c.c. of this freshly prepared suspension and about 3 c.c. of dilute epinephrin solution are mixed, the addition of from three to five drops of ammonia water gives a pink color, which increases in intensity for four or five minutes and then begins to fade.

A PSYCHIATRIC INDEX FOR FACILITATING THE STUDY OF PREVIOUS RECORDS. Dr. S. M. Bunker (by invitation).

The object of the psychiatric index is to promote a larger use of the psychiatric hospital records. The index essentially consists of about one hundred psychiatric symptoms selected as chiefly characteristic of the more common psychoses recognized today. Graph paper gives an opportunity to check in chronologic sequence the presence or absence of these symptoms in the development of any particular case. Case record systems have been developed at the expense of considerable labor and money in general hospitals and case records in general hospitals are used much more frequently than in psychiatric hospitals. The symptom index has been found useful at the Danvers and Rhode Island State Hospitals. The present index has been devised to serve as a key to records at the McLean Hospital. It shows the trend of the psychoses and stimulates interest in the chronic case. It is made elastic by providing for inclusion of symptoms peculiar to any particular case, thus aiding in the analysis of the individual case. Card index files are made from the symptom index which is filed with the case record. The consistent use of the symptom index would present several worth while possibilities: 1. It offers the basis for a dictionary of psychiatry. 2. It provides a quick and scientific method of presenting cases of like symptomatology at staff conferences. 3. It accepts Kraepelinian terms at their face value, thereby laying a fair basis for criticism of the whole Kraepelinian school. 4. It encourages students of psychiatry and psychology at our universities to consult original records rather than to depend on textbook theories. It is not a statistical study, but is designed to unlock the accumulated records of the past and make them accessible to the student of today.

DISCUSSION

Dr. H. I. Gosline: I have been working on this subject since 1914 and am familiar with the index used at Danvers State Hospital. When I was at Danvers the first record was made by the assistant superintendent before the patient was brought to the clinic. At the Rhode Island State Hospital at Howard it is made while the patient is in the clinic. I consider the Danvers method preferable because there is more time to do it.

The clinic director should have charge of the records. In some hospitals the same person is clinic director as well as pathologist, but this is unsatisfactory unless he has numerous assistants. Among these assistants should be a statistician, for a hospital of 1,400 patients.

Either we do not know enough about psychology or we psychiatrists have not used what is known by the psychologists. In making the new classification at Howard we have tried to arrange the psychopathologic symptoms as to whether the primary mode of appearance is in the perceptional or ideational sphere, the sphere of inner states or the sphere of activities. We have even tried to decide whether the symptom is in the perception of concrete objects, in the perception of time or space or of measuring; whether the ideas are defective; and whether the defect is of memory ideas, of imaginative ideas or of general ideas. Another advance that might be made is to separate the physical, mental and social aspect in recording histories. We are trying to find out more about the mental and social characteristics of the forbears as well as of the patient so that when the summaries are made out there may be included the mental history with the mental examination and the physical history with the physical examination. We may have a summary of the social condition but not a social examination. Perhaps in the future there may be some way of making a social examination. In approaching the social side I have found McDougall's "Social Psychology" most serviceable. Münsterberg's arrangement in his "Psychology, General and Applied," has made it possible to group the mental symptoms according to psychologic categories.

Lastly, I would criticize the grouping together of hallucinations and illusions. They are different and probably fundamentally so.

REPORT OF A CASE OF ADDISON'S DISEASE WITH PSYCHOSIS. K. J. Tillotson (by invitation).

A single woman, 50 years of age, a housekeeper, developed Addison's disease beginning in September, 1920. The case was typical. One year following the onset of this disease a depression set in which had considerable involutional coloring. This progressed to an acute hallucinatory episode which was followed by months of a confused, inaccessible period ending with sudden and practically complete disappearance of all psychotic symptoms, but with slight associated physical improvement. The case is reported because the literature contains no description of the association of Addison's disease with psychosis.

REACTION TIME AS AN INDICATOR OF EMOTIONAL DISTURBANCES IN MANIC-DEPRESSIVE INSANITY. Dr. Helge Lundholm.

Simple reaction times to sound stimuli were taken for twelve patients suffering from manic-depressive insanity, the readings being made twice a week for periods of four to seven months. Ten reaction times were taken every day of experimentation, and averages and standard deviations calculated. Clinical observations of the patient were carefully recorded independent of the laboratory study. The experiments show that an increase of the averages and standard deviations of a single day and also an increase of the averages and standard deviations for a period occurred as soon as a patient went into manic excitement. In four out of six instances the changes in the reaction times appeared before any noticeable change in the conduct on the ward, and consequently, the onset of the excitement could be predicted by the laboratory records. In a few cases of hebephrenic dementia praecox the characteristic finding was an absence of congruity between the clinical and the laboratory records. The latter indicated disturbance of one or the other kind, while the conduct on the ward was reported to be fairly normal. It is suggestive that

such a discongruity was found only in the introverted praecox personality type. The depressed patients were found to give a typical performance, the main characteristic of which was a considerable steadiness. In certain instances, however, there was an increase of averages and standard deviations, and this was always due to the fact that one or sometimes two reaction times of ten were much longer than the rest. These patients consequently gave either a high and narrow frequency curve approaching the normal, or gave the majority of the readings such a high curve while one or two times were at considerable distance from the rest on the abscissa. In opposition to this the frequency curve of a manic was always broad and low. Readings from patients in agitated states always gave frequency curves of the manic types, independent of the mood.

FURTHER OBSERVATIONS ON A RATING SCHEME FOR CONDUCT. Dr. James S. Plant.

One year ago this scheme was reported before the Society in embryonic form. With a year's experience at this hospital and certain briefer trials at other hospitals certain questions arising at the beginning can at this time be answered. Pearson's coefficients were calculated for all of the categories. Certain difficulties are still existent which we hope to overcome. The standard deviation of the mental categories is of great interest and probably some importance. I believe the scheme has great practical value.

Regular Meeting, May 18, 1922

F. H. Packard, M.D., *President, in the Chair*

THE RELATION OF FEEBLEMINDEDNESS TO A CRIMINAL CAREER. A. W. Stearns.

Four men were standing on a street corner, and at the suggestion of one of them they stole an automobile and started driving about. They were stopped by a policeman, and one of the men shot him. They were all convicted of assault with intent to kill and given from seven to nine years in the state prison.

The first man, Y., aged 20, had remained in school until he was 12, reaching the second grade. He had more or less trouble of a minor nature with the police and the truant officer. He was accused of burglary and sent to the Lyman School. A short time after leaving there, he was arrested four times for burglary, larceny, disorderly conduct and attempted larceny, was sent back to the Lyman School, ran away after nine months, and was committed to the school for the feebleminded at Waverly, where his mental age was said to be 8 years, and he was called definitely feebleminded. In 1918, he was again at large. He was arrested for burglary and served eight months at the Concord Reformatory. Shortly after leaving there, he became a member of this group. While at Concord, he became acquainted with D. and M., two members of the party. The fourth member he had known as a boy, and they had been associates for a number of years.

The second member, C., aged 19, reached the seventh grade in school, and had worked for two years as clerk in a store. In 1914, he was arrested for disturbing the peace; in 1915, for larceny, and in 1917 for larceny, when he was sent to Shirley for a short while. Later, he was arrested and sent back for eleven months. In 1919, he was arrested for stealing an automobile on two occasions, and was sent for a year to Concord Reformatory. At Concord, his mental age was found to be 9.4 years and he was classified as not feebleminded. While at Concord, he became acquainted with D. and Y. When at Shirley he became a friend of M.

M. went a year and a half to high school. He did well and was not troublesome until he was 16. At that time, he was arrested for stealing an automobile, and was sentenced, but the sentence was suspended. In 1918, he was again arrested for stealing an automobile, and was sentenced to Shirley, but the case was appealed. In 1919, he was arrested on three counts for stealing automobiles, and again the case was filed. He was again arrested on the same charge and was sent to Shirley, where he became acquainted with C. In 1919, he went to Concord Reformatory, where he spent nearly nine months. His intellectual level was 16, his intelligence quotient 1. He was classified as a responsible offender.

D. went two years to high school and did well, but had had trouble previously. In 1912 he was arrested for larceny, in 1915 for assault and battery, in 1916 for breaking and entering, in 1918 for drunkenness and in 1918 for larceny. He was sent to Shirley, where he spent ten weeks and became acquainted with C. In 1919, he was again arrested for stealing goods and was sent to Massachusetts Reformatory, where he became acquainted with M. and Y.

Of these four persons, one was definitely feebleminded, and one on the ragged edge and according to the scale feebleminded, but Dr. Fernald's opinion was that he was a borderline case. Two were not feebleminded but according to the tests a trifle superior. The two superior ones had good homes. Y had a broken home and he had grown up on the street. C. had an unsatisfactory home and a drinking father.

When studies were made of prison populations a few years ago and a considerable percentage were found to be feebleminded, we all felt that a great advance had been made in the study of criminology; but I find myself less and less satisfied with feeblemindedness as a sole cause of criminality. These four persons had almost identical careers. Is it fair to say that because one is feebleminded his career is explained, or should we search farther? This particular gang had been organized on the basis of common experience. Making a combination of hedonism and the gregarious instinct and judging individuals by elements of conduct, on the basis of a very strong tendency to conform to the customs, habits and conduct of associates, is there not a stronger argument in favor of factors other than the feeblemindedness determining the criminality in these cases? A short while ago, it was found that of a certain prison population 28 per cent. were left handed, and that fact could be used as an argument that left handedness was a cause of a criminal career. The group in question is a typical one. It is common to have from three to half a dozen young men arrested for the same offense, showing all degrees of intellectual attainment. In the state prison, about 20 per cent. are men born in Italy who are convicted of second degree murder. One case in particular is that of a man who was sitting about a card table with other men. They had had a drink or two, a quarrel began and he was expected to fight. He pleaded with

his associates that he had a family and he did not want to fight, but by public opinion he was forced to; he killed his adversary and was given a life sentence. He had conformed to the standards of his social station. Is it not fair to assume that the imbecile's career is at least as much dependent on his associates and on his experience as on his intellectual inferiority? The pressure to a criminal career is felt out of proportion by the feebleminded, yet feeblemindedness in itself is not an adequate and complete explanation of a criminal career. The elements in a criminal career must be looked for quite beyond feeblemindedness, and they may be found in sociologic study oftentimes as much as in psychiatric study.

DISCUSSION

Dr. F. L. Wells: The finding in delinquent cases is not necessarily one of defective intelligence. As in the psychotic cases, we may find a lowering of the intelligence level, but at the same time many cases are at and above the normal average. Some interesting studies have been made by Murchison of the college graduate as an inmate of penitentiaries. His work was done in Ohio, and he found that the proportion of college graduates in prison was somewhat larger than college graduates in the general population of the state.

Dr. Edward B. Lane: One difficulty in discussing this subject is that feeblemindedness is often described as an entity. It is not an entity. It is recognized in certain persons as a defect, and these defects are various. The majority of feebleminded persons are not criminal in their tendencies. A few years ago, the social workers ran off at a tangent and sought to prove that every immoral woman was feebleminded. A certain school teacher who had chosen to lead an easy life was kept under watch for a year as a feebleminded person, but after careful examination I could find no reason for considering her such. There is no reason to presume that because a person is feebleminded she is immoral or vice versa. But the practical point is that society has to be protected. This is the business of courts and of physicians. We used to hear of moral imbecility. The term is not used often now, but it describes the condition of people who all their lives, until 60 years of age or more, can never control their selfish desires and will never allow consideration of the rights of others to restrain them. A speaker has mentioned the knowledge of right and wrong test; these defectives are very keen to detect any attack on their own rights and make loud protests of the wrong done them.

Dr. J. A. Houston: The majority of repeated offenders that we are examining now in the courts, although perhaps not intellectually feebleminded, do show a marked defect. They can be picked out as being a little peculiar and different. They are defective in many ways; deficient in judgment, defective in their sociologic and moral sense. They have no regard for the rights of others; they are selfish and not amenable to fear of punishment nor susceptible to the rewards of well-doing. There is a defect, though it may not be a defect of intellect.

The state should take control of the care of its defectives. Care of the criminal class should be taken out of county control. Dr. Stearns has spoken of the four men becoming acquainted in three different institutions. In the county jails, there is too much opportunity for criminals to associate with each other. The last group which I examined had become acquainted at the state prison. There they had met a third person who was there for breaking and entering, who told them the circumstances of his burglary. Prior to their

release, they had formed a plan, and when free they carried it out, breaking into two stores. They were arrested and while awaiting trial they were associated with eight or ten others in jail, where they had nothing to do to occupy their time except to read, play games, tell stories and recount their experiences. These men had arranged their stories to be told at their coming trial so that they would all agree. It seems that the state might handle such cases more rationally than is being done by the counties.

Dr. Karl Bowman: Our experience at the Boston Psychopathic Hospital shows definitely that a large percentage of criminals are not feebleminded. Feeblemindedness is not the real basis of criminality. Our examination has not helped us to understand why these individuals are criminal. We can simply say that they have taken up a certain way of behaving. Dr. Tredgold, in the last number of the *Journal of Neurology and Psychopathology*, endeavors to explain this condition as an arrest of development. He has some very helpful ideas. One reason why the feebleminded person tends to become criminal is emphasized by Dr. Goddard in his latest book. An individual of less than 12 years is unable to grasp abstract ideas, and therefore, the inculcating of abstract ideas of justice, honesty, etc., cannot be successfully accomplished by ordinary methods.

Dr. A. W. Stearns, closing: Judging from these four cases, it seems highly improper to use a criminal career as an important factor in differential diagnosis, as is so frequently done. The social conduct is given too important a place in the diagnosis of feeblemindedness.

THE CEREBROSPINAL FLUID IN JAUNDICE. Hugo Mella.

What happens to the cerebrospinal fluid in those patients who have been treated with arsphenamin who develop jaundice? In 1912, Mestrazat studied the spinal fluid in four cases of icterus and only one patient gave a response to the bile test, and that was questionable. The other patients all gave negative tests, but still the fluid was yellow.

Of five patients whom we have had at the Long Island Hospital, Boston, one had been treated with arsphenamin for seven weeks. He had a negative blood reaction and a negative spinal fluid. After his last treatment, he developed marked jaundice. On testing his spinal fluid, we found the Wassermann reaction negative, the precipitation about normal, the alcohol test positive, ammonium sulphate test negative, colloidal gold not affected and the usual tests for bile on the urine positive. The spinal fluid was canary yellow. Tests applied for bile pigment and bile salts were negative. The second patient had a positive blood reaction. One week after his last treatment with arsphenamin, he developed a severe jaundice. In addition, there was a question of cord compression as he had a fracture of the first and second cervical vertebrae. There was evidence of mechanical block, but on lumbar puncture there was no clinical evidence of cord compression or subarachnoid block. If there is cord compression, there should, theoretically, be massive coagulation, and he had no massive coagulation. The spinal fluid Wassermann reaction was negative, but the gold test ran 3 3 3 3 2 1 1. Whether this curve was due to an old infection or whether the foreign body in the fluid from the jaundice produced this result, I cannot say. His bile tests, however, were negative. Of five other patients, practically the same facts held true. The fifth patient had received no treatment. This patient had a carcinoma of the pancreas and developed

marked jaundice. The spinal fluid was greenish yellow, but not the typical canary yellow that is seen in jaundice following arsphenamin therapy. That fluid also failed to respond to any of the bile tests. The question is, why are these fluids colored? Apparently, the color is not due to bile pigments, bile acids or bile salts. It might be possible that the meninges are colored and that the fluid took its color from them. Xanthochromia will certainly still bear investigation.

Cerebrospinal Fluid in Jaundice*

Case	Blood Wassermann Reaction	Weeks After Arsphenamin	Fluid Pressure	Color	Cells	Alcohol	Ammonium Sulphate	Colloidal Gold	Diagnosis	Spinal Fluid Wassermann Reaction	Degree of Jaundice
1	—	7	120	Canary yellow	0	+	0	— — ± 1 ± — — — — —	Arthritis	—	Marked
2	+	1	140	Canary yellow	10	++	0	3 3 3 3 2 1 1 — — —	Cord Compression and syphilis ?	—	Marked
3	+	4	150	Golden tint	8	+	+	5 5 5 4 4 3 2 1 — —	Tabes	+	Marked
4	+	1	130	Golden tint	0	0	±	3 3 3 2 2 1 1 — — —	?Tabes ?	—	Slight
5	—	No treatment	30	Greenish yellow	4	+	0	— — — — — — — — — —	Carcinoma of pancreas	—	Moderate
6	—	6	140	Golden	0	0	0	— — — — — — — — — —	Syphilis	—	Moderate

* In all the cases the surface tension was normal; nitrous acid, negative; iodin, negative; bile tests on urine, positive.

DISCUSSION

Dr. H. C. Solomon: The frequency with which Dr. Mella found coloration in the spinal fluid is much greater than the average. We have performed puncture in a number of patients with arsphenamin jaundice and rarely have found coloration of the fluid. Recently, I performed a necropsy in a case of acute yellow atrophy. All the peritoneal fluid and practically all the organs were colored, but in the central nervous system there was not the slightest trace of color. On the other hand, I have performed necropsy in cases of acute jaundice in which the coloration was very marked in the central nervous system. Gennerich states that there is a coloration which comes only when concentration of the bile pigments in the blood reaches a certain point, then the central nervous system will be colored and the color will remain there longer than anywhere else in the body. Schmorl states that, in three cases in which he found yellow fluid in the ventricles, there had been some injury of the choroid plexus and the fluid came through in large amounts into the ventricles.

Dr. Hugo Mella, closing: Regarding the color of the fluids, I have always asked some disinterested person to observe the color so as to check up on its presence. With the quick response to bile tests on the urine and the negative responses in the spinal fluid, we have not proved the presence of bile in the fluid in these jaundice cases, nor have we been able to determine the cause of xanthochromia.

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, April 28, 1922

C. H. Frazier, M.D., *President*

ROENTGEN-RAY LOCALIZATION OF A GLIOMATOUS CYST BY THE INJECTION OF AIR. Dr. F. C. Grant.

The patient presented symptoms and physical signs which suggested the diagnosis of brain tumor in the right motor area. At operation, reflection of the bone flap revealed an extremely tense dura. The pressure was reduced sufficiently, by callosal puncture and by intravenous injection of a 15 per cent. salt solution, to permit opening the dura in sections. As one section was opened an area of the cortex which felt cystic was encountered. A needle puncture evacuated 25 c.c. of fluid, and air was injected into the cyst cavity. Roentgen-ray studies localized the cyst accurately and showed a filling defect in its wall which later proved to be a gliomatous mass. A second operation was performed a week after the first. The osteoplastic flap was again laid back, the dura freely opened and the cortex incised, revealing the cyst. A nubbin of fairly well encapsulated gliomatous tissue about 3 cm. in diameter was removed. The cyst wall was too delicate to permit clean removal. An uneventful postoperative recovery ensued with beginning return of function on the left side. After a thorough course of radium treatment the patient was discharged.

CLINICAL RESULTS WITH MORE EXACT TECHNIC FOR ALCOHOLIC INJECTION OF THE SECOND AND THIRD DIVISIONS OF THE TRIGEMINAL NERVE. Dr. F. C. Grant.

The more exact technic for alcoholic injection of the second and third divisions of the trigeminal nerve by using the zygometer and measuring the horizontal and vertical angles between the needle shaft and the skin of the cheek with a protractor was outlined. Three types of cases were treated—major trigeminal neuralgia, malignant growths situated in the distribution of the fifth nerve and a case of masseter spasm. The conclusions were:

1. Alcohol injections of the three divisions of the trigeminal nerve are of value in treatment of tic douloureux, and as an adjunct to the treatment of painful growths about the face, tongue and jaws and in masseter spasm.

2. By the use of the zygometer and protractor an attempt has been made to render more accurate the description of the technic for injecting the maxillary and mandibular divisions of these nerves.

3. Clinical experience has coincided with anatomic studies. Injections of the maxillary division should be made from the 3 cm. mark, the needle should subtend an angle of 100 degrees from above downward in the horizontal plane, and 115 degrees from before backward in the vertical plane. The nerve is reached from 5 to 5.5 cm. from the surface.

4. Injections of the mandibular division should be made from the 2 cm. mark, the needle should subtend an angle of 90 degrees in the horizontal plane and 110 degrees from above downward in the vertical plane. The nerve is reached from 4.5 to 5 cm. from the surface.

5. By applying these facts to a surface of injections clinically, the percentage of failures to reach the nerve trunks has been materially reduced.

A CASE OF ENCEPHALITIS EXHIBITING HYPERTHYROID SYMPTOMS AND LATER THE PARALYSIS AGITANS SYNDROME.

Dr. F. H. Leavitt.

This case is of interest in that the patient gave a history of a febrile condition, which was undoubtedly an attack of epidemic encephalitis. Some months later he exhibited a clinical picture of acute hyperthyroidism and was treated for this condition in the hospital and dispensary. A few months following this, these symptoms were gradually replaced by the picture of a paralysis agitans syndrome, which he still shows. The disease has steadily but slowly progressed, and the only medication which has afforded any relief is digitalis in large doses.

DISCUSSION

Dr. Charles S. Potts: So far as my experience goes, a rapid pulse in encephalitis, which this patient had, is not uncommon. I have seen several patients in whom the temperature was practically normal, but the pulse rate varied from 110 to 130. All the other symptoms of epidemic encephalitis were present in this case.

Dr. C. W. Burr: The patient is probably suffering from a sequela of encephalitis, and the striking thing in his case is that on his first admission to the hospital the condition much resembled hyperthyroidism. When he came back the second time the condition resembled paralysis agitans.

Dr. Leavitt, in closing: We consider the case one of encephalitis, but the history given antedated the time when he showed hyperthyroidism, so that the encephalitis which may have occurred did not occur between the time he had hyperthyroidism and paralysis agitans. That was the confusing part.

LESIONS OF THE OPTIC CHIASM AND TRACTS WITH RELATION TO THE MIDDLE CEREBRAL ARTERY WITH REPORT OF CASE.

Dr. Temple Fay.

This paper will be published in full in the Archives of Neurology and Psychiatry.

MANGANESE POISONING: REPORT OF A CASE WITH SYMPTOMS SUGGESTIVE OF BILATERAL LENTICULAR INVOLVEMENT.

Dr. George Wilson.

Manganese poisoning was first described in 1834; the first detailed account, however, was not published until von Jaksch wrote his first article, in 1901; Edsall and Drinker and Casamajor of this country have also written on the subject. No pathologic changes have been found in the nervous system in the few cases which have come to necropsy, although no mention is made of a careful investigation of the basal ganglions. A considerable degree of biliary cirrhosis of the liver has been found, and the liver cells contain a great deal of pigment.

After from six months to three years of work in separating manganese from zinc, men may show symptoms of poisoning, the first being a disturbance in walking down hill. Men who work with manganese frequently notice this symptom, and they call the condition being "zinced." For instance, a man who wheels a barrow down an incline, often in the early stage of manganese poisoning, falls forward, a condition that might be called propulsion. Retropulsion and lateropulsion may also occur. Von Jaksch described a gait in which the

men walked on their metatarsophalangeal joints. Another peculiarity in the gait is that walking backward is impossible. Speech is slow, monotonous and sometimes slurring; Edsall calls it an "economical speech." The facies are marked and attacks of involuntary emotionalism may occur.

Animal experimentation has produced no results. The method of production of manganese poisoning seems to be through the inhalation of dust; men who work in the so-called water process in separating manganese do not develop symptoms, whereas those who work in the dust do.

The case which I report is that of a man, aged 31 years, whom I examined at the U. S. Veterans' Bureau on April 13, 1922. In October, 1917, he was struck by 13,000 volts of electricity and was unconscious for two hours. He denies venereal disease. He has been married four years and has one child living and well. He worked in manganese for four years prior to 1918.

A few weeks before his induction into the army on April 2, 1918, he began to have trouble in walking. This difficulty has gradually progressed, although it differs in severity from time to time. He says that his arms draw up; by this he means that they go into a condition of spasm. Without feeling at all depressed he sometimes has crying spells. While he had symptoms before he was inducted into the service, they were intensified by three weeks of drilling. He fell on the drill ground and was unconscious for one hour, and since that time his symptoms have progressed rapidly. He has difficulty in bringing the hands to the face, especially on the right side. An extraordinary symptom about which this man complains occurs during sexual intercourse. When copulation is attempted connection is made with facility, but at that point a halt occurs, and the man, because of a condition which may be perseveration of certain groups of muscles, can neither push forward nor retreat until some minutes have elapsed and the spasm disappears.

Physical Examination.—The face was flushed and masked, and the face and body in general were bathed in perspiration. The station, pupils, cranial nerves, deep and superficial reflexes and sensation were all normal, as were also the various laboratory examinations. Speech was low toned and monotonous. The gait was the most striking thing in this man's case. He walked with the legs markedly extended and rather widely separated, dragging the toes along the floor, and because of a tendency to propulsion it seemed as though each step would end in a fall. At times, though rarely, he showed lateropulsion. When the man attempted to walk backward, he fell. He had difficulty in sitting down and in turning over in bed. The legs sometimes became extremely rigid with intense contraction of the thigh muscles. The right upper extremity frequently assumed a forced attitude, the arm being abducted and the elbow and fingers flexed. In the finger to nose test there was difficulty in reaching the goal, especially on the right, because during action the muscles became rigid, which prevented coordinated movement.

This man presented signs that to me are indicative of organic disease, most likely of the basal ganglions—the facies, the speech, the rigidity and vasomotor disturbances all bespeak anatomic change, although some probably would conclude that because the man was seeking compensation the case must be one of hysteria.

DISCUSSION

Dr. Charles K. Mills: Possibly this patient may have had some hysterical symptoms or tendency as some patients with organic cases have, but I do not believe the case is one of hysteria. He had four or five symptoms which seem

to point to organic and probably lenticular disease; these are the forced attitude of arm and leg which are much like those of a case of degeneration of both striate bodies reported by me, distortion on movement, monotonous speech and some points in his history. I am fully in accord with those who criticize the too frequent diagnosis of hysteria. During many years of neurologic practice, I have observed that one mistake most frequently made by men whom we all regard as competent, is that of diagnosing hysteria when organic disease is present. Among the diseases regarding which this mistake is most frequently made are disseminated sclerosis, myasthenia gravis, brain tumor, spinal tumor, lenticular degeneration, localized encephalitis, combined sclerosis, and many other affections.

Dr. Charles W. Burr: This man gave Dr. Wilson a history unlike the one he gave to me. To me he said that he had been perfectly well until he received the electric shock. The gait was not exactly as it is at the present time, and my recollection is that it was as bad in one leg as it was in the other. He was a patient of mine at the Orthopedic Hospital and he became much better, so that he walked about the wards, perfectly well; then one day he received a letter from his wife; there was a row and he refused to stay in the hospital and went out. He walked without any help, walked with a perfectly natural gait, although somewhat slowly and weakly, and his speech became absolutely normal. That was, I think, about two years ago. He then gave me the history of electric shock and dated all his troubles from that. In my opinion this is a case of hysteria.

Dr. J. Hendrie Lloyd: Has anybody ever seen a case of manganese poisoning like this before? To me, it is like nothing but hysteria. The man, I have a strong suspicion, has a psychoneurosis. I do not see how Dr. Wilson can make out lenticular degeneration in this case. These bizarre disorders are usually psychotic. This man never hurts himself; he is emotional; he had a brief service in the army, which did not agree with him; he had to leave the army in three weeks; and he has been a claimant ever since. That settles the diagnosis for me.

Dr. T. H. Weisenburg: According to the history, this patient had symptoms four months prior to his induction into the service. This is against the theory that the patient was hysterical to avoid service. The gait of the patient, while bizarre, nevertheless is not unlike that of a patient who had been in the wards for nervous diseases of the Philadelphia Hospital for many years. This patient's case had been variously diagnosed—at one time as hysteria, then chorea and now as a striate case. In the course of years many cases have been presented before this society in which diagnoses of hysteria have been made and which have turned out to be organic cases of various types. I agree entirely with Dr. Wilson that this case is organic, and that probably a striate lesion is present.

Dr. Williams B. Cadwalader: Manganese is regarded as a general systemic poison. So far as I know, a postmortem study has never been made on such a case that showed lesions affecting the basal ganglions of the brain. It is hard to believe that the lenticular nuclei can be affected. In certain smelting processes, however, it is known that workmen may be poisoned by carbon monoxid. Furthermore, carbon monoxid may have a selective action on the blood vessels of the basal ganglions, and in this way bilateral softening of the lenticular nuclei may be produced. Drs. McConnell and Spiller have reported a case of illuminating gas poisoning before this Society in which they found

lesions of both lenticular nuclei at postmortem. During the lifetime of their patient there had been evidences indicating such lesions. I offer this as a suggestion to explain the symptoms in Dr. Wilson's patient. The first case of true progressive lenticular degeneration exhibited before this society was presented by me in 1912 and is recorded in the proceedings. At that time the opinion was expressed by some that it resembled hysteria. The differential diagnosis may be confusing. Notwithstanding the evidence presented by Dr. Wilson, I do not feel that his patient presents characteristics of true organic cerebral disease; the case impresses me as being one of pure hysteria.

Dr. F. X. Dercum: Has this man been observed when he himself has not known he was under observation? I think it is most important to know how this man conducts himself when he is alone; and how he conducts himself when food is placed on the table, whether he has the same difficulty in bringing food to his mouth as in bringing his hand to nose. We are sometimes forced to follow such a plan when we suspect malingering, and I think this is eminently the kind of case in which such a procedure should be followed.

Dr. N. W. Winkelman: There is a tendency to assume that because a man has been in the service and is seeking compensation, he is either a malingerer or a neurotic. This is a mistake. I have in mind a case studied in on of the hospitals here and diagnosed hysteria. At operation a tumor of the cord was found. The patient died, but his death was due in large part to the delay in operation. I agree with Dr. Wilson's diagnosis.

Dr. Wilson, in closing: I agree with those who say the gait of this man is bizarre; but is not the gait of certain patients with organic disease often bizarre? Take the gait in far advanced tabes or dystonia musculorn deformans or the festinating gait of paralysis agitans—are they not bizarre? The fact that the patient improved, as stated by Dr. Burr, is not proof so much that the patient necessarily was suffering from hysteria as it is that Dr. Burr knows how to employ psychotherapy. Real psychotherapy should not only cure the patient with the functional case, but it should make the patient with the organic case think that he is well, and this is what Dr. Burr did for his patient. I fully agree with Dr. Lloyd that this man's army experience did not agree with him—what man with a case of lenticular disease ever did enjoy military service? I cannot do more than reiterate the caution which Dr. Winkelman has expressed, namely, that if we assume that a man, because he is a claimant for compensation, is a malingerer or has hysteria, we will make grave diagnostic errors. So far as I know, carbon monoxid does not enter into the symptomatology of manganese poisoning. Dr. Cadwalader's remarks that the first case of progressive lenticular degeneration presented to this society was thought by some to be hysteria, are apropos. History is repeating itself, for while this patient does not have Wilson's disease, I believe that he has lenticular degeneration.

TRISMUS DEVELOPING IN THE COURSE OF A TUMOR OF THE PONS. Dr. George Wilson.

The following case is presented because of the development of trismus which came on in a man suffering from a tumor of the pons. This has been reported before, but is, I believe, sufficiently rare to warrant presentation.

A white man, 44 years of age, was admitted to the Episcopal Hospital on Jan. 20, 1922. His family and past histories were negative. His chief complaint

was double vision and dizziness. Last September he first noticed diplopia when looking at an object to one side. Two weeks later he began to have nausea and vomiting, although the vomiting was not projectile. He had had no headaches since the onset, but he said that his head felt numb all the time. For the last two weeks he has been unable to open his mouth completely, and he becomes dizzy after he sits up.

Physical Examination.—In the Romberg position there was marked swaying with the eyes closed, and the man immediately became dizzy, nauseated and vomited. The left seventh nerve showed weakness, especially in the lower branch. The left masseter was distinctly weak and on opening the mouth the jaw deviated to the left. The jaw could be opened only a short distance, and this condition of trismus gradually became worse during the man's stay in the hospital. The lower jaw could not be pushed down with moderate force. The tongue was protruded in the midline and was not atrophic. Neither eyeball could be moved outward or inward; the left eyeball moved slightly inward on attempts at convergence; upward and downward movements were well performed. Bilateral corneal anesthesia was present. The left palpebral fissure was narrower than the right. The eyegrounds were normal.

Asynergy and astereognosis were easily demonstrated in the right hand. Pain sense was diminished on the right side of the face, in the right arm and hand. All the deep reflexes were present and active, the right patellar reflex being more active than the left. Plantar stimulation produced flexion on both sides.

Smell and taste were normal. The ears were examined by Dr. Watson, who reported 1/18 hearing in the left ear and 2/18 in the right ear. The various laboratory reports were negative.

Book Reviews

THE DEFECTIVE, DELINQUENT AND INSANE. The Relation of Focal Infections to Their Causation, Treatment and Prevention. By HENRY A. COTTON, M.D., Medical Director, New Jersey State Hospital at Trenton. Pp. 192. Princeton: Princeton University Press, 1921.

It is fortunate that Dr. Cotton has condensed all of his views into one book. For a number of years, his theories have been given wide publicity, not only in the medical but also in the lay press. His views, with pictures of the author, the hospital, operating room, etc., have been syndicated throughout the country in the magazine sections of Sunday newspapers and in a number of magazines, including the *Literary Digest*. It is not in the domain of the reviewer to question the means by which such publicity has been gained, but it is only fair to call attention to it.

In brief, Dr. Cotton divides insanity into two kinds: (1) That form which is the result of definite organic changes, such as are brought about in paresis by the spirochete; (2) the functional psychoses—which term he rejects—which, according to him, are due to disorder of the brain arising from "a combination of many factors, some of which may be absent, but the most constant one is an intracerebral, biochemical, cellular disturbance arising from circulating toxins, originating in chronic focal infections situated anywhere throughout the body and probably to some extent in disturbances of the endocrine system." In this group he includes the manic-depressive psychoses, dementia praecox and paranoic conditions or chronic delusional states. He rejects what he calls the "old idea" that these mental disorders are in any way the result of constitutional defects. He takes issue with the freudians who believe that psychoses may have a sexual basis.

His method of handling this so-called toxic group consists, first, in making a diagnostic survey, which differs in no way from that used by any physician or well regulated hospital. It is in the interpretation of the results that Dr. Cotton differs from many physicians. According to him, most infection lies, first, in the teeth; second, in the tonsils; then in the gastro-intestinal tract, genital organs, sinuses, etc. After removal of teeth, tonsils or any organ cultures are made and autogenous vaccines are given.

To quote from Dr. Cotton's book, page 107: "Every patient should receive a course of treatment by autogenous vaccines after the infected teeth and tonsils are removed but not before because of the probability of a severe reaction. Within a week or two after the vaccine treatment has been completed, a course of treatment by anti-streptococcus and colon bacillus sera should be given. By these two methods the systemic infection should be eradicated. If the patient fails to recover and further examination reveals severe intestinal infection, then operation for removal of the infected area of the colon should be the next step. If the cervix, or the seminal vesicles are found to be infected they should also be removed by surgical means. No ill effects have been noted from the administration of either vaccines or serums."

Every tooth which is under the slightest suspicion is promptly removed. In fact Dr. Cotton prefers to err on the side of removal, rather than to save the tooth. The tonsils are treated with less consideration for practically all

of them are removed. The author has no hesitancy in advising resection of the colon, for he mentions that 150 of these operations have been performed for him by Dr. John W. Draper. In the female, operations on the genital organs, and in the male, on the seminal vesicles, are not at all uncommon.

Dr. Cotton reports a number of illustrative cases and compares the results obtained in the hospital in the last three years, during which time the present method of treatment has been in vogue, with that of former years, and he states that the residence of the patients has been less and that there are fewer chronic cases. For example, in 1918, there were admitted to the New Jersey State Hospital 380 patients, classified in the so-called functional toxic group. At the end of the year there remained 160, and at the end of the second year, sixty patients were in the hospital. Of these, twenty returned, and twelve of that number were found to have minor infections which had been overlooked. The remaining eight were found to have serious intestinal involvement and later were operated on. Of these, only four are in the hospital at the present time. Two and a half years later only fifty-one of the original 380 were in the hospital, and of these nine were convicts.

The author then emphasizes that readmissions to the hospital are not larger than the average for a ten year period before 1918. He states that the length of time in which patients recovered spontaneously prior to this method of treatment was ten months, whereas in the last three years it has been only three months. He is careful to state that good results are not obtainable in the old cases of dementia praecox and can be expected only in the cases in which treatment is instituted early. In the next to the last chapter of his book, he discusses the defective types; he says that there are a great many in whom similar toxic disturbances are causative factors, and if these were removed, the patients would recover.

The foregoing statements are made so as to give the reader an adequate idea of the writer's point of view. It is, of course, difficult to find fault with a method of treatment in which infections are removed. The majority of surgeons, however, will disagree with Dr. Cotton in his advocacy of resection of the colon and of the seminal vesicles. Perhaps many internists will differ with his routine method of vaccine treatment. A preponderant number of competent dentists do not agree with his point of view. But what is there in Dr. Cotton's theory of the removal of real focal infections which varies from that held by most physicians?

Until a few years ago it is true, as Dr. Cotton has stated, that most institutions for the insane were content to do nothing for their patients; they were simply large boarding houses. Unfortunately, this is still the case, not only in this country but throughout the entire world, and Dr. Cotton deserves a great deal of praise for his "do something" policy, especially in consideration of its having stirred to action the authorities at a great many institutions who are beginning to scrutinize their patients. On the other hand, must he indiscriminately remove teeth, tonsils and internal organs because he has a theory to uphold?

The reviewer, as well as other neurologists of Philadelphia, are qualified to discuss Dr. Cotton's work, because they have seen some of his results. Quite a large number of Dr. Cotton's "cured" patients have fallen into their hands. It is possible that Dr. Cotton, in defending his point of view, would say that all focal infection had not been removed. The chiropractor offers a somewhat similar apology for his failures in that the patient is told that he has not had sufficient adjustment.

Dr. Cotton's statistics of admissions and discharges and the so-called cures in the New Jersey State Hospital at Trenton are in no way better than those of any up-to-date institutions, in spite of the fact that the latter practice conservative methods and continue in the belief that dementia praecox has hereditary and constitutional factors in its causation.

In medicine, as well as in everything in life, it is never wise to be too dogmatic, for there is always a possibility that one's point of view may be wrong. Dr. Cotton, however, has burned his bridges behind him, for on page 122 he expresses sorrow for "these afflicted individuals" who differ from him.

In the meantime the removal of teeth, tonsils, intestines and seminal vesicles will be continued.

ANISOCORIA ON LOOKING LATERALLY (THE REACTION OF TOURNAY). By Dr. André Noyer. Pp. 90. Lescuyer Frères, 1921.

In a monograph of ninety pages Noyer gives the results of his investigations of a reaction described by Tournay in 1917 and 1918. This reaction consists of the production, on looking laterally, of an inequality of the pupils which is due to dilatation of the pupil of the abducted eye and appears after the eyes have been carried laterally and held there for a few seconds. The inequality was shown by Noyer to be due to dilatation in the abducted eye and not to contraction of the adducted eye. The reaction is independent of the stimulus of light and can be demonstrated in a dark room by means of the light reflected from an ophthalmoscopic mirror.

Noyer examined this reaction in several thousand normal people and found it present in all of them. It is much easier to obtain in those with moderately large pupils than in those with small. Emmetropia, hypermetropia, myopia and astigmatism do not interfere with the reaction. The average increase in the size of the pupil as measured by special apparatus is 0.5 mm.

In an experiment to determine the presence of the reaction in various animals, Noyer established the following:

1. Animals having eyes comparable in location and mobility to those of man have a positive Tournay reaction (cat and dog).

2. Animals having lateral and mobile eyes have a negative Tournay reaction (horse).

3. Animals having eyes in an extremely lateral position, almost immobile and with very dilated pupils (rabbit) show a permanent Tournay reaction in each eye.

Cocain, atropin and pilocarpin prevent the reaction from occurring. Epinephrin prevents it from occurring in those segments of the pupil which are dilated.

Noyer tested the reaction in a large number of cases showing various diseases and reports the results in 386 of them. In disorders of the eye in which the pupil remained mobile, the reaction was obtained in spite of the lack of perception of light due to cataract or to optic atrophy. This indicated that the reaction was not essentially a sensorimotor reflex but an associated movement completely independent of vision. In diseases of the sympathetic supply to the iris the reaction was normal. It is also normal in general conditions, such as syphilis, exophthalmic goiter, rheumatism and pneumonia. In dis-

eases of the nervous system the reaction was absent in only 15 cases: 7 of general paralysis, 1 of tabes, 3 of multiple sclerosis, 1 of poliomyelitis and 2 of Parkinson's disease.

Noyer concludes by stating that the number of cases examined was too small to warrant definite conclusions, but he believes that the reaction may possibly come to have a value analogous to that of the Argyll Robertson pupil.

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EFFECTS OF ANTISYPHILITIC THERAPY AS INDICATED BY THE HISTOLOGIC STUDY OF THE CEREBRAL CORTEX IN CASES OF GENERAL PARESIS

A COMPARATIVE STUDY OF FORTY-TWO CASES *

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METHODS OF INVESTIGATION

The problem in this investigation was to determine whether any changes due to antisyphilitic treatment can be observed by histologic methods. Clinical studies have given rise to considerable divergence of opinion as to the results of antisyphilitic treatment in patients with general paresis. On the one hand there is a group of clinicians who have reported what to them have seemed satisfactory results in the treatment of paretic patients. In contrast there is probably an equally large group of clinicians who feel that the results obtained are insignificant, and there are even some who believe that the patient is made worse by the administration of antisyphilitic drugs. On theoretic grounds, likewise, there are two antipathic points of view. It has been pointed out by Spielmeyer,[1] for example, that most of the pathologic changes which occur in paresis are capable of being influenced from without or by extraneous measures. Thus, theoretically, meningitis and perivascular infiltration can be reduced, the spirochetes killed, and with the cessation of toxin formation, degenerative changes may be halted; following this, clearing up of the cellular debris, and an

* From the Neuropathological Laboratory of the Boston Psychopathic Hospital.

* This study was greatly aided by funds granted by the United States Interdepartmental Social Hygiene Board.

* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

1. Spielmeyer: Paralyse; Tabes; Schlafkrankheit, Ergebn. d. Neurol. u. Psychiat. **1**:217, 1911.

improvement in the pathologic picture may result. A contrary theoretical attitude championed by Noguchi and Moore points out that the spirochetes are probably in the deep tissue of the cortex at some distance from the vascular supply, that antisyphilitic drugs are on the whole prevented by a filtering process from reaching the central nervous system, and that they do not penetrate to spirochetes in the deeper

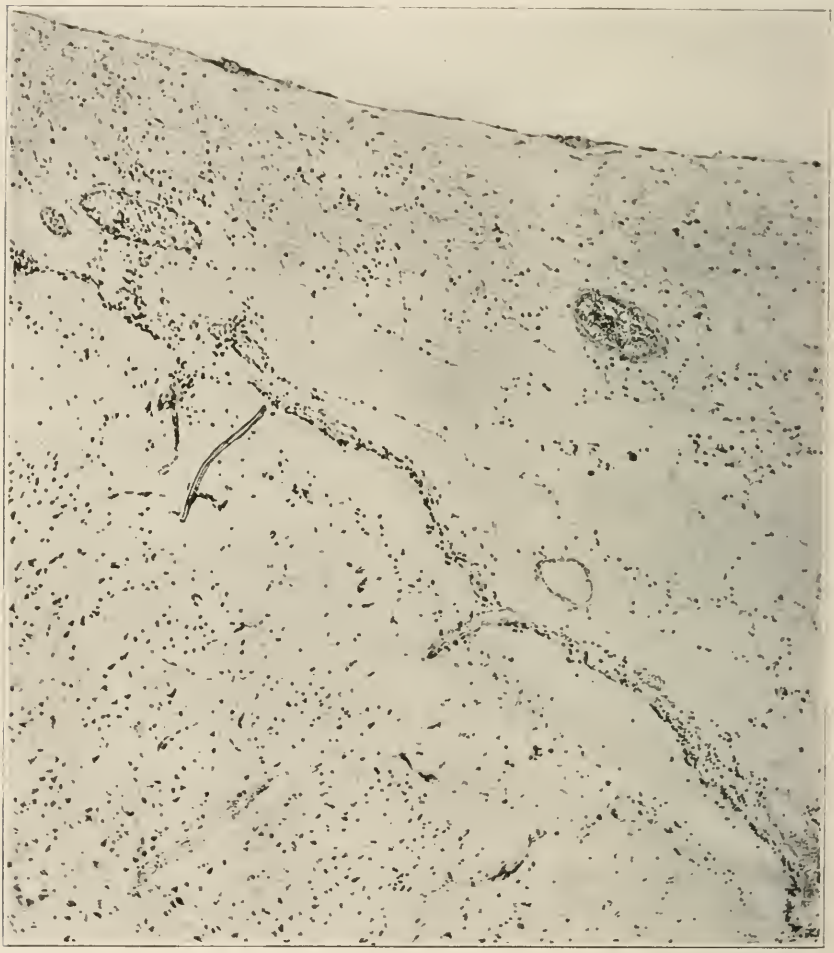

Fig. 1.—Cellular nodules in outer layer of the arachnoid; also pial edema.

situations and therefore do not accomplish any noteworthy therapeutic effect. There is, therefore, no agreement, either as to the facts or the theory, concerning the value or the possibilities of antisyphilitic treatment in cases of general paresis.

In order to determine whether there was any evidence of change in the histologic structure resulting from treatment in cases of general

paresis, a series of brains from paretic patients who had received treatment were studied in comparison with a group of brains from untreated paretic patients. The material selected consisted of brains of patients, diagnosed as having general paresis, who died in one of the Massachusetts state hospitals. It is necessary to mention that the treated

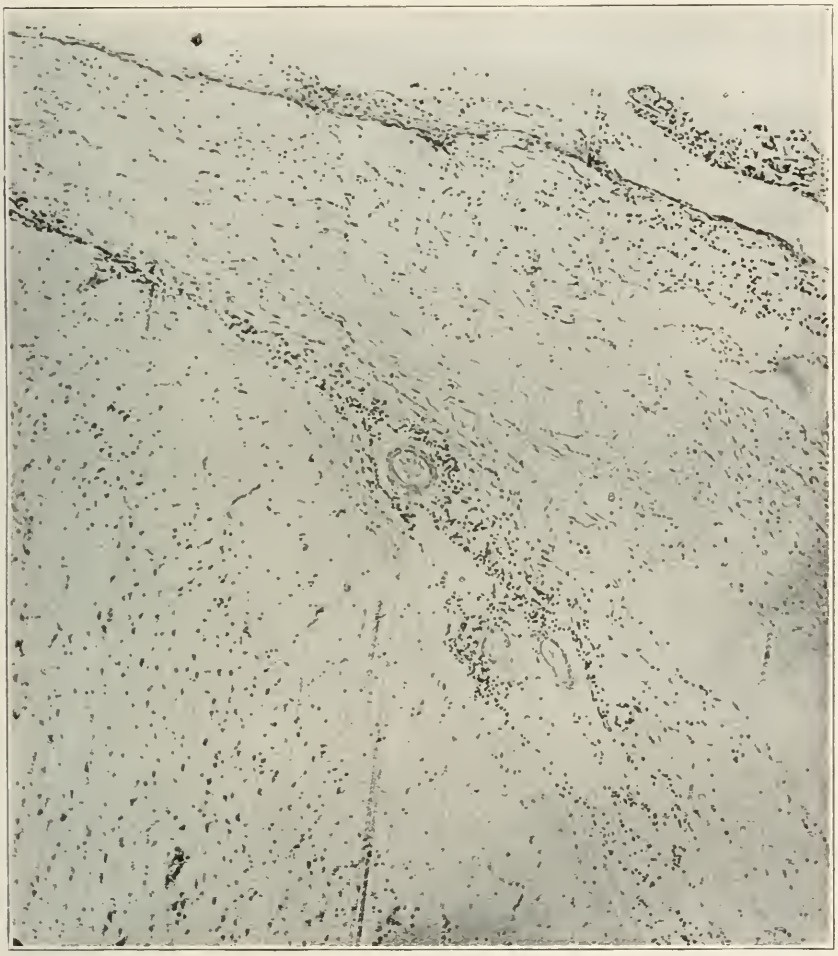

Fig. 2.—Pial edema; also characteristic type of cell infiltration, confined mainly to the pial membrane.

patients in this series did poorly from a clinical point of view, that is, they succumbed to the disease. Consequently, any changes which occur in these cases as a probable result of treatment may be expected to occur in an even greater degree in cases in which the clinical course is more favorably influenced by therapy. Blocks of tissue from brains

hardened in liquor formaldehydi were taken from the following areas of the cortex of both hemispheres of the brain: upper precentral lobe, upper postcentral lobe, tip of the temporal lobe, posterior two thirds of the first temporal gyrus, angular gyrus, calcarine cortex, cornu ammonis,

Fig. 3.—Section from central cortex; no perivascular infiltration.

base of the second frontal lobe, prefrontal lobe, Broca's area and areas of special interest. Paraffin was used chiefly in embedding, although celloidin and freezing methods were used when special stains required such methods. The stains employed were: cresyl echt violett to show

cell changes and cellular infiltration; Mallory's phosphotungstic acid hematoxylin for study of meningeal, vascular, and glial changes; Weigert's myelin sheath stain for nerve fiber study; either Marchi or sharlach R to demonstrate the presence of fat. Bielschowsky's stain for nerve fibrils was used on a few sections, but the findings did not seem of sufficient value to continue this method at length.

The cases studied were divided into two series: (1) twenty-seven patients with general paresis who had received antisyphilitic treatment in an attempt to modify the paretic process, and (2) fifteen patients with general paresis who had received no antisyphilitic treatment after the onset of psychotic symptoms. An attempt was made to study and chart in a scale the degree of intensity of the pathologic changes with reference to pial edema, pial infiltration, marginal gliosis, ameboid glial reactions, reaction of the glial cells with round nuclei, rod cell reaction, nerve cell changes, increased vascularity, vascular thickening, endarteritis, perivascular infiltration of lymphocytes and plasma cells, perivascular gummas and external hemmorrhagic pachymeningitis.

HISTOLOGIC STRUCTURE

In general, the histologic findings agree with those described by Nissl [2] and Alzheimer [3] as characteristic of general paresis. An internal hemmorrhagic pachymeningitis of long standing existed in four of the forty-two cases. This proportion is relatively small as compared with the frequency described by Wernicke,[4] Kraepelin,[5] and Bleuler.[6] Ziehen found it present in nearly one half of his cases.

The pia mater is almost always involved. Edema was present in some degree in every case. According to Alzheimer, no case of general paresis exists without pial changes. In this material the meningeal cellular infiltrate seemed to be confined mainly to the pial layer of the meninges, particularly in the vicinity of the blood vessels (Figs. 1 and 2).

The question of nerve cell changes seems well expressed by Nissl when he says that considering the prompt reaction of nerve cells to all possible injurious agencies, one cannot wonder at the variety of nerve cell changes and the importance of differentiating those found in general paresis from those in other diseases. Death in general paresis seldom occurs without some complicating terminal infection

2. Nissl: Zur Histopathologie der paralytischen Rinderkrankung, Nissl histologische und histopathologische Arbeiten **1**:315, 1904.

3. Alzheimer: Histologische Studien zur Differentialdiagnose der progressiven Paralyse, Nissl histologische und histopathologische Arbeiten **1**:18, 1904.

4. Wernicke: Grundriss der Psychiatrie, Ed. 2, Leipzig, Thieme, 1906.

5. Kraepelin: Lehrbuch der Psychiatrie, Leipzig, Barth, 1910.

6. Bleuler: Lehrbuch der Psychiatrie, Ed. 2, Berlin, Springer, 1918.

such as pneumonia, decubitis, etc. More than one half of the patients of this series died of acute terminal infections. This would seem to interfere with any possible conclusions concerning the cellular reaction in treated and untreated patients, especially with regard to the presence of fat in the cells of the cortex. For this reason, as well as for the fact

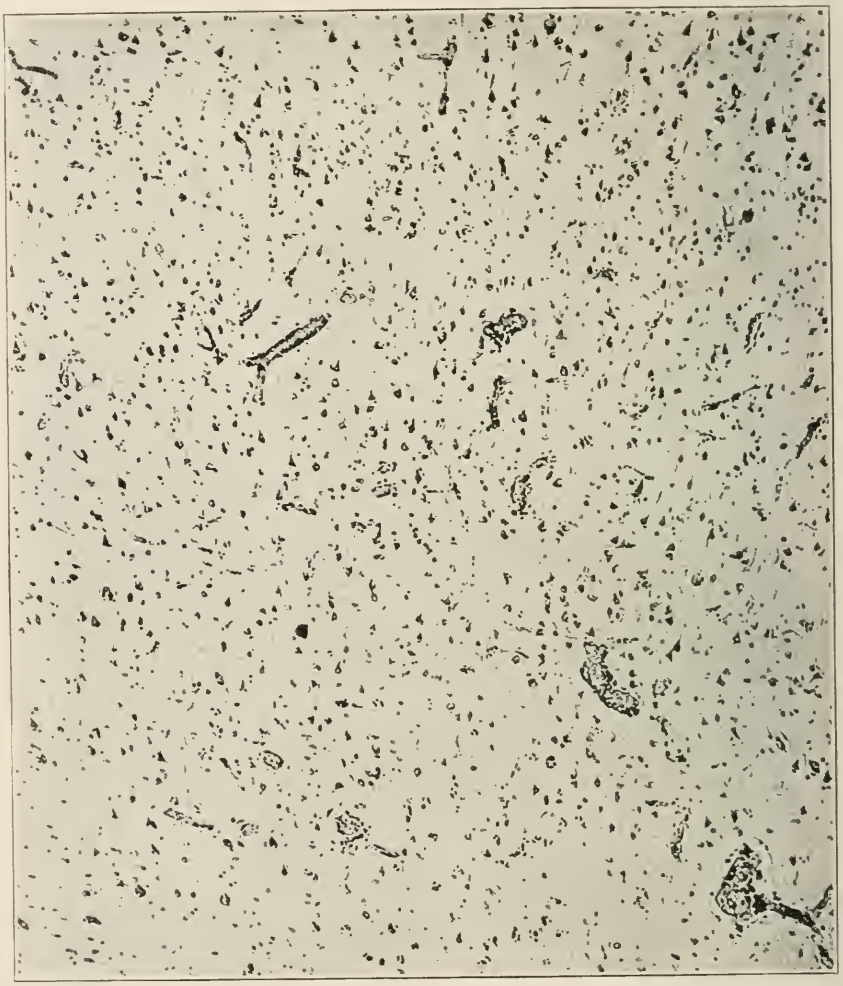

Fig. 4.—From same case as Fig. 3. Temporal lobe. Note characteristic sheath infiltration of capillaries and arterioles.

that it is quite difficult to estimate the extent or degree of cell loss of one case in comparison to another, no conclusions concerning cell changes are attempted. Bielschowsky's stain for nerve fibrils shows no specific changes of significance. This has also been shown by Spielmeyer.

The neuroglia is apparently always increased in general paresis. This, of course, is a general statement. In the cases of this series there was some increase in the marginal glia fibers with the usual focal increase of astrocytes in the outer cortical layer, and frequently long fibers extended from the margin well down into the cell layers. This last was never more than moderate in degree.

Satellite cells were found in smaller proportion than is often seen in conditions other than paresis. Ameboid glia cells were found frequently in varying numbers. They were most numerous in the presence of frank tissue degeneration; otherwise, their variation seemed to depend on the presence or absence of acute infective processes. This was not constant, however, as they were found in cases without a history of terminal infection. The ameboid glia was limited almost exclusively to the white substance except when in relation to an area of degeneration, in which case it usually was accompanied by an increase in rod cells of various forms and small round glia cells. It is often noticeable that the white substance may contain enormous numbers of all these types of cells while the cortical portion is almost free from them. The reverse condition did not appear.

Vascular changes are usually emphasized in descriptions of paresis. Mott has said that the endarterium is affected in all cases. Alzheimer speaks of endothelial swelling. Ziehen rarely finds them present. Bleuler mentions atheroma; Kraepelin also found endothelial thickening. In this series the most frequent change was a general thickening of the media, often fibrous, with no demonstrable changes in the intima. This was true of vessels of all sizes, and the increase of the thickness of capillary walls was noticeable. Capillary hyperplasia was relatively infrequent and only of moderate degree. No significant differences in the vessels were noted in treated and untreated patients.

In the changes mentioned there is nothing diagnostic of general paresis although these changes are never lacking in this condition. The determining factor, histologically, is the presence of perivascular infiltration of plasma cells, the latter usually accompanied by lymphocytes. The manner in which the plasma cells surround the vessels is worthy of note in that it is a true adventitial infiltration, resulting in the formation of a sheath about the muscular portion of the vessel wall rather than merely in a collecting of plasma cells in the perivascular space. According to Nissl, both the lymphocytic and plasma cells are hematogenous, and he considers the plasma cell a transition form of the lymphocyte.

Because of the diagnostic value of the plasma cell infiltration in general paresis, much thought has been given to the possible significance of both plasma cells and lymphocytes in this disease. Alzheimer, in his

1912 "Paralysereferat," has insisted on the importance of the plasma cell in the histologic diagnosis of paresis; when plasma cells are diffusely present the diagnosis of paresis is probable, while in their absence this diagnosis can hardly be made. Both plasma cells and lymphocytes are

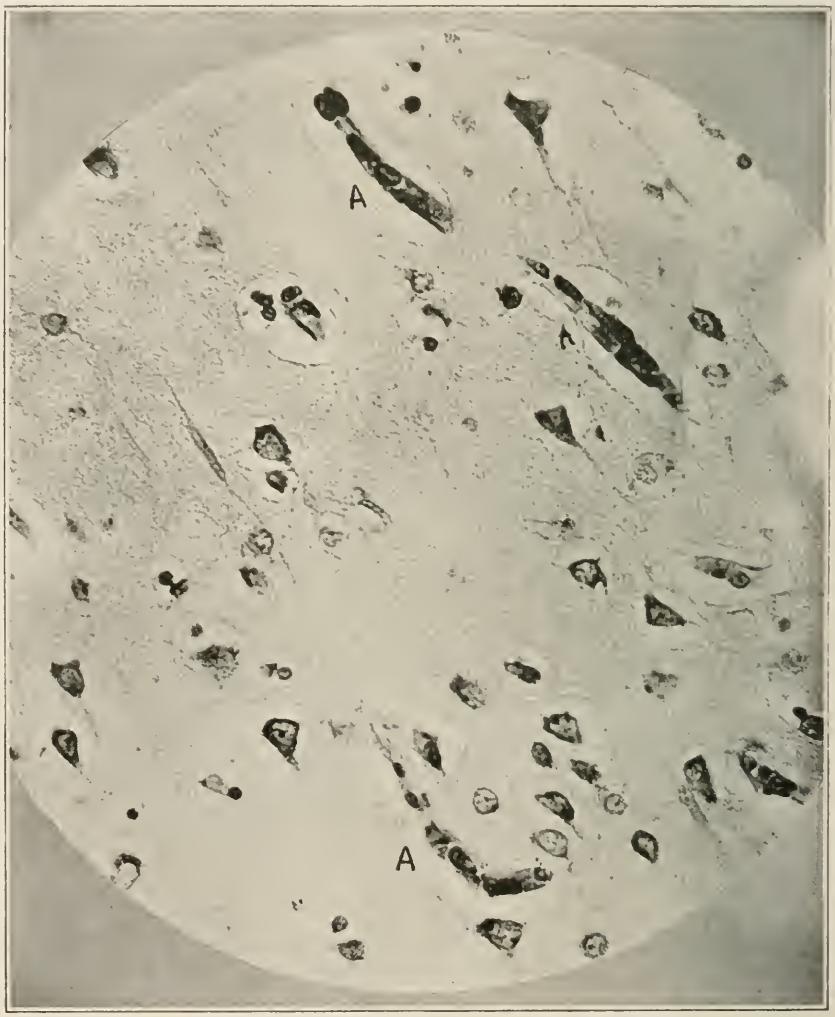

Fig. 5.—Capillaries (*A*) with plasma cells closely applied to their walls. (Untreated case.)

inflammatory cells, but whether they precede, follow or occur simultaneously with the parenchymal changes has never been determined. If the occurrence of infiltrating cells is a direct response to the toxin formation of those spirochetes which lie in close relation to the blood

vessels, the effect of antisyphilitic treatment may be different than if these perivascular cells arise in response to the irritation caused by the destruction of parenchymatous tissue; for if the latter assumption is correct, the perivascular reaction may continue even after most of the

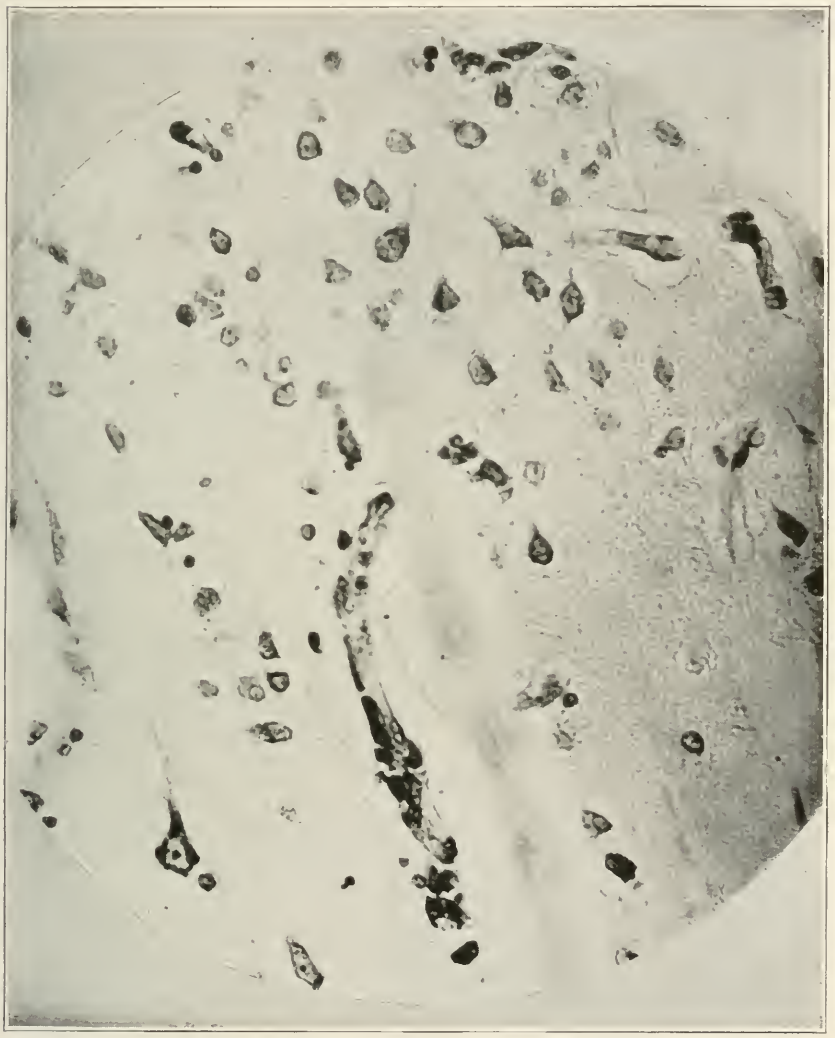

Fig. 6.—Same as Figure 5; untreated case.

organisms lying in close proximity to the vessels have been destroyed, owing to the continued destructive action on the parenchyma of a few spirochetes situated more deeply. At all events, the presence of plasma cells is known to be an evidence of chronicity, and must be considered to have this significance in paresis.

Gruner [7] discusses plasma cells at length and calls them "irritation" cells—a functional state of any lymphoid cell—and says that they revert to the lymphoid state after the stimulus of irritation has ceased.

Nägeli's [8] idea of plasma cells agrees in the main with the foregoing. He says that they are present in infections and irritations. They are found in connection with lymphocytosis but never in leukocytosis of marrow origin. Nägeli considers lymphocytes as lipoid antigens, finding them increased in post-toxic states and various other conditions. Gruner feels that little is known of the function of the lymphocyte but agrees that any infection of lipoid character attracts them.

There seems to be no fixed rule governing the area in which the greatest degree of perivascular change may be found, but the findings in our series seemed to be most extreme the nearer one approached the base of the brain. This is especially well illustrated by one case in which the sections from the convexity were of such normal appearance as to suggest that the diagnosis of paresis was not possible. Those near the base, however, presented a perivascular plasmacytosis of marked degree (Figs. 3 and 4).

From what has been said it becomes evident that in making any comparative studies it is necessary to have sections from many areas of the cortex; this was attempted in the present study.

FINDINGS IN THIS INVESTIGATION

Our greatest interest, a comparison of the histologic findings in treated and untreated patients, revolves around the lymphocytic and plasma cell reactions in the pia and about the blood vessels of the cortex for these reasons:

1. They are the most easily compared. 2. The plasma cells are of prime diagnostic importance in general paresis. 3. Inflammatory reactions of the pia and the perivascular region are theoretically amenable to influence by drugs (for example cerebrospinal syphilis). 4. Definite differences between the two groups of cases were found in our series.

Plasma cells were present in all patients, both treated and untreated. The treated cases could nevertheless be distinguished in the majority of instances by the smaller number of plasma cells present. Lymphocytes were frequently present in treated cases and usually in a relatively greater number as compared with the plasma cells. This held true of all cases, except in the presence of definite tissue degeneration in the

7. Gruner: Biology of Blood Cells, New York, William Wood & Co., 1914.

8. Nägeli: Blutkrankheiten und Blutdiagnostik, Berlin und Leipzig, Gruyler, 1919.

form of miliary or perivascular gummas. In this instance treatment seemed to produce no perceptible change. The importance of Nissl's statement that the presence of plasma cells about the capillaries is the most significant finding in general paresis is well borne out here. The characteristic pericapillary arrangement of plasma cells in the sections

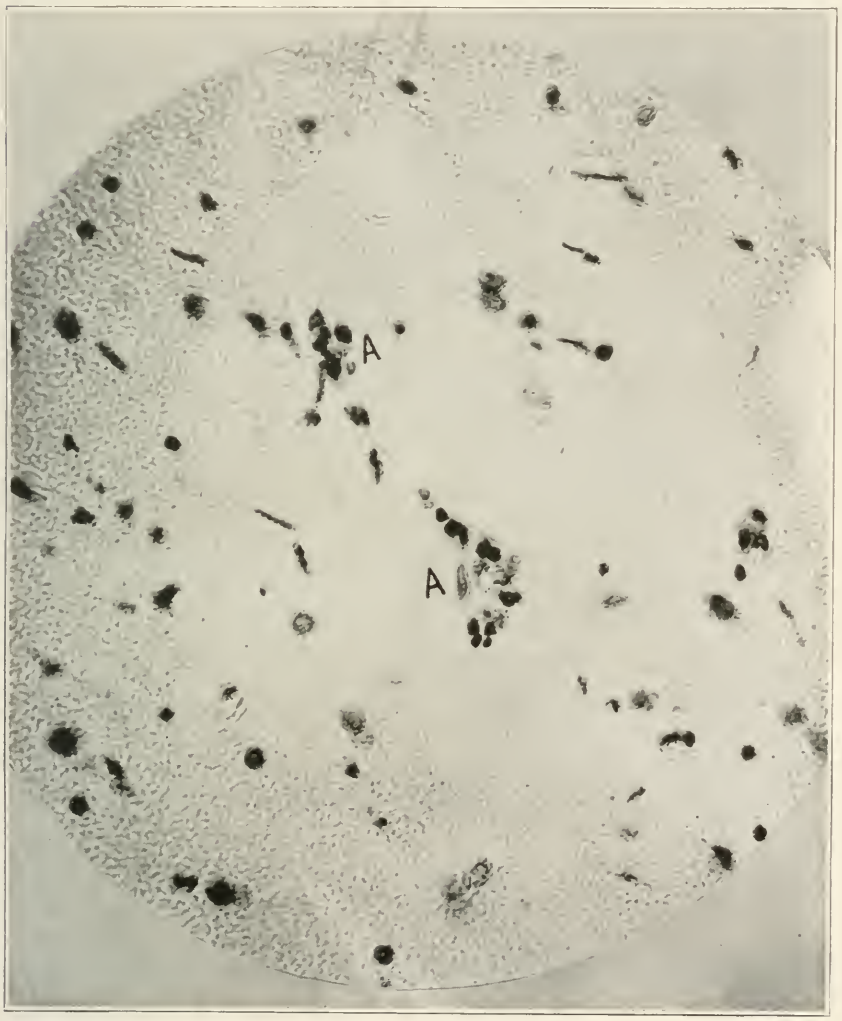

Fig. 7. — Capillaries (a). Compare with Figures 5 and 6. This patient received treatment.

from cases without treatment (Figs. 5 and 6) contrasts sharply with the absence of plasma cells in the perivascular spaces or in their occasional presence either accompanied or unaccompanied by a small number of lymphocytes in treated cases (Fig. 7).

Table 1 gives a comparison of the perivascular plasma cell, lymphocytic and pial infiltration in treated and untreated patients. The amount of infiltration is recorded as slight, moderate or considerable. Slight infiltration indicates that in no part of the various areas of the cortex examined was there more than an occasional infiltrating cell present. Considerable infiltration was credited to those cases in which the infiltration was really extensive. The others were considered as showing moderate infiltration. It will be noted that there are marked differences in the degree of plasma cell infiltration in the brains of treated and untreated patients. Thus, of the treated series of twenty-seven patients, the brains of sixteen, or more than one-half, showed slight plasma cell infiltration, whereas of the fifteen untreated patients none showed so slight a degree of plasma cell reaction. This is a difference which seems to be sharp and clear cut. Six of the treated patients, or less than one fourth, showed a moderate lymphocytosis as compared to five, or one third, of the untreated series; while five, or less than one fifth of the treated patients, showed a considerable plasmacytic reaction as compared to ten or two thirds of the untreated cases.

TABLE 1.—Comparison of Infiltration in Treated and Untreated Cases

	Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Treated	16	6	5	12	10	5	9	7	3
Untreated	0	5	10	0	9	6	1	7	4

Similar findings, although not quite so striking, are shown as regards the perivascular lymphocytic infiltration. Twelve, or almost one half of the brains of the treated patients showed a slight lymphocytic infiltration, whereas in none of those untreated was the infiltration of such minor degree. Ten, or a little less than one third of the treated patients, presented a moderate lymphocytic infiltration as compared to nine, or almost two thirds of the untreated ones; and of the treated patients only five, or less than one fifth, as contrasted with six, or more than one third of the untreated brains, showed considerable lymphocytic infiltration.

A number of the brains had had the pia stripped before this study was undertaken. However, there were nineteen brains of treated patients and twelve of the untreated ones with the pia intact. Among the treated cases nine, or practically one half of those studied for pial reaction, showed a slight pial cellular reaction as compared with one, or one twelfth, of the untreated cases. These results are given in graphic form in Fig. 8. Fig. 9 is a graphic representation of the relative proportions of the perivascular plasma cell and lymphocytic infiltration and pial infiltration, in the treated and untreated patients, by the employment

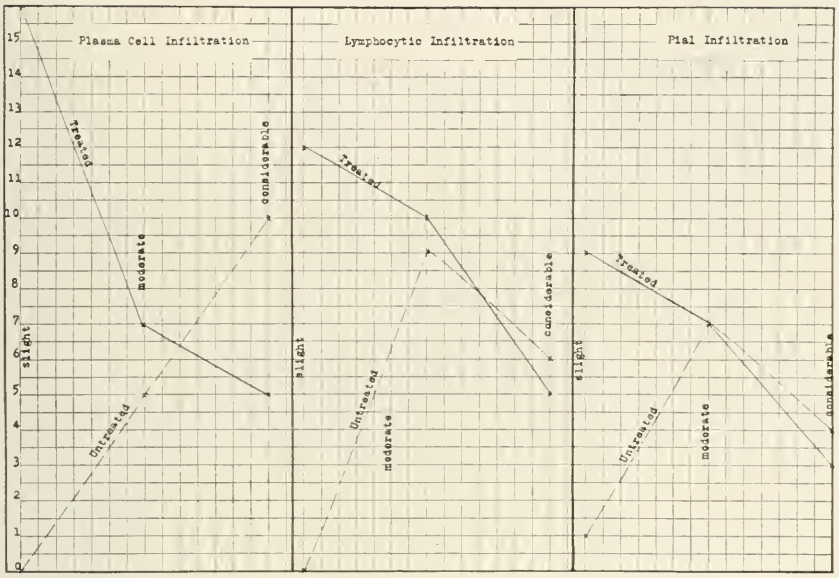

Fig. 8.—Histologic findings in treated and untreated patients with general paresis.

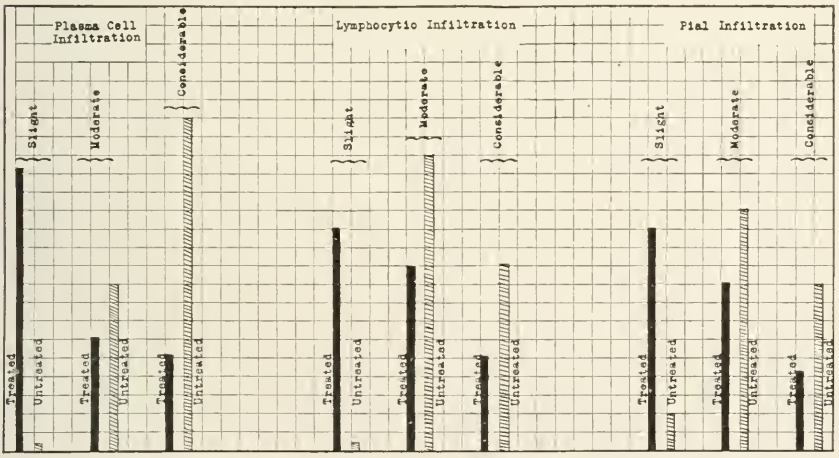

Fig. 9.—Histologic findings in treated and untreated patients with general paresis. These are charted to show relative proportions by using common denominators for the two series of cases.

TABLE 2.—Infiltration in Treated Patients Arranged in Order of Amount of Treatment Received

		Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Amount of Treatment	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Dal.	60	..	+	..	..	+	..	..	..	..
Un.	50 (5 vent.)	+	..	..	+	.	..	..	..	..
Cah.	41	+	..	..	+	..	..	..	..	..
Rey.	37 (2 sp.)	+	..	..	..	+	..	..	..	..
Hal.	31 (2 vent.)	..	+	..	+	..	..	+	..	.
O'B.	27 (5 sp.)	+	..	..	..	+	..	.	+	..
Smy.	22	..	..	+	..	+	.	..	..	+
Lar.	21	+	..	..	+	.	.	+	..	..
Per.	21	..	+	..	..	+	..	..	..	..
Hay.	21	.	..		..	..				
Gal.	20 (2 vent., 4 sp.)	..	+	..	..	..	+	..	..	.
Mor.	20+	..	..	+	..	+	..	..	..	
Bren.	19	+	..	..	+	.	..	+	..	..
Tho.	16	..	+	..	..	+	..	..		..
Ken.	15	+	..	..	+	..	..	..	+	..
Mon.	14	+	..	..	..	+	.	..	..	..
Duf.	13	+	..	..	+	.	..	+	..	..
Sea.	12	+	..	..	+	..	..	+	..	..
Win.	11 (2 sp.)	+	..	..	+	..	..	..	+	..
Par.	10+ (1 sp.)	+	..	..	..	..	+	..	+	..
Ric.		+	.	..	+	..	.	..	..	+
Ne.	8	..	..	+	..	+	..	..	+	..
Dob.	8	..	..	+	..		+	+	..	..
Bur.	6	..	+	..	..	..	+	+	..	..
Nel.	(5) 12	+	..	..	..	+	..	..	+	..
Pa.	Mercury 22, subdural	+	..	..	+	..	..	+	..	..
All.	Mercury, spinal drainage	+	..	..	+	..	..	+	..	..
		16	6	5	12	10	5	9	7	3

The numbers in the columns to the right of the name symbols indicate the number of intravenous injections of arsphenamin, while those in the next column indicate the number of intraventricular and spinal injections.

TABLE 3.—Infiltration in Untreated Patients

	Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Cry.	..	+	..	..	+	..	+	..	..
McN.	..	+	..	..	+	..	..	+	..
McG.	..	+	..	..	+	.	..	+	..
Tin.	..	+	..	..	..	+	..	..	+
Spe.	..	+	..	..	..	+	..	..	..
Tru.	..	..	+	..	+	..	..	+	..
For.	..	..		..	+	..	..	..	+
Hub.	..	..	+	..	+	..	..	..	..
Dra.	..	..	+	..	..	+	..	+	..
Bla.	..	..	+	..	.	+	..	+	..
Pim.	..	..	+	..	+	..	..	..	+
Tit.	..	..	+	..	+	..	..	..	+
Fre.	..	..	+	..	+	.	..	..	..
Mas.	.	..	+	..	..	+	..	+	..
San.	..	..	+	..	..	+	..	+	..
	0	5	10	0	9	6	1	7	4

of a common denominator for the two series. The figures here are relative and not actual and represent a graph that would show the proportion had there been the same number in each series.

Table 2 shows the findings in the individual cases arranged in the order of the amount of treatment received. A perusal of this chart will show that the various reactions bear no definite relation to the amount of treatment received, since several of the patients who had received a considerable amount of treatment show more reaction than others who had received a smaller amount. It is also indicated that there is not always a parallelism between the amount of perivascular lymphocytic

TABLE 4.—Infiltration in Treated Patients Arranged According to Age

		Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Age	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Nel.	32	+	..	..	+	..	..	..	+	..
All.	33	+	..	..	+	..	..	+		..
Gal.	33	..	−	..	..	..	+	..	..	..
Per.	34	..	+	..	..	+	..	..	..	..
Uni.	36	+	..	..	+	..	..	..	..	..
Mor.	36	..	.	+	..	+	..	..	..	+
Pal.	38	+	..	..	+	..	..	+	..	..
Bur.	38	..	+	..	..	..	+	+	..	..
Dal.	39	..	+	..	..	−	..	..	..	..
O'B.	39	+	..	..	−	..	..	..	+	..
Hal.	40	..	+	..	+	..	..	+	..	..
Lar.	41	+	..	..	−	..	..	+	..	..
Tho.	41	..	+	..	..	−	..	..	..	..
Ric.	42	+	..	..	+	..	..	..	..	+
Cah.	42	+	..	..	+	..	..	..	..	..
Doh.	42	..	..	+	..		+	+	..	..
Hay.	42	..	..	+	..	..	+	..	+	..
Rey.	43	+	..	..	..	+	..	..	..	..
Smy.	43	..	..	+	..	+	..	..	..	+
Duf.	45	+	..	..	+	..	..	+	..	..
Sea.	46	+	..	..	+	..	..	+	..	..
Par.	49	+	..	..	..	..	+	..	+	..
Ken.	53	+	..	..	+	..	.	..	+	..
Bre.	56	+	..	..	+	..	..	+	..	..
New.	57	..	..	+	..	+	..	..	+	..
Mon.	57	..	..	..	..	−	..	..	..	..
Win.	60+	+	..	..	+	..	..	..	+	..

reaction and the pial reaction in the same case, although in general the relationship is fairly close.

A point of some interest and importance is presented in certain cases in which a considerable amount of treatment has been given (e.g., Table 2, Smy. No. 7). Although this patient had received twenty-two intravenous injections of arsphenamin he showed a considerable amount of pial infiltration. This would seem to indicate that often the pial inflammation is not so readily amenable to antisyphilitic drugs as is ordinarily supposed.

Table 3 shows findings in the untreated cases charted as are the findings of the treated cases in Table 4.

Besides the amount of treatment received, there are other factors which presumably might influence the amount of exudative reaction in this series, such as the age of the patient, the clinical type of the psychosis, its duration and the interval between the last treatment and

TABLE 5.—Infiltration in Untreated Patients Arranged According to Age

		Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Age	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Tru.	34	..	..	+	..	+	..	..	+	..
Tin.	36	..	+	..	..	+	..	..	..	+
Dra.	38	..	..	+	..	..	+	..	+	..
Hub.	43	..	..	+	..	+	..	..	..	..
Spe.	44	..	+	..	..	..	+	..	..	..
McG.	45	..	+	..	..	+	..	..	+	..
Tit.	?	..	..	+	..	+	..	..	..	+
Bla.	49	..	..	+	..	..	+	..	+	..
McN.	52	..	+	..	..	+	..	..	+	..
Fo.	53	..	..	+	..	+	..	..	..	+
San.	54	..	..	+	..	..	+	..	+	..
Pi.	55	..	..	+	..	+	..	..	..	+
Cry.	56	..	+	..	..	+	..	+	..	..
Fre.	60	..	..	+	..	..	+	..	+	..
Mas.	77	..	..	+	..	..	+	..	+	..

TABLE 6.—Type of Psychosis in Treated Patients

	Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Simple Deterioration									
Mor.	..	..	+	..	+	..	..	..	+
Ric.	+	..	..	+	..	..	..	..	+
Sea.	+	..	..	+	..	..	+	..	..
Tho.	..	+	..	..	+	..	..	..	..
Uni. (tabes)	+	..	..	+	..	..	..	..	..
Win.	+	..	..	+	..	..	..	+	..
Doh.	..	..	+	..	..	+	+	..	..
All.	+	..	..	+	..	..	+	..	..
Bre.	+	..	..	+	..	..	+	..	..
Cah. (convulsions)	+	..	..	+	..	..	..	..	..
Dal. (convulsions)	..	+	..	..	+	..	..	..	..
Hal. (tabes)	..	+	..	+	..	..	+	..	..
Mon.	+	..	..	..	+	..	..	..	..
Duf. (convulsions)	+	..	..	+	..	..	+	..	..
Agitated or Depressed									
Hay.	..	..	+	..	..	+	..	+	..
Nel.	+	..	..	..	+	..	..	+	..
O'B.	+	..	..	..	+	..	..	+	..
Smy.	..	..	+	..	+	..	..	..	+
Expansive									
Bur. (tabes)	..	+	..	..	+	..	+	..	..
Par.	+	..	..	..	..	+	..	+	..
Rey.	+	..	..	..	+	..	..	..	..
Confused									
Ken.	+	..	..	+	..	..	..	+	..
Pai.	+	..	..	+	..	..	+	..	..
Per.	..	+	..	..	+	..	..	..	..

the death of the patient. Tables 4 to 9 inclusive indicate the findings arranged in the light of these factors. The only other striking fact brought out by our investigation was that in treated patients dying shortly after receiving treatment there tended to be a greater degree of

TABLE 7.—Type of Psychosis in Untreated Cases

	Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Simple Deterioration									
Pim. (tabes)	..	..	+	..	+	..	..	..	+
Dra.	..	..	+	..	..	+	..	+	..
Fo.	..	..	+	..	+	..	..	..	+
Tin.	..	+	..	..	..	+	..	..	+
McN.	..	+	..	..	+	..	..	+	..
Tru.	..	..	+	..	+	..	..	+	..
Hub.	..	..	+	..	+	..	..	..	..
Agitated or Depressed									
Bla. (tabes)	..	..	+	..	..	+	..	+	..
Fre.	..	..	+	..	..	+	..	..	..
Expansive									
Spe.	..	+	..	..	..	+	..	..	..
San.	..	..	+	..	..	+	..	+	..
Tit.	..	..	+	..	+	..	..	..	+
Confused									
McG.	..	+	..	..	+	..	..	+	..

TABLE 8.—Duration of Psychosis

		Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Duration	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Lar.	5 mos.	±	..	..	+	..	..	+	..	..
Nel.	6 mos.	+	..	..	..	+	..	..	+	..
Gal.	9 mos.	..	±	..	..	..	+	..	..	..
Ric.	2 yrs.	±	..	..	+	..	..	..	..	+
Cah.	2 yrs.	+	..	..	+	..	..	..	..	..
New.	2 yrs. 2 mos.	..	+	..	..	+	..	..	+	..
Rey.	2 yrs. 2 mos.	+	..	..	..	+	..	..	..	..
Mor.	2 yrs. 2 mos.	..	..	+	..	+	..	..	..	+
Per.	2 yrs. 4 mos.	..	±	..	..	+	..	..	..	..
Hal.	2 yrs. 5 mos.	..	+	..	+	..	..	+	..	..
Duf.	2 yrs. 5 mos.	+	..	..	+	..	..	+	..	..
Mon.	2 yrs. 9 mos.	+	..	..	..	+	..	..	..	..
Par.	3 yrs.	±	..	..	..	..	+	..	+	..
Dal.	3 yrs.	..	+	..	..	+	..	..	..	..
Hay.	3½ yrs.	..	+	..	..	..	+	..	+	..
Ken.	3½ yrs.	+	..	..	+	..	..	..	+	..
Pa.	3¾ yrs.	+	..	..	+	..	..	+	..	..
Al.	4 yrs.	+	..	..	+	..	..	+	..	..
O'B.	5 yrs.	+	..	..	..	+	..	..	+	..
Tho.	5 yrs. 5 mos.	..	+	..	..	+	..	..	..	..
Win.	6 yrs.	+	..	..	+	..	..	..	+	..
Sca.	6 yrs.	+	..	..	+	..	..	+	..	..
Doh.	7 yrs. 2 mos.	..	..	+	..	..	+	+	..	..
Uni.	8 yrs.	+	..	..	+	..	..	..	..	..
		No Treatment								
Bla.	3½ mos.	..	..	+	..	+	..	..	..	+
Dra.	1 year	..	+	..	..	..	+	..	+	..
McN.	1 year	..	+	..	..	+	..	..	..	..
Cr.	1 year	..	+	..	..	+	..	+	..	..
San.	1½ years	..	..	+	..	..	+	..	+	..
Hub.	1¾ years	..	..	+	..	..	+	..	+	..
Tru.	3 years	..	..	+	..	+	..	..	+	..
Pi.	3 years	..	..	+	..	+	..	..	..	+
Spe.	4 years	..	+	..	..	..	+	..	..	..

plasmacytic reaction than in patients in whom a lengthy interval had elapsed between the end of treatment and death (Table 9).

We may conclude, therefore, that treatment definitely reduces the amount of plasma cell infiltration in cases of general paresis. This reduction is so striking that the histologic study of the cases gives a fairly good indication of whether the patient had received antisyphilitic treatment or not.

What becomes of the plasma cells if they are not present in treated patients in the same proportion as in untreated patients? If we are to assume with Gruner and Nägeli that plasma cells are the result of

TABLE 9.—Amount of Infiltration in Patients According to Length of Interval Between Last Treatment and Death

		Plasma Cell Infiltration			Lymphocytic Infiltration			Pial Infiltration		
	Interval	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Cah.	8 days	..	+	..	+	..	..	..	..	..
Hay.	14 days	..	..	+	..	..	+	..	±	..
Lar.	14 days	±	..	..	±	..	..	+	..	..
Hal.	1 mo.	..	+	..	+	..	..	+	..	.
Gal.	1 mo.	..	+	..	..	..	+	..	..	..
Dal.	1 1/10 mos.	..	+	..	..	+	.	..	..	..
Per.	1 1/6 mos.	.	+	.	..	+	..	..	..	..
Nel.	1 1/4 mos.	+	..	..	..	+	..	..	−	..
Ric.	2 1/8 mos.	−	..	..	+	..	..	..	..	+
Bu.	2 1/3 mos.	..	+	..	..	..	+	+	..	..
O'B.	2 1/2 mos.	+	..	..	..	+	.	..	+	..
Mon.	3 1/4 mos.	−	..	..	..	+			..	..
Pa.	4 mos.	+	..	..	−	..	.	+	.	..
Uni.	4 mos.	+	..	..	+	..	.	..	..	..
Smy.	4 1/6 mos.	..	..	+	..	+	..	..	..	+
Doh.	6 mos.	..	..	±	..	..	+	+	..	..
Rey.	8 mos.	+	..	..	..	+	..	..	..	..
Par.	1 year	−	..	..	..	..	+	..	+	..
Duf.	1 year	+	..	..	+	..	..	+	..	..
Win.	1 yr. 1/2 mo.	+	..	..	+	..	..	..	+	..
Mor.	1 yr. 1 mo.	..	..	+	..	+	..	..	..	+
Bre.	1 yr. 3 1/2 mos.	+	..	..	−	..	..	+	..	..
Ken.	1 yr. 6 mos.	+	..	..	+	..	..	..	+	..
Sea.	1 yr. 6 mos.	+	..	..	+	..	..	+	..	..
Tho.	1 yr. 10 mos.	..	+	..	..	+	..	..	..	..
New.	1 yr. 11 mos.	..	..	+	..	+	..	..	+	..
All.	3 yrs. 3 mos.	+	..	..	+	..	..	+	..	..

irritation, it might follow that the amount of irritation produced by the spirochete had been reduced as a result of treatment and thus less tendency existed for the formation of plasma cells. Or it is possible that arsphenamin may provoke a more acute reaction than occurs in patients with untreated paresis. This would be similar to the so-called arsphenamin neurorecidives. In either case the conclusion would be that treatment had produced the change through its antispirochetocidal properties. It does not seem probable, however, that the reaction produced is of the type of the neurorecidive as it occurs in patients that have received a great deal of treatment, whereas the arsphenamin

neurorecidives occur after the first few treatments; further, there is a decrease in the lymphocytes while in the neurorecidive there should be an increase in these elements. Therefore it seems most likely that the decrease in plasma cells and lymphocytes represents a lessening of the irritative phenomena.

No definite differences are noted, so far as the glia reaction is concerned, between treated and untreated patients. This relates both to the ameboid glia, the round glia cells, and also to the rod cells. Tables 10 and 11 indicate the findings in the two series.

Several points of general clinical interest have come to our attention in this study. It would seem that the cell count of the cerebrospinal

TABLE 10.—Glia Reaction in Treated Patients

	Round Glia			Rod Cells			Ameboid Glia		
	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Dal.	..	+	..	..	..	..	..	..	+
Uni.	..	−	..	..	..	..	..	..	−
Cah.	..	..	−	..	..	..	..	..	±
Hal.	..	−	..	..	..	..	..	..	+
O'B.	..	....	−	..	+	..	..	+	..
Smy.	..	±	..	±	..	..	..	+	..
Lar.	..	+	..	..	..	..	..	..	+
Per.	..	−	..	..	..	..	..	..	..
Hay.	..	..	−	..	+	..	..	±	..
Gal.	..	+	..	..	..	..	..	+	..
Mor.	..	±	..	..	..	..	..	..	+
Bre.	..	..	−	..	..	+	..	..	+
Tho.	..	+	..	..	−	..	..	+	..
Ken.	..	..	−	..	..	+	..	..	+
Mon.	..	+	..	..	..	..	..	+	..
Duf.	..	±	.	..	+	..	..	±	..
Sca.	..	..	+	..	..	..	..	+	..
Win.	+	..	..	..	..	..	..	..	..
Par.	..	+	..	..	..	+	..	..	+
Ric.	..	+	..	..	..	..	..	+	..
New.	..	..	−	..	..	..	..	..	±
Doh.	..	..	−	..	..	..	..	..	+
Bur.	..	..	−	..	..	−	..	..	+
Pai.	+	..	..	..	+	..	..	..	+
Nel.	+	..	..	..	..	..	..	..	..
All.	..	..	−	..	..	+	..	..	..
	3	13	10	1	5	5	0	10	13

fluid obtained from the lumbar region during life does not give a satisfactory indication of the extent of the cerebral meningitis; that is, it gives little evidence of cellular infiltration of the meninges. Thus in two of the patients from the untreated group (Fo. and Pi.) who had a marked pial infiltration, the cell count of the spinal fluid was 10 per cubic millimeter in one and 14 per cubic millimeter in the other, whereas two others of this group (McG. and Da.) who had a moderate meningeal involvement, that is less than Fo. and Pi., showed 17 and 93 cells per cubic millimeter, respectively.

Similar observations were made in patients treated. For instance, Mo., who had marked meningitis, had a cell count in the spinal fluid varying from 2 to 4 cells per cubic millimeter on several occasions. Similarly Par., who had a marked lymphocytic infiltration of the pia, had a cell count that was within normal limits on all but two occasions, the following numbers indicating the cell count per cubic millimeter on successive examinations: 2, 0, 17, 2, 2, 6, 2, 3, 5, 1, 0, 0, 8, 2, 3, 4, 2, 0, 6 (Fig. 10).

In contrast, Ha., who had no greater amount of pial involvement, had cell counts of 20, 35 and 55 cells per cubic millimeter on three successive examinations; Doh. and Bu., who had slight infiltration of the cerebral meninges, had cell counts of 18 and 20, respectively.

Our material further proves that the colloidal gold reaction may become negative as a result of treatment in cases of general paresis.

TABLE 11.—Glia Reaction in Untreated Patients

	Round Glia			Rod Cells			Ameboid Glia		
	Slight	Moderate	Considerable	Slight	Moderate	Considerable	Slight	Moderate	Considerable
Tru.	..	+	..	..	..	+	..	+	..
Pim.	..	+	..	..	..	..	..	+	..
McN.	..	+	..	..	+	..	..	+	..
McG.	..	+	..	..	+	..	..	+	..
Mas.	..	+	..	..	+	..	+	..	..
Tit.	..	+	..	..	..	..	..	+	..
San.	..	+	..	..	..	..	..	..	+
Cry.	..	..	+	..	..	+	..	..	..
Fo.	..	..	+	..	..	..	..	..	+
Hub.	..	..	+	..	+	..	..	..	+
Dra.	..	..	+	..	..	+	..	..	+
Bla.	..	..	+	..	..	..	..	..	..
Fre.	..	..	+	..	..	+	..	..	+
Tin.	..	..	+	..	..	+	..	..	+
Spe.	..	..	+	..	..	..	..	..	+
	0	7	8	0	4	5	1	5	7

This is an observation which has, of course, been made clinically a number of times: that is, in cases clinically labeled general paresis a so-called paretic curve present at the outset of treatment has become normal during treatment. Our point is that we have been able to confirm the diagnosis of paresis by postmortem examination in such cases. For instance, in the case of Dal., numerous colloidal gold tests were made which either were negative or gave a mild reaction; necropsy showed definitely the histologic changes of general paresis. Similar variations from a paretic gold curve to a normal curve occurred in other patients of this group during the course of treatment, and in these cases the diagnosis was confirmed by histologic examination.

What has been said of the colloidal gold reaction is equally true of the Wassermann reaction. The Wassermann reaction in cases of general paresis may become negative as a result of treatment. This in

no way disproves the diagnosis of paresis, and the disease may progress and the patient may die. This occurred in several cases, for example, in the cases of O'B. and Mon. In the latter case (Mon.), the Wassermann reaction became negative in dilutions from 0.1 to 1 c. c. of spinal fluid; the cell count fell to within normal limits, and the gold reaction was much reduced. Nevertheless, the patient died with the signs and symptoms of general paresis, and necropsy confirmed the diagnosis both grossly and histologically.

As is well known, the ventricular fluid in cases of general paresis is entirely negative in some cases and positive in others. In our series

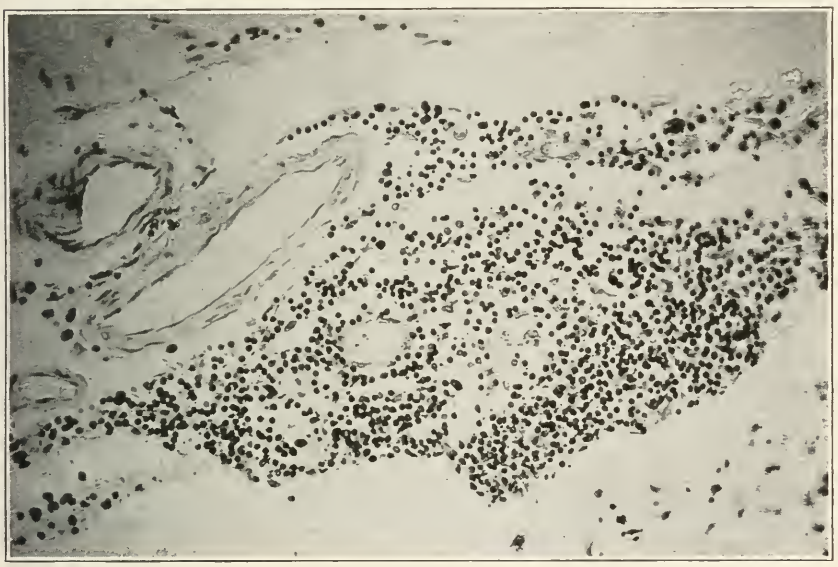

Fig. 10.—Meningitis in patient with paresis who had been treated. Treatment did not remove the infiltrate that is supposed to react readily to antisyphilitic drugs. However, the cell count in the spinal fluid was low, giving no indication of the amount of cerebral meningitis.

there were three patients who had been receiving ventricular injections. In one (Gal.), the ventricular fluid was quite normal, whereas in the other two (Un. and Hal.) the ventricular fluid showed findings in keeping with the spinal fluid in cases of general paresis; namely, positive reactions in the Wassermann, colloidal gold, globulin, and albumin tests. In all three cases the postmortem examination confirmed the diagnosis of general paresis, and no significant differences were observed in the histology of these cases. The negative findings in the ventricular fluid probably indicate a relative imperviousness of the foramina of Lushka and Magendie so that the elements producing

these reactions do not have easy access from the subarachnoid space to the ventricles or that the flow of fluid from the ventricles to the subarachnoid space is active and in that direction almost exclusively.

The inference to be drawn from those cases in which the patient had received intraventricular injections of arsphenamized serum is that no damage is done by such injections. Clinically, there is no evidence of damage nor does the examination of the ventricular fluid subsequent to the injection show any evidence of irritation or inflammation. Thus, in the case of Gal., the ventricular fluid remained negative after the intraventricular injections, and in the other two cases there was no cellular reaction resultant on such treatment. Histologically the ventricular surfaces and the choroid plexus showed no evidence of trauma. We may, therefore, conclude that the introduction of arsphenamized serum into the ventricles does not produce any reactions which contraindicate this type of treatment. On the other hand, we have no evidence from the limited material in which ventricular injections were made that any strikingly good results were accomplished. It seems fair to emphasize that the three patients of this series who received ventricular injections showed no clinical improvement, whereas other patients receiving similar treatment have shown marked improvement. It is at least possible, if not probable, that the findings in the patients who improved with this treatment (not included in this series) would have shown more histologic evidence of this treatment. This statement is in consonance with one made at the beginning of the article calling attention to the fact that all the material available in this study is from patients who did poorly from a clinical standpoint.

SUMMARY

In order to determine whether antisyphilitic treatment produces any effect on the paretic process in the cerebrum that can be recognized histologically, a study was made of brains from cases of general paresis. The series studied was made up of two groups: twenty-seven brains from patients who had received antisyphilitic treatment during the period of the psychosis and fifteen brains from patients who had not received antisyphilitic treatment subsequent to the onset of symptoms of paresis. It was not possible to draw any conclusions concerning parenchymatous changes, nor concerning the true vascular or neurologia changes from a comparison of the two groups. That no significant comparative changes would be shown was to be expected because of the nature of the pathology of these structures in general paresis.

However, the inflammatory reactions, perivascular and pial infiltration, offer theoretically a satisfactory basis for comparison. The degree of cellular infiltration in one case can be compared with the degree of

infiltration in another case. Further, this type of reaction is apparently the result of irritation by a toxic agent. If the activity of the agent is reduced, one expects a reduction of the inflammatory process. This is what happens in cases of tertiary cerebrospinal syphilis in which the patients receive treatment. Plasma cells diffusely present in the perivascular and pial infiltration is the critical finding in general paresis. Hence, a comparative study was made of the amount of perivascular plasmacytic and lymphocytic infiltration and pial reaction in the treated and untreated groups. It was found that plasma cells were few and infrequent in most of the treated patients, especially in comparison with the untreated ones. This was so striking that in many cases it was possible to predict from the histologic picture whether or not the patient had received treatment. The lymphocytic perivascular infiltration was also much less, on the whole, in treated than in untreated patients. This was not as striking, however, as the apparent reduction of plasma cells. We believe that the plasma cells are an indication of a chronic irritation, and it seems probable that the reduction of this element in the treated patient is similar to that which occurs in the treatment of an indolent ulcer in which in the course of improvement the more chronic type of reaction is replaced by a more acute and active reaction. If this is true, it would seem to indicate that treatment had influenced the paretic process to a certain degree in most of the cases of our series.

The pial infiltration was likewise strikingly less in the treated than in the untreated patients as a group. However, in some patients who had received treatment the pial infiltration was of considerable extent, indicating that at times systemic antisyphilitic treatment (at least in moderate amounts) is incapable of greatly influencing cerebral meningitis. This is in keeping with clinical observations in cases of simple cerebral meningitis.

The charts show the results of the studies concerning these points.

Neither the age of the patient, the clinical variety of the psychosis, nor its duration seemed to have any distinct bearing on the amount of cellular inflammatory reaction.

CONCLUSIONS

1. Antisyphilitic treatment of patients with general paresis affects the histologic picture.

2. It tends to reduce the plasma cell infiltration of the perivascular spaces, so that in many cases there are fewer plasma cells than are commonly found in untreated cases.

3. This reduction of the plasma cell reaction is probably an evidence of lessened chronicity of the process.

4. Perivascular lymphocytosis is often reduced in amount by treatment.

5. Pial inflammation is often reduced in amount by treatment.

6. Intraventricular injections of arsphenamized serum ordinarily produce no injurious effects on the choroid plexus or ependymal lining of the ventricles.

7. The cell count of the spinal fluid does not give a true indication of the amount or extent of cerebral meningitis.

8. The colloidal reaction, Wassermann reaction and cell count of the spinal fluid in paresis may become negative during treatment.

DISCUSSION

Dr. Bernard Sachs, New York: I should like to know whether there is any reason to suppose that this plasmacytic reaction has any effect on the underlying morbid process, such as general paresis.

Dr. Henry Viets, Boston: I believe that Dr. Solomon's view is important from the clinical standpoint. If spinal fluids become negative, we cannot depend very much on the reaction of the cerebrospinal fluid in the treatment of our patients.

Dr. Herman H. Hoppe, Cincinnati: Recently I have been treating paretic patients with the hypertonic salt solution, followed six hours later by an intravenous injection of arsphenamin. Several of these patients became violent, this state lasting from twenty-four to thirty-six hours. In all of the cases we obtained some acute cortical reaction.

Dr. Bernard Sachs, New York: Is this perhaps the result that one might have expected after the nucleate of soda injections that were in favor with many physicians a number of years ago? It is interesting to note the effects of the use of various remedies which were so popular in the past.

Dr. Peter Bassoe, Chicago: I wish to relate the case of a physician with rather advanced paresis, who received quite intensive Swift-Ellis treatment. After the last injection he contracted a severe streptococcic sore throat which was followed by a streptococcic meningitis, of which he died. An examination of the brain revealed a marked decrease in the amount of perivascular infiltration. In fact, a great number of the perivascular spaces in the cortex showed practically no cells; they showed loose connective tissue network almost free from either lymphocytes or plasmacytes. I suppose we cannot assume that an acute meningitis which lasted a few weeks would bring about a change of that kind, so that perhaps the condition may be ascribed to the previous treatment.

Dr. Solomon, in closing: In regard to Dr. Sachs' question as to the important underlying morbid process in general paresis and the relation to the plasmacytic reactions so commonly found, I can give no satisfactory reply. I do not know why plasma cells occur, unless it is a response to a toxic agent acting over a long period. We look on the plasma cell as one evidencing a chronic type of reaction. Recent work by Jahnel, Jakob, and Valente apparently shows that spirochetes are present in large numbers, particularly where activity is most marked. We have not had a technic that was sufficiently good to attempt to show spirochetes. It would be interesting to know whether in these cases the spirochetosis had been decreased or increased.

There were several of these patients that had the miliary gummas in various spaces scattered throughout, and those patients invariably had the lymphocytic and plasmacytic reaction about the gummas irrespective of whether it was to be found elsewhere.

One of the patients in this series had received sodium nucleinate injections, also ventricular, spinal and a considerable number of intravenous injections. He showed a large amount of lymphocytic reaction. Unfortunately, however, I did not have the pia to examine, but it seemed to have more reactive cells than in most of the cases. Otherwise I have no knowledge of the exact effect of sodium nucleinate.

Dr. Kolmer and Dr. Lucke's article concerning the findings in the monkeys and rabbits treated with mercury has always been a mystery to me, unless the condition is similar to a lead encephalopathy.

Hypertonic salt solutions followed by intraspinal injections cause a tremendous reaction of the patient, fever, vomiting, nausea and headache, but we have not experienced so much reaction with the intravenous injections. About 100 c.c. of 15 per cent. salt solution does not give much change in the cerebrospinal fluid pressure, which we observe for approximately five hours.

In regard to the colloidal gold and Wassermann reactions, we have found in only two cases that the gold became negative, which shows that it could happen in cases of paresis confirmed by necropsy. In these cases the globulin reaction was positive. The gold reaction, as is known, is the result of the balance between the albumin and globulin. The colloidal gold reaction may be negative although globulin remains present, as in my cases. By a negative gold reaction is meant a reaction of one plus or less.

We had a patient similar to Dr. Bassoe's, a juvenile paretic who developed an acute cerebrospinal meningitis as the result of a faulty technic in intraspinal injection. She died four weeks later of cerebrospinal meningitis, and at necropsy the meninges showed a peculiar gummy type of reaction, almost free from cells, which was difficult to understand.

PROGRESSIVE FUNICULAR MYELOPATHY (SUBACUTE COMBINED DEGENERATION)*

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Most investigators agree that the clinical entity known as subacute combined degeneration or subacute funicular myelitis is not a true system disease, but that the disease process begins in numerous more or less irregularly distributed foci, which later coalesce.

Shimozono [1] and Wohlwill,[2] employing modern methods, attempted to establish the sequence of the disease process. Their aim was to discover the structural unit which first suffers. They claim that the axis cylinder is first attacked and that the other changes are secondary.

Shimozono studied three cases of pernicious anemia and a number of experimental animals in which severe anemia was produced by the injection of pyrodin. He concluded that the disease process was mainly neurolytic. He describes the axis cylinder changes as occurring in three distinct phases. First, there is slight swelling in the axis cylinder leading to irregularities in its outline; second, there is loss of staining properties and loss of fibrillar structure, and finally, dissolution. He attributes great importance to the presence in large numbers of so-called Elzholz bodies. In his description of these bodies he does not differ from that of Elzholz.[3] They are small round bodies, staining like Marchi bodies. They occur most commonly in the neighborhood of the node of Ranvier and for some distance between the myelin sheath and the membrane of Schwann. They are also frequently seen in the nuclei of the neurilemma cells, where they have an eccentric position and tend to herniate into the surrounding cytoplasm. They are considered by Shimozono as indicative of primary degeneration in the axis cylinder. Elzholz considered them products of decomposition. Their staining reactions suggest their origin from myelin. Elzholz also found these bodies in normal nerve fibers, though not in as great numbers as in diseased nerves. This led him to suggest that they may be the product of metabolic changes in the myelin. Shimozono's inter-

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* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

1. Shimozono: Deutsch. Ztschr. f. Nervenheilk. **35**: 1908; Arch. f. Psychiat. **53**:972, 1914.

2. Wohlwill: Deutsch. Ztschr. f. Nervenheilk. **68-69**:423, 1921.

3. Elzholz: Jahrb. f. Psychiat. u. Neurol. **17**: 1897.

pretation of the axis cylinder involvement as primary is still doubtful. One would not expect to find well preserved axis cylinders in an area of destruction of long standing were the axis cylinder the first structure to be attacked. We shall show that naked axis cylinders are frequently encountered in the diseased foci. Again, the occurrence of hemorrhages in the material which he studied led Shimozono to the hypothesis that the blood which has escaped from a partially injured blood vessel undergoes decomposition and liberates certain products which are specifically detrimental to the axis cylinders. These hemorrhages are infrequent, according to the reports of other investigators, as well as in the material used in the present study, and may be altogether absent. Hence we are not warranted in assigning to them a specific causative action. Schroeder [4] observed hemorrhagic extravasations in the so-called "Ringwall-Herdchen." He takes the ground, however, that these mild hemorrhages cannot be considered as causative factors in the disease process of pernicious anemia. The absence of adventitial changes in the involved blood vessels, in his opinion, points to the probability that these extravasations play a secondary rôle.

Wohlwill, in a large number of cases, found anatomic features similar to those described by Shimozono. He also considers the so-called neurolytic swelling the first step in the disease process. He based his observations, however, on the finding of one single nerve fiber, which he studied in cross section. He claims that one almost never sees intact axis cylinders in the path of the degenerated myelin sheaths, and that the process in this disease differs thus from that in multiple sclerosis. The demyelinization here is secondary to the axis cylinder dissolution. On the other hand, he describes ball-like terminations in some axis cylinders, similar to those found by Marinesco and Minea in multiple sclerosis.

Hassin's [5] observations in two cases of subacute combined cord degeneration led him to conclude that the "lesion affects principally the myelin, the axones becoming affected later on, when we have before us the picture of Wallerian degeneration....." "The process of destruction," he continues, "begins in the myelin, later involves the axone, finally resulting in Wallerian degeneration."

REPORT OF CASES

Case 1.—*History.*—H. N., a woman, aged 57 years, was admitted to the hospital on April 11 and died on April 23, 1921. Two brothers had died of pulmonary tuberculosis. The patient, until the onset of the illness, had been well. The present illness began gradually, six months previous to admission, with a feeling of weakness in the lower extremities, which was at first more

4. Schroeder: Monatschr. f. Psychiat u. Neurol. **35**: 1914.
5. Hassin: Med. Rec. 1917.

marked in the left leg. Within four weeks she was completely paralyzed in both legs. At the same time the extremities felt numb and she occasionally suffered from paresthesia. A gradual wasting was noticed in both lower limbs. Six weeks before admission she lost control of the bladder and rectum, and superficial ulcers developed over the buttocks. The strength in the muscles of the trunk and upper extremities was well preserved.

Physical Examination.—The patient was a fairly well developed woman with marked pallor of the skin. There was bilateral ptosis, more marked on the right. The pupils reacted equally to light and accommodation. Horizontal nystagmus on lateral fixation was present. The fundi were normal. There was general atrophy of both upper extremities, with marked wasting in the interossei. Moderate hypotonia; marked incoordination, and adiadokokinesis; marked wasting, hypotonia and almost complete paralysis of both lower extremities were present. Deep reflexes were present in the upper extremities, and absent in the lower. The abdominal reflexes were lost. A bilateral Babinski sign was present. There was general hypalgesia. Temperature, muscular and vibratory senses were lost.

Blood Examination.—The blood was examined twice. The first examination revealed: 3,500,000 red cells; 65 per cent. hemoglobin; 8,000 white cells; 74 per cent. polymorphonuclears; anisocytosis; some cells hyperchromatic, and a few macrocytes. The hemoglobin index was 1.1. The second examination revealed: 2,820,000 red cells; 65 per cent. hemoglobin; platelets, 304,000; white cells, 3,800; 39 per cent. polymorphonuclears; 58 per cent. lymphocytes; 2 per cent. eosinophils; 1 per cent. monocytes; coagulation time, seven minutes; bleeding time, one and a half minutes. A note by Dr. Rosenthal reads as follows: "Hyperchromatic anemia showing numerous macrocytes, polychromatophilia and some anisocytosis, apparently resembling pernicious anemia. Blood platelet count, however, is unusually high."

Course of Illness.—On the day before the patient's death, speech became nasal, breathing labored and swallowing difficult. There was some exophthalmos, facial paresis, more marked on the left side, and increased weakness in the upper extremities. Atrophy of the intrinsic muscles of the hand increased. The reflexes of the upper extremities were increased. Memory was poor. The patient was easily fatigued. The pulse was very rapid.

Case 2.—*History.*—M. B., a woman, aged 68 years, was admitted to the hospital on Aug. 26, 1921, and died on Sept. 9, 1921. She gave no history of previous illness. Seven months before admission she complained of a peculiar tingling in the fingers of both hands. This paresthesia became persistent; at the same time general weakness developed, accompanied by loss of weight.

Physical Examination.—The patient was a poorly nourished woman, very anemic and extremely weak. There were no changes in the innervation of the cranial nerves. The reflexes were normal; no paralyses and no gross changes in sensation were present.

Blood Examination.—Examination revealed 2,000,000 red cells; hemoglobin, 55 per cent.; color index, 1.3; white cells, 4,800; polymorphonuclears, 58 per cent.; lymphocytes, 40 per cent.; monocytes, 2 per cent.; red cells showed hyperchromia, polychromatophilia, poikilocytosis and anisocytosis. Two later examinations showed gradual increase in the color index to 1.4. Gastric analysis disclosed absent free hydrochloric acid. The total acidity was 33.

Course of Illness.—During her stay in the hospital, the patient developed mental disturbance. She became disoriented, speech was incoherent at times, and there was a mild muttering delirium. Definite lateral nystagmus appeared in both eyes, and ataxia of the left arm developed. The knee reflexes were lost.

Pathologic Anatomy.—Material and Methods: The spinal cords of the patients in Cases 1 and 2, and the brain in Case 1, were available for study. Numerous blocks were fixed in liquor formaldehydi, alcohol and Weigert's glia mordant. Some formaldehyd fixed material was further carried into Müller's fluid and into Müller-osmic-acid solution. Celloidin, paraffin and frozen sections were made. The following stains were used: Delafield's hematoxylin, Heidenhain's iron hematoxylin, Spielmeyer's myelin sheath stain, Weigert-Pal, Marchi, Herxheimer's fat stain, Bielschowsky's silver, Alzheimer-Mann and Jacob's methods.

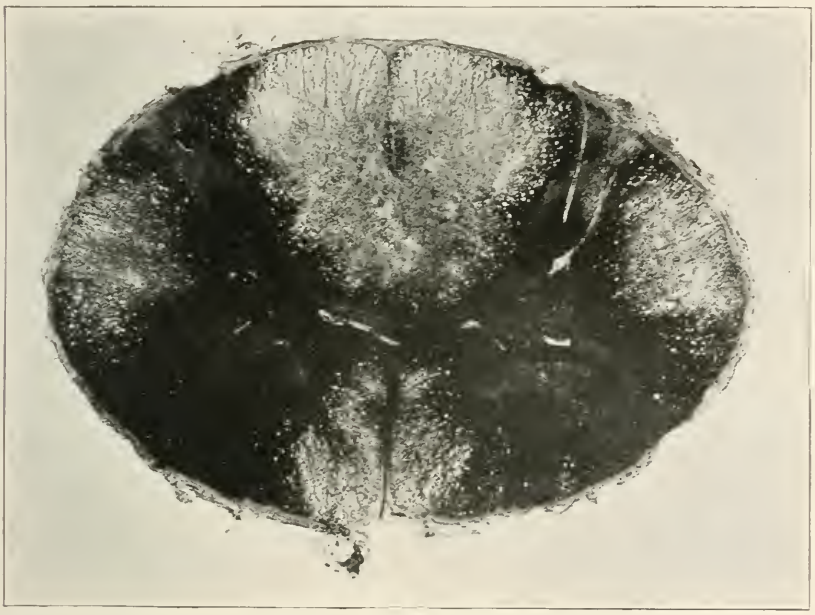

Fig. 1 (Case 1).—Section of a dorsal segment showing the almost complete involvement of the dorsal, lateral and anterior pyramidal tracts.

Gross Anatomy: Both spinal cords appeared markedly reduced in size. The meninges presented no evidence of gross pathologic change. Several cross cuts made in the cord showed a distinct degenerative process in the dorsal, lateral and ventral columns. In Case 1 the lateral and anterior pyramidal tracts showed a most intense destructive process in the lumbar region. In the cervical segments a destructive process in the region of the spinocerebellar tracts was added. The areas involved were best brought out in stained preparations, presenting a picture of distinct combined funicular disease (Fig. 1). A section in the dorsal region, stained by the Marchi method, showed by the appearance of large areas staining black that the process was still active.

Microscopic Anatomy.—In studying the diseased areas in the spinal cord, two grades of process were found. There were lesions which showed active

destructive or regressive process and other areas, irregular in distribution, giving evidence of a more or less chronic, productive reaction. In the acute lesions the extent of the process of dissolution was impressive, large zones of white matter being replaced by products of softening and by phagocytes. This resulted in a cribriform appearance. In preparations stained with scarlet red, such an area of softening showed numerous granular cells (gitter Zellen), and vessels whose adventitial spaces were filled with granular cells loaded with fat. In the chronic foci there was progressive healing by formation of glia fibers.

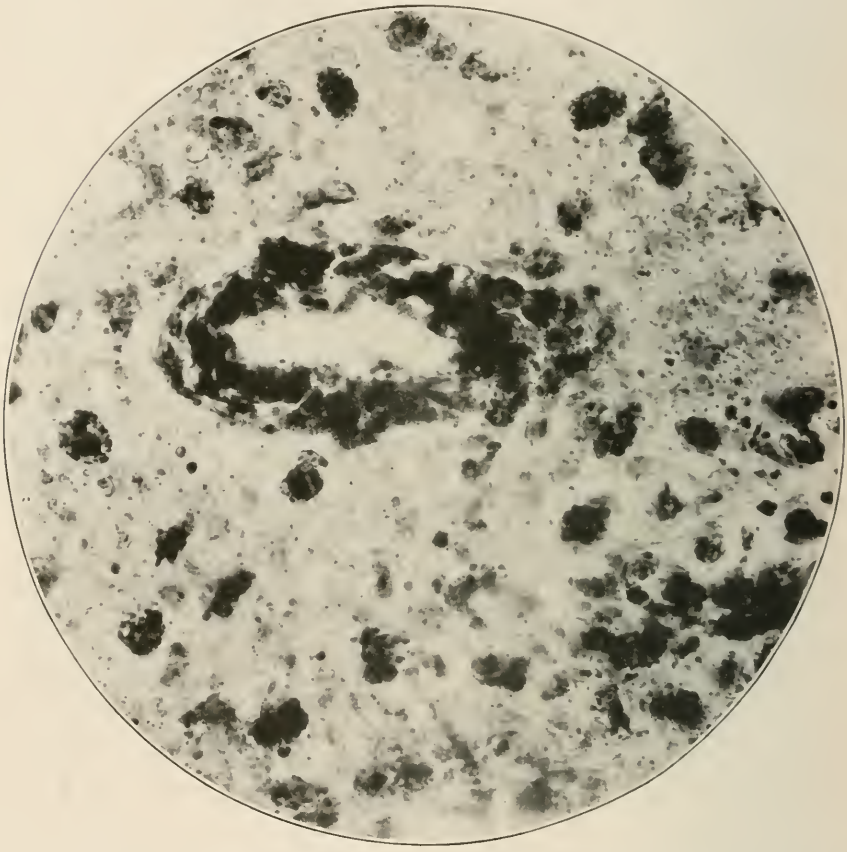

Fig. 2.—Section of an area in the dorsal region of the spinal cord, showing an intense degenerative process evidenced by the presence of large numbers of granular cells loaded with fatty particles. A small vessel surrounded and infiltrated by gitter cells is seen in the field. Vessels of this character are found in large numbers throughout the diseased area of the cord.

In the acute destructive lesion it was highly important to attempt to establish the sequence of events with reference to the involvement of the various structural units including the myelin sheath of nerve fibers, the axis cylinders, the interstitial supporting glial elements, the ganglion cells of the gray matter, and also the mesodermal structures, particularly the blood vessels.

The Myelin Sheath: Our material showed conclusively and uniformly that the myelin sheath was the seat of the most intense disease process. In areas in which the softening process was most acute, the myelin cover of nerve fibers almost completely disappeared. The resultant products of destruction were picked up by phagocytic elements (Fig. 3) which were mainly glial in origin. Where the myelin still remained it was fragmented and occasionally incorporated in Marchi bodies. Transitional stages in the degenerative process of the myelin were frequently seen in the form of swelling or irregularities in outline.

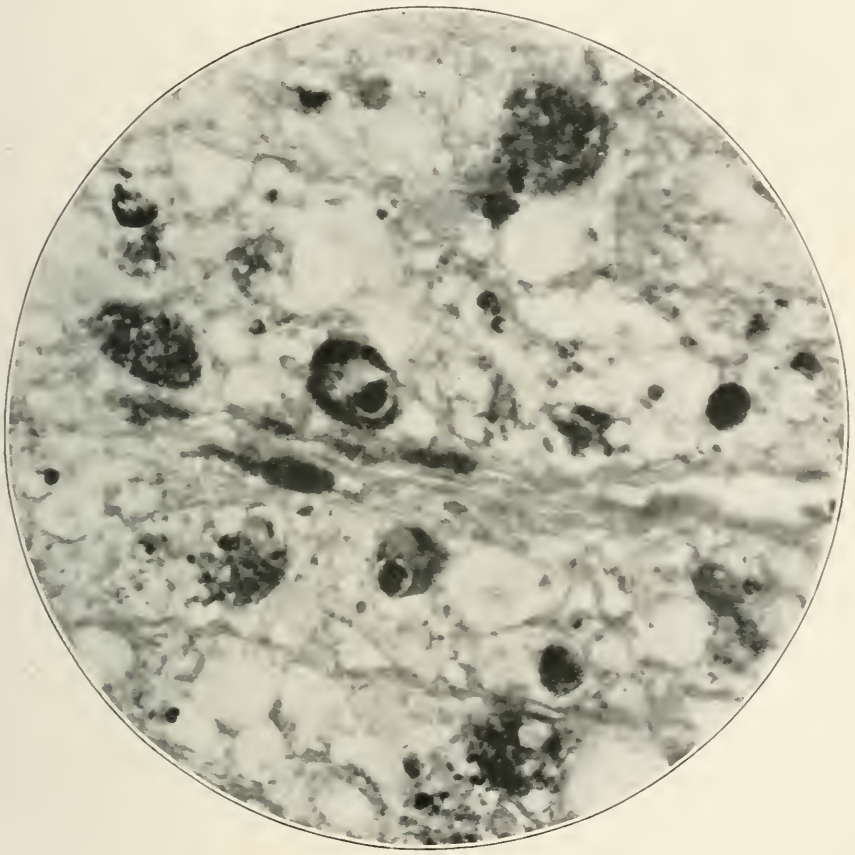

Fig. 3.—Gitter cells of various types containing lipoid particles are shown in relation to blood vessels. Some of the gitter cells contain definite enclosures (myelophages).

Axis Cylinders: The axis cylinders showed changes which, in our opinion, were proportional to the structural modifications noted in the myelin sheaths. The axis cylinders had been involved in the process secondarily to, or in some instances coincidentally with, the destruction of the myelin sheath. This view is based on the fact that in many scars devoid of myelin coat and normal nerve fibers there were naked axis cylinders, fairly uniform in outline, uninterrupted in their course and showing practically no pathologic changes

(Fig. 4). We are not in accord with the observations of Shimozono or Wohlwill, but support the studies of Hassin. It is true that there exist numerous naked axis cylinders which show advanced pathologic changes, such as vacuolization, fragmentation, swelling, cork-screw formation and ball-like terminations. These changes, however, in our opinion, are secondary. With the swelling of the myelin sheath there commonly occurs a coincident change in the outline of the axis cylinder, and as the pathologic process in the myelin sheath advances, the change in the axis cylinder progresses. Complete destruction of the myelin sheath leads eventually to dissolution of the axis cylinders.

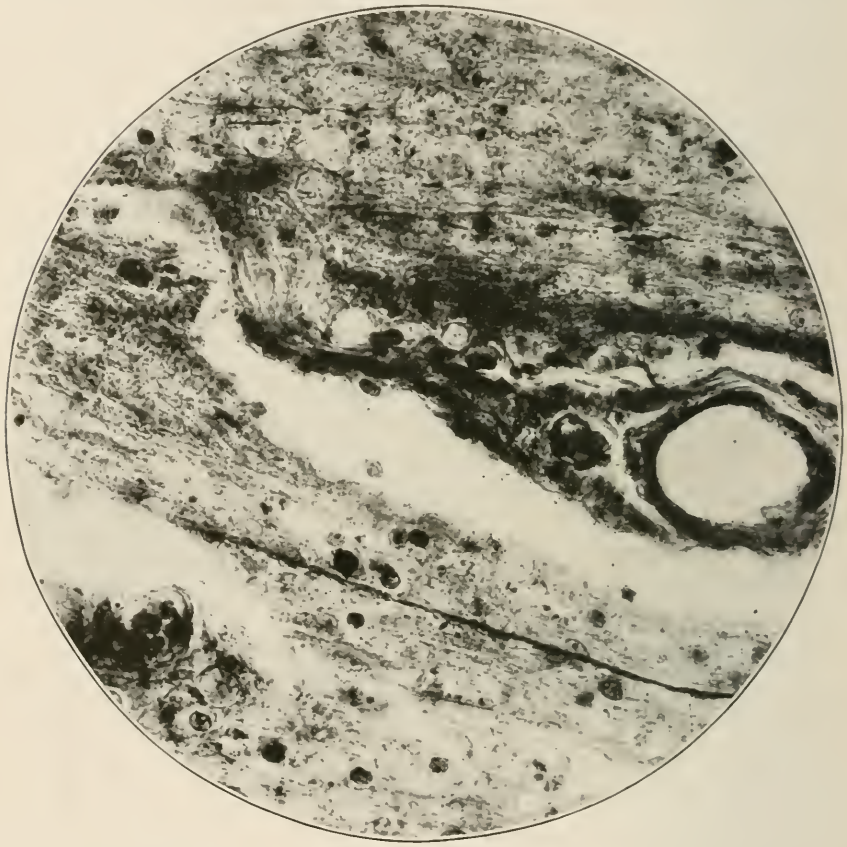

Fig. 4.—Section through an area of softening showing a naked axis cylinder fairly uniform in outline, free of myelin sheath, and surrounded by numerous granular cells; occasional Elzholz bodies.

Elzholz Bodies: These were everywhere in large numbers, particularly in areas of acute softening. They occurred along the course of naked axis cylinders between myelin sheaths and neurilemma, and independent of axis cylinders or myelin sheaths. The lack of uniformity in distribution, the absence of a definite relationship to axis cylinder or to myelin sheath, leads us to conclude that they cannot be looked on as an indication of primary axis cylinder disease.

Glia: The most striking histologic changes were offered by the reactions of the various types of glia elements in both acute and chronic areas of degeneration.

Granular cells were found in extremely large numbers wherever the destructive process was still in progress. They occurred in close proximity to naked axis cylinders, within nerve fibers, where they had replaced the myelin, in the interstices formed by the reticular network of the normal neuroglia and occasionally with no trace of myelin or axis cylinder in the vicinity. Again, they were found in large numbers in the adventitial coat of blood vessels, occasion-

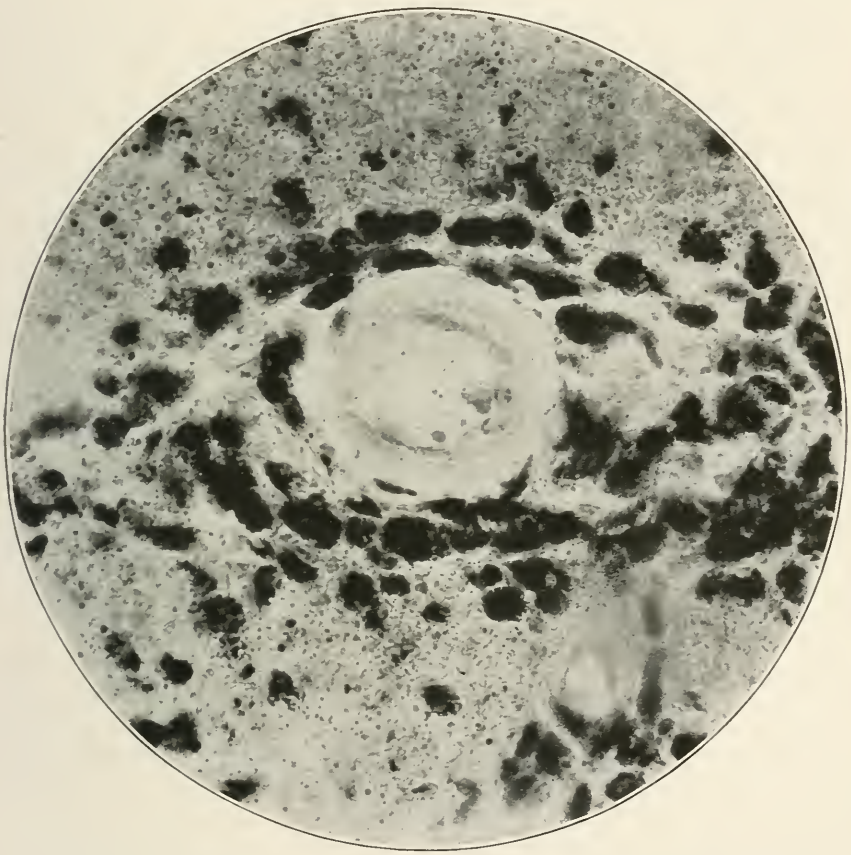

Fig. 5.—A blood vessel in an area of acute degeneration, showing marked adventitial infiltration with the media and intima intact and unmodified.

ally forming several layers about a small vessel (Fig. 5). When stained by fat stains they were seen to be crowded with large fat droplets. On the other hand, when the fat content was washed out by the clearing agent in the process of embedding, their cytoplasm had a reticulate appearance.

The fiber-forming, or monster, glia cells were found (Fig. 6) in areas in which the regressive process was complete and the organizing process was in progress. They were most common in the vicinity of blood vessels and sent processes to the adventitial coat of the blood vessel. Naked axis cylinders were frequently found in these areas of gliosis.

Blood Vessels: The adventitial spaces (Virchow-Robin) of the small and medium-sized vessels, as well as of an occasional larger vessel, were crowded with fat-containing granular cells. The adventitial connective tissue of some of the vessels underwent a marked proliferation. In some instances there was an apparent thickening of the adventitial coat. These changes, however, cannot be interpreted as an inflammatory reaction. There were no well defined pathologic changes in the adventitia, media or intima of the blood vessels throughout the spinal cord, which would suggest an inflammatory or even a

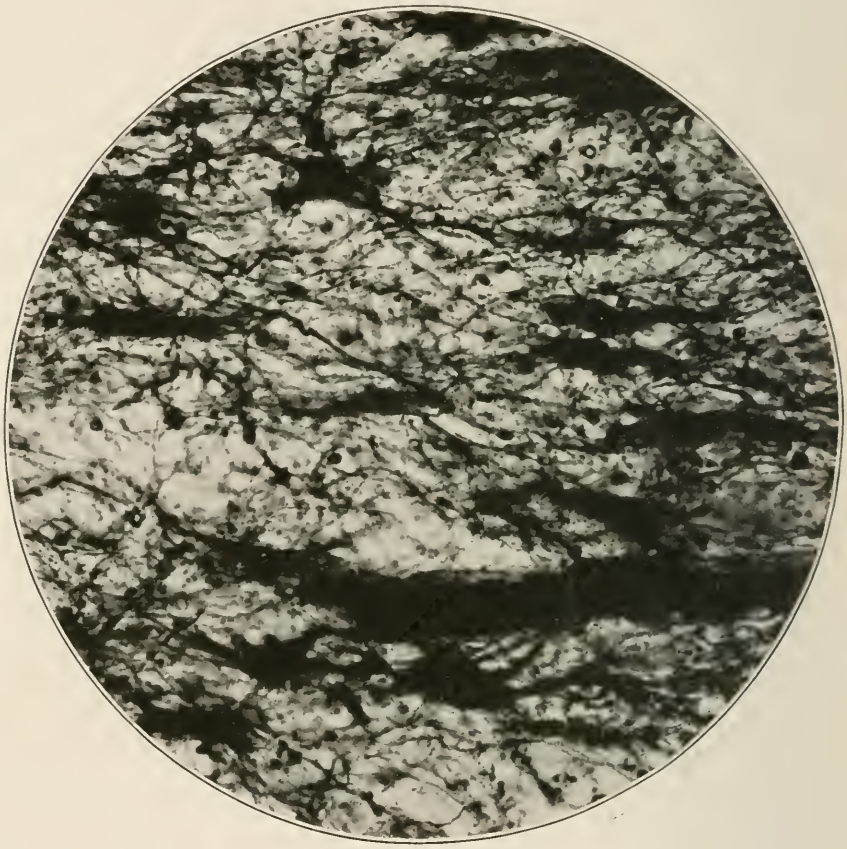

Fig. 6.—Gliosis in the area of the scar showing many monster glia forming cells, arranged about a medium sized blood vessel.

degenerative change in the wall of the blood vessel. While occasionally there appeared to be some tendency toward the hyalinization of the media or a slight increase in the size of an endothelial cell of the intima, there was no definite evidence of an endarteritis or other disease of the blood vessels.

Brain: A systematic study of numerous sections from the brain stem and cerebral hemispheres in Case 1 showed only small areas of perivascular softening, with an accumulation in the vicinity of the vessel of a limited number of "gitter" cells and occasional amyloid bodies. The vessels themselves showed

only moderate change. In some there appeared a deposit of a slight amount of yellowish pigment in the intima, with no change in the lining cells, while in others the adventitia showed an accumulation of fairly large quantities of lipoid material, without change in the media and intima.

Spinal Roots: Preparations showed deposits of fat and Marchi bodies.

SUMMARY

It is quite evident that the morbid changes found in so-called combined system disease are to be regarded as degenerative in character. The almost total absence of a reaction on the part of the mesodermal components excludes an inflammatory origin. For this reason the term "subacute funicular myelitis," first suggested by Henneberg, is inaccurate. With Spielmeyer and Wohlwill we are convinced that it is a purely degenerative process, and accordingly propose the name "progressive funicular myelopathy, to indicate the character as well as the topographical relationship of the lesions.

The pathologic process is of such a nature that we may predicate the action of a toxin of unknown origin. It is probable that this agent is responsible not only for the changes in the spinal cord and brain, but also for the clinical and pathologic manifestations of pernicious anemia. It seems probable that the degenerative changes in the central nervous system and the changes in the rest of the organism are the joint result of a common factor, rather than related to each other as cause and effect. It is also likely that the same disease process is frequently present in cases in which cord lesions are associated with anemia not pernicious in character. We also feel that the histologic picture in this disease is, in the main, similar to that found by Hassin in multiple sclerosis. In both conditions there is probably an endogenous toxin which has a selective affinity for the myelin. The dissolution of the myelin leads to the exposure of the axis cylinders, which undergo degenerative changes, and are eventually destroyed. This progressive destruction of the parenchyma calls forth a large number of phagocytic elements of glial origin. Side by side with this there occurs a progressive activity of fiber-forming glia cells. The Elzholz bodies are, in our opinion, to be considered as incidental to the destructive changes. Elzholz himself considered them as products of destruction (Abbauproducten) or of myelin metabolism. He did not regard them as specific for degeneration of the axis cylinders. In general the pathologic picture shows a strong similarity to the histologic picture of periaxial neuritis described by Doinikow.[6]

6. Doinikow, Nissl and Alzheimer: Histologische und histopathologische-Arbeiten **4**:445, 1911.

DISCUSSION

Dr. Colin K. Russel, Montreal: Has Dr. Strauss observed in his studies any variation in the severity of the degeneration at the different levels of the same tract? For example, in the pyramidal tract has he noticed that the degeneration in the peripheral part of that tract, in the lower dorsal region, is more marked and more definite than the degeneration of that tract in the pons or in the internal capsule? Or in the posterior columns is the degeneration more marked in the upper cervical than it is in the lumbar region? In other words, has he noticed that the peripheral part of the axis cylinder degenerated before that part approximate to the nerve cell? Such an observation was made by Nageotte, in his work on tabes dorsalis, and it would be interesting to know whether Dr. Strauss' observation confirmed this.

I do not think the suggested change in nomenclature has any advantage over the old term subacute combined sclerosis given by Risien Russell in 1900.

Dr. Lewis J. Pollock, Chicago: Was there any axonal change in the motor ganglion cells? As in central neuritis, in which we have diffuse degeneration of axons, we should expect to find this change in the combined degenerations of the spinal cord.

Dr. George B. Hassin, Chicago: If subacute combined cord degeneration and multiple sclerosis show the same histologic changes, they might be considered as analogous pathologic and clinical entities. There are, however, histopathologic differences. In subacute cord degeneration there are absent the microscopic foci of sclerosis so abundant in multiple sclerosis; the short nerve fibers, especially of the gray matter, are hardly affected in subacute cord degeneration where the long fibers are principally if not exclusively involved. The entire morbid condition in subacute cord degeneration is much more severe and acute than in multiple sclerosis.

I should like to ask Dr. Strauss whether he studied the subarachnoid spaces and the choroid plexus for lipoids?

Dr. Joseph Collins, New York: At the last meeting of the Academy of Medicine in Paris, Dr. August Pettit of the Pasteur Institute demonstrated to the satisfaction of his audience a spirochete which he had been able to transmit to rabbits, mice and monkeys, which caused the typical characteristic lesions of multiple sclerosis.

Dr. Georges Guillian, speaking of this discovery, admitted that he was quite satisfied that the spirochete that had been isolated and with which he had inoculated the animals was undoubtedly the cause of this disease and that it was truly an inflammatory process. Of course, if that is true, there can be no justification for Dr. Hassin's conclusions.

Dr. Henry Viets, Boston: Is there any value in the term "subacute" as used in the title of this paper? Also is not the pathology used by Putnam and Taylor twenty years ago of "diffuse degeneration" the better terminology?

Dr. Adolf Meyer, Baltimore: In the first place, what we had demonstrated to us is not particularly a funicular disease. I think that Dr. Strauss showed the specimen of a section in which the patchy character comes out very well; one part of the funiculus is affected and then farther down it is again involved. Whether it is exactly the same or not, and what the intermediate sections show, I do not know.

It is my conviction (and I think those pictures have shown it again, as have my own specimens) that funiculi are not affected but certain superficial topographical regions, and those rather in a patchy form.

I therefore should not like the term "combined sclerosis" either. There seems to be an autolytic process with secondary reactions that belongs to almost every degenerative process, and therefore multiple sclerosis sections are somewhat similar to this, although in that condition I would perhaps much rather expect myelitic patches with rare destruction of the tissue as such; whereas this seems to me to be an autolysis of tissue in which, of course, various parts of the tissue are unequally resistant. My belief, therefore, is that we deal in multiple sclerosis with patches of various sizes but remarkably circumscribed, capable of involving both gray and white matter irrespective of any funicularity of tissue, whereas in this anemia process, which evidently is much more specifically nutritional, or at any rate in which the metabolism is determined, we have certain usually superficial patches or regions of the spinal cord, far less frequently farther up in the brain stem, in a state of tissue dissolution.

Moreover, from the point of view of symptomatology, the two conditions are so dissimilar that I should consider it rather unfortunate to give the impression of close relation between them.

Dr. Williams B. Cadwalader, Philadelphia: For a long time I have believed that infections or toxins, totally different in nature, are capable of producing lesions in the spinal cord that cannot be differentiated with accuracy by the miscroscopic appearance alone. If, therefore, we consider the alterations found in the spinal cord associated with severe anemia in this light one might readily find similarities to multiple sclerosis such as Dr. Strauss has shown. But we also know, as Dr. Spiller pointed out at the meeting of the Research Society in 1921, that there is a considerable variation in the appearances of the lesions of multiple sclerosis, depending on the duration of the disease. In a very early stage there are certain changes that Dr. Spiller has shown that appear quite different from those of the advanced stage of the disease. In the combined sclerosis of anemia there are also variations in the appearances of the lesions, depending on the duration of the toxic process. There is a great deal in favor of believing that the process is a toxic one, for occasional cases are found in which the red blood count is normal or nearly so, and yet there is evidence of considerable degeneration in the posterior and lateral columns of the spinal cord. Alterations have been found in the nervous system of certain patients with encephalitis that resemble multiple sclerosis; and the similarity of the lesions of acute anterior poliomyelitis to epidemic encephalitis is well known. In spite of this I do not feel that we are justified in immediately concluding from these facts alone that the diseases are necessarily caused by the same toxin or the same organism. I quite agree with Dr. Meyer that the changes found in combined sclerosis of the spinal cord associated with severe anemia should not be confused with those of multiple sclerosis. The two diseases are in no way related, and are quite different in their clinical aspect as well as their pathology. Minute similarities to which Dr. Strauss has called attention might exist in more than one disease, but they are not discriminating.

Dr. Strauss, in closing: This process has been known by a number of names, none of which has been considered satisfactory. It is true that it does not start with the degeneration of a system, beginning in foci mainly—almost exclusively in the white matter. As these foci grow and coalesce secondary degeneration becomes evident, and if the various foci are large enough and close together there will be a degeneration which might affect an entire column, which might be the terminal system; hence the name "subacute funicular myelopathy."

It is subacute because it is still in progress, and the process takes a number of months and sometimes years. We chose the word "subacute" purposely because in most cases it is in progress.

The cord is more involved than the other parts, the medulla and pons very little. The parts affected are chiefly below the medulla.

It is far from our intention to confuse multiple sclerosis with this disease. We know that the conditions are not alike. We wish to emphasize the fact that the process is a degenerative one and that the picture histologically and anatomically is very similar to that presented in multiple sclerosis. Therefore, if this process can be due to a toxin, it lends support to the view advanced by many that multiple sclerosis is due to a toxin. It is an argument based on similarity of the pathologic and histologic picture.

We did not stain the choroid plexus. The subarachnoid space showed numerous granular cells. We found in one of the cases a thickening of the glia, which Dr. Hassin found in multiple sclerosis and which he regarded as being due to an irritative reaction.

With regard to the pictures shown by us and those shown by Hassin in multiple sclerosis, if they are due to an inflammation, they are seen in no other inflammatory disease that we know of in the central nervous system. Neither poliomyelitis, syphilis nor encephalitis produce a picture similar to this. In those conditions there is a distinct inflammatory reaction. Whether a spirochete is the cause of multiple sclerosis, it is certainly not the cause of funicular myelopathy, for if it were it would be reasonable to suppose that the picture histologically and physiologically would be similar to that which is seen in diseases caused by this organism.

There is only one curious clinical fact that would point to a spirochetal origin of multiple sclerosis, that being the frequency of the colloidal gold reaction in the spinal fluid.

Regarding the resemblance of an acute multiple sclerosis to this, I believe that even the cases of Spiller and similar cases in the literature are either syphilitic or more probably encephalitic.

PAPILLOMA OF THE FOURTH VENTRICLE*

REPORT OF A CASE

ERNEST SACHS, M.D.
ST. LOUIS

A butcher, 50 years old, complained of headache, dizziness and falling on walking. The past history was unimportant. Two and a half years ago he began to have headaches and pain in the lower part of the abdomen. One year ago he had an attack of influenza. During this period his headaches were less severe. During the two months before admission he had intense headaches accompanied by vomiting without nausea and was unable to walk without help. He fell to either side, but most frequently forward. During the past two weeks he had several attacks of unconsciousness lasting from two to ten minutes, unaccompanied by convulsions or twitchings.

The positive findings in the physical examination were: questionable lateral nystagmus to both sides, at times a lateral nystagmus which was quite definite with a slow component to the right, the head held to the right in a cerebellar attitude, hypesthesia of both corneas, more on the right, and normal eyegrounds and visual fields. The visual acuity was: left 20/60, right 20/48. The pupils were equal and reacted to light and accommodation.

There was some cerebellar ataxia, the patient walking with a broad base. When he attempted to stand on either foot he reeled to the right and backward. There was hypotonia of the right leg. There was no adiadokokinesis in either hand; finger to nose test and all tests to determine finer movements of the fingers were normal. There was a history of regurgitation through the nose and difficulty in swallowing. Roentgen-ray examination was negative. Lumbar puncture showed 13 cells, + + Pandi and a negative Wassermann test. The only abnormalities that the Bárány tests showed were that when the right ear was douched with hot water the patient did not past point with the left hand, when the horizontal canals were tested; when the vertical canals were tested with the patient's head back the patient always past pointed to the left with both hands. Dr. Lyman's comment on these tests was as follows: "The vestibular tests suggest a lesion in the brain stem in the region of the posterior longitudinal bundles. The cerebellum gives practically normal reactions."

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* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

Fig. 1.—Papilloma of the fourth ventricle removed as shown in Figure 2, under local anaesthesia, through a median line incision. The tumor extended up into the aqueduct of Sylvius. Complete recovery with disappearance of all symptoms.

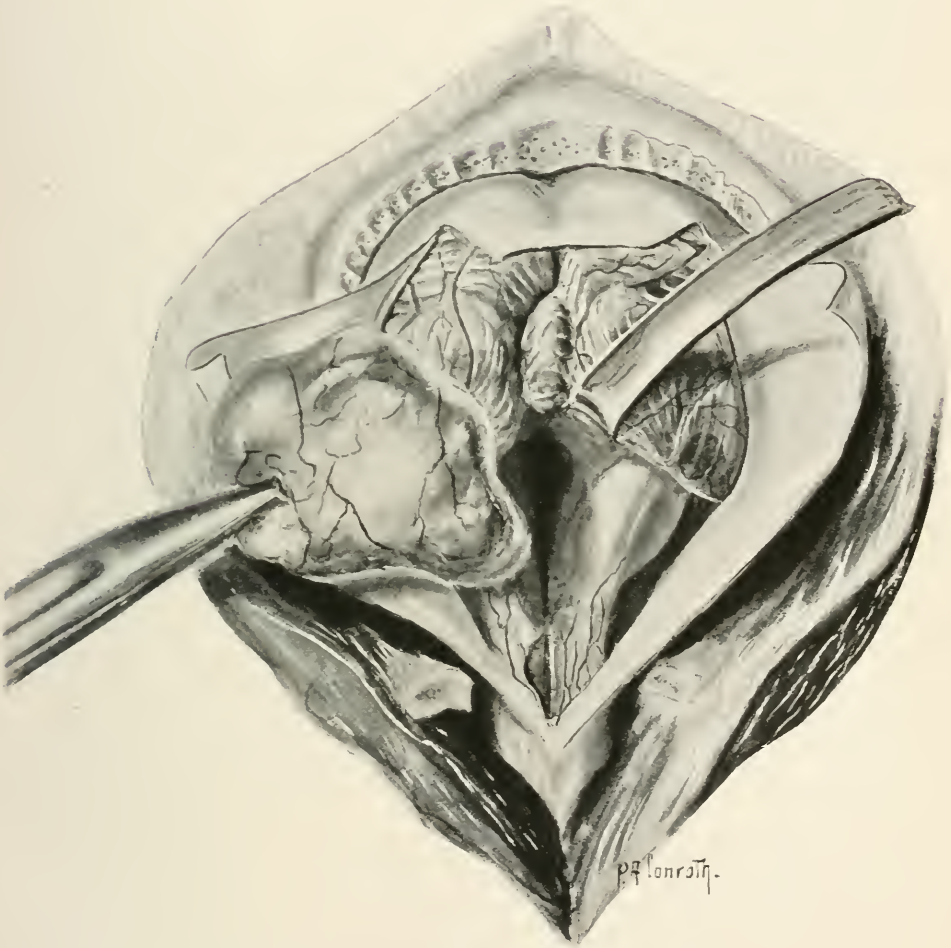

Fig. 2—Removal of papilloma of fourth ventricle.

The symptoms were so clearly bilateral that it seemed quite probable that the lesion lay in the median line. In view of the occupation of the patient, Dr. Schwab and I both thought of the possibility of a cysticercus infection. The absence of nystagmus suggested that the lesion was superficial and not near the nuclei of the cerebellum. The absence of choked disk suggested that the lesion was growing slowly.

In view of the probable median line location of the process, the usual cross bow cerebellar exposure was not employed; merely a median line incision was made with retraction of the muscles and removal of the occipital bone and the arches of the atlas and axis. This was done under local anesthesia and gave an excellent exposure of the fourth ventricle and the vermis. On opening the dura a white glistening tumor was seen filling the fourth ventricle. This was well encapsulated and was enucleated without much difficulty and without pain to the patient. The tumor extended up into the aqueduct of Sylvius, which was greatly dilated. The only discomfort complained of during the operation was pain in the abdomen. The patient made an uneventful recovery and left the hospital on the eighteenth day after operation. Now, a year after the operation, he is entirely free of symptoms with the exception of slight ataxia when he walks rapidly up stairs.

The three reasons for presenting the case are: 1. The constant pain in the abdomen, which I believed might be interpreted as evidence that there are afferent fibers in the vagus nucleus. This abdominal pain was present both before operation and when the tumor was lifted from the floor of the fourth ventricle. 2. The tumor had completely obstructed the aqueduct of Sylvius and therefore produced an obstructive hydrocephalus, and yet the patient had normal eyegrounds. 3. This case demonstrates the possibility of removing tumors of considerable size in the region of the fourth ventricle through a simple median line incision without freeing the muscles from their attachment to the superior curved line of the occipital bone.

DISCUSSION

Dr. Foster Kennedy, New York: Abdominal pain similar to that associated with this tumor is often found in vasovagal attacks, confirmatory evidence of the involvement of the vagus in seizures of that type.

MAGNUS AND DE KLEIJN PHENOMENA IN BRAIN LESIONS OF MAN*

A CONSIDERATION OF THESE AND OTHER FORCED ATTITUDES IN THE SO-CALLED DECEREBRATE MAN

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Late Associate Professor of Neurology, University of
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LOS ANGELES

The phenomena of Magnus and De Kleijn[1] occur with striking regularity and in a pronounced degree in the so-called decerebrate state of both animal and man; that is, in the animal after ablation of both hemispheres of the cerebrum and in man when disease of the cerebrum is of such extent as to eliminate more or less completely its influence on the periphery. In this state the limbs, always the anterior, less constantly the posterior, change posture as a result of passive displacement of the head. These reactions vary with the type of head displacement. They may be bilaterally identical, the limbs on both sides undergoing flexion or extension, or the limbs on one side undergo flexion, while those on the other side undergo extension. The first type of reaction may be one of two: the anterior limbs may flex and the posterior extend or vice versa; or all the extremities may go either into flexion or into extension. When the displacement of the head does not alter its symmetrical relationship to the body, as when flexed directly ventrally or dorsally, the reactions are the same on both sides of the body; the anterior limbs undergoing flexion and the posterior limbs extension in the former instance, the reverse condition occurring in the latter. If the head is rotated, the reactions on one side are the direct opposite of those on the other side—the facial limbs undergoing extension, the occipital limbs flexion. These reactions have been shown by Magnus and De Kleijn to originate in stimuli which arise in the muscles and articular structures of the upper four cervical joints, and have been called by them cervical reflexes. Of these, the type brought about by rotation of the head is generally the most pronounced.

Another type of reaction, called by these observers labyrinthine

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* Read before the Section on Nervous and Mental Diseases at the Seventy-Third Annual Session of the American Medical Association, St. Louis, May, 1922.

1. Magnus, R., and De Kleijn, A.: Die Abhängigkeit des Tonus der Extremitätanmuskeln von der Kopfstellung, Arch. f. d. ges. Physiol. **145**:455, 1912.

reflexes, is brought about by displacements of the head which change its position in space without altering its position with relation to the body. These reactions, they have shown, originate in labyrinthine impulses. The cervical reflexes are not affected by extirpation of the labyrinths; the labyrinthine reflexes are abolished by this operation. The latter persist if the subject, with labyrinths intact, has its head, neck and thorax so encased in plaster of Paris as effectually to eliminate all movements of the head at the neck, a procedure which makes the appearance of cervical reflexes impossible. The labyrinthine reflexes exhibit themselves in identical change of posture in all the limbs, the anterior as well as the posterior limbs—the latter, however, with less constancy—undergoing either flexion or extension, the type of movement depending on the position of the head with relation to the horizontal level in space.[2] All these reactions are tonic in character; they are reactions of posture, depending on the *position* of the head, not brought about by the movement of the head toward the new position. The reacting limbs are, therefore, maintained in the new position so long as the head remains in its altered position, with the exception of a brief latent period between the displacement of the head and the resulting reaction.

The phenomena of Magnus and De Kleijn being preeminently phenomena of decerebration, are like decerebrate rigidity,[3] of great neurologic interest. These phenomena point to some influence or influences which in the normal state interfere with or render unnecessary their manifestation. What the nature of this influence or these influences may be and what the structural basis is are still mooted questions. The phenomena of Magnus and De Kleijn, as well as decerebrate rigidity, have been correlated by a number of authors with forced movements and forced attitudes. Thus Magnus and De Kleijn [4] interpret the rolling movements of an animal after a unilateral extirpation of the labyrinth as being largely a result of the rotation of the head produced by this lesion, and its consequent asymmetrical reactions in the limbs.

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2. Magnus, R., and De Kleijn, A.: Arch. f. d. ges. Physiol. **145**:455, 1912; **160**:440, 1914-1915.

3. Sherrington, C. S.: Decerebrate Rigidity and Reflex Coordination of Movements, J. Physiol. **22**:319, 1897; Flexion Reflex of the Limb, Crossed Extension Reflex, and Reflex Stepping and Standing, ibid. **40**:103, 1910; Remarks on the Reflex Mechanism of the Step, Brain **33**:1, 1910; Postural Activity of Muscles and Nerve, ibid. **38**:19, 1915. Integrative Action of the Nervous system, London, Archibald Constable Co., 1908, p. 299.

4. Magnus, R., and De Kleijn, A.: Analyse der Folgezustände einseitiger Labyrinth Extirpation mit besonderer Berücksichtigung der Rolle der tonischen Hals Reflexe, Arch. f. d. ges. Physiol. **157**:238, 1913. Magnus, R., and Van Leeuwen, W. Storm: Die acuten und dauernden Folgen des Ausfalles der tonischen Hals und Labyrinth Reflexe, ibid. **157**:196, 1914.

Rothfeld [5] utilized the Magnus and De Kleijn phenomena in his explanation of the forced movements brought about by stimulation of the labyrinth (by douching or rotation) and the variation in these movements in accordance with the position of the head with relation to the body. The circus movements and falling reactions following such stimulation in animals and the falling reactions and past pointing in man are all, he thinks, evolved from the cervical reactions as described by Magnus and De Kleijn.

Walshe [6] believes that the extended type of spastic paralysis is identical with decerebrate rigidity.

Kinnier Wilson [7] suggests that decerebrate rigidity is responsible for the attitudes in certain tonic fits, occasionally observed in patients with lesions of the midbrain or cerebellum. He extends his theory to embrace the transient positions assumed by the limbs in the movements of chorea and athetosis which, he suggests, are merely fragmentary manifestations of the complete and prolonged decerebrate attitudes.

MAGNUS AND DE KLEIJN PHENOMENA IN BRAIN LESIONS OF MAN

Magnus and De Kleijn originally observed these cervical and labyrinthine phenomena in the decerebrate animal. In these experiments, the cerebrum is removed by transection of the midbrain at the level of the corpora quadrigemina. They concluded that the same phenomena should be observed, perhaps less fully developed, in man when destruction of the cerebrum is of such extent as to obliterate all its functions. This prediction was verified. They report seven patients,[8] each exhibiting the cervical reactions and two of them the labyrinthine reactions as well. In all of these cases (two necropsies) the cerebral functions were more or less completely abolished, but probably not to the extent attained in the decerebrate animal.

Another case showing the cervical reactions was reported by von Weiland.[9] In this case the patient had an epileptiform attack due to

5. Rothfeld, J.: Ueber den Einfluss der Kopfstellung auf die vestibularen Reactions bewegungen der Tiere, Arch. f. d. ges. Physiol. **159**:607, 1914.

6. Walshe, F. M. R.: The Physiological Significance of the Reflex Phenomena in Spastic Paralysis of the Lower Limbs, Brain **37**:311, 1914-1915; On the Genesis and Physiological Significance of Spasticity and other Disorders of Motor Innervation; with a Consideration of the Functional Relationships of the Pyramidal System, ibid. **42**:1, 1919.

7. Wilson, S. A. Kinnier: On Decerebrate Rigidity in Man and the Occurrence of Tonic Fits, Brain **43**:220, 1920.

8. Magnus, R., and De Kleijn, A.: Ein weiterer Fall von Tonischen "Halsreflexen" beim Menschen, München. med. Wchnschr. No. **46**:2566 (Nov.) 1913; Arch. f. d. ges. Physiol. **160**:429, 1914-1915. Also footnote 1, p. 527.

9. Weiland, Walther, von: München. med. Wchnschr. No. **46**:2539 (Nov.) 1912.

cerebrospinal syphilis and he was in coma. The cervical reflexes were identical with those observed in the decerebrate animal but were limited to the arms. There was no necropsy.

A case showing the typical cervical reflexes is reported also by Kinnier Wilson [7] (Case 14 of his series). Marie and Foix [10] have also reported examples. They state that the reflexes may be observed in ordinary hemiplegia and are brought about by lesions limited to the pyramidal tract system which remove cortical inhibition from the lower centers. The validity of this observation may be questioned. I have looked for these phenomena in numerous cases of recent and old hemiplegia, with and without contractures, and never have found them. According to André-Thomas,[11] he could evoke these phenomena in a number of cases when the brain lesions were severe and extensive (he does not state the nature of the lesions) and when they were associated with intellectual efficiency. This statement is, in a broad sense, borne out by my own observations.

REPORT OF CASES

Case 1.—*History.*—F. A., a girl, aged 14, was brought to Los Angeles County Hospital on July 10, 1921. Four and a half hours before she had suddenly begun to vomit and soon after that to have generalized convulsions. She quickly passed into coma. The coma and convulsions continued until July 12. The temperature on admission was 103.5 F. It continued to be irregularly elevated until about July 27, when it became normal. The history was obtained from her guardian.

The child was deserted by her parents when she was three years old. Her birth was normal and she was bottle-fed. A brother, a little over a year old, taken care of by the same guardian, suffered from a similar disease. He had paralysis of all limbs and was subject to occasional convulsions. (This brother was brought to the hospital about a month later in a state of coma and convulsions. He died about four hours later before a satisfactory clinical examination could be made. His brain was much larger and generally appeared to be much less diseased than that of the girl. No microscopic examination was made). No data as to the patient's heredity or early infancy were obtained. The child, was never able to sit up; it never made an attempt to walk and never learned to articulate. A year before the biceps femoris of either limb had been transplanted into the patella. Previous to this the child's lower limbs had been rigid with the legs at right angles to the thighs. While at the hospital for this operation she had had an attack of generalized convulsions which lasted for about twenty-four hours.

Examination.—The patient was lying on her back in considerable opisthotonos (Fig. 1); her head retracted and turned so that it was inclined toward the right. With little resistance it could be moved forward, backward and laterally.

10. Marie et Foix: Phénomène de Magnus et De Kleyn chez l'homme et mouvements conjugués d'automatisme, Rev. neurol. **28**:120, 1914-1915; Les reflexes d'automatisme dits des defense, ibid. p. 236; Les syncinesies des hemiplegiques, ibid. **30**:145, 1916.

11. André-Thomas: Rev. neurol. **28**:120, 1914-1915. (Discussion.)

All limbs were in spastic paralysis. The lower were in utmost extension with toes pointing down and heels drawn up. They were held rigidly in this position but possessed considerable mobility at all joints. There were markedly increased knee reflexes, ankle clonus and a Babinski sign, more pronounced on the right. The right arm was generally in utmost extension at shoulder and elbow, with abduction at the shoulder, complete flexion and hyperpronation at the wrist and complete flexion of the phalanges. The left arm was generally in abduction and flexion at all its articulations (Fig. 1). These postures of the upper limbs were only the predominant ones—they were not constant, being frequently interrupted, generally at the rate indicated in the tracing (Fig. 2)[11a] by involuntary movements which affected both limbs but the right more markedly. During these involuntary movements the right arm would assume a position of flexion

Fig. 1 (Case 1).—Predominant posture of patient.

and adduction or adduction only, and the left a posture markedly similar to the predominant one in the right. The mouth was generally spastically closed. The lower jaw also showed involuntary movements. The mouth would open wide (as in gaping). Some movements of opening and closing the mouth were similar to those occasionally observed in paralysis agitans, but of slower rate and greater range. There were no cranial nerve palsies. Ocular movements were normal, the pupils widely dilated, but they reacted normally to light. There was no nystagmus and the fundi were normal. The patient responded to strong optic and acoustic stimuli fairly well; also to intense stimuli applied to any part of the body, to which she responded by a sharp groan. She appeared

11a. The tracings in Figures 2, 3 and 4 have been obtained by means of Marey's tambours in the manner described in the author's article, The Physiologic Significance of the Babinski Toe Response, Arch. Neurol. & Psychiat. **4**:309 (Sept.) 1920.

to have no difficulty in swallowing. The Wassermann test of the blood and spinal fluid was negative; the fluid was clear, under normal tension and yielded fifteen lymphocytes per cubic millimeter. It showed a trace of globulin.

Mentally, she showed little development. She ordinarily took no notice of surroundings, only occasionally turning her head in the direction of a noise or bright light. She did not cooperate while being fed and understood no commands.

Otologic examination was made by Dr. Isaac H. Jones. Caloric stimulation of the right ear with head back 60 degrees (with water at 68 F.) gave, after eighteen seconds, horizontal nystagmus to the left. The quick component, however, was very sluggish and there was almost persistent conjugate deviation to the right. Caloric stimulation of the left ear gave normal nystagmus to the right. The results indicate a normal condition of the labyrinth but a break somewhere in the cerebral mechanism[12] that is responsible for the quick component in vestibular nystagmus to the left.

The patient exhibited both types of the cervical reactions of Magnus and De Kleijn; that is the type which affects the limbs on the two sides symmetrically and the type which affects them asymmetrically. The reactions occurred exclusively in the upper limbs, possibly because the lower limbs were rather firmly held in complete extension. Thus, when the patient's head was flexed so that the chin was brought almost in contact with the chest, both upper limbs underwent flexion; whereas, if it was sharply retracted, these limbs underwent extension. In either case the arms maintained their position all the time the head remained in its new position (Fig. 3). If the head was rotated, directing the face to one side, the arm toward which the face was directed underwent extension, the other one flexion, the limbs in this case, too, staying in their new position so long as the head remained in its altered relationship to the body (Fig. 4).

That the duration of the new position of the limbs almost always corresponded with that of the head is remarkable in view of the fact that the limbs in the absence of passive displacement of the head were almost continually in motion with involuntary movements of flexion and extension. The reactions were much more pronounced in the right arm than in the left as observed on numerous occasions for about two months following the patient's admission. After that the upper limbs, like the lower, became practically immobile, ultimately assuming an attitude of complete flexion of all segments with gradual diminution and finally disappearance of all reactions. (The patient did not exhibit the labyrinthine reactions of Magnus and De Kleijn. These reactions were also inconstant and little marked in the cases reported by these authors).

Necropsy Examination.—The patient died on Nov. 23, 1921. The necropsy examination performed next day revealed a small cerebrum and a normal-sized cerebellum (Fig. 5). The total water displacement by all the intracranial structures was 470 c. c., by the cerebellum alone 65 c. c. The cerebrum was markedly atrophic in the region of the motor cortex on both sides. In certain areas it gave to touch a sensation of stony hardness. There were no hemorrhagic foci, nor were there any indications of an old meningitis or encephalitis. The

12. Wilson, J. Gordon, and Pike, F. D.: The Effects of Stimulation and Extirpation of the Labyrinth of the Ear, and their Relation to the Motor System. Phil. Tr. Roy. Soc. London, B. **203**:127, 1912; The Mechanism of Labyrinthine Nystagmus and its Modification by Lesions of the Cerebellum and Cerebrum, Arch. Int. Med. **15**:31 (Jan.) 1915.

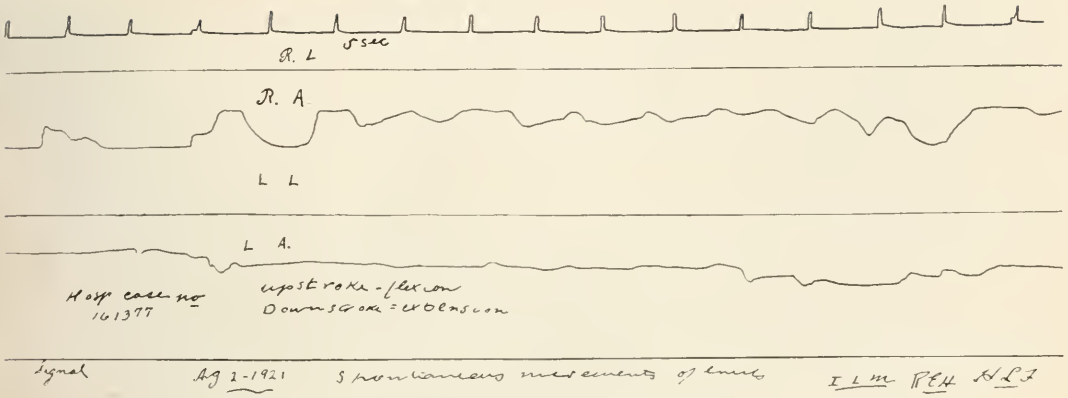

Fig. 2 (Case 1).—Involuntary movements of upper limbs; upstroke represents flexion; downstroke, extension of forearm.

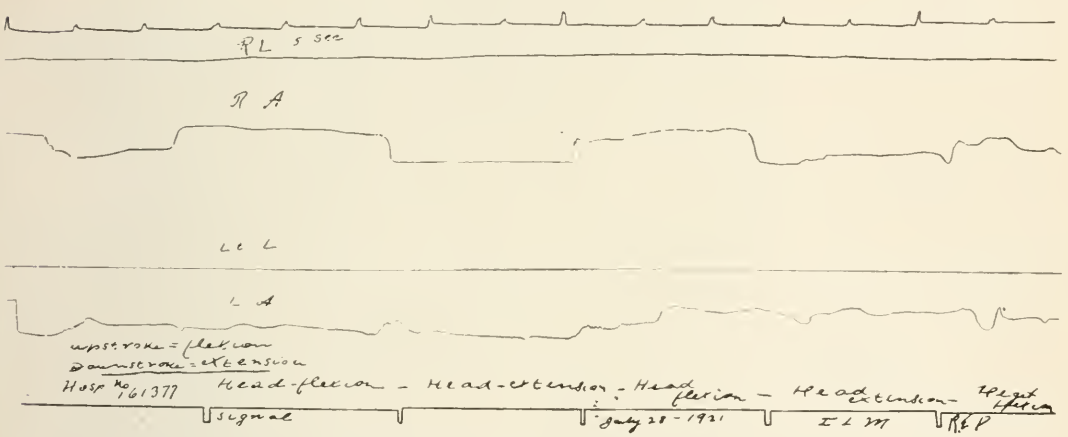

Fig. 3 (Case 1).—Cervical reactions of Magnus and De Kleijn of the symmetrical type. Upstroke represents flexion, downstroke, extension of forearm.

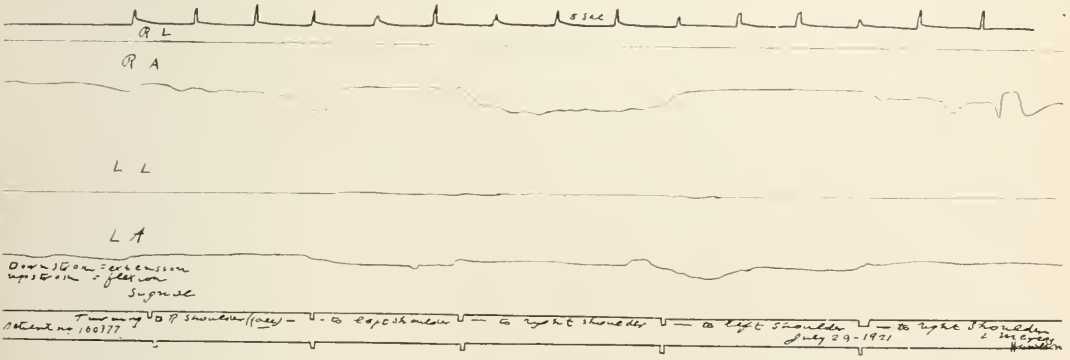

Fig. 4 (Case 1).—Cervical reactions of Magnus and De Kleijn of the symmetrical type. Upstroke represents flexion, downstroke, extension of forearm.

central nervous system was studied microscopically by Dr. George B. Hassin, Chicago. His report follows:

Structures Studied: (1) Spinal cord, (2) cerebellum, including vermis and peduncles, (3) pons, including tegmentum and region of vestibular nuclei, (4) medulla, (5) motor cortex of the cerebrum, (6) right frontal lobe, (7) occipital lobe, (8) island of Reil, (9) cornu ammonis, (10) midbrain structures. Summary of Findings: Secondary degeneration of the pyramidal tracts on both sides throughout the spinal cord (Weigert-Pal stain); degeneration of the motor cortex with secondary proliferative changes in the adventitial and endothelial cells of blood vessels; degeneration of the putamen and globus pallidus (fat accumulation in their ganglion cells and perivascular spaces), normal pons, midbrain (including the nucleus ruber), and cerebellum; frontal and occipital lobes normal; inflammatory changes absent. The degenerative condition, which was confined to the motor cortex and lenticular nuclei, was apparently very severe.

Fig. 5 (Case 1).—Brain of patient.

Another case which exhibited the Magnus and De Kleijn reactions as well as other attitudes of the preceding one, although differing from it in certain particulars, was the following:

Case 2.—*History.*—A Mexican child, 2 years of age, was admitted to the Los Angeles County Hospital on Oct. 5, 1921. The patient was the youngest of three children, all males. The two brothers were normal. The father and mother were well. There was no neuropathic history on either side. The mother had had no other pregnancies. The Wassermann test of her blood was negative. The patient's birth was spontaneous but precipitate. It occurred four days after the mother had recovered from a severe attack of influenza. The child was largely bottle-fed. He was apparently normal, his mother says, until he was 7 months old, when he began to make peculiar involuntary movements with his limbs, chiefly the upper. The child was never able to sit up, to creep or utter a word. His first teeth appeared at 14 months of age. He had measles and, following this, whooping-cough at the age of 19 months.

Examination.—The child was lying on his stomach groaning a good deal of the time. The limbs were spastic in semiflexion (Fig. 6) at the elbows and phalangeal articulations (but not at the wrists) in the case of the upper, and at the hips and knees in the case of the lower limbs. This posture was not constant; it was continually interrupted by involuntary movements of extension.

Fig. 6 (Case 2).—Patient on his back. He is prevented from undergoing "rolling" movements by nurse holding his head in symmetrical relationship to his body.

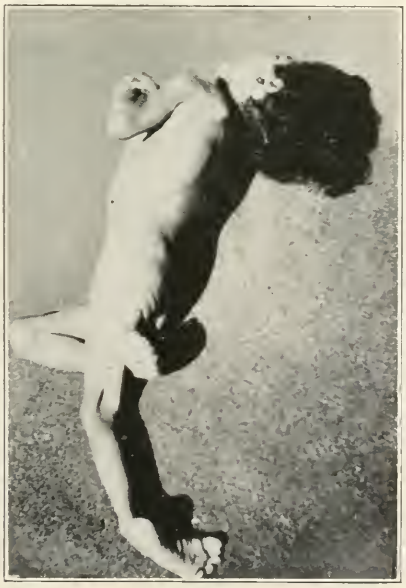

Fig. 7 (Case 2).—Forced movements affecting his entire body. Note especially the position assumed by the lower limbs and compare this with that of the upper limbs in Figure 1.

These movements were generally of small range but occasionally affected the left lower limb to such an extent as to bring about utmost extension at the hip and knee, utmost plantar flexion with eversion of the foot (so that the dorsum of the foot became directed toward the median line of the body) and the same degree of plantar flexion of the toes. This involuntary movement of the left lower limb was only part of an involuntary movement affecting the entire body. There was extreme retraction of the head, extreme opisthotonos and a movement of complete flexion at all the articulations in the right lower limb (Fig. 7). It will be noted that in this forced movement the attitude of the lower limbs is practically identical with the predominant attitude of the upper limbs in the first case (Fig. 1), the only difference being in the limbs affected. It will be recalled that the predominant posture of the right upper limb was one of extension at the shoulder and elbow, flexion and hyperpronation at the wrist and flexion at the phalangeal articulations. This was, of course, identical with the extension at the hip and knee, plantar flexion with eversion of the foot and complete flexion at the phalangeal articulations in the left lower limb of the second patient. The contralateral limbs in either case were during these forced movements in complete flexion at all their

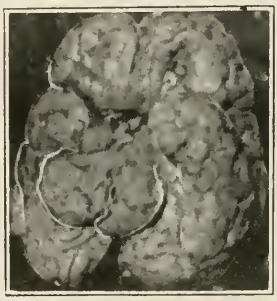

Fig. 8 (Case 2).—Brain of patient.

articulations. The patient was unable to be on his back for longer than a few minutes, as he invariably turned around so as to lie on his stomach, the rotation taking place most generally toward his left side, but occasionally toward his right. In this rotation the head led, the trunk following it. Such a rotation around the longitudinal axis, while observed with great frequency in experimental lesions of the eighth nerve and occasionally in lesions of the cerebellum, is rarely seen in man. It was observed by Stewart and Holmes in only one of their forty cases of cerebellar tumor.[13] These rolling movements in this patient could be effectually stopped by holding his head immobile in the median line (Fig. 7). This is in accord with the observations of Magnus and Van Leeuwen [14] in the case of the rolloing movements in animals following unilateral extirpation of the labyrinth.

While the patient was in the sustained muscular spasm which held him in the attitude described, none of his tendon reflexes could be obtained and it

13. Stewart, T. G., and Holmes, Gordon: Symptomatology of Cerebellar Tumors; Study of Forty Cases, Brain **27**:525, 1904.

14. Magnus, R., and Van Leeuwen, W. Storm: Arch. f. d. ges. Physiol. **157**:196, 1914.

was difficult to obtain any response to plantar stimulation, but the abdominal reflexes were present. In order to bring about relaxation of this muscular spasm, the patient was kept in a warm bath for a little over an hour. It was then noted that his tendon reflexes were normal, that he had no ankle clonus, and that his plantar response was flexor in type. At the same time it was found that he exhibited the cervical reaction of both types; that is the type produced by ventral or dorsal flexion of the head and affecting the limbs on the two sides symmetrically, as well as the type which results from rotation of the head and affects the limbs asymmetrically. This examination following relaxation induced by a prolonged warm bath was repeated several

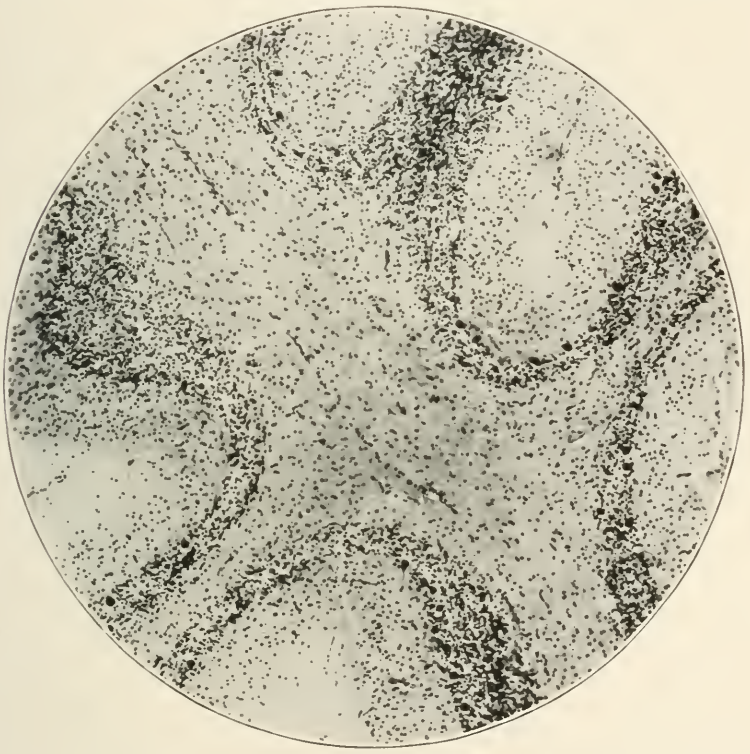

Fig. 9 (Case 2).—Herxheimer scarlet red stain; X 230. Marked and extensive degeneration of ganglion cells which are replaced by fat.

weeks later with the same results. The rotation of the head to one side or the other for the purpose of eliciting the asymmetrical reaction was, however, quickly followed by movements of rotation of his entire body.

The patient showed no cranial nerve palsies, his pupils were equal and reacted well to light. There was no nystagmus, and the fundi were normal. He showed no Trousseau, Chvostek or Erb phenomenon. The muscles showed no atrophy and responded normally to electricity. Mentally, he was in the same condition as the first patient. He could not sit up, he made no attempt to articulate and did not cooperate while being fed.

An otologic examination by Dr. Isaac H. Jones revealed: Turning to the right, head 30 degrees forward (child held in proper position by an adult

who revolved with him) yielded horizontal nystagmus to the left, very large amplitude and very slow, duration twenty-five seconds. After turning to the left a similar large slow nystagmus to the right was obtained. After douching the left ear, there occurred after thirty seconds conjugate deviation of the eyes to the left, then horizontal nystagmus to the right, then back again to conjugate deviation to the left. In douching the right ear there occurred after thirty seconds horizontal nystagmus to the left and then a tendency to conjugate deviation of the eyes to the right. Vestibular stimulation thus showed vestibular responses but some interference with the quick component, the eyes

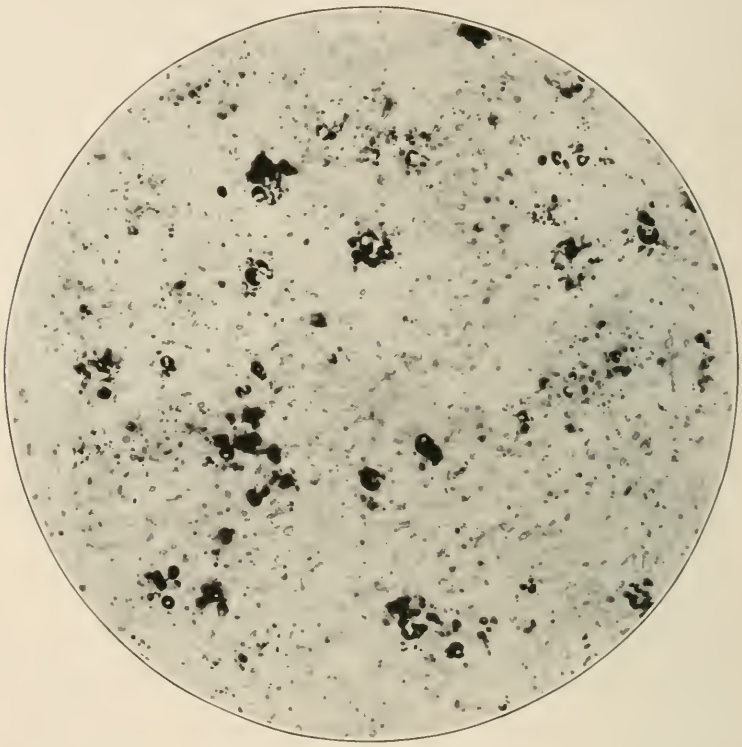

Fig. 10 (Case 2).—Upper vermis of cerebellum. The granular layer of the cerebellum is markedly rarefied and atrophied. The numerous black spots are glia cells. Thionin stain, X 60.

having a tendency to persist in conjugate deviation. The child showed in addition absence of constitutional responses to such stimulation. There was no pallor, no sweating, no nausea.

Necropsy Examination.—The patient died on Oct. 29, 1921. The brain gave a water displacement by all the intracranial structures of 730 c. c.; by the cerebellum alone of only 30 c.c. Macroscopically, the cerebrum showed no atrophies, no scars and no hemorrhagic foci. The cerebellum, on the other hand, was markedly atrophic, and aside from its small relative size, the left hemisphere was much narrower and generally smaller than the right (Fig. 8). The central nervous system was studied microscopically by Dr. George B. Hassin.

The structures studied were: (1) nuclei of the seventh and eighth nerves; (2) cerebellum, including the vermis; (3) peduncles, including the nucleus ruber; (4) medulla; (5) lenticular nuclei; (6) island of Reil; (7) right frontal lobe; (8) left temporal lobe; (9) left motor cortex, and (10) right occipital lobe. His findings were: absence of secondary degeneration of the spinal cord; normal medulla and pons. The nucleus ruber showed in silver specimens no particular change in the glia cells. The putamen and nucleus caudatus were practically normal in contrast to the globus pallidus which showed an abundance of fat (Fig. 9). The motor cortex showed no degenerative changes; the cerebellum showed preserved Purkinje cells but a rarified, actually atrophied granual layer (Fig. 10).

THE PATHOGENESIS OF THE CLINICAL MANIFESTATIONS IN THESE TWO CASES

In studying the clinical phenomena here reported in their relationship to the pathologic findings, we note first that whereas some of the phenomena were common to both patients, others were peculiar to each. Of the latter variety were the "rolling" movements of the second patient. These were undoubtedly due to the cerebellar atrophy which was quite extensive and generalized. That the vestibular system was apparently intact throughout its entire course, i. e., beginning in the labyrinth up to and including its connection with the nucleus of the sixth and third nerves as shown, clinically, by the presence and normal direction of the nystagmus on vestibular stimulation and anatomically by the absence of any lesions in the medulla or pons, is noteworthy. It tends to show that lesions limited to the cerebellum and not involving the vestibular system are capable of producing this type of forced movements. This, as well as the direction of the movements, which in the case of this patient occurred mostly toward his left side, in the direction of the cerebellar hemisphere most affected by the atrophy, are subjects of considerable controversy and have not as yet been definitely settled.[15]

The phenomena which were exhibited exclusively by the first patient were those that are dependent on destruction of the pyramidal tract system; namely, the exaggerated tendon reflexes, ankle clonus, Babinski sign and absence of abdominal reflexes.

Both patients were markedly spastic. In the first patient it ultimately fixed the segments so that all involuntary movement became impossible. In the second patient it produced a state of semiflexion only, allowing slight involuntary movements at all times, and occasionally also of such extreme degree as shown in Figures 1 and 6. The latter type of spasticity, with involuntary movements of varying degree,

15. Muskens, L. J. J.: An Anatomico-Physiological Study of the Posterior Longitudinal Bundle in its Relation to Forced Movements, Brain **36**:352, 1914. Meyers, I. Leon: Galvanometric Studies of the Cerebellar Function, J. A. M. A. **65**:1348 (Oct. 16) 1915.

has been noted also in the striate syndromes described by C. and O. Vogt.[16] It was present in association with involuntary movements of the tremor variety in the cases of progressive lenticular degeneration reported by Kinnier Wilson,[17] which, as in my second case, showed clinically, no exaggerated reflexes, no ankle clonus and no Babinski sign; and pathologically, absence of motor cortex and pyramidal tract affection. The spasticity in this type of cases, i. e., in lesions of the striate system, is difficult of interpretation.[6, 19]

Other phenomena exhibited by both patients were the reflex and spontaneous attitudes of decerebration; the first, as represented by the cervical reflexes of Magnus and De Kleijn; the latter, by the involuntary movements of the body as well as of the limbs. The attitudes assumed by these patients in some of the involuntary movements were, I think, incomplete attitudes of decerebrate rigidity. The extension of the upper limbs at shoulders and elbow, the flexion of wrist and hyperpronation—flexion of the phalanges, as seen in the right upper limb, in the first case, practically the same attitude of the left lower limb in the second case, retraction of the head, opisthotonos and spastic closure of the mouth, are features which are so characteristic of the decerebrate state as to lead us unavoidably to this conclusion. The attitudes assumed by either of our patients were transient only, never so persistent as in the decerebrate animal. Probably this is because the lesion responsible for the attitudes was not so complete as in the experimental animal submitted to transection of the midbrain.

It should be noted that the second patient exhibited the decerebrate attitudes regardless of the cerebellar atrophy. This is in accord with the observations of Sherrington,[3] Thiele,[18] and Magnus [19] that removal of the cerebellum in animals does not diminish decerebrate rigidity. Both patients exhibited also a tendency to persistent conjugate deviation of the eyes on vestibular stimulation—impairment of the quick component of the nystagmus. This component, experimental evidence shows, is a corrective movement for the purpose of restoring the eyes to their normal position following their displacement while in conjugate deviation, and is cerebral in origin. Its impairment is, therefore, to be interpreted as indicating a disturbance of this cerebral function. Finally, neither patient could sit up, move about or articulate, an incapacity far greater than could be accounted for by the spasticity.

16. Vogt, Cecile, and Oskar: Zur Lehre der Erkrankungen der Striären Systems, J. Physiol. u. Neurol. **25**:631, 1920.

17. Wilson, S. A. Kinnier: Progressive Lenticular Degeneration, Brain **34**: 295, 1912.

18. Thiele, F. H.: On the Efferent Relationship of the Optic Thalamus and Deiters' Nucleus to the Spinal Cord, J. Physiol. **32**:355, 1905.

19. Magnus, R.: Arch. f. d. ges. Physiol. **157**:225, 1914.

The fact that these symptoms were common to both patients and that the only important lesion common to both was degeneration in the lenticular zone, leads us to conclude that it was this lesion that formed the basis for these phenomena. The fact that in these cases the pathologic process was congenital and set in before the ganglion cells and their conducting fibers had the opportunity to mature may account for the extreme severity of their various clinical manifestations.

THE PHYSIOLOGIC INTERPRETATION OF THE DECEREBRATE ATTITUDES

Magnus and De Kleijn [1] interpreted the cervical reactions of the decerebrate animal as components of certain normal attitudes, attitudes which are inaugurated by movements of the head but which affect the entire body. Thus, when a normal cat drinks milk from a cup on the floor, in lowering her head, she flexes the fore-limbs and extends the hind-limbs to facilitate the approach of her head to the cup. She makes just the reverse movements with the limbs when she elevates the head to seize a piece of meat above her. An animal extends the limbs on the side toward which the face is directed when gazing around to one side or the other. In the decerebrate animal, according to this view, the limbs assume postures in response to passive displacements of the head corresponding to their movements caused by active or voluntary displacement in the normal animal.

This is also the explanation of Marie and Foix,[10] who designate them associated movements of the coordinative type (syncinésie de coordination), and ascribe them to the automatic activity of the lower centers (l'automatisme medullaire).

The conclusion is that these phenomena occur only in the presence of exalted spinal automatism, which is produced only by a very severe cerebral lesion, a lesion involving the lenticular zone and especially the phylogenetically older part of it, the paleostriatum.

As regards the phenomena constituting decerebrate rigidity, Sherrington [20] believes that they represent the postural reflex of standing. "Standing appears to be the functional meaning of the rigidity." The decerebrate animal is capable of maintaining its balance when on its feet; when placed on the ground "it stands," whereas the spinal animal cannot do so. The decerebrate rigidity is, according to this conception, produced by the sustained and extreme contraction of those muscles which oppose the force of gravity, tending to pull the body or its various parts down. The rigidity, in other words, is the expression of the unrestrained activity of one of the two systems of motor innervation, which are postulated by him in accordance with the teachings of Hughlings Jackson, namely, the tonic system, situated in the midbrain or hindbrain. This system, in accordance with his theory, innervates

20. Sherrington, C. S.: J. Physiol. **40**:107, 1910.

predominantly the extensors or antigravity muscles, thus subserving the maintenance of the standing posture, the "continuous movements" of Hughlings Jackson, as opposed to the other system, represented by the phasic centers in the cerebrum which by subserving the "changing movements" of Jackson innervate predominantly the flexors.

"There can be no doubt," says Kinnier Wilson, an adherent of this theory, "that decerebrate rigidity is a release phenomenon, and that a lower influx invades what a higher abandons." This theory is open to certain objections. In the first place, the decerebrate attitude is not one of standing. Postures are assumed in this attitude by various parts of the body which do not in any way form components of the normal standing. The head is retracted, the back opisthotonic, the tail elevated, the mouth rigidly closed and the toes, occasionally also the hand or paw, flexed. One gets the impression that the capacity of the decerebrate animal to "stand" is but an inevitable accompaniment of its attitude, and not the primary purpose of the attitude. Second, it is difficult to conceive of a neuromuscular mechanism differentiated for special activities, local or postural. All the physiologic evidence available tends to show that all motor activity, whether originating in brain or spinal cord, is directed toward the accomplishment of certain purposive movements,[21] and this is probably uninfluenced by the type of movement, whether it is to subserve posture or not, and the kind of muscles, antigravity or others, that are required for the purpose. I should, therefore, like to suggest that the decerebrate attitudes are compensatory, adopted by the animal (or man) as a protective measure following the loss of its cerebrum, and consequently the faculty by which it is enabled to correct deleterious muscular displacements. This capacity to correct muscular maladjustment, either for maintaining the body equilibrium or for the proper execution of other movements, appears to be possessed chiefly by the cerebrum; in the higher animals probably exclusively by this organ. The integrity of this organ, as pointed out in the foregoing, is essential for the correction of the conjugate deviation of the eyes which results from stimulation of the labyrinth. It is also essential, as shown by Muller and Weed,[22] for the rotation of an animal, when dropped from a height with its feet up. The decerebrate animal under such circumstances falls on the back, side, etc. It makes no attempt to correct its position in space in order to alight on its feet. This cerebral faculty is lost, it appears from the pathologic evidence in the cases here reported, by a lesion

21. Beevor, Charles E.: Muscular Movements and their Representation in the Central Nervous System. London, Adlard and Son, 1904, p. 77.

22. Muller, Henry R., and Weed, Lewis H.: Notes on the Falling Reflex of Cats, Am. J. Physiol. **40**:377, 1916.

of the lenticular zone, and especially its pallidal portion. That the corpus striatum, and especially the pallidal portion (the paleostriatum of Edinger) is, as shown by the anatomic studies of Arien Kappers, de Vries, and others,[23] both an afferent and efferent structure, makes the loss of this faculty in lesions of this organ intelligible either on the assumption that it is a sensory function, an expression of sensory impressions and conscious knowledge of position, or that it is a purely motor function and dependent on a normal efferent mechanism and an appropriate motor innervation of the body musculature. The attitude of decerebrate rigidity represents, then, a biologic reaction by means of which the animal seeks to prevent its displacement as a whole or in part by the continuous environmental stimuli, displacements which the animal in the absence of the cerebrum is incapable of correcting. The reaction consists of powerful contraction of the strongest muscles of the body: the retractors of the head, the erectors of the spine, the elevators of the lower jaw, the extensors of the shoulder and elbow, the pronators of the forearm and flexors of the phalanges in the case of the upper limbs, and the extensors of the hip and knee, the envertors and extensors of the foot [24] and the flexors of the phalanges of the lower limbs. In this way the animal offers its maximum of resistance to such external forces as might bring about malpositions in various parts of its body. This reaction originates in the vestibular nuclei of the pons. Their integrity is essential for this phenomenon. Section of the medulla below these structures is not followed by rigidity (Sherrington and Thiele), and this operation in the decerebrate preparation abolishes the rigidity already developed.

Such compensatory reaction by one part of the central nervous system, following the loss of another, is not unknown in neurology. The patient with a cerebellar tumor rotates his trunk so that the shoulder on the side of the lesion is held in front and higher than the contralateral shoulder in order to prevent his walking in a circle,[13] the cerebrum compensating the loss of cerebellar activity. The tabetic patient propels his foot violently forward in order to make sure that it is elevated above the ground, etc.

If this theory is correct, the decerebrate attitudes, the impairment of the quick component of nystagmus and the inability to sit up, to creep and to articulate, as exhibited by both of my patients, are not independent phenomena, but manifestations of one fundamental disturbance; namely, the loss of capacity to bring the muscles into harmonious relationship for the execution of voluntary and purposive

23. Wilson, S. A. Kinnier: An Experimental Research into the Anatomy and Physiology of the Corpus Striatum, Brain **36**:479, 1914.

24. Duchenne, G. B.: Physiologic des Mouvements, Paris, 1867.

movements and to correct such maladjustments as are continually brought about in the body by the incessant activity of the environmental stimuli.

718 Brockman Building.

DISCUSSION

Dr. Mary Freeman, Perrine, Fla.: Is the cause of this condition known?

Dr. I. Leon Meyers, Los Angeles: The cause is unknown. It appears to be a primary degeneration. In the case of the girl we do not know the family history as the patient was a deserted child, but the fact that the brother also suffered the same trouble would indicate agenesia or lack of development.

DIAGNOSTIC VALUE OF BLOOD SUGAR CURVES IN NEUROLOGY*

SIDNEY I. SCHWAB, M.D.

ST. LOUIS

This study was begun with the idea of ascertaining whether characteristic sugar curves were found in instances of suspected glandular anomalies, for the purpose of differentiating one type from another through the curve characteristics. The only thing of value discovered was a low sugar curve and an increased tolerance in some cases in which dysfunction of the pituitary was evident. In such instances the diagnostic value of the curve was of little importance when contrasted with other symptoms and findings. As this work went on it became evident that some other factor was present which produced curves of a distinctly abnormal kind in cases which showed no clinical evidence of glandular dysfunction. This element by exclusion was thought to be some kind of mental anomaly associated with or originating from emotional abnormality. Of particular importance in this early series of cases were states of anxiety, fear, apprehension, repression and conditions to which the term depression was given. In many instances a high sugar curve was found. There was nothing in cases of this kind to cause a deviation from the normal except the mental state. General and neurologic findings in these patients were uniformly negative. The curves were tabulated as a possible aid in differential diagnosis. About this time F. H. Kooys' article on "Hyperglycemia in Mental Disorders" came to my attention. The significant point in this paper is the conclusion that the emotional state is responsible for the altered types of curves, no matter what particular type of disease the patient clinically presents. This conclusion appeared to confirm the observations made in our early preliminary series.

The study of sugar curves was then extended for the purpose of answering several questions naturally arising:

1. Are characteristic types of curves found in certain diseases and not in others?
2. Have these curves any diagnostic value?
3. Is emotion in a broad sense the factor of consequence?
4. Are sugar tolerance studies of sufficient value neurologically to make the procedure routine in all cases?
5. Have blood sugar curves any prognostic or therapeutic value?
6. What physiologic and chemical mechanism produces such curves?

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* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

In order to answer these questions an unselected series of neuropsychiatric cases were studied in reference to sugar tolerance curves. From these were excluded those in which sugar values might be influenced by other than neurologic factors. Diabetes, acute infectious diseases, thyroid abnormalities, gastro-intestinal diseases, hypertension, etc., were excluded. About 150 instances fell in the category of primary neurologic cases, and these form the material on which this study is based. An analysis of this material shows that it includes all the ordinary neuropsychiatric diseases such as might be admitted into the neurologic service of a general hospital. Thirty-eight were frankly psychoses; that is, cases in which the mental symptoms dominated the picture. The neuroses are next in number; then come epilepsies, brain

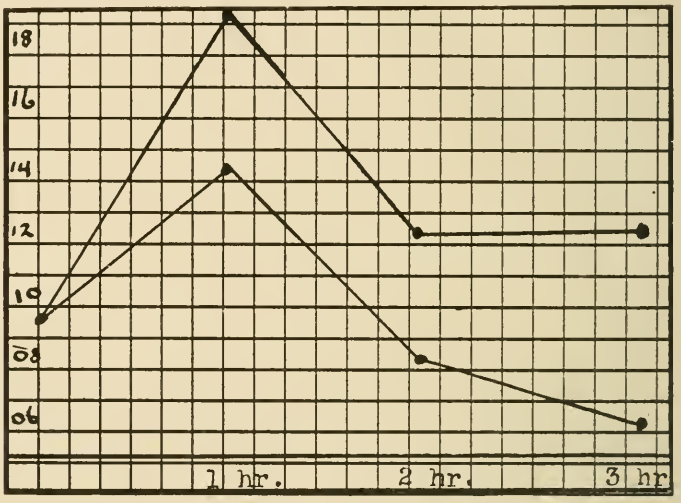

Chart 1.—Normal blood sugar curves preceded by twelve hours of fasting; findings given at the end of one, two and three hours.

tumors, cerebrospinal syphilis, encephalitis and other types of organic nervous diseases. These cases were all studied under hospital conditions and were put through the neurologic routine usual in the neurologic service of the Barnes Hospital. The laboratory work was carried out under the direction of Dr. Olmstead, head of the metabolic ward of the hospital. This work was done under exactly the same conditions, so far as technic was concerned, as was used in the study of a series of cases published by him recently under the title of "A Study of Blood Sugar Curves Following a Standardized Glucose Meal." This paper is referred to for the laboratory technic and methods. Attention should be called to the fact that in this series of cases two methods of sugar determination were used—Meyers and Bailey's modification

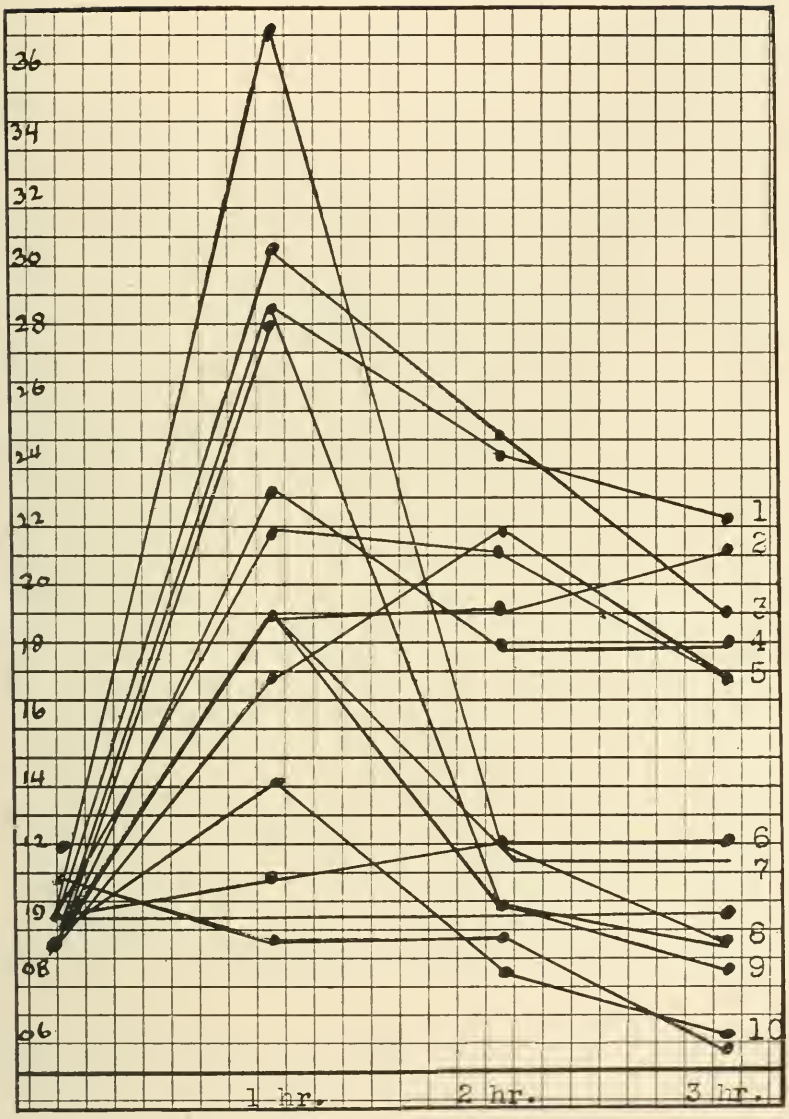

Chart 2.—Blood sugar curves from a group of patients with psychoses after twelve hours of fasting. 1, manic-depressive cases; 2 and 6, dementia praecox; 3, toxic disorientation; 4, psychosis (hallucinosis); 5, senile psychosis; 7, deterioration; 8, depression (paranoid); 9, organic dementia; 10, depressed state (suicidal).

of the Benedict and the Hartman-Schaffer; one is a calorimetric and the other a trituration—an iodometric. Although there is a difference in the amount of sugar percentage obtained, the Hartman-Schaffer giving a consistently higher value, the characteristics of the curve are not altered. The typing of curves, therefore, can be used without reference to the technic employed. In the series of cases here studied a normal curve was first obtained as a laboratory standard and a clinical control by the study of five normal persons and a series of about forty patients in the hospital who showed no demonstrable cause for disturbed glycogenic function. These curves agree with those of

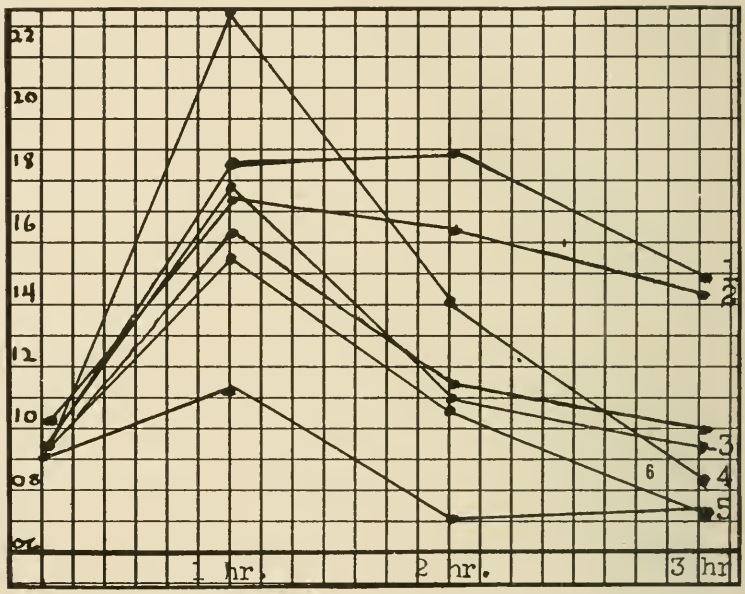

Chart 3.—Blood sugar curves from a group of patients with neuroses after twelve hours of fasting. 1, 4 and 5, hypochondriasis; 2, psychasthenia; 3, neurasthenia; 6, hysteria.

other observers. Figures for the normal curve are as follows: After a twelve hour fasting period the blood sugar shows a variation from 0.09 to 0.1; after one hour from 0.14 to 0.19; after the second hour from 0.08 to 0.12; after the third hour from 0.06 to 0.12 per cent. All curves which deviated in any considerable manner from these normals were regarded as atypical. In the study of abnormal types of curves particular attention was directed to two variations. First the high sugar content after the first hour; second, the sustained elevated curve and the low sugar value throughout the three hours. These represent the three extremes on which a diagnostic value might

be based. The initial hyperglycemia after fasting was considered of physiologic interest only, as was its opposite—a low one; that is, a hypoglycemia. Minor variations of all sorts which altered the normal appearance of the curves were not taken into consideration.

In the group of the psychoses twenty out of thirty-eight cases showed distinctly abnormal curves. These were shown by two things —an initial rise far beyond the normal and a sustained rise beyond

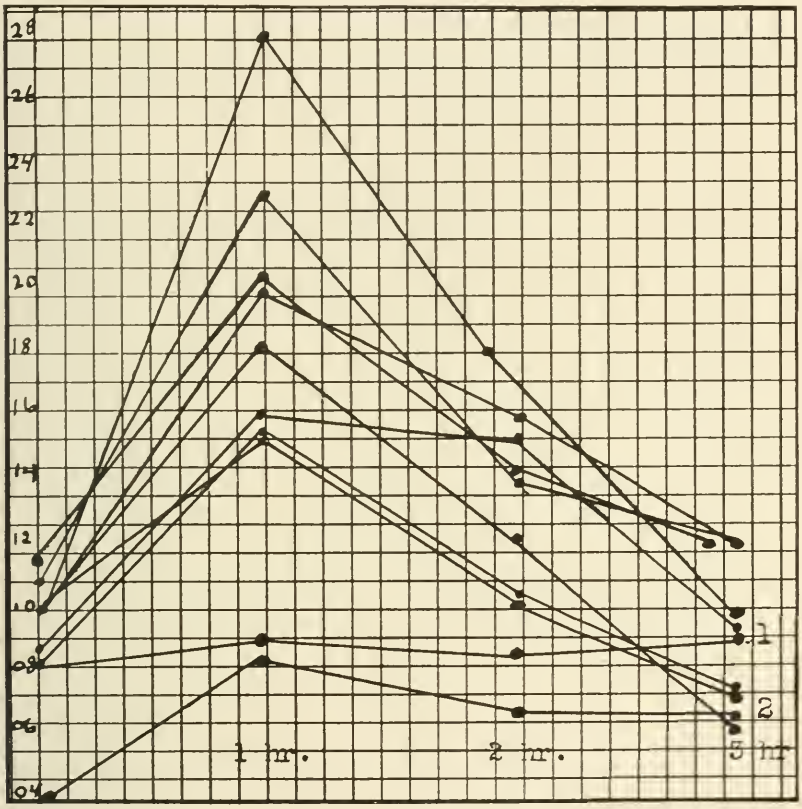

Chart 4.—Blood sugar curves from a group of patients with epilepsy after twelve hours of fasting. 1, postepileptic stupor; 2, pituitary disorder.

the second hour and often no return to the normal level. It is sugnificant that the type of curve had absolutely no relation to the clinical picture presented; that is, there was no curve which might be said to represent, for example, dementia praecox, or manic depression, or any other condition. The patients who presented clinically a dull, apathetic, anxious, or depressed state seemed to show on the whole the most definite sugar value deviations. No diagnostic value other than this could be obtained.

In the neuroses group of twenty-five cases few abnormal curves were found. Six curves were definitely considered abnormal; two of these should be excluded on account of complicating factors. Of the three remaining, two were in marked cases of hypochondriasis in which the anxiety elements were pronounced. This is of some interest as it supports what has been previously pointed out—that of all the neuroses this type approaches more nearly a psychosis in mechanism.

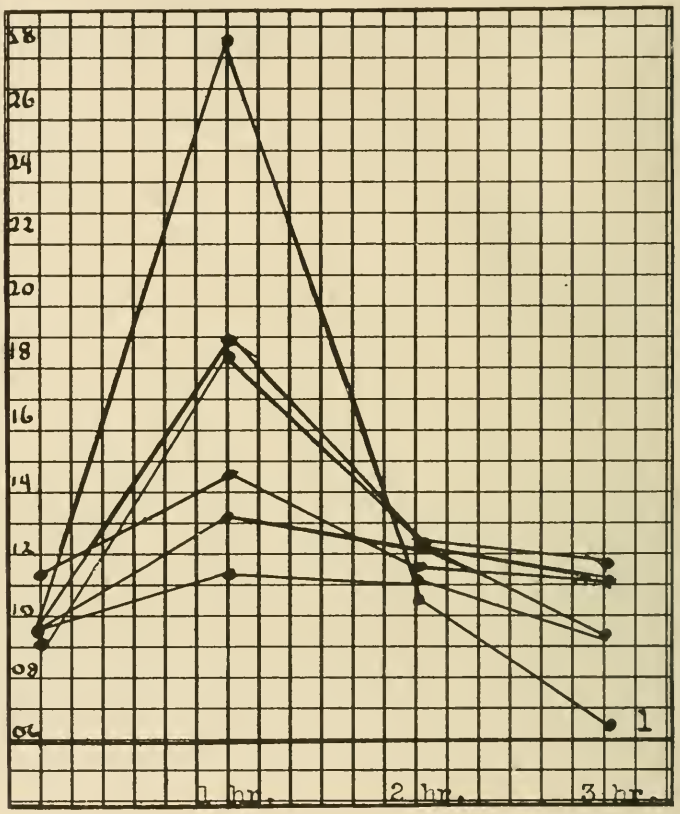

Chart 5.—Blood sugar curves from a group of cerebral tumors after twelve hours of fasting. 1, mental symptoms.

Practically no case of hysteria showed any abnormal curves. In the group of patients with syphilis of the nervous system no abnormal curves were found except in instances in which definite psychotic symptoms were present. The group with paresis showed no abnormal curves. In almost all forms of epilepsy the curves were normal, with the exception of one or two instances in which there were marked mental symptoms. The curves in cases of brain tumor, other than the two instances

in which there was evidence of mental symptoms, were normal. The remaining cases of organic nervous disease cannot be classified in respect to curves. They showed nothing that could be in any way connected with the particular disease in question.

Certain conclusions are fairly obvious, and I believe that the series itself is comprehensive enough to give a broad point of view on which the value of this procedure might be based. The abnormal types of sugar curves were found chiefly in the psychoses. Their occurrence in the neuroses is too uncertain and too scattered to be seriously considered. Organic diseases of themselves do not affect the sugar mechanism sufficiently to alter the curve value; if it is affected, an additional factor has entered into the case. Whenever anomalous curves are

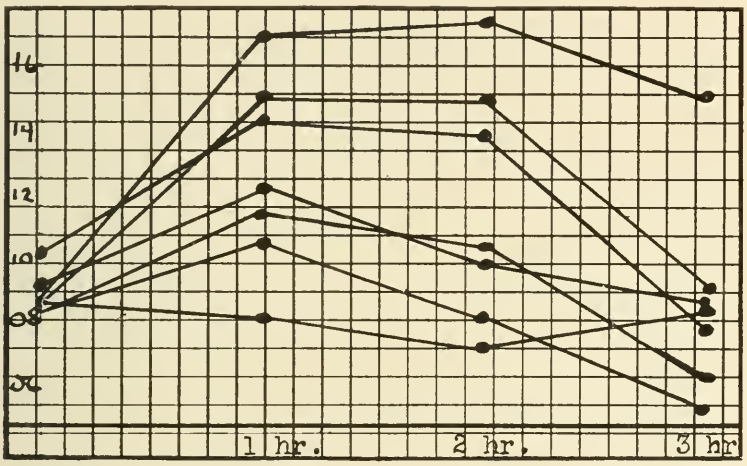

Chart 6. — Blood sugar curves from a group of patients with epidemic encephalitis after twelve hours of fasting.

found outside of the psychoses there is evidence also of an abnormal mental state, usually one in which there is no adequate muscular outlet. States in which there is a good deal of excitement or restlessness do not show an abnormally high curve. Unusually excited patients are not included in this series, as they are not commonly admitted to the neurologic service at the Barnes Hospital. The low curves seen in hypopituitarism or hypothyroidism are of little significance in material such as this, because the neurologic symptoms here present are not primary. The participation of these glands, as well as of the thyroid gland, in abnormal mental states is a matter in which so much confusion of opinion exists at the present time that no adequate conclusion can be formed

It is believed as a result of a consideration of these curves that it is impossible to attach characteristic types of curves to one type of disease. This refers to the psychoses as well as to other types of nervous and mental disease; that is, there is no specific diagnostic value in any one type of curve. The most that can be said is that the group of psychoses as a whole shows by far the largest percentage of abnormal curves, and that in other diseases of the nervous system, whether

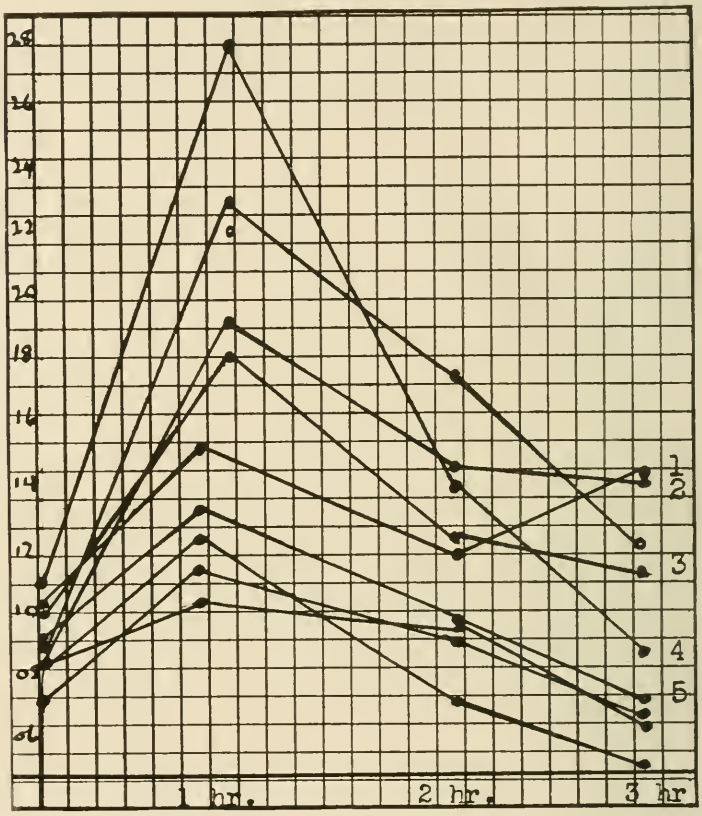

Chart 7.—Blood sugar curves from a group of patients with cerebrospinal syphilis after twelve hours of fasting. 1, dementia praecox; 2, 4 and 5, paresis; 3, tabes.

organic or not, in which atypical curves are found, the most reasonable causative factor seems to lie in the kind of mental reaction that is present.

Sugar curves have no important differential diagnostic value. The one factor that seems to stand out as a causation in the modification of sugar curves is emotion, or rather in a broad sense, the emotional factor in the patient's abnormal mental processes; that is, states of

primary depression, anxiety, apathy, unconscious conflict processes appear to be the states in which high sugar curves are almost universally found. The purely intellectual defects, such as are seen in paranoid states, do not seem to produce abnormal types of curves. On the whole it might be said that deteriorating processes or secondary dementing processes do not of themselves cause abnormal sugar values in the blood.

Sugar tolerance studies are not believed to be of sufficient value neurologically to make this procedure routine in all cases. The whole technic is difficult to carry out; it is time consuming, often disagreeable to the patient. Therefore, cases should be selected in which the type of sugar curve might prove of some value. Just what this value might be is somewhat difficult to say at the present time, but it is possible

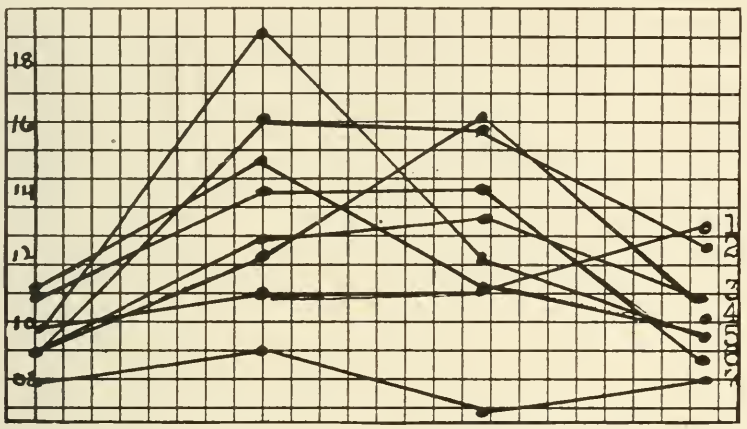

Chart 8.—Blood sugar curves in a group of patients with miscellaneous diseases of the nervous system after twelve hours of fasting. 1, arteriosclerosis (pontile hemorrhage); 2, Meniere's disease (otitis hemorrhagica); 3, neuritis; 4, cerebral hemorrhage, paralysis agitans; 5, dystrophy muscularis; 6, old hemiplegia; 7, trigeminal neuralgia.

that it might be used in differentiating cases in which it is important to find out whether the whole picture is primarily an emotional one or in which the emotional reaction is purely secondary. This would refer particularly to the neuroses in which the patient is in a borderland between neuroses and psychoses. Even here the value of this procedure might be questioned.

Blood sugar curves have no prognostic value, and their change in type cannot at the present time be interpreted as a proof of the effectiveness of therapeutic procedures.

The physiologic and chemical mechanism involved in the production of these abnormal curves is still a matter of debate. The theories

which have been advanced to explain them revolve chiefly around the original ideas of Cannon as a result of the various experimental studies on emotional glycosuria. The chemical factor that has shown the most definite causative influence is the increase in epinephrin. Even this fact has been disputed. The biologic significance of emotion in the production of abnormal mental states seems to be supported, however, by a study of this kind, and the fact that there is almost a constant increase in blood sugar values in emotional states that are organized into a picture of the psychoses seems to stand out clearly. Kooy has advanced the theory of the importance of the primitive emotional states in certain types of mental diseases. His conclusions in this regard appear to be amply substantiated by the results of the study herein recorded. The real value of his observation and of a wider study of blood sugar curves in pyschoses is apparent. It may mean eventually that the nondegenerative types of psychoses associated with depression will be viewed from a biologic point of view as a return to primitive emotional states in which the increase of glycogenic function serves the definite purpose of supplying increased muscular energy in carrying out maneuvers for the protection of the individual. In the static conditions represented by the inhibiting influence of emotionalism seen in depressed and anxious states, the glycogenic mechanism provides an increased ability to keep sugar in the blood preparatory to the expected muscular overaction in maneuvers of flight, concealment and other protective measures.

DISCUSSION

Dr. Smith Ely Jelliffe, New York: With regard to Dr. Schwab's statement that no precise diagnostic value is gained from these studies, I should like to ask him whether he would not use a different phrase, stating that there is no value for presently accepted diagnostic criteria. All observations are of value, and the only point of view is that the findings which he has narrated to us cannot yet be fitted into the imperfect schemes of diagnostic nosologic conceptions that we now have. There will come a time when our present unsatisfactory nosologic conceptions will be of great importance.

Dr. Walter Timme, New York: Dr. Schwab's conclusions are practically similar to those that most of us have obtained through a long and wide experience.

A sugar curve taken per se, without any other observations, has about as much value as the temperature alone, and the diagnosis of a patient's condition from it, the pulse rate or any single factor is impossible. In order to be of any value it must be taken in connection with many other conditions which the patient presents. Under such conditions one can possibly go a little further into the diagnostic values of the sugar curve. It perhaps bears the same relationship to the patient's condition that a metabolic study does, being valueless in diagnosing the patient's condition unless all the factors at the time of the experiment are taken into calculation.

To name one or two specific instances, a blood sugar curve must be interpreted in relationship to the point at which it begins, which is the original

blood sugar content. A patient whose sugar content is 0.09 and who has a rise in the sugar curve is entirely different from the patient who begins with a 0.06 sugar content and has a similar type of curve.

The so-called psychoneurotic patients and the army patients with neurocirculatory asthenia usually show a low sugar content as the first sign of disease. The slightest emotional disturbance will make the sugar content rise tremendously during the first and second hours and, depending on the character of the case and its compensations, it will go down.

Likewise the hebephrenic type of dementia praecox begins with a low sugar content, with a lower curve than the neurocirculatory asthenias, but with a fairly high sugar curve. The blood sugar curve must be taken in connection with other factors before a diagnosis can be determined.

Dr. Schwab, in closing: In reply to Dr. Jelliffe's comments, my point is that at the present time we do not have sufficient differential diagnostic knowledge or information to make these things valuable.

All of the cases were studied with great care. I did not include clinical reports in this paper. All of the cases were examined in conjunction with the internal medical department of the hospital from every point of view, over quite a long period.

I excluded from the series all those instances in which the sugar curve might be influenced by other factors. This does not include any cases of cardiac disease, effort syndrome or diabetes. They were a group of neuropsychiatric cases studied primarily from the point of view of determining whether this procedure was valuable in a hospital study of the case. The initial hyperglycosemia was carefully considered in all of the cases, but it was of no value because of the variation which could not be interpreted. We have a curve as low as 0.04 in a person who had otherwise a perfectly normal case.

We found the highest blood sugar value in a young married woman, who had a fixed sensation of sweetness in her tongue and mucous membrane and was always haunted by a sensation of tasting sweet things. The initial first hour curve went up to 0.38, which was one of the highest initial curves, and the case was eliminated because of impossible differentiation from a diagnostic point of view.

MALIGNANT TUMORS OF THE NASOPHARYNX WITH INVOLVEMENT OF THE NERVOUS SYSTEM *

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The frequency and polymorphism of extranasopharyngeal symptoms seen in early cases of malignant disease of the nasopharynx does not seem to be widely appreciated. This applies particularly to the neurologic aspect. The absence, so far as I know, of any previous contribution covering this field and our experiences at the Mayo Clinic seem to justify a rather broad sketch of the neurologic phase of the subject.

New [1] has recently called attention to the relation of nasopharyngeal malignancy to other diagnoses, emphasizing the frequency of early extranasopharyngeal symptoms and the need of a wider understanding of the condition. His cooperation and skill enabled us to explain many unusual and difficult cases referred to the neurologic department for what often seemed to be disease primarily involving the nervous system.

An early diagnosis is not always easy. Table 1 shows that of the twenty-five cases comprising this series, only one was correctly diagnosed. These twenty-five cases were included in a series of seventy-nine cases of malignant tumors of the nasopharynx reported by New.[2]

Fifteen of the tumors were squamous-cell epithelioma, and six were lymphosarcoma (Table 2). The origin of these growths is usually in the fossa of Rosenmüller. While benign tumors occasionally involve the nervous system by penetrating the base of the skull, such tumors have not been included in this series.

Reports of forty-four cases were found in the literature, although the type of case was seldom indicated in the title of the paper. The sequence of events in the history, and the extranasopharyngeal and necropsy findings are briefly tabulated in Table 3. Unfortunately, the neurologic symptoms did not interest many of the writers, and such details are often slighted with some such remark as "brain mischief."

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* Read before the Section on Nervous and Mental Diseases at the Seventy-Third Annual Session of the American Medical Association, St. Louis, May, 1922.

1. New, G. B.: Relation of Nasopharyngeal Malignancy to Other Diagnosis, Minn. Med. **4**:419-422, 1921.

2. New, G. B.: Syndrome of Malignant Tumors of the Nasopharynx: A Report of Seventy-Nine Cases, J. A. M. A. **79**:10 (July 1) 1922.

TABLE 1.—Erroneous Diagnosis and Treatment in Twenty-Five Cases of Malignant Tumors of the Nasopharynx, with Involvement of the Nervous System

Diagnosis or Type of Treatment	Cases
Tonsillectomy	6
Extraction of teeth	6
Dissection of glands from the neck	6
Nasal sinuses drained	4
Trifacial neuralgia *	3
Nasal polyps and adenoids removed	4
Submucous resection	2
Operations on the nose	3†
Paracentesis of the tympanic membrane	2†
"Abscess" lanced in the throat	1†
Hodgkin's disease	1
Mumps	1
Pituitary tumor	1
Dementia paralytica	1
Syphilis	1
Nasopharyngeal sarcoma	1

* Alcohol injections and nerve sections.
† Several operations.

TABLE 2.—Involvement of the Cranial Nerves in Twenty-Five Cases of Malignant Tumors of the Nasopharynx *

Type of Tumor	Cases	Nerves Involved												
		First †	Second ‡	Third	Fourth	Fifth (Sensory)	Fifth (Motor)	Sixth	Seventh	Eighth §	Vago-Accessory: Palate¶	Vago-Accessory: Vocal Cords	Vago-Accessory: Eleventh (Spinal)	Twelfth #
Squamous cell epithelioma	15	..	1	2	2	6	4	10	1	..	4	1	1	4
Adenosarcoma	1	..	1	..	..	1	..	..	..	..	..	..	..	..
Lymphosarcoma	6	..	1	..	..	3	1	6	..	..	2	2	2	1
Sarcoma	2	..	1	1	1	1	1	1	..	..	..	..	..	..
Mixed cell sarcoma	1	..	1	1	1	..	..	1	..	..	..	..	..	..
Total	25	?	5	4	4	11	6	18	1	?	6	3	3	5

* Males, 20; females, 5; age of patients with sarcoma, 6 to 63 years; average age, 49.3 years. Age of patients with epithelioma, 35 to 64 years, average 49.1 years. Onset of first symptoms in cases of carcinoma, six weeks; of sarcoma, four weeks; longest duration in cases of carcinoma, five years; of sarcoma, three years; average duration, 1.4 years and 1.2 years, respectively.

† The frequent nasal obstruction makes it impossible to determine involvement.

‡ Choked disks, bilateral once and unilateral twice. Secondary optic atrophy, homolateral once. Simple optic atrophy with homolateral blindness and heterolateral temporal hemianopia once.

§ Loss of hearing and tinnitus in at least one half of the cases, probably due to eustachian tube obstruction.

¶ Difficult to determine because of mechanical displacement or direct involvement of the muscle by the tumor.

In one case, hemiatrophy of the tongue was the first and only complaint.

TABLE 3.—Reported Cases of Tumor of the Nasopharynx Having Neurologic Complications

Author	Date	Sex and Age	Symptoms and Course	Clinical Findings (Extranasopharyngeal)	Diagnosis	Operative and Necropsy Findings
Ord, W. M.: Case of polypus nasi, extending upwards, and producing absorption of the body of the sphenoid bone, and obliteration of the internal carotid artery, followed by abscess of the brain, Brit. M. J., 1858, pp. 471-472	1858	M 50	Polyp removed thirty years before; deaf; blind in right eye; epilepsy; left hemiplegia	Deaf; blind in right eye; right internal strabismus; left hemiplegia	Polyp	Erosion of sphenoid; obliteration of internal carotid; three brain abscesses
Fleury: Polype fongueux (cancéreux) s'étendant à l'arrière-gorge, à la narine droite, pénétrant dans la cavité orbitaire, dans le sinus sphénoidal, et perforant la base du crâne après avoir détruit le corps du sphénoïde, Bull. Soc. de chir. de Paris **4**: 447-449, 1864	1863	M 20	Pain in right side of face; nasal obstruction; right proptosis; erysipelas; died three months after onset	Right proptosis; pupil immobile; "eye lost"	Polyp fongereux (cancéreux)	Tumor eroding sphenoid and ethmoid; softening of adjacent brain
Verneuil, quoted by Veillon: Contribution à l'étude des tumeurs malignes naso-pharyngiennes, Paris, 1874	1867	M 40	Enlarged right cervical glands for three months; right proptosis and complete ophthalmoplegia; deafness; pain right side of head and nasal obstruction; death	Right proptosis; paralysis right third, fourth and sixth nerves, partial seventh and twelfth; deafness	Embryonic sarcoma	Erosion of the sphenoid with involvement of right second, third, fourth, fifth, sixth, seventh, eighth, tenth, left second, third, fourth and sixth nerves; dura intact
Verneuil and Schweich, quoted by Laval, F.: Destuneurs malignes du nasopharynx, (Etude clinique), Toulouse, 1904; Arch. internat. de laryngol. **19**: 55-75, 1905	1867	F 40	Pain in left side of neck; deafness; death...	Left ptosis; mydriasis; facial palsy....	Sarcoma	
Verneuil and Flour, quoted by Laval.....	1873	F 39	Tumor of neck for seven years.....	Vocal cord paralyzed, due to gland....	Carcinoma?	
Veillon, F. T.: Contribution à l'étude des tumeurs malignes naso-pharyngiennes, Paris, 1874	1874	M 14	Swelling of left cheek; proptosis, nasal obstruction; hemorrhage; dysphagia; amaurosis on left; removal of tumor; erysipelas; nephritis; exitus one month after first seen	Left eye blind; left facial paralysis; left deafness	Sarcoma	Erosion of sella, of left sphenoid wing, left orbit with destruction and friability of second, third and sixth nerves and ocular muscles; erosion of left anterior fossa and right anterior fossa; extension along fallopian tube and injury of left facial nerve by pressure; metastasis to kidneys, mesentery, lungs, and spleen
Weinlechner: Verzweigtes Sarcom in der Nasen Rachen-augenhöhle mit Verdrängung des Bulbus; ungeheilt, Berl. d. k. k. Krankenanst, Rudolph-Stiftung in Wien 1876, p. 350	1876	M 14	Pain, nasal obstruction; right proptosis; blind	Loss of right vision; optic atrophy....	Sarcoma	
Bryk, quoted by Laval.....	1881	28	.....	"Fourth ventricle nuclei" involved.....	Round-cell sarcoma	
Shrady, G. F.: Removal of a large nasopharyngeal tumor with extensive attachments to base of skull. Unexpected brain complications, death, Med. Rec., **22**: 311-314, 1882	1882	M 14	Occlusion of left nostril for four years; polyp removed; left exophthalmos; operation; death	No neurologic findings clinically (see necropsy findings)	Fibro-sarcoma	Tumor 2 cm. in diameter penetrating the foramen laecrum medium into the middle fossa
Weir, R. F.: Fibro-sarcoma of the nose, removed by Chassaignac's operation; recurrence in the brain, New York M. J. **45**: 282, 1887	1887	M 42	Obstruction of right nostril; hemorrhages....	Left blindness and divergent squint....	Fibro-sarcoma	Operation showed extension through the sphenoid and ethmoid

Fox, S. A.: Naso-pharyngeal carcinoma. Report of a case, with a consideration of the treatment of the disease, New York M. J. **51**: 259-260, 1890	1890	M 40	Bregmatic and frontal headaches for eleven months; nasal obstruction, deafness, diplopia	Strabismus; optic disks clouded; left hand weak	Epithelioma	Erosion of 3 inch opening through the middle fossa, involving the body and wing of the sphenoid; petrous temporal bone
Roncalli, F.: Sarcoma of naso-pharynx; fatal case, with necropsy, Rep. Superv. Surg.-Gen. Mar. Hosp. **19**: 151, 1890-1891	1890	M 40	Fullness and soreness of throat for two months; dysphagia	External and internal ophthalmoplegia	Sarcoma	Erosion of ethmoid and sphenoid
Ingals, E. F.: Fibro-sarcoma of naso-pharynx, Internat. Clin. **3**: 336-342, 1891	1891	M 39	Deaf for one year; pain in occiput; dysphagia; pushes food down throat with finger	"Diabetes insipidus;" urine specific-gravity 1.003, passes 16 to 18 pints each day; tongue paralyzed and atrophic	Fibro-sarcoma?	
Müfarth, M. L.: Ueber maligne Geschwülste des Nasenrachenraumes, Köln, 1893	1893	F 26	Dysphonia; dysphagia	Paralysis of the right and left sixth nerves	Giant-cell sarcoma	
Roncalli, F.: Sarkom des Nasenrachenraumes, 1 Fall, Jahresb.u. d. chir. Abt. d. Spit. zu Basel (1892), 1894, p. 19	1894	M 43	Impaired hearing, left side, three months later right side also; left cervical glands; two years after nasal obstruction, proptosis, divergent squint and blindness; pneumonia; death three months later	Left cervical glands enlarged; proptosis; complete palsy third nerve; choked disk; blindness	Lympho-sarcoma	Erosion of the base and dura; metastasis to the gastric mucosa; gangrenous pneumonia; brown atrophy of the heart, spleen and liver
Alexander, quoted by Laval.....	1895	40	.....	Paralysis of the palate and sixth nerve	Sarcoma	
Etiévant, L.: Quelques considérations sur les phénomènes asphysiques provoqués par les polypes naso-pharyngiens; un cas de paresthésie du femorocutuné externe accompagnant un lympho-sarcoma du pharynx, Rev. internat. de rhinol., otol. et laryngol. **6**: 92, 1896	1896	M 18	Nasal obstruction for five months; pain under the left eye; two months later tracheotomy; anesthesia of the area supplied by the left femorocutaneous nerve	Anesthesia of the area supplied by the left femorocutaneous nerve; paralysis of the left third, fourth and sixth nerves	Lympho-sarcoma	
Hubbard, T.: The history and necropsy of a case of fibro-sarcoma of the naso-pharynx and middle cerebral fossa; associated conditions; ethmoiditis; empyema of the sphenoid cell; otitis media; pachymeningitis, Arch. Otol., **26**: 168-174, 1897	1897	M 50	Pain in left side of head for ten months; diplopia; loss of vision of left eye	Left eye, vision poor, pupil rigid; abducens palsy	Small round-cell fibrosarcoma	Erosion of the tumor through the left middle fossa from the sphenoid to the foramen ovale; pus in the sphenoid
Hellat, P. P.: Cancer of the nasopharynx, Vrach, **21**: 1019-1021, 1900	1900	43	Coryza for six months, nasal obstruction; deafness; death	Anesthesia of the pharynx; cord palsy; rapid pulse and respiration; hemiparesis of the tongue	Carcinoma	
Ratinow, quoted by Laval.....	1900	..	Palsy of the cranial nerves for two months; death	"Palsy of the cranial nerves".....	Carcinoma	
Jackson, C.: Primary carcinoma of the nasopharynx. A table of cases, J.A.M.A. **37**: 371-377 (Aug. 10) 1901	1901	F 23	Pain in right side of face and ear for one year; partial ankylosis of the jaw	Low grade optic neuritis; twitching of the right facial muscles	Columnar epithelioma	
Lotzbeck, quoted by Jackson.....	1901	F 37	.....	Bilateral proptosis and amaurosis.....	Carcinoma	
St. Mary's Hospital, quoted by Jackson...	1901	M 45	Left nasal obstruction for two and one-half years; headache; epistaxis; dysphagia; vertigo	Cervical glands; "left strabismus;" impairment of the right sensory fifth nerve and facial palsy	Epithelioma	
Compaired, quoted by Laval.....	1902	M 48	Pain for four months; nasal obstruction; loss of vision	Proptosis, blind in one eye; ophthalmoplegia	Epithelioma	
Bronner, quoted by Laval.....	1903	63	"Cerebral symptoms" for eight months.....	Proptosis; optic atrophy.....	Carcinoma	

TABLE 3.—Reported Cases of Tumor of the Nasopharynx Having Neurologic Complications—(*Continued*)

Author	Date	Sex and Age	Symptoms and Course	Clinical Findings (Extranasopharyngeal)	Diagnosis	Operative and Necropsy Findings
Stenger: Maligner Tumor des Nasenrachenraumes: citrige Mastoiditis, Arch. f. Ohrenh. **61**: 247-250, 1904	1904	M 54	Pain in the right side of head and face for sixteen months; tinnitus; diplopia for six months; ptosis; loss of vision; two weeks later sudden tetraplegia and death	Hyperemic disk, external ophthalmoplegia; hyperesthesia and hyperalgesia of right side of face; impaired hearing on the right side	Sarcoma; mastoiditis	
Baldwin, Kate W.: Malignant growth of the nasopharynx: A report of two cases, J. Ophth. and Oto-Laryngol., **2**: 12-17 1908	1908	F 42	1904, left earache and discharge; 1905, pain in right side of face and head; loss of memory, irritability, epistaxis; 1906, right ophthalmoplegia; 1907, nasopharyngeal tumor found; right eye blind	Deafness on right side; paralysis of right second, third and fourth nerves, and sensory part of fifth nerve after July, 1906	Epithelioma	
Brown, C. M.: Carcinoma of the nasopharynx, Laryngoscope **21**: 1069, 1911	1911	M 49	Pain in the left temple for six months; discharge from the left nostril and ear; left side of face numb; diplopia; and ptosis eight months later	"Diplopia"; ptosis; impaired sensation (subjective?) of the left side of the face	Squamous cell carcinoma	Died of meningitis; the neurologic signs were all shortly antimortem in their appearance
Guthrie, T.: Carcinoma of the nasopharynx in a girl aged 17, J. Laryngol. **26**: 449-452, 1911	1911	F 17	Nasal obstruction; pain in left side of face and ear; epistaxis, syncopal attacks; deafness; cervical glands enlarged; three months later left proptosis and blindness; dysphagia	Left cervical glands enlarged; impaired hearing; proptosis, blindness	Carcinoma	
Aboulker, H. (Garel): Contribution à l'étude des tumeurs malignes du naso-pharynx, Bull. d'oto-rhino-laryngol. **15**: 115-134, 1912	1912	M 45	Nasal obstruction for six months; headache; death eight months later	"Evidence of compression of nerves at base of skull"	Epithelioma	
Todd, H.: Malignant disease of left sphenoidal region; proptosis with blindness of eye on same side; enlarged cervical glands on both sides, Proc. Roy. Soc. Med., Laryngol. Sect. **6**: 19, 1913	1912	M 52	.....	Left proptosis and optic atrophy.....	Epithelioma?	
Courtillet and Aboulker; quoted by Aboulker	1912	M 42	Headache on the right side for seventeen months; right nasal obstruction; deafness and blindness; strabismus; death eleven months later	Right deafness and blindness; strabismus; vocal cord palsy	Fibrosarcoma	
Molinié, J.: Cancer du naso-pharynx, Larynx, l'orielle et le nez **6**: 75-78, 1913	1913	M 40	Pain in the right side of neck for four months; deafness; cervical glands enlarged; diplopia; nasal obstruction; dysphagia; death	Right cervical glands enlarged; deafness; "diplopia"	Cancer	
Oppikofer, E.: Ueber die primären malignen Geschwülste des Nasenrachenraumes, Arch. f. Laryngol. u. Rhinol. **27**: 526-564, 1913	1913	M 61	Pain in right half of head, ear and tongue for six months	Proptosis; paralysis of the right third, fourth, sixth, tenth and twelfth nerves	Carcinoma	
		M 19	Nasal obstruction for one and one-half years; dysphagia; deafness and headache for four months	Right vocal cord palsy, and deviation of the tongue to the right	Large cell sarcoma	
		F 58	Impaired hearing for three months, after nine and one-half months of bulbar symptoms	Paralysis of the right side of palate and entire tongue	.....	Erosion through the sphenoid and petrous temporal bone, not penetrating the dura, but touching it; involvement of the right fourth, fifth and sixth nerves, and left twelfth nerve
		M 17	Impaired hearing for five months, pain in the right jaw and occiput for two months; right facial palsy eight months after onset; ophthalmoplegia; death	Right pupil small; paralysis of the right superior rectus, external rectus and right facial nerve; deaf	Endothelioma	Metastasis to cervical glands; base of brain pushed upward near the sella; third, fourth, fifth and sixth nerves involved intracranially, seventh nerve extracranially (gland); gasserian ganglion invaded

Oppikofer, E. (Continued)		F 13	Headache for two months; dysphagia.....	Bilateral external rectus palsy and right half of tongue	Carcinoma	Tumor attached to vertebral column, extending downward to the hyoid, upward through the sphenoid; dura not penetrated
		M 51	Epistaxis for seven months; impaired mastication for five months; ophthalmoplegia eight months after onset; death nine months later	Palsy of the right palate and third fourth and sixth nerves	Lymphosarcoma	
		M 30	Difficulty in breathing for one month; pain in the right ear and occiput; hoarseness and diplopia	Involvement of the ninth, tenth, eleventh and twelfth nerves on the left and both sixth nerves	Sarcoma	Dura elevated from base of skull near the petrous part of the temporal bone
Finzi, A.: Fall von Tumor des Nasenrachenraumes mit Metastasen an der Gehirnbasis und im Rückenmark, Mitt. d. Gesellsch. f. inn Med. u. Kinderh. in Wien **13**: 161-163, 1914	1914	M 22	Pus and blood from the cervical gland for two years; pain on left side of face and head for one year; left nasal obstruction; deafness	Bilateral cervical glands; anosmia on left; left deafness; proptosis; complete left third and sixth, and fifth motor and sensory nerve palsies; palate weak on left side; hyperesthesia over the fifth and sixth dorsal segments; sixth and seventh dorsal spines tender, right positive Babinski sign	Sarcoma ?	
Oppikofer, E.: Primäres Lymphosarkom des Nasenrachens, Cor.-Bl. f. schweiz. Aertze **46**: 1177, 1916	1916	M 17	Pain in the region of the right side of face	Right proptosis and external ophthalmoplegia	Endothelioma	Dura elevated, but not penetrated
Stähli, J.: Ueber augenmuskellähmung als initialis Symptom von Malignem Nasenrachentumor, Klin. Monatsbl. f. Augenh. **65**: 888-891, 1920	1920	F 62	Left abducens palsy for four and one-half months; improvement for three months; returned nine months after onset; nasal obstruction eleven months after onset; ptosis and amaurosis on the left	Impaired vision on the left; right ptosis; dilated pupils; fundi normal; bilateral abducens palsy	Carcinoma	
		M 49	Slight headache for one month; paralysis of the right third nerve; blind in the right eye	Right blindness and third nerve palsy	Sarcoma	

SYMPTOMS

The clinical picture at first suggests a melange of head symptoms and signs, but on closer inspection a more precise formulation becomes possible. Occasionally it is difficult to decide whether the involvement of the nervous system was caused by the tumor, or by later complication; for example, in Sédillot's [3] case a cerebral infection apparently followed operation; in Ord's [4] case three brain abscesses were found at necropsy; in Brown's [5] case, the neurologic findings appeared shortly before death, and necropsy revealed basilar meningitis.

It is noteworthy that in sixteen of my twenty-five cases there were no nasopharyngeal symptoms. Pain in the face, side of the head, or ear was perhaps the commonest symptom, having been the chief complaint in fourteen of the cases; in five cases, however, it was altogether lacking. This group has been referred to in the literature as the neuralgic type. There was generalized headache in four cases. Paresthesia of the face without pain was an annoying complaint in five. Deafness and tinnitus in one or both ears are common, owing nearly always to obstruction of the eustachian tube by the growth. Seven patients complained of diplopia and three of blindness, ptosis, or exophthalmos. Stähli,[6] in two well reported cases, shows that ocular palsies may be transitory and for a long time the only symptom of nasopharyngeal tumors.

In the nasopharyngolaryngeal group, six patients complained chiefly of nasal obstruction, two of dysphagia, and two of recurrent aphonia, due to vocal cord palsy. In a miscellaneous group, five patients had cervical glandular enlargement, two had syncopal and epileptiform attacks, one had a psychosis (Case 22), and one had pain in the leg due to metastasis in the spine with radiculitis (Case 9).

RESULTS OF EXAMINATION

The nasopharyngeal findings will be omitted, since they have been taken up in detail by other writers on the subject. For the incidence of involvement of the various cranial nerves and certain comments on these, the reader is referred to Table 2.

The abducens was the nerve most often affected (eighteen of the twenty-five cases), the third and fourth less often. There was objec-

3. Sédillot: Polype nasal; racines pénétrant dans le sinus sphénoïdal, Soc. de méd. de Strasb. (1858-1863) **1**:190-192, 1864.

4. Ord, W. M.: Case of Polypus Nasi, Extending Upward, and Producing Absorption of the Body of the Sphenoid Bone, and Obliteration of the Internal Carotid Artery, Followed by Abscess of the Brain, Brit. M. J., 1858, pp. 471-472.

5. Brown, C. M.: Carcinoma of the Naso-Pharynx, Laryngoscope **21**: 1069, 1911.

6. Stähli, J.: Ueber Augenmuskellähmung als initialis Symptom von malignem Nasenrachentumor, Klin. Monatsbl. f. Augenh. **65**:888-891, 1920.

tive sensory disturbance in the domain of the fifth nerve in eleven cases, the motor branch being involved in six. The dissociations were often peculiar. In Case 10 there was complete loss of pain sensibility, partial loss of temperature sensibility, and slight impairment of tactile sensibility over the left half of the face. The motor root was almost completely paralyzed. It is the peripheral portion of the nerves that is most often caught in the tumor growths but the gasserian ganglion has been known to be involved (Oppikofer).[7] I found no necropsy reports of involvement of the fifth nerve within the central nervous system, so that the peculiar dissociation and distribution of the anesthesia cannot be explained on this basis. Trigeminal involvement was mentioned only five times in the cases collected from the literature.[8] In one (Finzi's),[9] there was motor involvement also. Doubtless this low incidence is apparent rather than real, since most of the cases were reported solely from the rhinologic standpoint. In none was curious dissociation and distribution of the anesthesia emphasized.

The facial nerve was not paralyzed in any of our cases; only one patient, Case 12, showed fibrillary tremors in the facial muscles. In five of the forty-four cases from the literature the facial nerve was involved: four times in combination with ocular palsies and one with fifth nerve palsy. The vestibular nerve is usually intact. Oppikofer[7] says that the vestibular reactions were normal in all of his cases. The ninth, tenth, and eleventh nerves are said to be paralyzed by glandular involvement rather than by the primary growth. That this is always true is doubtful. These nerves might easily be involved by the growth near the jugular foramen. Palatal immobility may be caused by direct pressure from the tumor and by involvement of the levator palati muscle (Trotter),[10] as well as by nerve injury. The twelfth nerve is commonly affected, and generally extracranially near its exit through the anterior condyloid foramen.

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7. Oppikofer, E.: Ueber die primären malignen Geschwülste des Nasenrachenraumes, Arch. f. Laryngol. u. Rhinol. **27**:526-564, 1913.

8. St. Mary's Hospital quoted by Jackson, C.: Primary Carcinoma of the Nasophyarynx: A Table of Cases, J. A. M. A. **37**:371-377, 1901 Stenger: Maligner Tumor des Nasenrachenraumes: eitrige Mastoiditis, Arch. f. Ohrenh. **61**:247-250, 1904. Baldwin, Kate W.: Malignant Growths of the Nasopharynx: A Report of Two Cases. J. Ophth. & Oto-Laryngol. **2**:12-17, 1908. Brown, C. M.: Carcinoma of the Naso-Pharynx, Laryngoscope **21**:1069, 1911. Guthrie, T.: Carcinoma of the Nasopharynx in a Girl Aged Seventeen, J. Laryngol. **26**:449-452, 1911.

9. Finzi, A.: Ein Fall von Tumor des Nasen-Rachenraumes mit Metastasen an der Gehirn-basis und im Rückenmark, Mitt. d. Gesellsch, f. inn. Med. u Kinderh. in Wien. **13**:161-163, 1914.

10. Trotter, W.: On Certain Clinically Obscure Malignant Tumors of the Nasopharyngeal Wall, Brit. M. J. **2**:1057-1059, 1911.

As a rule, several cranial nerves are affected simultaneously, particularly those entering the orbital cavity. Next in frequency is a combination of these with the trigeminal (six cases in the series). Solitary fifth nerve involvement and the jugular foramen group are next in frequency (three of each in the series). All combinations of cranial nerve palsy seem possible.

PATHOLOGIC REPORTS

Pathologic reports are rather scant (Table 3). As most of the growths arise near the orifice of the eustachian tube, it is readily seen why the cranial nerves are so extensively involved. The bony structures surrounding this area are for the most part made up of thin lamellae readily eroded; there are numerous foramina and fissures through which the growths may extend. The only heavy bones are the pars basillaris, the proximal portions of the sphenoid wings, and the petrous portion of the temporal bones. The sphenoid and the ethmoid are usually eroded early. The sphenomaxillary fissure, the orbital fissure and internal and inferior orbital plates and the foramen lacerum are readily penetrated. In several cases there was erosion of the tip of the temporal bone.

That direct involvement of the ocular muscles may occur is well shown by Veillon's [11] case. Involvement of the cranial nerves is for the most part extracranial. Even when the dura has been reached it may be elevated, but is rarely penetrated. Veillon has shown that bilateral chocked disk is not conclusive evidence of intracranial involvement, since in these cases it is usually caused by invasion of the orbital cavities.

Invasion of the pituitary region once led me to a wrong conclusion. The findings were typical of pituitary tumor (Case 1). Since this experience I have never neglected to examine the nasopharynx in cases of suspected pituitary tumor. Segui [12] says Jaboulay reported a case in which a nasopharyngeal tumor occupied the pituitary fossa, but he gives no bibliographic reference.

Metastasis is not common. In one of our cases (Case 9) there was metastasis to the lumbar spine, producing caudal symptoms. Enlarged glands in the neck in this case directed suspicion toward the nasopharynx; on examination a lymphosarcoma was found. Metastasis

11. Veillon, F. T.: Contribution à l'étude des tumeurs malignes nasopharyngiennes, Paris, 1874.

12. Segui, H.: Contribucion al estudio de los sarcomas de la nasofaringe; frecuencia y puntos de insercion, Rev. de med. y cirug. de la Habana **23**:241-248, 1918.

to the stomach (Roncalli),[13] mesenteries, lungs, kidneys, spleen (Veillon),[11] pleura and lungs (Benda,[14] Oppikofer) has been described.

SUMMARY

1. Malignant tumors of the nasopharynx are more common than is generally believed.

2. Early diagnosis is difficult because of the common incidence of early extranasopharyngeal symptoms; in sixteen of twenty-five cases there were no nasopharyngeal symptoms. Among early complaints and signs are pain in the face or side of the head, headache, deafness, tinnitus, diplopia, blindness, proptosis, paresthesia of the face, cervical adenopathy, dysphagia, aphonia, hoarseness, and malignancy in distant parts of the body.

3. Twenty-five cases with involvement of the nervous system were selected from seventy-nine cases of malignant tumor of the nasopharynx seen at the Mayo Clinic. Cranial nerves were usually involved extracranially, those passing through the orbital fissures most commonly, particularly the sixth. Next most often involved was the trigeminal; eleven of the twenty-five patients showed sensory changes and six motor paralysis.

4. In all unexplained cases of cranial nerve palsy, in suspected tumors of the gasserian ganglion, in paralysis of groups of cranial nerves constituting the various classical syndromes, such as the jugular foramen syndrome, in glandular enlargement of the neck, in metastatic malignant disease in which no primary growth can be discovered, and in all cases of suspected pituitary tumor, the nasopharynx should be adequately examined.

REPORT OF CASES

Case 1.—Mr. F. A. A., aged 33, came to the Clinic, Feb. 11, 1917, complaining of blindness of the right eye, stiffness of the neck, and headache. Three years before, he had had headache, vertigo, and blindness of the right eye, for six months; then he had been well until three weeks before, when he fainted and was unconscious for an hour; his neck became stiff and painful. He vomited and had slight headache. After removal of spinal fluid the headache stopped. A diagnosis of brain tumor had been made.

Examination of the nasopharynx was not made in this case. Vision in the right eye was 0 with atrophy of the nerve; in the left eye 6/7, with pallor of the nerve head on the temporal side and temporal hemianopia. Hearing was diminished on the left. A roentgenogram of the head showed destruction of the sella turcica. A pituitary tumor was suspected.

At operation, a tumor 2 cm. in diameter, under and to the right of the optic nerve, was removed. The patient died several days later. At necropsy

13. Roncalli, F.: Sarkom des Nasenrachenraumes, 1 Fall, Jahresb. u. d. chir. Abt. d. Spit. zu Basel (1892), 1894, p. 19.

14. Benda: Quoted by Oppikofer, Footnote 7.

an irregular extradural, degenerating sarcoma 5.5 by 4.5 by 3 cm. was found. It completely filled the eroded area of the ethmoid and sphenoid bones and had eroded the petrous portion of both temporal bones.

This case was of interest because clinically it resembled pituitary tumor. Unfortunately, the tumor removed at operation was lost before sections were made. It seemed to be completely encapsulated and differed in appearance from the mass extending upward from below; however, we must assume that the tumor was part of a mass extending upward from the nasopharynx.

Case 2.—Mrs. F. E. N., aged 36, came to the Clinic, Sept. 23, 1918, complaining of ptosis of the right eyelid and impaired vision of one year and ten months' duration. She had had headache, numbness of the right side of the face, and deafness on the right for one month.

An adenocarcinoma of the posterior pharynx was found. On the right were central scotoma, optic atrophy, ptosis, and a small pupil which did not dilate on instillation of cocain, presumably a sympathetic paralysis. Vision in the left eye was normal. The patient died Feb. 11, 1919.

Case 3.—Mr. O. M. F., aged 54, came to the Clinic, Sept. 17, 1918, complaining of pain in the region of the nose and forehead on the right side, of one and one-half years' duration, and diplopia for five months. Several operations had been performed for removal of nasal polyps. An epithelioma of the right nasopharynx and slight enlargement of the left cervical glands were found. The right external rectus was paralyzed. The patient died, Nov. 16, 1919.

Case 4.—Mr. M., aged 45, came to the Clinic, May 15, 1919, because of sore throat lasting one and one-half months. The throat had been lanced several times but no pus found. He had had a hemorrhage from the nose, and for one week he had been strangled when swallowing.

An epithelioma, filling the right nasopharynx and extending to the hypopharynx, and enlarged right cervical glands were found. The right eyelid drooped slightly and the right pupil reacted slowly to light and was smaller than the left, probably due to sympathetic paralysis, Horner's syndrome. There were moderate dysphagia, definite weakness of the right sternocleidomastoid and trapezius muscles, and paralysis of the right vocal cord.

Case 5.—B. N., a girl, aged 6 years, was brought to the Clinic, July 9, 1919, because of nasal discharge and an ache in the left side of the head of five weeks' duration. One month before, the left eye had turned in. Adenoids had been removed without relief of symptoms.

A sarcoma filling the nasopharynx was found. A roentgenogram of the head showed a cloudy antrum and destruction of the sella turcica. External and internal ophthalmoplegia on the left was complete.

Case 6.—Mr. A. C., aged 49, came to the Clinic, Jan. 17, 1920, because of catarrh of many years' duration. For three months the patient had noticed a mass on the right side of the neck, drooping of the right lid, diplopia and tingling, and a "shaving" pain in the region of the right temple and face.

An ulcerated area was found in the right nasopharynx which on biopsy proved to be squamous-cell epithelioma. Cervical glands of each side were enlarged. There was slight exophthalmos on the right, and the external rectus muscle was paralyzed.

Case 7.—Mr. W. A. S., aged 44, came to the Clinic, Jan. 27, 1920, because of pain and swelling in the neck of one and one-half years' duration. For one year the right ear had ached and hearing had diminished; for five months

hoarseness and regurgitation of fluid through the nose had been noticeable, and for one month the right side of the tongue had felt stiff.

A lymphosarcoma filling the nasopharynx and enlarged submaxillary glands on each side were found. The patient could not hear a watch tick on the right, and the right half of the tongue was paralyzed and atrophied. Reexamination, July 1, showed, in addition, paralysis of the right half of the soft palate, and of the right vocal cord and moderate weakness of the right sternocleidomastoid and trapezius muscles. The patient died, April 2, 1921.

Case 8.—Mr. E. F. B., aged 64, came to the Clinic, Feb. 9, 1920, complaining of pain in the right ear and face of three years' duration.

An extensive squamous-cell epithelioma (biopsy) was found filling the right nasopharynx and obstructing the orifice of the eustachian tube. The right cervical glands were enlarged, and the right temporal region bulged diffusely; the right eyelids were sewn shut. Other positive findings were complete sensory and motor paralysis of the right fifth nerve, and inability to hear a watch tick on the right.

Case 9.—Mr. F. D., aged 60, came to the Clinic, May 15, 1920, because of pain in the left sacro-iliac area of eight months' duration. A gland in the left cervical region had been enlarged for two years.

A slight bulge in the left nasopharynx, 0.5 cm. in diameter, on biopsy proved to be a lymphosarcoma. The cervical glands on each side were enlarged. A roentgenogram of the chest was negative. Other neurologic findings were absence of knee and Achilles' reflexes, and loss of touch, pain and temperature sensibilities over the distribution of the left fourth and fifth lumbar segments. A roentgenogram showed a lesion of the fourth and fifth lumbar vertebrae. The pain in the back and leg and the clinical picture were typical of tumor of the cauda equina. A diagnosis was made of malignant growth in the lumbar spine, metastatic from the lymphosarcoma found in the nasopharynx. The patient died, Oct. 13, 1921.

Case 10.—Mr. H. A. C., aged 30, came to the Clinic, June 26, 1920, complaining of fullness, pain and loss of hearing in the left ear of two years' duration, for which submucous resection, tonsillectomy, extraction of teeth, sinus operation, and four or five paracenteses had been performed. For four months there had been numbness of the left side of the face and recently severe general headache and vertigo.

A lymphosarcoma, verified by biopsy, was found filling the left upper pharynx and blocking the orifice of the eustachian tube. There was slight fullness of the left parotid region; the cervical glands on either side were enlarged. Other findings were left exophthalmos with choked disk and absence of the corneal reflex, almost complete paralysis of the left external rectus, paralysis of the left motor fifth nerve, loss of pain sensibility, moderate impairment of temperature sensibility, and slight diminution of tactile sensibility over the left half of the face and tongue.

Case 11.—Mrs. J. B., aged 56, came to the Clinic, Sept. 2, 1920, because of nasal obstruction of three months' duration. There had been pain over the right lip and nose and diplopia for two months. Operation had been performed on the nose, and the teeth had been extracted without relief.

A large lymphosarcoma (biopsy) obstructing the right nasopharynx and enlarged right cervical glands were found. The right external rectus muscle was paralyzed.

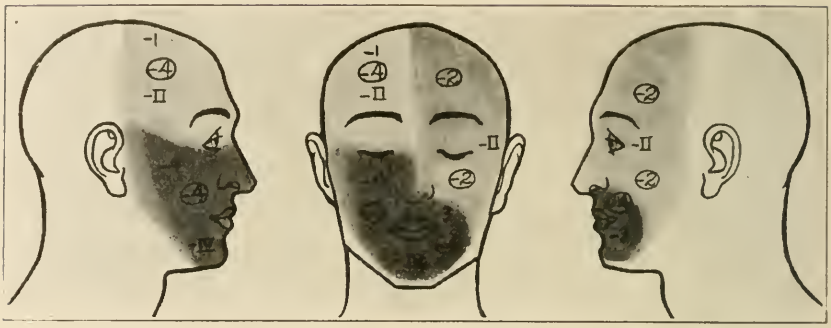

Fig. 1 (Case 12).—Oct. 16, 1920. Besides the sensory disturbance, the patient had a right choked disk, left papilledema, horizontal nystagmus to the left, rotary toward the right, complete bilateral paralysis of the sixth nerve; fibrillary tremors, but no weakness of the muscles supplied by the right motor fifth nerve; dysphagia; right patellar and Achilles reflexes more active than the left, and strongly positive Oppenheim, Rossolimo and Gordon reflexes on the left. Circled Arabic figures refer to loss of pain sensibility; Arabic figures to loss of tactile sensibility, and Roman figures to loss of temperature sensibility, on a basis of —1 to —4.

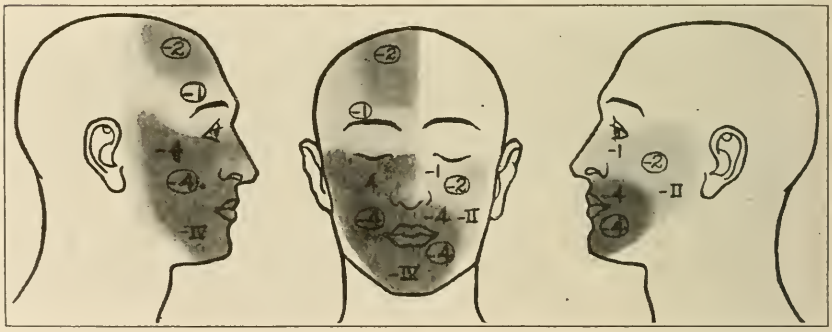

Fig. 2 (Case 12).—Feb. 9, 1921. Besides the sensory disturbance the patient had slight ptosis, horizontal nystagmus, complete paralysis of the sixth and motor fifth nerves, and moderate hemiparesis and hemiatrophy of the tongue on the right side. The right patellar reflex was slightly more active than the left, and the Babinski sign was questionable. The Oppenheim, Gordon, and Rossolimo reflexes were strongly positive on the left.

Case 12.—Mr. T. F., aged 49, came to the Clinic, Oct. 14, 1920. For five years he had had a heavy feeling in the region of the right ear. Two years before, a gland in the right cervical area had enlarged; for one year there had been diplopia, for six months the right half of the face had been numb and burned, and for five months he had had a sensation of strangling.

A squamous-cell epithelioma (biopsy) obstructing the orifice of the right eustachian tube was found. Successive neurologic findings are indicated in Figures 1, 2, and 3.

Case 13.—Mr. W. A., aged 63, came to the Clinic, Dec. 8, 1920, because of nasal obstruction of one and one-half years' duration. Deafness of the left ear for six months and numbness of the left side of the face and diplopia for one month were accompanying symptoms. Twice a mass had been removed from the patient's nose, and excision of cervical glands, tonsillectomy, and extraction of teeth had been performed without relief.

A lymphosarcoma (biopsy) obstructing the left nasopharynx and enlarged cervical glands on both sides were found. The external recti were paralyzed.

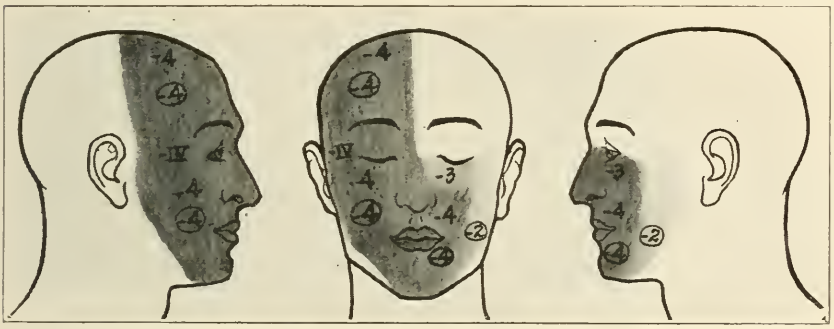

Fig. 3 (Case 12).—Aug. 11, 1921. Besides the sensory disturbance, the patient had complete external and internal ophthalmoplegia, paralysis of the motor fifth nerve, and hemiparesis, hemiatrophy, and fibrillary tremors of the tongue on the right side.

Case 14.—Mr. H. G. D., aged 62, came to the Clinic, Dec. 22, 1920, complaining of obstruction of the left nostril and pain in the left side of the head of four months' duration and of diplopia for two months.

A highly malignant, squamous-cell epithelioma (biopsy) was found filling the left nasopharynx. The left external rectus muscle was palsied. The patient died, May 17, 1921.

Case 15.—Mrs. C. L., aged 58, came to the Clinic, Jan. 26, 1921, complaining of an enlarged cervical gland of ten months' duration and of diplopia for four months.

A highly malignant squamous-cell epithelioma (biopsy) was found occupying the posterior wall of the pharynx. The cervical glands on each side were enlarged. There were deafness and diplopia.

Case 16.—Mrs. F. C. B., aged 54, came to the Clinic, Feb. 5, 1921, because of blindness of the right eye. The trouble had begun three months before with pain in the right temple and tinnitus and diminished hearing in the right ear. For two months the patient had had right nasal obstruction, difficulty

in opening the mouth, numbness, sharp sticking pain, and swelling over the right side of the face, and right temple. One month before, the right eyelid had drooped. Two weeks before, the right eye had begun to protrude, became immobile, and blind.

A nasopharyngeal tumor on the right side of the nasopharynx was found blocking the orifice of the eustachian tube and extending past the middle line. The right submaxillary gland was enlarged; the antrums were cloudy on transillumination. The neurologic findings are shown in Figure 4.

Case 17.—Mr. H. C. C., aged 47, came to the Clinic, Feb. 7, 1921, complaining of "mumps" on the left side, persisting for two years. For eight months he had had tinnitus and deafness of the left ear; for four months, slight aching of the left ear and numbness of the left cheek and mouth, and for two weeks, transitory diplopia.

A slightly malignant, squamous-cell epithelioma (biopsy) in the vault, with obstruction of the orifice of the eustachian tube on the left, was found. There was anesthesia of the left side of the face and tongue. Subjectively a numb, crawling sensation was felt on the left side of the face, and there was slight diplopia.

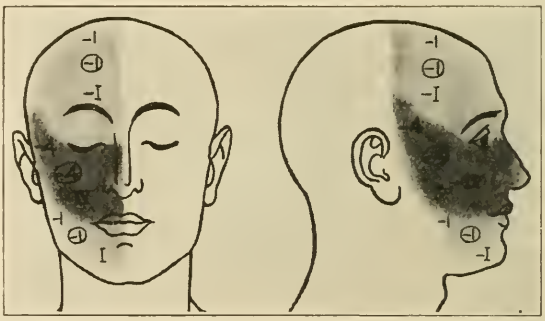

Fig. 4 (Case 16).—Besides the sensory disturbances the patient had anosmia on the right; blindness, blurred disk, proptosis 4 mm., complete external and moderate internal ophthalmoplegia on the right; paralysis of the right motor and fifth nerves; deafness in the right middle ear; paralysis of the right half of the palate, and slight hemiparesis of the tongue on the right.

Case 18.—Mr. J. E. R., aged 51, came to the Clinic, Feb. 22, 1921, complaining of a "squeezing" pain in the right temple and over the right eye of one year and two months' duration. He had had diplopia for five months. A nasal polyp had been removed, several alcohol injections given, the antrum irrigated, and the teeth extracted without relief.

An ulcerating epithelioma (biopsy) was found occupying the fossa of Rosenmüller and obstructing the orifice of the eustachian tube. There was slight ptosis of the right eyelid; the left external rectus was paralyzed, and the left pupil was small. There was slight weakness and loss of pain sensibility of the right fifth nerve.

Case 19.—Mrs. C. W. I., aged 57, came to the Clinic, April 20, 1921, complaining of catarrh and hemorrhages from the nose of three years' duration. For one year, she had had pain in the head, nasal obstruction with loss of the sense of smell, earache, tinnitus, and deafness on both sides, and for three months, diplopia.

An extensive, highly malignant, squamous-cell epithelioma (biopsy) obstructing the orifices of both eustachian tubes was found in the nasopharynx. The right external rectus was completely paralyzed; fibrillary tremors on both sides of the tongue were more marked on the left; atrophy of the left half of the tongue was advanced.

Case 20.—Mr. F. W., aged 46, came to the Clinic, Aug. 4, 1921, complaining of enlarged glands of the neck and nasal obstruction on the left of one year's duration. Septic tonsils had been removed. For eight months, there had been a hissing noise with impairment of hearing on the left, and for three months, pain on the left side of the head and diplopia. Tonsillectomy and block resection of the glands in the neck had been performed; the antrum had been drained, teeth extracted, nasal polyps removed, and treatment for syphilis given without relief.

A tumor, probably an epithelioma, was found filling the left half of the nasopharynx. Cervical glands were enlarged on each side. The left external rectus was weak, hearing was diminished, and the left half of the palate was partly paralyzed.

Case 21.—Mr. M. B., aged 35, came to the Clinic, Sept. 20, 1921, because of headache and diplopia of two months' duration. Nasopharyngeal symptoms were absent.

In the vault of the nasopharynx a highly malignant, squamous-cell epithelioma was discovered. The left external rectus was paretic, and the sella turcica and the sphenoid body were totally destroyed.

Case 22.—Mr. C. W. S., aged 46, came to the Clinic, Dec. 9, 1921, complaining of drowsiness and loss of mental power. One brother and two sisters had migraine. The first symptom had been noticed two and one-half years before when the patient's disposition had begun to change. He had always been jolly and good natured, but he became irritable and vindictive; he flew into a rage because of children, and he was sour and morose. He had lost his business acumen and had been swindled out of $1,000. Continuously for two years he had had left frontal and occipital headaches, pounding in character. Diplopia had been an accompanying complaint. In October, 1919, a mass about 3 cm. in diameter had been excised from the left cervical region. In May, 1920, nasal polyps had been removed. Although blood tests were negative, he had been treated for general paresis. In November, 1920, the left antrum had been drained and teeth extracted. The patient soon began to have night terrors; he cried a great deal, he thought he was being fed fire and that he was drowning; he threatened to take his wife's life. He had lost all personal pride; he would spit or defecate anywhere. Intense pain and a pounding noise had been present in the left ear for one year. In April or May, 1921, tissue was excised from the nose for diagnosis and pronounced sarcoma. Three months before, attacks of syncope had come on, and two months before the left side of the face, the left arm, and leg had become "dead" and cold. Vision in the left eye had been poor.

A squamous-cell epithelioma (biopsy) of the left nasopharynx involving the eustachian tube was found. External swelling was noticeable in the left temporal region. The left cervical glands were enlarged. The patient was stupid, noncooperative and hoarse. His right antrum was cloudy on roentgen-ray examination. Vision in the left eye was poor. The pupil did not react to light either direct or crossed and was very small. The fundi were normal. Tactile sensibility was definitely impaired throughout the left side of the face,

and there was pain over the second and third divisions. The right motor fifth nerve was paralyzed. The patient did not seem to hear a watch on either side. Dysphagia was present; the vocal cord was fixed. Anesthesia of the pharynx and hypopharynx was present on the left, and there was incoordination in the finger to nose test on the left. The gait was ataxic. The Babinski and Chaddock reflexes were questionable on the left.

Case 23.—Mr. I. G., aged 36, came to the Clinic, Feb. 11, 1922, because of headache and transitory aphonia of eight or nine months' duration. For three years he had noticed enlargement of the left cervical glands, which had been removed in 1919 and in 1921. There had been dysphagia for four months, strabismus for three months, and syncopal attacks for two months.

A mass was found pushing the palate forward and filling the nasopharynx. Hearing was impaired and the palate palsied; the sixth nerve, vocal cord, sternocleidomastoid, and trapezius muscles, and tongue were paralyzed on the left.

Case 24.—Mr. M. L., aged 24, came to the Clinic, April 6, 1922, complaining of pain in the right eye, forehead, and maxilla of one year and three months' duration. Seven months before he had had an operation "to get the nerve," on the assumption that trifacial neuralgia was present. Roaring noise and impaired hearing on the right side had followed. Four months before, a similar operation had been performed. The patient had had diplopia for three months. He had been taking powders containing acetanilid, caffein, sodium bicarbonate, and charcoal for relief of pain for seven months and had noticed that during the past three or four weeks his face was becoming a dusky blue.

Examination revealed a tumor in the right nasopharynx, weakness of the right external rectus and complete sensory and motor paralysis of the right fifth nerve, and partial paralysis of the right seventh nerve, probably due to operation. The Bárány test was negative. Spectroscopic examination of the blood showed methemoglobin.

Case 25.—Mr. F. B., aged 33, came to the Clinic, May 5, 1922, because of constant dull pain over the left side of the face, frontal and temporal areas, of three and one-half months' duration. Five months before the left nostril had become obstructed and an operation had been performed. For four months earache had been severe on the left. Three and one-half months before, another operation on the nose had been performed without relief. For one and one-half months the patient had noticed enlarged left cervical glands which had been excised two weeks later, and impaired vision on the left. Two weeks before, swallowing had caused pain.

The soft palate was found to bulge because of a nasopharyngeal tumor, which biopsy proved to be mixed-cell sarcoma. Other findings were blindness, chocked disk of 3 diopters, loss of reaction to light, ptosis, limited rotation of the eye upward and downward, and paralysis of the external rectus muscle.

DISCUSSION

Dr. Gordon B. New, Rochester, Minn.: During the last six years, I have examined seventy-nine patients with nasopharyngeal tumors. Dr. Woltman has reported on the neurologic findings in twenty-five of these cases. This group includes only the lymphosarcomas and epitheliomas. The syndrome usually presented by these tumors is not generally recognized. Many of the patients are operated on and treated for months or years without a definite diagnosis, owing to the fact that often they have no nasal or nasopharyngeal symptoms.

Patients with cases of this type are sent to my section for examination from other sections because of some finding which suggests the nasopharyngeal syndrome. Seventy-four operations were performed on the seventy-nine patients for relief of symptoms before a diagnosis was made. Tonsils and adenoids were removed in twenty-four cases; the glands of the neck in eighteen; and wisdom teeth were extracted in twelve. Intranasal operations were performed in nineteen cases, which included ethmoid, antral and septum operations. Mastoid operation was performed in one case.

From the neurologic standpoint, the nasopharynx has been overlooked. As Dr. Woltman says, in nearly one third of the cases of malignant tumors of the nasopharynx, there are neurologic findings.

Dr. M. A. Bliss, St. Louis: Our experience with cases of this type has been largely in confusing them with the tic douloureux. Nearly all of the cases we have seen here have been diagnosed before coming to us as trifacial neuralgia.

Abstracts from Current Literature

DEMENZIA AFASICA (BIANCHI'S DISEASE): A CLINICAL STUDY.

ENRICO ROSSI, Ann. di nev. **1**:1, 1922.

The whole article might be summarized in the words of the author: "The hurried ultramodern conceptions (especially those of Marie and Head) of this subject have, instead of imperiling a magnificent structure, simply succeeded in constructing small buildings which are incapable of holding all the clinical pictures. Psychophysiology has succeeded in furnishing us with clear knowledge of the various speech centers, based on certain embryologic and developmental facts integrated with numerous accurate clinical and anatomic observations." The author gives credit to Bianchi for first accurately describing the mental side of the aphasic in 1887; that is, long before Pierre Marie did so.

The author reports a case of aphasic dementia in a 33-year old man who had previously been mentally normal. He became depressed by family worries, was suspicious, had lacunar memory defects and neglected his affairs. He was picked up in Milan disoriented and with signs of alcoholism. On examination, there was a generalized tremor of all extremities made worse by movement; uncertain and shuffling gait. He could not stand on one foot and was unable to obey simple commands, such as to button his coat, squeeze one's hand, etc., without great difficulty and much retardation. The right hand was weak. There was no facial weakness. The pupils were sluggish, equal in outline and size, and vision was equally diminished in both eyes.

Apparently there were sensory changes in the right hand. There was no Babinski sign or clonus; the patellars were hyperactive and equal. The patient was stupid; he appeared dazed and said nothing, even if directly addressed, unless the remarks were repeated several times; then he would say simple words, such as "mamma" or "Giuseppe." His name was pronounced Gius-pe. He had difficulty in repeating even monosyllables. He turned in the direction of sounds. He seemed to understand chiefly by signs and motions. He gave spontaneously a good account of happenings in his life prior to his illness, but chiefly by recalling visual imagery. He had poor verbal and visual images, but especially bad auditory ones. He was best able to recall visual images of events, objects and persons but could not translate these into words, even if they were suggested to him by asking him to copy or by dictating these things to him. He could not write his own name spontaneously. He read poorly and failed to copy even large letters. When asked "How old are you"? he would remain silent and apparently did not understand, but as the question was repeated he would write incorrectly with detached syllables and in a hesitating manner, repeating the request. If anything was dictated to him, the result as he wrote it was not understandable. Vowels and syllables were transposed.

The author explains the patient's difficulty by assuming defective formation of auditory, verbal and visual images and lack of coordination in the field of ideation of the formation of letters and syllables in the construction of speech. The patient's ability to write fairly correctly simple dictation after much repetition was due to integrity of the writing center and freedom of the centrifugal conduction pathway from it, and to a blocking of the pathway from the auditory word centers to the graphic center. This explanation of course does not tell

the whole story nor does it adequately explain any considerable part of the patient's trouble. He repeated, with omission of syllables, the names of objects shown him and calculated poorly even simple sums in addition and multiplication. His answers in writing were unintelligible hieroglyphics. He did recognize some colors but confused blue and black, yellow and green.

The patient was a dement. His ideas were necessarily confused, because of the fragmentary information he received. He was silly and euphoric. However, with verbal auditory reeducation he should improve. As he grew to recognize the sound of monosyllables, he was made to repeat them in words. As this improvement progressed, there occurred an improvement in copying and writing spontaneously, although still with a great percentage of error.

How the author arrived at his localization of the trouble in the temporal and inferior parietal lobes is hard to understand even though he points to the absence of hemiparesis (How explain the weakness in the right hand?) as removing the lesion from the third left frontal lobe, which he says is the site of lesions in paralytic aphasic patients. The patient therefore demonstrated as a result of these lesions: word deafness, alexia and agraphic, plus grave mental deterioration.

Bianchi, in 1921, differentiated the type of dementia in senility, dementia praecox and paresis from that which occurs in aphasia. In the former types the defect is global, affecting perception, association and memory and disturbing affect and attention. In aphasia, however, the rest of the cortex with the exception of that which has to do with language functions is intact. Is the aphasic demented simply because he is aphasic? The author argues the question. Language, intelligence and feeling develop apace as the individual makes contact with his environment. It is such an intimate evolutional synthesis that in breaking down the disturbances of language there are manifested disturbances in the production of vocal sounds and combination of syllables. This, of course, is the law of the beginning of destruction in disease of our most recently acquired functions.

Language and intellect are so intimately conjoined that the slightest disturbance of the former disturbs ideation in a particular manner much different from the disturbances seen in other mental conditions. In idiots and imbeciles the spoken word is either monosyllabic or extremely simple with much error of construction in phrasing, etc. In dements, however, speech is more of the confused type because of poor associations of words and ideas making concepts impossible and resulting often in perseveration of senseless syllables or phrases. In all of these cases one cannot speak of aphasia because, while the intelligence is severely disturbed, the use of language is not lost. Therefore, there is not an absolute connection between language and intelligence. Even in the sensory aphasias of Wernicke and the word deafness of Kussmaul, in which intelligence is so deeply disturbed, apparently the explanation is to be found in the fact that auditory images are so much more important than visual or motor images in building up concepts.

In the author's case the paraphasia, paragraphia, alexia and auditory amnesia made the synthesis of concepts impossible, thus explaining his dementia. He also had violent impulses (the patient was destructive and assaultive) which might lead one to believe him to be a real dement if it were not for the differential points already mentioned.

Thought is an intricate process requiring an exquisite harmony in the integration of various association cells in the cortex; only when thought is spoken is the voice necessary (speech). The word may be written or seen.

When one reads, one articulates mentally; therefore it follows that the articulate element in reading is of primary importance, the visual recognition being of secondary value. Or the word is revealed through the pressure of fingers on a pen in writing as occurs in the blind. In that case the tactile pressure sense is of secondary importance, internal speech causing the conversion by means of the pen into the written word.

In the author's patient the center for word images was not injured in its cellular (cortical) elements, but along the tract uniting in association the center for auditory memories and the psychomotor center of Broca, which explained the fact that he could in small part invest his ideas with the spoken word. The auditory word center is of great importance attracting to it the streams of association fibers from the kinesthetic, visual, gesture, touch and hand centers. Speech is possible, however, by the exclusive use of pathways from the visual, hearing, touch and movement centers directly with the prefrontal centers. But refined, elevated ideas and concepts can only be expressed when the cells presiding over the imagery of the spoken word are brought into play. This center is the Broca area and this conception has successfully withstood all attacks since 1863. Mingazzini has assigned to Broca's areas in both hemispheres the function of storing the motor images of language.

The author believes that the little used cells of the right Broca's area may, on occasion, assume the functions of the disturbed left area in cases of aphasia. He believes that the verbal auditory images are stored in the posterior third of the first left temporal lobe. In spite of the fact that his patient showed verbal auditory aphasia he was able to repeat, parrot like, names and phrases, though often incorrectly, just as a child does when it repeats without understanding the words it hears. There was incoordination between the movements necessary to articulate words and the motor articulate memories, also of the vision of the written word and incoordination between the motor writing memories and the written word. Probably words frequently repeated are actually registered in the auditory area as images of the sound of the spoken word. The child who hears is under the instinctive necessity to repeat because of the motor speech area. This, of course, places the author in the position of giving the child a speech area before it is able to speak or see and understand what it sees, or understand what it hears. It is practically the old facultative doctrine over again.

The author's patient not only had word deafness, but he did not recognize other sounds; therefore there existed a profound mental deficiency. Bianchi formulated the doctrine that the prefrontal lobes were the synthetizing centers directing and regulating the material elaborated by the sensory areas, and these later when dissociated were simply inadequate and weak, resulting in an appearance of dementia.

The author as a representative of Bianchi's school disagrees absolutely with Head. Bianchi has clearly shown that aphasic patients eventually, because of their defects, become demented. They remember nothing of what has happened to them, even recently; they lose the memory of objects, even though they understand what is said to them and are able to obey spoken commands. The author again attempts to classify his case; he says it was not one of pure word deafness nor of ordinary sensory aphasia, but a type of the transcortical aphasias of Lewandowsky. This case combined the elements of sensory aphasia and word deafness, because while he could hear he did not understand what he heard. He also had paraphasia—a conduction aphasia due to interruption of the auditory and motor pathways. No less important was the alexia

and paragraphia. This was due to a break in associations between the auditory word area and the visual, because writing is only possible through verbal association with the motor and visual areas. The depression in the word-acoustic area was felt also in the word motor and word visual areas making the recalling of images difficult.

The author calls attention to the hemiopically contracted visual field in his patient as proof that the visual pathways were involved rather than the word center itself. The patient also showed grave word memory defects causing a notable defect of intelligence even to dementia. For this reason the lesion is placed in a circumscribed area in the left temporal lobe and inferior parietal, also partly in the superior temporal gyrus in the insula and in the base of the ascending frontals (what real cortex was left whole?). One can best give the kind of reasoning employed by the author by simply doing as I have done—making practically a translation of the whole article. Its many discrepancies, its fallacious psychology are even more obvious in the original. All of the author's statements are based on a clinical case, neurologically incompletely examined. The diagnosis may even be questioned. Was it really a case of true aphasia even as clinically presented?

Osnato, New York.

CONTRIBUTIONS TO THE STUDY OF SENSATION. H. Doebeli, Schweizer Arch. f. Neurol. u. Psychiat. **9**:227-243, 1921.

The sensation of itching was studied by the application of an itching powder (mucuna pruriens). The subject was blindfolded and not told what was to be expected. By means of a skin microscope it was seen that this so-called powder is really not a powder at all, but that it is made up of numerous fine, needle-shaped hairs from 3 to 8 mm. in length and 0.25 mm. in thickness. These hairs have a dull and a sharp end and are quite rigid. On the slightest movement the sharp end imbeds itself in the corneal layer of the skin to a depth of less than 0.5 millimeter. In a normal subject the opposing surfaces of the fingers, the volar side of the forearms, especially near the wrist, the interscapular region and the tibial crest are most highly irritable, while the palms of the hands and the soles of the feet are least so. In addition to localization, the degree of itching produced is also dependent on the number of hairs applied. In the three cases of syringomyelia under investigation, the powder was applied in the form of streaks passing vertically and horizontally to the borders of the anesthetic areas.

An attempt was made to determine whether this itching was produced chemically or mechanically. Analysis showed that there are no acids or toxins present, such as Haberlandt found for the nettle. Other factors which speak for a mechanical basis of itching are the fact that triturated spun glass or a vibrating tuning fork produce this sensation, and that the itching can be stopped at once by removal of the powder with soap and water, which is not possible in nettle rash or insect bites. When a needle is pricked into the skin pain results. The difference, mechanically, between the production of pain and that of itching is that to produce the latter the stimulation must be minimal, and that no less than two or three pain endings must be stimulated simultaneously. It was found, in cases of syringomyelia, that wherever there is loss of pain sensibility, itching cannot be produced, even though tactile sensibility remains normal. Where pain sensibility is normal it is always easy to produce itching. While the difference in production of pain and itching seems to be only one

of degree, and the impulses presumably travel the same tracts in the cord, the affect reaction produced by these two types of stimulation is quite different and must be a function of the brain.

Pressure-pain sensibility was investigated by means of Head's instruments. It was found in the dissociated anesthetic areas of the syringomyelic patients under observation that pressure-pain sensibility was reduced. Up-to-date impairment of this form of sensibility was described only over the totally anesthetic areas (Schlesinger). There are cases of syringomyelia in which analgesia of deep structures coincides with analgesia of superficial structures; in such cases one is inclined to assume that these tracts ascend the cord in juxtaposition. In one of Doebeli's cases, however, there was complete superficial analgesia, while pressure pain was preserved. It is possible, therefore, that normal pressure pain is made up of two components, that is, pain caused by stimulation of deeper structures. Furthermore it appears that if pressure pain is normal while there is complete anesthesia of the skin, it must pass up another part of the cord.

Joint-pain sensibility was investigated by hyperextension and hyperflexion of the joint under consideration. This can easily be done with all joints working on the hinge principle. The examination is simple, the responses accurate and immediate. It was found that in syringomyelia joint pain may be diminished or lost. In the three cases under investigation, this form of pain sensibility was lost in all joints in a field of complete loss of superficial and pressure-pain sensibility.

Position of joint sensibility was tested in the usual manner by asking the patients to indicate any change of movement in the joint. The three patients examined gave normal responses. It demonstrated that this form of sensibility may be preserved even when joint pain sense is completely lost. Doebeli thinks, as do von Frey and Meyer, that postural sensibility does not belong to deep sensation, but is a quality of superficial sensibility produced by slight movements in the skin over the joint under consideration. In support of this he cites the experience of Vanghetti-Sauerbruch, who found that a patient having an artificial elbow with a normal stump above could detect the slightest movements of this elbow, presumably through the slight pressure and tension changes produced in the skin above.

Following the application of an Esmarch bandage a sensation of blood hunger appears; on its removal there is a sensation of blood passing through the vessels. Doebeli believes that these forms of sensation, while well understood in a general way, have not been described before. When an extremity has been emptied of blood there is a sensation of heaviness, weakness and fatigue. Syringomyelitic patients retain this form sensibility. The return of blood to the anemic extremity at first produces an unpleasant feeling, then a sensation of burning, and shortly a pleasant sensation of warmth. Although these patients lost temperature sensibility, they retained the burning and warmth which goes with this.

In order to test the ability of a patient to perceive the direction of rapidly succeeding stimuli, Doebeli stroked the skin in different directions with the tip of his finger. The result was interesting in that every variety of disturbance was noted. No definite rule could be established. In a general way, where there was diminished tactile and localizing ability, stroking of the skin was simply perceived as touch. Disturbances of directional sensibility in the main were present only where superficial sensation was involved; in one case, how-

ever, in which this was normal the patient was quite unable to indicate the direction of the stimuli over certain areas. This was verified repeatedly over a period of three months.

From the psychogalvanic investigation method M (Veraguth: Das psychogalvanische Reflexphänomen, Karger, 1911) was employed. The stimuli included acoustic tests, pricking of the skin in different regions and points de feu. The result was instructive in that there was no galvanic response wherever superficial sensibility prevented the appreciation of the stimulus. The writer recommends a wider use of this method in determining whether an anesthesia is of hysterical origin or not.

Woltman, Rochester, Minn.

THE PHYSIOLOGY AND PATHOLOGY OF TICKLING. Luigi Insabato, Riv. di patol. nerve. e ment. **26**:121 (Nov. 12) 1921.

The author arrives at certain conclusions concerning the affective sensations of tickling and itching, based on the physiology of the condition as we know it through the work of many authors, whom he quotes, and also on certain original observations made on himself and on twenty-nine patients. These patients suffered from hemiplegia, with or without thalamic or other sensory disturbances, dementia praecox or manic depressive psychoses. There was a group also of perfectly normal persons.

In some of the cases of hemiplegia, with thalamic or other sensory disturbances, the loss of the normal tickling sensation was unilateral. Some patients having postencephalitic phenomena were also included in the twenty-nine subjects experimented on.

The author draws a very sharp distinction between the sensation of tickling, which he calls "Solletico profundo," and the sensation of itching, which he calls "Solletico superficiale."

The superficial sensation which he calls itching is characterized by the following special considerations: 1. It is produced by gently stroking small areas of skin or mucous membrane. 2. It may be produced by oneself. 3. It is strongly analogous with the spontaneous sensation of pruritis. It is also characterized by the fact that the sensation lasts a considerable time after the stimulus is removed, and only gradually disappears. It may, however, be made immediately to disappear by scratching or strongly rubbing the part stimulated, just as one obtains the sensation of satisfaction when a pruritic spot is scratched. The sensation is also further easily inhibited by the will.

This particular type of "Solletico" is very different from tickling, which is produced by the irregular and energetic stroking of certain parts of the body, namely, the axilla, the sides of the chest, the neck, the soles of the feet and the abdomen.

This tickling sensation cannot be self-provoked. It depends to a considerable extent on deep sensations and ends when the stimulus is removed. It is invariably tied up with motor reactions which have the characteristics of reflex acts. The author also feels that the superficial abdominal reflexes are intimately connected in their physiology with this latter sensation ("Solletico profundo"). This last affective sensation of tickling is very complex and depends on the special consciousness of a peculiar state of the organism, particularly the cutaneous and musculo-aponeurotic sensations.

There is also added the perception of reflex muscular movements of the regions stimulated and of other parts of the body remotely removed from the

point of stimulation. These reactions may be attitudes of mimicry or emotional attitudes of crying or laughter, and various evidences of changes in the sympathetic innervation may also make themselves manifest. These last may be vasomotor, secretory, respiratory or cardiac.

In other words, when the sensation of tickling is actively induced, one obtains a reaction which is really a profound emotional discharge obtained through reflex paths stimulated peripherally through the aponeurotic tendinous pathways, chiefly.

One, therefore, sees why the sensation of superficial "Solletico" (itching) cannot be the same as the great emotional discharge which accompanies tickling. The emotional element in the former is very slight, because the sensation can be self-induced. In other words, the affect element predominates in tickling or ticklishness, whereas the sensation element predominates in itching. Vasomotor and pilomotor reactions also occur in itching, but are only local sympathetic reactions.

The author states that while the phenomenon of ticklishness is an emotional reaction, it is a more primitive form of emotional reaction than one sees in fear, joy and pain. There the reaction is less a spastic one than it is a tonic contraction limited to the muscles of expression; whereas, in ticklishness, extensive muscular movements occur of a convulsive type, with uncontrollable laughter or crying. These last two states which accompany ticklishness help to explain the phylogenetic origin of the phenomenon.

The author thinks that the motor phenomena and ticklishness, namely, the rigidity of muscles close to the point of stimulation, opisthotonos, etc., show how closely allied it is to what occurs when the abdominal reflexes are obtained. Both of these are probably due to activity of the sympathetic nervous system through its connection with the motor extrapyramidal pathways in the basal ganglions.

Insaboto argues that the presence of painful ticklishness in certain of his cases showing psychic reactions and mental confusion and in certain of his postencephalitic cases with syndromes of the corpus striatum attests the importance of the basal ganglions in the production of this sensation. In further support of his theory that both the abdominal reflexes and ticklishness have a sympathetic basis, he calls attention to the fact that ticklishness has its point of strongest stimulation in the sides ("fianchi") where the most definite segmental sympathetic innervation also exists, supplying the large muscles of the abdomen.

Great stress is laid on the fact that some of his cases showed unilateral absence of ticklishness, and precisely in those cases was it true that the signs pointed definitely to lesions in the corpus striatum.

According to the principles of Vogt, the center for ticklishness, therefore, must exist in the neostriatum. This theory is based on the principle laid down by this investigator, who says that pallidal syndromes are always bilateral, while neostriatal syndromes are unilateral.

The author disagrees with Havelock Ellis that ticklishness is increased in the manic-depressive insanity. In two of his cases, it was diminished.

The author further feels strongly that his studies in connection with the pathology and physiology of ticklishness show that hysteria may have an organic basis in functional disturbance of the thalamus and basal ganglions. He specifically refers, however, to the motor crises of hysteria. In fact, he feels that the intense emotional crisis exhibited by the hysterical patient,

spontaneously, might be interpreted as a greatly exaggerated pathologic state of similar character as the normal emotional reaction, following active strong tickling.

He finally concludes that the significance of tickling is not teleologic but phylogenetic. In other words, tickling is an undifferentiated, general, non-specific emotional reaction, upon which has been gradually built the more specific utilizable colorings, namely, the emotional reactions brought out in defense, eroticism, play, fight, etc.

The article takes up forty-five pages of the number in which it appears and contains a splendid bibliography with many useful references. It is, furthermore, very well written. The only discrepancy which I found in the author's statements was his assertion, made several times, that the abdominal reflexes were like the reaction of tickling, in that they were not autoprovocable (p. 135). The morning after I had finished reading the article, I asked a psychoneurotic patient who was completely negative from the organic neurologic point of view to stroke his own abdomen and was able to see each one of the upper and lower abdominal reflexes come out quickly and actively.

Osnato, New York.

FURTHER PATHOLOGICAL STUDIES IN DEMENTIA PRAECOX, ESPECIALLY IN RELATION TO THE INTERSTITIAL CELLS OF LEYDIG. Frederick W. Mott and Miguel Prados y Such, Dementia Praecox Studies, Psychiat. of Adolescence **5**: No. 2 (April) 1922.

Mott compares the histologic pictures of the testicular interstitial cells in the various psychoses with the normal picture at different age periods and with each other. Hematoxylin eosin and Heidenhain eosin technic were employed. Irreproachable normal material was examined at birth, at 4 months, at 10 years and after puberty. The study of tissue from young adults dying from shock convinced Mott that "Leydig cells have a comparatively short life and are continually maturing, decaying, and being renewed. All stages of small nuclei resulting from active division can be observed, followed by division of cell and growth to the mature cell, such as was seen in the newborn child. The cytoplasm of the normal mature cell is abundant and is stained by the eosin dye a deep pink, so that with a low power, islands, columns, and islets of cells can easily be recognized in the interstitial tissue.

When examined with an oil immersion details can be observed which cannot readily be seen with a low power; e. g., the amount of chromatin in the nucleus can be gauged and varying degrees of vacuolation in the cytoplasm corresponding lipoidal contents can be estimated. "I have come to the conclusion from my observations that vacuolation and disappearance of the pink cytoplasm are associated with a tendency to make the outline of the cells ragged or indistinct; and if marked, to convert the island of cells into a nucleated pale vacuolated syncytium." In slides from one of three octogenarians, while there was, of course, diminished spermatogenic action and considerable diminution in the number of interstitial cells, yet, they appeared fairly normal and presented less evidence if functional regression than did the majority of the cases of dementia praecox. Pigmentation is presumably a criterion of senility, yet, it was found in the majority of the group of schizophrenic patients who died before the age of 30. In twelve patients with paresis there was only one complete arrest of spermatogenesis. "Moreover, the nuclei and the mitotic figures showed a good basophil reaction, contrasting in this respect to the tubules in the earlier stages of dementia praecox where as often as not I found unequal

basophil nuclear staining." In manic-depressive conditions terminating in deterioration and in so-called "dementia presenilis" the findings were similar to those observed in advanced dementia praecox. In benign manic-depressive cases there was active spermatogenesis, but relatively deficient interstitial preservation. Twenty-seven cases of dementia praecox were included in the series. Here the results may be classified according to the severity of the regressive modifications. In the first stage "active spermatogensis could be observed in numbers of tubules, but examination with an oil immersion lens showed that the heads of the spermatozoa were not infrequently of irregular shape, unequal size and staining with eosin instead of the basic dye." In the second stage there were "many tubules showing active spermatogenesis, but many in which there was obvious regressive atrophy of the spermatogenic cells and thickening of basement membrane. There were pronounced changes of the Leydig cells in both." There were nine instances of pronounced spermatogenic regressive atrophy of tubules, and no eosin clumps of Leydig cells could be seen with low power. In the final stage were found "no spermatogenesis, tubules atrophied, often containing only Sertoli cells, with lipoid granules, thickened basement membrane. No normal Leydig cells—generally increase of fibroblasts."

Cause and effect conclusions are not justified by Mott's presentation and are not claimed by him, but he should be credited with a valuable contribution.

STRECKER, Philadelphia.

PATHOLOGY AND TREATMENT OF SPINAL CORD TUMORS. OSKAR FISCHER, Ztschr. f. d. ges. Neurol. u. Psychiat., No. 76: 81, 1922.

Fischer considers several points: treatment by means of the roentgen rays, the occurrence of tumor cells in the spinal fluid, the arrangement of the sensory tracts in the lateral columns and the significance of the abdominal reflexes.

He treated two patients with metastatic malignancy of the spine by means of the roentgen ray. In each case on the following day a trophic cutaneous disturbance developed rapidly and progressed to deep ulceration followed by sepsis which eventually caused death. The nervous symptoms were much exaggerated during the first two days, the partial paraplegia becoming complete, with retention of urine and complete loss of sensation in the area of previously disturbed sensation. Lumbar puncture showed a large increase in the number of cells, and those which before had appeared normal were now shrunken and vacuolated, stained poorly and otherwise appeared necrotic. After a few days, however, the power returned to some extent in the legs, and sensation was much improved. There were hyperesthesia and spontaneous pain in one of the cases.

In two other cases the effect of irradiation was gratifying. In both cases Fischer found in the fluid what he believed were tumor cells; yet he was unable to localize the level satisfactorily, and the distribution of the sensory disturbances made him diagnose intramedullary tumor. Here also irradiation was followed almost immediately by aggravation of symptoms of cord compression, but by no trophic disturbances. Also the number of cells in the spinal fluid was increased, and the large heavily stained cells had become pale and vacuolated. In a few days, however, the disturbance cleared up only to be repeated at each successive irradiation, but with gradual disappearance of

the signs and symptoms of tumor, even the spinal subarachnoid block, until the patients were discharged, one having recovered partially and the other completely.

Fischer recommends irradiation of spinal cord tumors when operation is contraindicated by a poor general condition, primary malignancy elsewhere in the body, when the level is uncertain and when tumor cells are found in the fluid. He argues that this last can take place only when a soft unencapsulated tumor involves the meninges. His technic for the discovery of these cells seems rational.

FREEMAN, Philadelphia.

THE FIELD DEFECTS PRODUCED BY TEMPORAL LOBE LESIONS.

HARVEY CUSHING, **Brain 44**:4, p. 341, 1921.

Cushing reports on fifty-nine brain neoplasms in which the temporal-sphenoidal region was implicated, with particular clinical and pathologic reference to quadrantic field defects. Accurate perimetric graphics were obtained in thirty-nine cases. In six there was no field hiatus; eight had already advanced to a homonymous hemianopsia; and in twenty-five there was more or less quadrantic defect. The latter group was divisible into the stationary type, the cases which were in the process of advancement to a homonymous hemianopsia and those in which the quadrant was a recession phenomena resulting from a reduction of pressure by means of decompression. As a clinical criterion of gross temporal pathology, one may quote Foster Kennedy's well known syndrome. "Common to a tumor of either lobe were: (1) convulsions of major and minor (uncinate) type, (2) bilateral choked disc, usually more marked on the side of the lesion, (3) post-epileptic transitory disturbances of motion and of the reflexes which later become persistent." In addition, a tumor on the left was said to produce some degree of aphasia. Cushing's analysis of his material which in general had not reached such an advanced pathologic stage constitutes a valuable extension of our clinical knowledge. Of primary importance are the quadrant defects. Generalized convulsions appeared in twenty of the fifty-nine patients, the greatest number in one person being twelve. While petit mal and dreamy states occurred in twenty-four instances, true uncinate seizures with characteristic olfactory or gustatory impression appeared only fourteen times. The tremendous importance of careful perimetric studies is proved by the fact that field defects were present in eighteen cases in which no history suggestive of petit mal or dreamy states could be secured. Visual hallucinations were recorded in thirteen cases and were almost always related to the uncinate seizures. Such hallucinations are pictorial as distinguished from the relatively simple visual phenomena (colors, lights, etc.) of occipital disease and "certainly bear some relation to the damaged geniculo-calcarine radiation, for in this series, whenever its situation has been mentioned, the hallucination has always been referred by the patient to the side opposite that occupied by the lesion, in other words, in the defective fields." One is somewhat surprised at the comparative insignificance of the clinical auditory phenomena. Hearing was unimpaired in thirty-eight instances; there was slight controlateral deafness in five and ipsolateral in two instaces; eleven patients had mild degrees of tinnitus. Aphasia is dismissed as a neighborhood sign. Unless the fields are carefully traced, a temporal growth may be mistakenly diagnosed as cerebellar, for nystagmus, dizziness, vertigo, primary suboccipital headache were relatively frequent and even definite ataxia and static instability were not wanting. Cushing regards the ophthalmoscope as

less important to the neurologist than the perimeter, and he has presented a clear-cut clinicopathologic argument which should stimulate the free employment of this instrument of precision.

STRECKER, Philadelphia.

CEREBRAL AND UNILATERAL FEVER. OSKAR FISCHER, Ztschr. f. d. ges. Neurol. u. Psychiat., No. 76: 131, 1922.

Fever is a fairly common accompaniment of tumors of the basal portions of the brain, and is also seen in some cases of insanity, especially in the agitated depressed cases. In the latter a dose of morphin will not only stop the agitation but will also control the fever. On the other hand, sudden stopping of morphin in drug addicts will be followed by fever, a sort of rebound by the cerebral center of control. Aseptic fever has also been noted in cases of paresis when probably the infectious process was progressing in the corpus striatum. Though the center for heat regulation is situated in the corpus striatum, it controls the contralateral portion of the body, as has been observed in a number of instances. Heat production, of course, is peripheral; and in several cases that Fischer studied, in which lesions of the basal ganglions on one side were present, the temperature of the opposite side of the body was higher than that of the side on which the lesion was present, and sometimes higher than the temperature as taken in the midline by mouth or by rectum. This was not the temperature of the skin, but taken in the axilla or between the fingers or toes, a true measurement of the internal temperature on the two sides. The farther removed from the head the temperature was taken, the greater the difference on the two sides, for in the nares and the external ears the temperature was practically the same on the two sides.

In one case of paresis, in which differences of temperature were noted on the two sides, there were clonic forced movements that much resembled hemichorea. It might be argued that the cause of the higher temperature was the muscular activity, but Fischer says that even the most intense muscular exertion is followed by only a minimal rise of temperature; hence the difference observed must be due to faulty action of the cerebral controlling center. In one case of encephalitis, rhythmic movements of one side were manifest, yet no fever resulted until a pressure sore became septic; then that same side of the body exceeded the other in temperature by several tenths of a degree Centigrade. Fischer concludes that the pyrogenic agent, the toxin, acted more strongly on the damaged center in the contralateral portion of the midbrain.

The article is well written and points the way for further observations. Fischer himself suggests that the mechanism of heat production and sweat secretion may be studied by direct microscopic observation of the cutaneous capillaries. Again, in some cases of cerebral insult without paralysis, difference of temperature on the two sides of the body may help to localize the lesion or differentiate apoplexy from other causes of coma.

FREEMAN, Philadelphia

SEQUELAE OF EPIDEMIC (LETHARGIC) ENCEPHALITIS. WILLIAM HOUSE, J. A. M. A. **79**:211 (July 15) 1922.

The author says that doubt has been expressed as to whether any patients with epidemic encephalitis ever fully recover because so many have been left with disagreeable sequelae. After deducting the fatal cases, probably one third of the patients are now well, though with rare exceptions convalescence was prolonged; and he was indeed fortunate who, having suffered from encepha-

litis, was quite well at the end of a year, though many resumed work in from three to six months. The remaining patients are still uncomfortable, many of them helpless, more in a condition of semi-invalidism which permits some activities, but robs life of much of its joy.

He divides these chronic cases into four groups: Group 1 is composed of those who in the acute stages exhibit myoclonic symptoms and who still suffer from muscular jerking and twitching, though in steadily decreasing severity. They also exhibit neurasthenic symptoms.

Group 2 is made up of those who exhibit definite psychoses; the most common characteristics of these were suggestive of dementia praecox.

Group 3 is composed of those who showed symptoms of neurasthenia or psychasthenia. This is the largest group of the four.

Group 4 comprises patients who exhibit signs of gross organic lesion of the brain or cord, which he divides into three sub-groups: (*a*) those with hemiparesis, (*b*) those showing symptoms depending on pontile or medullary lesions, (*c*) parkinsonian cases.

Among atypical sequelae he notes two patients who had marked glycosuria after the acute onset of the disease, and he attributes this phenomena to irritation of the fourth ventricle.

Nixon, Minneapolis.

PATHOGENESIS OF DISTURBANCES OF SLEEP FOLLOWING ENCEPHALITIS LETHARGICA. Z. Bychowski, Ztschr. f. d. ges Neurol. u. Psychiat., No. 76: 508, 1922.

Though disturbances of sleep are especially common in children, they occur with some frequency in adults, and seem to be linked with disturbances of motility; whether these two are related directly, Bychowski is unable to state. The insomnia enters the clinical picture after the acute stage of the disease has passed, at a time when the parkinsonian features are also likely to appear. The insomnia is characterized by restlessness, the assumption of curious attitudes and even forced movements such as those seen in chronic chorea. The subjects are martyrs to the condition. In some way the restlessness is dependent on the supine position, for many of the patients sleep better when propped up in a chair.

That the condition depends on disease of the basal ganglions, Bychowski believes to be shown not only by the pathologic findings, but also by a study of a wounded soldier who had a fragment of bone from the parietal region driven deep into the brain. He showed the same inability to maintain a single pose long enough to get to sleep. The author has encountered similar difficulties in severe cases of paralysis agitans.

He inclines to the belief that the hypophysis is diseased in these cases, first, from the anatomic juxtaposition of the basal ganglions, the infundibulum, third ventricle and hypophysis; second, from reported pathologic alterations in this gland in cases of encephalitis, from histologic studies of alterations in the glands in hibernating animals, and finally, from the affections of the pituitary gland leading to somnolence on the one hand and wakefulness on the other. He shows that other symptoms of pituitary dysfunction have arisen in a large number of cases of encephalitis. He believes that the inflammatory process which began in the brain stem and basal ganglions diffused slowly and invaded the infundibulum and hypophysis, possibly by way of the third ventricle.

The article is suggestive, but no consideration of the sleep mechanism is complete without due consideration of disease of the great ganglion for afferent

impressions, the thalamus. The author throughout has used "corpus striatum" to include the pallidum, nucleus caudatus and putamen. These, it is well known, are concerned with motion rather than sensation. The suggestions as to the hypophysis, however, are especially helpful.

FREEMAN, Philadelphia

RESULTS OF FIFTY DECOMPRESSIONS FOR EPILEPSY. VOLLAND, Ztschr. f. d. ges. Neurol. u. Psychiat., No. 74: 506, 1922.

About half of the cases of epilepsy resulted from trauma, but among these the results were not markedly better than among the others. The patients seem to have been selected at random, rather than with the idea of choosing those most fitted for the operation. There were some whose attacks had existed over a period of twenty years, and in many over ten. Hence, the proportion of definite improvement is perhaps lower than usual. Out of the mass, however, for each case is considered separately, Volland draws certain conclusions as to the indications for operation. He says that early operation is preferable in traumatic cases, including birth injuries, and also in encephalitis originating in the acute exanthems. A clean-cut aseptic wound of the cortex he says leaves little or no reactive inflammation and causes no subsequent irritation. He recommends excision of a portion of the cortex even though no abnormalities are found in the hyperexcitable area. Contraindications, Volland says, are: age over 40, syphilitic infection, toxic states and evidences of congenital malformation. If these conditions are not present, he advises a trial of the operative treatment in all cases in which medical, hygienic and dietary treatment has been unavailing. He says that the few patients who can be redeemed from the fate of continued convulsions with later psychic degeneration will make the operation worth while. There were four recoveries, fourteen improvements and one postoperative death in the series.

FREEMAN, Philadelphia.

MONGOLIAN IDIOCY IN A CHINESE BOY. I. HARRISON TUMPEER, J. A. M. A. **79**:14 (July 1) 1922.

Cases of mongolian idiocy that have been reported up to the present time have occurred in the Caucasian race. The case described by the author illustrates the fact that mongolian idiocy occurs in the Mongolian race and that the features of mongolian idiocy are not masked by those of the Mongolian race.

This case also confirms the recent finding in mongolian idiocy described by Timme, which consists of an excavation of the anterior clinoid process and presumably under the olivary process and the optic groove. The theory of exhaustion as an etiologic factor in mongolian idiocy is not borne out by this case, since there were normal children born before and after the patient. However, the father was 57 years old at the birth of the boy.

The fact that the basal metabolism rate was not significantly lowered confirms the view that the condition is not, primarily at least, a thyroid hypofunction and should not, therefore, be confounded with myxedema.

NIXON, Minneapolis.

Society Transactions

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, May 26, 1922

CHARLES H. FRAZIER, M.D., *President*

HEMIHYPERTONIA APOPLECTICA: REPORT OF A CASE. DR. A. M. ORNSTEEN.

There are three reasons for presenting this case: (1) Its resemblance to the hemihypertonia apoplectica described by von Bechterew; (2) the presence of signs of optic thalamus involvement, and (3) the presence of multiple areas of cerebral softening in a young person with resultant pseudobulbar palsy.

The illness began eight and one-half years ago when the patient was 26 years old. At that time she had been married four years, had had two normal deliveries and no miscarriages. After a rather restless night she awoke unable to speak; she appeared to be greatly agitated, and although she understood when spoken to and seemed to make an effort to reply, she would point to her mouth and frantically cry out, "ah-ah," the only sound she could emit. This symptom persists to date. About a month later, she suddenly became hemiplegic on the left side; whether or not consciousness was lost I am unable to determine. The paralysis must have been complete because she was bedridden for about two years, becoming greatly emaciated and developing large bedsores on the left buttock and other pressure points on the left side. She was unable to walk unaided in a satisfactory manner at the end of three years. There was left hemiplegia with motor aphasia in a right-handed person.

The condition remained unchanged for the next three or four years, when her facial expression became somewhat fixed with the mouth wide open and a silly smile; there was much drooling, and she began to shriek spasmodically with sudden outbursts of laughter; also ability to get around diminished until she again became bedridden a year ago. She now has urinary and fecal incontinence.

Examination: She shrieks and laughs spasmodically; any form of stimulus, such as asking her to close her eyes, will result in one of these outbursts. She is mute but seems to understand everything said to her, responding correctly with gestures of her head and right arm, although her reactions are greatly exaggerated. She has never been known to cry involuntarily. Memory and orientation are apparently well preserved. Attention and perception are good. Further investigation of her mental processes is impossible, with the exception of writing. It is distinctly agraphic, although occasionally a word can be recognized. She attempts to write from dictation but only her name is partly discernible.

The pupils are irregular, unequal and react poorly to both light and convergence, which may be partly due to the existing primary optic atrophy. Vision cannot be tested, but there is no evidence of gross defect in the fields. Ocular movements are well performed without nystagmus. Volitional power in the frontalis and orbicular palpebral muscles is good. In the orbicularis

oris volitional power is poor, the woman being unable to bring her lips together, or to retract the corners of the mouth, but in a spasmodic outburst the orbicularis oris is actively contracted. The tongue lies motionless in the floor of the mouth, and the patient is unable to move it in any direction. Eating and drinking are interfered with, the soft palate is slightly raised on volition, and she is unable forcibly to bring the jaws together.

The left arm is held extended, and to passive motion the resistance is great, but she is able to raise the arm quickly above the head without much sign of rigidity. The same difference is seen in the left leg, i. e., a much greater tonicity to passive than to voluntary motion. The fingers of the left hand are strongly flexed over the thumb by a spasm, not a contracture. This spasm may be seen to disappear allowing the fingers slowly to extend and occasionally to overextend through spasm of the extensors. The same alternation of spasm of the pronators and supinators of the arm may be seen. It is a slow mobile spasm. The toes, although held mostly in a flexor spasm, occasionally become involved in this mobile spasm. She is able to raise the left leg quickly from the bed; her left hand-grasp, although weaker than the right, is fair. In other words, she has not a hemiplegia, but a hemihypertonia with spasm. The reflexes on this side are exaggerated and a Babinski reflex is obtained. During active movements on the right side, the left arm shows some associated movements.

Voluntary movements and power in the right extremities are good; the movements, as stated in the foregoing, are very active and quick in response to a stimulus. The reflexes are exaggerated and a typical Babinski reflex is also present on this side.

The perception of touch and pain is preserved on the left side, but it is not as keen as on the right. Point discrimination and localization could not be tested for obvious reasons. Thermal sense appears to be normal. If a key be placed in her right hand, with eyes blindfolded, when asked if she recognizes it, she will nod her head in the affirmative and take the key between her fingers and turn her hand as if opening a lock. With the left hand she is unable to recognize the key. A left hemi-ataxia exists. Pressure of the musculature on the left side is more painful than on the right; whether or not she experiences the dysesthetic phenomena of thalamic disease it is impossible to determine. For many months she has complained of pain in the left side.

The underlying pathologic factors are probably bilateral interruptions in the cortical projection systems. A lesion in the right capsule extending into the thalamus and lenticular nucleus may be surmised in explanation of the left capsulothalamostriatal syndrome, namely, initial hemiplegia with regression, hemihypertonia with spasm and hemianesthesia for deep sensibility, associated with a disturbance of emotional tone. A bilateral involvement of the corticopontile fibers for the pseudobulbar symptoms, interruption of the frontothalamic and the thalamofrontal fibers (the anterior thalamic peduncle), loss of cortical inhibition of the primordial emotional reflexes with elevation of affective tone and instability of the emotions were present. The initial loss of speech, before the involvement of the muscles of articulation, must be looked on as the result of a lesion subcortical to the left operculum.

The lesions are probably thrombotic softenings of syphilitic origin. The blood Wassermann test is negative; the spinal fluid was not examined because of unsuccessful punctures. The cardiovascular and renal systems are normal.

Roettiger, in 1921, gave the following points, among others, as characteristic of hemihypertonia apoplectica: Cases follow apoplectic hemiplegia with regression of paralysis; no secondary contractures occur as in capsular lesions; passive movement increases the tonus, voluntary movement diminishes it; movements of the unaffected side are more energetic than usual, sometimes assuming the character of associated movements; frequently forced laughter occurs; occasionally tremor and athetosis and dysarthia are seen.

DISCUSSION

DR. C. K. MILLS: To my mind, the idea of tonicity being due to a withdrawal of inhibition is not correct. Tonicity and other tonectic phenomena are results of actual stimuli discharged from cortical or subcortical regions, these impulses being often markedly interfered with in their transmission, as when the pyramidal system is diseased. Cases such as reported by Dr. Ornsteen may be due to lenticulocapsular lesions.

DR. M. K. MEYERS: This patient was in my service at the Jewish Hospital. I regarded her as having a case of pseudobulbar palsy. I think that she was less emotional at that time. Never, to my knowledge, did she act in the exaggerated manner that she does tonight. She has deteriorated markedly since I saw her last, over a year ago.

A CASE OF TUMOR OF THE OCCIPITAL LOBE. DRS. L. J. HAMMOND and J. HENDRIE LLOYD.

Ferrier believed that the region of the angular gyrus was especially the cortical center for vision, but he claimed that a lesion here did not cause hemianopsia but complete amblyopia of the opposite eye, and possibly partial amblyopia of the eye of the side of the lesion. In order to obtain hemianopsia he thought that the occipital lobe must be impaired along with the angular gyrus. These experiments on monkeys, however, are open to the grave criticism that it is quite impossible to measure the visual fields in a monkey.

Attempts have been made to distinguish the macular fields, or fields for central vision, from the panoramic fields, or fields for wider peripheral vision. It has been asserted, for instance, that in lateral homonymous hemianopsia the blind half sometimes shows a small central area, or half-area in which vision is retained; this is the so-called macular area; and in double hemianopsia this small central area may, it is said, still be active. In other words, the patient is not completely blind. He goes peering about as though he were looking through a knot hole. Those who still follow Ferrier believe that the center for macular vision is in the angular gyrus, but others locate it in the cuneus, on the mesial aspect of the occipital lobe, and believe that the fields for panoramic vision surround it. The latter view is probably correct, for thus the macula, or center of the retina, is represented in the center of the visual cortex. Bramwell, some years ago, recorded a remarkable case of bilateral cortical blindness, of twenty-five years' duration, with preservation of a small macular field in each eye, in which necropsy revealed a small normal area in each cuneus, surrounded by an area of degeneration in each occipital lobe. This would seem to prove that the macula is represented in the cuneus, and that the center for panoramic vision surrounds the center for the macula. In the human subject we are dependent on pathologic lesions, and such lesions are often too gross, or not well enough demarcated, to furnish an exact localization. Such as they are, however, we must avail ourselves of them; therefore, we ought to record those cases as they arise

In the present case there was right lateral homonymous hemianopsia, which was practically the only localizing symptom caused by a tumor which compressed the left occipital lobe. The patient was a single woman, aged 53, admitted to the service of Dr. Hammond, in February, 1922. About ten months previously she began to have pain in the occipital region. The pain was severe but intermittent, with vomiting, lasting for from two to four days. There were intermissions of two or three weeks. Vision gradually failed, until on admission she could not see to read but she could distinguish faces across the room. There was no paralysis of any limb or cranial nerve, no convulsions and no anesthesia. There was some vertigo, but no forced movements. The head was carried tilted to the right. The mind was rather sluggish, general health good.

Examination revealed right lateral homonymous hemianopsia. There were no visual hallucinations. The gait was unsteady; some dysmetria of the hands was noted. There was no anesthesia, but some astereognosis of the right hand. The pupils were equal, slightly dilated and responsive to light. The Wernicke pupillary sign was lacking; that is, the pupils reacted to light thrown on the blind halves. There was no aphasia. Dr. Moore found choked disks of a high grade, small central vessels, edematous retinas, but no hemorrhages.

The roentgen-ray report was negative, as were the laboratory tests of the blood and spinal fluid.

The Bárány tests showed a lesion in the right hemisphere of the cerebellum, at or about the semilunar lobe. This localization did not agree with the one indicated by the other findings, but unfortunately it was allowed to determine the site of the operation. Dr. Hammond performed an operation over the cerebellum, but found nothing. The patient died about four weeks later.

The tumor was comparatively large, and sprang from the membranes of the left occipital lobe. It lay partly at the extreme posterior end of the lobe in such a way as to cause pressure on the mesial aspect of the lobe and on the cuneus or calcarine region. Hence it had rather unusual value as a localizing lesion. The injury done was almost entirely to the occipital lobe, although the size of the growth was such that it may have made some pressure forward on the superior parietal lobule. The temporal lobe did not seem to be involved.

The main features in this case were: severe headaches, paroxysmal in kind, with nausea and vomiting; papilledema, advancing rapidly to blindness; right hemianopsia; slight astereognosis of the right hand; unsteady gait, not forced or suggestive of cerebellar lesion.

The symptomatology is significant for what it includes and for what it lacks. There was no paralysis, no anesthesia, except the slight astereognosis; no convulsions; no affection of gait or forced movements, except an unsteady gait, partly due no doubt to increasing blindness; no aphasia. Of the positive symptoms the hemianopsia was by far the most significant, the only one that had any localizing value, except the astereognosis, which tended rather to indicate a possible parieto-occipital lesion and hence was a little misleading.

Affections of the form fields were seen, of course, in other than strictly localized occipital lesions. In another case a large tumor in the parieto-occipital region caused hemianopsia to the opposite side, but there were other symptoms that served to distinguish it. Cushing has recently called attention to tumors of the temporal lobe as causes of various types of anopsia. It is easy, of course, to understand that a lesion anywhere in the course of the optic radiations will cause such symptoms; but the point to be emphasized in

the present case is the fact that the lateral homonymous hemianopsia was the only reliable symptom, and that if we had relied on it we should have been led to the seat of the tumor.

We feel obliged to point out that in this case the Bárány tests were misleading. These tests are only tests of the vestibular nerve; the possibility of a misinterpretation of them is incalculable; and the doubt raised by them may be little less than demoralizing to the diagnostician. Why do we attach so great importance to this one nerve? We do not attach localizing value to a mere choked disk. Disturbance of the vestibular nerve, taken by itself, may be no more of a sure guide than a choked disk.

DISCUSSION

Dr. C. K. Mills: The one doubt that might have arisen in Dr. Lloyd's case was whether the lesion was on the surface or in the interior of the occipital lobe. The astereognosis is easily explained by the pressure or direct involvement of a part of the parietal lobe.

To a certain extent I am a believer in Bárány tests, as clear results can be obtained by this method in cerebellopontile angle lesions. Even an alleged Bárány determination of a cerebellar lobe lesion can be carefully scrutinized. The examination of panoramic and macular vision is important, as the former can be present without the latter or the latter without the former.

Dr. H. Maxwell Langdon: I feel that the Bárány tests are a valuable addition to our methods of brain localization; they are additional evidence, and should be weighed in the same scales with the other evidence. I know of some cases in which the Bárány tests have been almost astounding in the directness of their evidence, and other instances in which their findings did not fit in with other examinations at all. If we could distinguish between direct and transmitted pressure signs, many of our cases could be localized, whereas now we miss them.

When there is exact lateral homonymous hemianopsia, I believe that in ninety-nine cases out of a hundred there is direct and not transferred pressure.

Dr. J. Hendrie Lloyd (closing): I agree that the Bárány tests are of value sometimes in localizing peripheral nerve lesions and pontile angle lesions. In syphilis of the eighth nerve they may show that the functions of the vestibular nerve are abolished, and thus confirm the diagnosis of a lesion of the eighth nerve. But when these examiners get inside the brain stem they are lost. In one case of syphilis of the eighth nerve, the man who made the Bárány tests tried to draw conclusions as to localizations inside the pons. I did not agree with him. Inside the brain stem the course of the vestibular and acoustic nerves cannot be followed with scientific accuracy. When the attempt is made to diagnose a lesion in the right cerebellar hemisphere on data given by the Bárány tests, it is making deductions from insufficient premises.

Dr. Fay, I think, referred to hemianopsia in pituitary tumors. I think they are usually cases of bitemporal hemianopsia due to pressure on the chiasm. That is what is generally taught. I have not seen many such cases.

The question was raised as to the possibility of a lesion of the cerebellar hemisphere causing pressure upward through the tentorium and thus causing hemianopsia. I feel that the case is added proof that the visual cortex is on the mesial aspect of the occipital lobe. I do not believe that macular and panoramic vision are located in different regions of the cortex but that macular vision is localized in the cuneus and panoramic vision surrounds it.

MARKED ATROPHY IN EARLY TABES. Dr. Herbert Fossey.

The patient, a white man, 30 years old, was admitted to the Philadelphia Hospital Aug. 23, 1921, complaining of urinary incontinence and gastric pains. He presented marked emaciation and appeared to be very sick. Examination revealed severe cystitis, pyelitis and an infected penis due to continuous friction of the urinal in addition to the typical signs of tabes dorsalis. He was suffering intensely from gastric crises which had been present for the last six weeks. Two weeks prior to entrance he had been operated on for appendicitis.

The most striking finding was the extreme atrophy in the disease which was of only four years' duration. That his symptoms started one year after the initial lesion is noteworthy.

Déjerine mentions the tabetic type of neuritic atrophy which may be confused with tabes. Lapinsky speaks of an initial neuritis in young people which gives marked early muscular atrophy. According to Marie, tabetic muscular atrophies may be divided into two groups: (1) those appearing late, presenting a symmetrical distribution, rarely marked by fibrillary twitchings; (2) those occurring often in the earlier stages of the disease, usually unilateral in distribution, marked by fibrillary contractions and sometimes by the reaction of degeneration. The first group embraces atrophies confined to the distal portions of the extremities, and recalls the conditions found in multiple neuritis. The second group contains lingual hemiatrophy, localized atrophies of the shoulder, of the back, of the hand, and one-sided involvement of the cranial nerves. They are analogous to lesions of the gray matter. Both the central and peripheral lesions are found, and in the associations indicated in the foregoing. The wasted muscles present the usual histologic change due to degeneration in the lower motor neuron.

Herman Lippman ("Concerning Muscular Atrophy in Tabes Dorsalis") states that "Lapinsky and others have found that section of the posterior root causes changes in the cells of Clarke's column and in the nerve cells of the anterior horn; changes which in their essentials consist of a swelling of the cells and loss of Nissl bodies. From this standpoint he explains the atrophy in tabes. Déjerine thinks that the muscular atrophy of tabes depends on a peripheral neuritis, proceeding slowly to the anterior roots. The muscles which these nerves supply have thin round fibers which in portions fall apart and are filled with pigment. The connective tissues in these muscles are increased and rich in nuclei, the fibers thin and few. Clinically there is fairly symmetrical atrophy of the extremities. Fibrillary twitchings are not observed; the reaction of degeneration is frequently seen. Déjerine is of the opinion, because of these findings, that the spirochete or its toxin at times locates in the peripheral motor nerves. The clinical and pathologic findings are the same whether the neuritis is due to poisoning or to a mechanical injury. It has been known for a long time that in tabes, as in alcoholism, the motor nerves are vulnerable. A toxin which a normal person can withstand may injure the nerves of an alcoholic or a tabetic person. Leyden, Remark, Möbius and others believe that in tabes there is a tendency to paralysis because, owing to the degeneration of the posterior roots, impulses do not reach the anterior horn cells. The resistance of these cells is decreased, and they are easily injured.

An objection to the theory of Déjerine is that in his studies he used the older methods of staining, and the author believes that the newer methods, especially the special cell stains, are necessary to determine the entire picture, especially as regards the anterior horn cells.

The author concludes that muscle atrophy in tabes occurs under these conditions: (1) due to accompanying disease; (2) as a result of the general weakness and anesthesia of the muscles toward the end of tabes; (3) as a result of the peripheral neuritis brought out, not through the poison of tabes, but through other injurious processes; (4) as a result of the localization of the toxin of syphilis in the nerve roots and anterior horn cells, whereby the motor impulses are more or less impaired.

The spinal cord of the patient under discussion revealed the following: The usual degeneration of the posterior roots seen in tabes is very intense in the lumbar region and even in the midcervical region. The nerve cells of the anterior horns of the lumbar region show considerable degeneration of the type of central chromatolysis; that is, a disintegration of the chromatophilic elements, particularly of the center of the cell body with peripheral displacement of the nucleus. This is a common finding in multiple neuritis and would indicate that the peripheral nerves were considerably degenerated. The nerve cells of the anterior horns of the midcervical region show a similar reaction at a distance but not so intense. The nerve cells are possibly not so numerous as one would expect. Intense degeneration of the posterior root from the upper limbs with some central chromatolysis of the nerve cells of the anterior horns indicate that a similar degeneration of the peripheral nerves was present in the upper limbs. Such widespread degeneration of the posterior roots is uncommon in tabes of such short duration and the process had reached a height which is usually seen in tabes only after much longer duration. The action of the spirochete in this case must have been exceptionally virulent, producing within a short time lesions uncommon at so early a period.

DISCUSSION

Dr. C. M. Byrnes: I should like to ask Dr. Fossey whether there were any objective sensory changes in his case, and whether the patient had been treated with mercury or arsphenamin before the development of the atrophy. Through the courtesy of Dr. Spiller, I have been studying round cell infiltration in various nervous lesions and I was much interested to find that in syphilitic cords there is not infrequently, contrary to the usual teaching, marked cellular exudate about the anterior roots. In several instances, the anterior roots on both sides were practically embedded in a plastic exudate, sufficient, it seemed, to account for the occasional atrophies occurring in tabes.

Dr. Herbert Fossey: The patient had hyperesthesia generally distributed over the extremities. He had received no antisyphilitic treatment prior to his admission.

A CASE OF PERMANENT QUADRANT ANOPSIA, POSSIBLY DUE TO MIGRAINE. Dr. J. C. Mulrenan.

John F., aged 28 years, married, complained of defective vision. In 1918 he had had influenza and pneumonia. For several years he had suffered from periodical headaches; otherwise he has been well. His habits have always been good. The headaches occur about once in two weeks and are usually located in the right frontolateral region. During the attack he is pale, but as a rule does not vomit. There have never been hallucinations of vision, taste or smell. One evening in April, 1920, he had a severe headache. The next morning while quietly standing after some heavy lifting, he was suddenly seized with a "feel-

ing of numbness and pins and needles in the left hand, arm and side of the face. Everything became black, but he was not unconscious and did not fall." Immediately afterward there was a violent headache, and he vomited. For about five minutes he was completely blind. After the vomiting vision returned but was blurred, and it has remained so since.

Dr. L. C. Peter reported a refractive error (hyperopia) and left superior quadrant anopsia and a large scotoma for colors in the lower nasal area of the right field. Color fields were concentrically contracted following the form fields. An enlarged blind spot was present in the right eye, otherwise the eyes were normal. Neurologic examination was negative, as was also the medical report made by Dr. G. M. Piersol. Examination of the nasopharynx by Dr. Butler was also negative, with the exception of chronic pharyngitis. Syphilis was denied, and the Wassermann test was negative.

His mother and grandmother had suffered from similar headaches.

DISCUSSION

Dr. Charles S. Potts: This patient was in my service at the Polyclinic Hospital. While I at first thought that the attack was probably embolic, and a case somewhat like those described by Dr. Woods in the February number of the *Journal of Nervous and Mental Diseases,* the history of headaches, the fact that the mother and grandmother were subject to headaches of a migrainous type, the negative Wassermann test and the absence of cause for an apoplectic disturbance, made me think that this case bore a similarity to the cases described by Hunt and others occurring in patients subject to migraine.

Dr. C. K. Mills: I think it is a mistake to give out the idea that migraine can in some inscrutable way cause a more or less permanent anopsia or hemianopsia, unless a destructive focal lesion is present.

Dr. C. S. Potts: With reference to what Dr. Mills has said I would state that my belief is that arterial spasm caused the condition. Whether the spasm lasted long enough to cause degeneration, or whether thrombosis occurred in the artery, I cannot say. During an attack of migraine I believe there is arterial spasm, and it therefore might produce the contraction of the arteries that caused the lesion producing this condition. There is no reason to believe that the patient had syphilis; and he was carefully studied from all standpoints and no cause found for an embolism.

Dr. Alfred Gordon: We are accustomed to believe that migraine is a temporary but periodic condition, which comes and goes; but this patient had distinct subjective sensory phenomena, limited to the left arm. He had tingling in that arm and right hemianopsia. It is difficult for me to understand that migraine could cause a lesion of such character. I would attempt to localize the lesion in the posterior portion of the internal capsule and in the optic radiations. This would explain the hemianopsia and the sensory phenomena. I believe that the lesion is vascular. An alternating spasmodic contraction of the blood vessels is a plausible assumption.

Dr. H. Maxwell Langdon: There is a type of case which ophthalmologists see rather infrequently which may throw some light on what happens to the cerebral circulation in these cases of migraine: namely, spasm of the retinal arteries. Some years ago I reported such a case before the American Ophthalmological Society. It was that of a man who for many years had had attacks of transient monocular blindness, the attacks never being simultaneously bilateral—each eye was affected at different times; the attacks would last from three to five

minutes, during which time vision was completely gone, and then it would return to normal. Unfortunately there was no opportunity to examine the eyes during an attack. One eye eventually suffered from an attack which was permanent, there being a complete collapse of the retinal circulation. The man had advanced arteriosclerosis, and one of the interesting questions to be solved is whether spasm of perfectly normal vessels occurs. Should a spasm occur in normal vessels I do not believe it is as likely to be permanent in its results as when the vessels are sclerosed and are likely to become permanently blocked. Similar cases have been reported when examination was made during an attack, one case in this city being seen by several observers, among them Drs. Zentmayer and de Schweinitz. During the attack the retinal circulation would be completely lost, and then the vessels would gradually fill again until the condition was restored to normal. I think what happened in these cases is what happened in Dr. Mulrenan's case, only that in his case it happened in the cerebral circulation instead of in the ophthalmic.

Dr. L. C. Peter: Four or five years ago I saw a case similar to this one. It occurred in a young lawyer who had been over-worked, and who, in the midst of a conversation with his partner, suddenly became aphasic. He did not fall, but was hardly able to stand up. He had left-sided motor and sensory disturbances, which cleared up in a few days. On the day after the attack, he had a left inferior quadrant anopsia which changed slightly in the course of five or six months and finally left quite a defect in this particular area. He did not have a lesion in the cuneiform body, but a lesion somewhere around the capsule, possibly in the beginning of the optic radiation. The condition cleared up entirely, the aphasic phenomena lasting two or three days.

These fields bring to mind a thought of Dr. Cushing, when he referred to the asymmetry in homonymous hemianopsia, the greatest advance, as a rule, being homolateral to the lesion. It has been difficult for me to reconcile the cause usually assigned to this asymmetry with the facts in hand. Associated nerve fibers representing corresponding retinal points may or may not be in close contact after they leave the chiasm, during their course to the occipital lobe. Defective technic may lead to error and apparent asymmetry. The main factor, however, in asymmetry of homonymous hemianopsia is the relative difference of retinal sensitivity in the nasal and temporal retinae.

In the case of Dr. Mulrenan it is not likely that the lesion was in the cuneiform body, because of the motor and sensory symptoms, but far forward, probably in the beginning of the optic radiation of Gratiolet.

TUBEROUS SCLEROSIS. Dr. W. Freeman.

This paper will be published in full in a future issue.

DISCUSSION

Dr. N. S. Yawger: I have had three epileptic patients in whom I have made the diagnosis of tuberous sclerosis. Dr. Freeman has referred to two of these.

TWO CASES OF IDENTICAL ACHONDROPLASIA WITH EPICANTHUS IN BROTHERS. Dr. A. E. Taft.

Two boys, aged 16 and 9 years, respectively, showed identical anomalies, which were congenital and not progressive. The personal and family histories were negative; the Wassermann test was negative.

Both cases presented the following features: A lock of white hair at the midline of the frontal hair margin; bilateral epicanthus; narrow, high-arched palate with overlapping teeth; complete deafness; "high shoulders"—scapulae in embryonal position opposite lower cervical vertebrae; maldevelopment of elbow joints preventing normal flexion of forearms; radius relatively longer than ulna and maldevelopment of carpals, thus forcing hands into ulnar position; marked lack of muscular development of upper extremities reducing function to a minimum, though other skeletal muscles were well developed Intelligence was normal.

Book Review

PSYCHOANALYSIS. ITS THEORIES AND PRACTICAL APPLICATION. By A. A. Brill, Ph.B., M.D., Lecturer on Psychoanalysis and Abnormal Psychology, New York University. Third edition. Cloth. Price, $5 net. Pp. 468. Philadelphia: W. B. Saunders Company, 1922.

The fact that this book is now reprinted in its third edition inside of ten years speaks both for its popularity and for the growing interest in the subject. Shortly after the war, we witnessed a rapid increase in popular interest in psychanalysis, and on this wave of interest there floated to us a mass of books and magazine articles, some of them valuable but many little short of objectionable to the psychiatrist. Many medical theories and practices have had to withstand a similar flare of notoriety, and have done so. Now, with the newspaper popularity of the endocrins, it seems that psychanalysis may be suffered to drop out of the limelight to the sphere in which it belongs, as a part of medical practice. Psychanalysis was developed by a physician as a means of treating disease, and in medical practice it will always find its greatest usefulness. This book is written by a physician for physicians to tell them something about a method of treatment.

The author approaches his subject from a strict freudian point of view, with some references to the work of Jung and Bleuler. He makes no mention of the broader biologic principles which the English school have brought into the subject, where other instincts than the sexual are considered. The author's frankness of diction might offend the fastidious, but when writing about the psychology of sex one must use well-known terms which are not pretty, or euphemisms which easily lead to inaccuracies. The author is never guilty of the latter fault.

The book opens with a chapter on the psychoneuroses which presents Freud's views quite clearly. The following chapters on the psychopathology of every-day life, dreams and the actual neurosis, cover ground already covered in earlier editions. Masturbation forms the subject of the first new chapter. This chapter is more readable than many of the others and presents a fair, clear-minded view of this subject, still bound up with so much supposition and stupidity in many minds. The medical world needs more of such material and advice as this chapter holds.

The compulsion neuroses, the unconscious, the use of psychanalysis in the psychoses, and paranoia are treated in separate chapters, from the point of view that Freud has offered us. The new chapter on paraphrenia strikes one as rather unconvincing and leaves one with a doubt about its existence as a clinical state. In the third new chapter, homosexuality is presented with the author's characteristic frankness, and is well done.

The chapter on hysterical fancies and dream states contains much interesting material, and is one of the best in the book. The much discussed Oedipus complex gets a chapter to itself and shares with the following chapter on the only child, the quality of containing much good advice to parents which has little chance of being accepted in modern life in our large cities. Fairy tales and anal eroticism are treated in separate chapters, and the book closes with a long exposition of Freud's theory of wit, which is already well known

to psychiatrists. Appended to the book is a glossary which is quite incomplete, and one feels that the author has not been fortunate in some of his definitions.

On the whole, the book leaves a favorable impression. The arrangement of chapters is not good and there seems to be little system in the presentation of the subject. However, if one looks on it not so much as an exposition of psychanalysis as an exposition of the author's large experience with psychanalysis in the treatment of neurotic and psychotic patients, the book is distinctly of value. The captious critic will discover much in it with which he may find fault, but he who reads it for what it is—a medical presentation of a medical subject based on years of experience with patients— will glean from it points of view and hints of symptom meaning that will help him in the understanding and treatment of this largest and most neglected group of patients in practice.

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AN ANALYSIS OF FOURTEEN CONSECUTIVE CASES OF SPINAL CORD TUMOR*

CHARLES H. FRAZIER, M.D., AND WILLIAM G. SPILLER, M.D.

PHILADELPHIA

While tumors of the spinal cord, the spinal roots or meninges are less frequent than tumors of the brain, in the ratio of 1 to 6, the proportion of operable tumors of the cord from the standpoint of localization and facility of removal is greater than that of tumors of the brain. In twelve of the fourteen consecutive cases chosen for review, the tumor was accessible, not difficult of localization, well encapsulated and distinctly an operable lesion. The ratio of spinal tumors to tumors at large is about 1 to 50 (Schlesinger). Perhaps because of their relative infrequency, they are often overlooked; and years may elapse before the true nature of the lesion is recognized. In many instances the pain of which the patient complains is attributed to a lesion in the territory to which the pain is referred. Neuralgia, neuritis, rheumatism if in the neighborhood of a joint, angina, gallbladder disease and diseases of other abdominal organs have been held accountable for the pain of a spinal tumor, and not infrequently abdominal operations have been performed under one of these mistaken diagnoses.

Whatever the cause, in the series under discussion the final diagnosis was not established until an average of 2 3/5 years had elapsed from the date of the initial symptom. The elapsed time in the individual cases was as follows: One case, 9 months; one case, 10 months; one case, 1 year; one case, 13 months; one case, 16 months; two cases, 2 years; three cases, 3 years; one case, 4 years, and three cases, 5 years. Of the fourteen cases of spinal cord tumor presented, ten occurred in women and four in men from 18 to 64 years of age. Ten were between 30 and 50 years, two were over 60, and of the remaining, one was 18 and one 29 years of age. As to location: Nine were extramedullary and subdural, two were extradural, one was a caudal tumor, one a tumor of the vertebral column, one was partly spinal and partly intra-

* Read before the Section on Nervous and Mental Diseases at the Seventy-Third Annual Session of the American Medical Association, St. Louis, May, 1922.

cranial. As to segmental location: Six involved the cervical segments, three the upper thoracic, four the lower thoracic and one the cauda equina.

In reviewing our cases with respect to sequence of symptoms, we find that in thirteen of the fourteen cases the first symptom was pain; and in the single exception, the tumor was extradural, and at no time throughout the course of the disease did the patient complain of pain. The constancy of pain, not only as the initial symptom, but as a con-

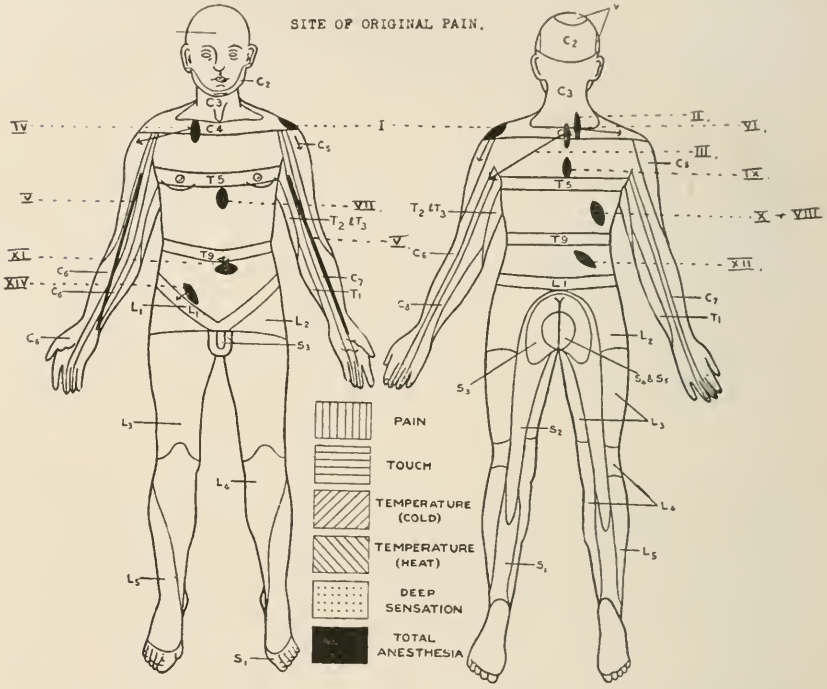

Fig. 1.—Representation of location of the points to which the pain was referred as the initial and a constant symptom in thirteen of the fourteen cases of the series.

spicuous symptom, was so striking we were surprised to read that, in the experience of another writer,[1] "the majority of patients with spinal lesions do not have any severe pain during their illness and only the occasional case has any whatsoever;" and "to wait for the development of pain in order to make a positive diagnosis of spinal tumor is as great a fallacy as to require the presence of headache, vomiting and choked disc for the diagnosis of brain tumor." Of course it is well known that spinal cord tumors may run a painless course. Cases of

1. Sachs, Ernest: J. Missouri M. A., April, 1919.

this character have been reviewed by Oppenheim, Bailey, Clarke and Schultze. The location of the tumor with relation to the roots would of course affect the incidence of pain.

The pain was first observed at one more or less definitely localized point, almost invariably at a level corresponding to the segment involved (Fig. 1), and was described variously as tearing, burning, as a "knife," or as a dull ache, never as lancinating or shooting in character. It was often intermittent with intervals of freedom of days or months, and often worse at night or in the early morning. Especially in tumors of the cervical cord was it aggravated by movements of the neck or arms. In several instances, there was an appreciable subsidence of pain at the onset of paralysis. Errors in diagnosis were influenced by the location of the pain. Several of the cervical cord lesions had been

TABLE 1.—Time Between Pain and First Signs of Motor Impairment*

Case	Duration of Pain	Duration of Motor Impairment	Interval Between Onset of Pain and Motor Impairment
1	5 years	2 years	3 years
2	9 months	3 months	6 months
3	1¼ years	6 months	6 months
4	2 years	1 month	2 years
5	9 months	6 months	3 months
6	2 years	4 months	1⅔ years
7	5 years	2 years	3 years
8	4 years	2 years	2 years
9	3 years	2 months	2¾ years
10	1¼ years	3 months	1 year
11	6 years	1½ years	4½ years
12	1 year	6 months	6 months
13	0 years	2 years	
14	3 years	3 months	2¾ years

* In six cases three or more years had elapsed, in two cases two years, in two cases between one and two years, and in three cases less than a year. This relationship is expressed in graphic form in Figure 2.

erroneously diagnosed as Pott's disease; "neuritis" was the diagnosis in practically all cases in which the shoulder or arm was involved; in one case with pain referred to the left precordial region the case was diagnosed as "angina;" in one case with pain referred to the abdomen as gallstones; in another, to the lower extremities, as sciatica. Hysteria was not an infrequent diagnosis but was more common when pain was referred to the lower than to the upper extremities.

Table 1 indicates the time which elapsed between the onset of pain and the first signs of motor impairment.

We have dwelt on the pain phenomenon because of its outstanding importance as a warning in spinal tumors. Given a case with pain of definite localization, persisting without variation except in degree, in its original territory for months, and especially for longer periods, one should at least have in mind the possibility of spinal tumor and be on the lookout for further confirmatory evidence, such as paresthesias, hyperesthesis, anesthesia, disturbance of reflexes and motor impairment

(Fig. 3). But pain alone, even though localized for a considerable time, may be caused by radiculitis or meningomyelitis, and we must wait for the development of other symptoms before operation is justifiable. Pain associated with atrophy in root distribution of the upper limb should arouse the suspicion of tumor, and yet if roentgen-ray examination reveals no pathologic condition it seems to us as a general rule advisable to defer operation until some clinical evidence of implication of the cord is obtained. Exaggeration of the tendon reflexes of the lower limb, especially if associated with the Babinski reflex, on the

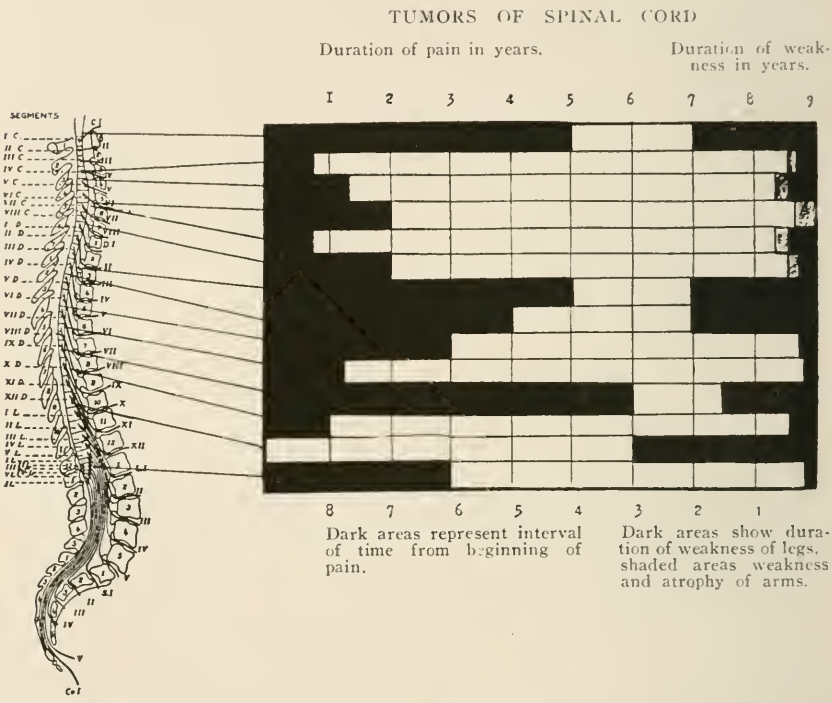

Fig. 2.—Duration of pain in years as compared with the duration of motor impairment in the individual tumor cases of this series.

same side as the pain and atrophy of the upper limb, is a combination that may justify early operation. Should in addition to this a diminution of pain and temperature sensations be found in the lower limb of the opposite side, operation, under ordinary circumstances, should be performed.

This interesting phenomenon was observed in Case 6. Before the operation the prick of a pin in the sole of the left foot would produce a vigorous reflex of defense in the left lower limb, such as could not be obtained from the contact with the head of the pin or by touching

the sole with the finger. In these parts objective pain sensation was entirely lost, although the patient could distinguish the point of the pin from the head because the prick of the pin was "unpleasant," and yet this "unpleasantness" was not intense. The interest of the observation lies in the fact that the reflex of defense was active for stimuli

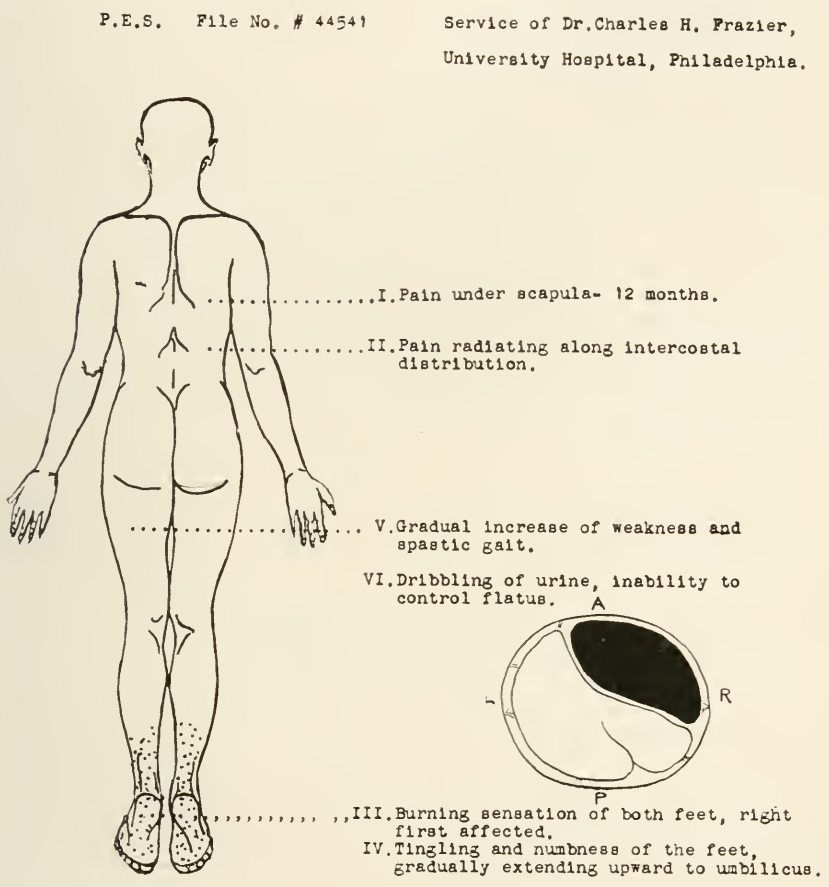

Fig. 3.—Representation of the usual sequence of symptoms in spinal cord tumors; namely, pain, paresthesias, motor impairment.

which normally produce pain, although the perception of pain was abolished. These stimuli in this case were capable of exerting their effect on the motor nerve cells of the lumbar region, but as the break in the pain conduction was in the cervical region the brain was not capable of recognition of painful stimuli. This observation was not peculiar to this case and has been confirmed by us in the examination

of another case. Irritation of fibers of pain as by slight pin prick is a very satisfactory way of obtaining the reflex of defense. These observations have physiologic importance. In cases in which it is desirable to increase the activity of the nerve cells of the anterior horn of the spinal cord, even when analgesia or hypalgesia exists, mild stimuli which normally produce pain, such as pin prick, may be of value in addition to massage or electricity.

PARESTHESIAS

While the pain, present in all but one case, was the first symptom, other subjective sensory disturbance was invariably the second symptom, preceding in all cases, when present, any motor disturbance (Table 2). Four patients described a sense of numbness; two in one upper extremity (Cases 2 and 4) and two in one leg and foot (Cases 3 and 7); it may be noted that in three cases (2, 3 and 4) the numbness was on the same side and in one (Case 7) on the side opposite a tumor situated anterolateral to the cord. Elsberg states that in five anterolateral tumors of his series there was paresthesia in the lower contralateral limb.

In the remaining cases the sensation was described as stinging (Case 6), burning (Cases 8, 9, 10, 11), itching (Case 14), tingling (Cases 10, 13), a sense of constriction about the knee (Case 10), of pressure or a tight jacket about the trunk (Case 12) and as a sleepy feeling in the fingers (Case 6). In no case did pressure on the cord cause severe pain in the portions of the body innervated from the spinal cord below the tumor. This is important in regard to Gordon Holmes' views on pain produced by lesions of the cord substance. Pain from intramedullary or extramedullary spinal lesions not implicating roots must certainly be regarded as uncommon.

The Brown-Séquard syndrome in the classical symptomatology of spinal tumors is represented as the second of the three cycles, the first being the root cycle and the third that of paralysis of motor and sensory functions. If one were able to examine the patient at all times in the life history of the tumor there might be a time when in the majority the Brown-Séquard syndrome could be detected. But in our series in only five out of fourteen were there unilateral sensory phenomena, and these not of the classical Brown-Séquard type. In three there was no sensory blunting, and in the remainder the loss or impairment of sensation had a bilateral distribution. One would expect to see this syndrome only when the tumor is situated on the lateral aspect of the cord. In five cases, where the sensory disturbances were unilateral, the tumor was recorded as contralateral in four cases and posterior in one.

When the sensory loss was present on both sides, the location of the tumor was recorded as posterior in three, caudal in one, and right anterolateral in two.

Motor disturbances were present in greater or less degree in most cases. There were, however, exceptions. Under conditions quite comparable as far as one could see, one patient within nine months of the onset of symptoms had a disabling paraplegia; another, with a

TABLE 2.—Disturbances of Sensation

Case	Location	Paresthesias	Loss or Impairment of Sensation
1	Left lateral C 1 C 2	Absent	Present: unilateral, contralateral
2	Right posterolateral C 4	Present: unilateral, hemolateral	Present: unilateral, contralateral
3	Left anterolateral C 4 C 5	Present: unilateral, hemolateral	Absent
4	Right anterolateral C 3 C 4	Absent	Present: bilateral
5	Right anterolateral T 3	Absent	Absent
6	Right anterolateral C 8 T 2	Present: unilateral, hemolateral	Present: unilateral, contralateral
7	Left lateral T 3 T 5	Present: unilateral, contralateral	Present: unilateral, contralateral
8	Posterior T 5 T 6	Present: unilateral	Present: unilateral
9	Posterior T 5 T 6	Present: bilateral	Present: bilateral
10	Right anterolateral T 8 T 9	Present: bilateral	Present: bilateral
11	Posterior T 10	Present: central	Present: bilateral
12	Right lateral T 12	Present: unilateral, hemolateral	?
13	Posterior L 2 L 4	Present: bilateral	Present: bilateral
14	Caudal	Present: bilateral	Present: bilateral

TABLE 3.—Motor Symptoms

Duration	Side	Location	Motor Disability	Left or Right
6 months	Left	Intradural	Spastic paraplegia	
5 months	Right	Intradural	Spastic paralysis	Right leg
2 years	Posterior	Intradural	Spastic paraplegia	
3 years	Posterior	Extradural	Spastic paraplegia	
2 years	Left	Intradural	Spastic weakness	Left leg
5 months	Right	Intradural	Paresis	Right leg
1½ years	Posterior	Intradural	Spastic paraplegia	
2 weeks	.....	Caudal		
2 years	Left	Intradural	Spastic paraplegia	
5 months	Right	Vertebral	Spastic paraplegia	
2 months	Right	Intradural	Spastic weakness	Right and left legs
4 months	Left	Intradural	weakness	Left leg
7 months	Right	Intradural	Spastic paralysis	Right arm
3 months	Posterior	Extradural	Spastic paraplegia	

tumor of equal dimensions, was still able to walk with comparative ease four years after the onset of symptoms. Table 3 shows the motor symptoms, duration of lesion and relation of the tumor to the cord.

In only two of the fourteen cases was there disability in the upper extremity; in half of the cases both lower extremities were involved, and in the remaining only one. The development of motor disability was in most instances (nine out of fourteen) a matter of weeks or months. This is in rather striking contrast to the period of root pains, which averaged two years. In other words, when the tumor had

increased sufficiently in size to cause cord compression the motor phenomena developed rapidly.

With the history of root pains, followed by sensory disturbances, paresthesias and anesthesias and later by motor impairment, the diagnosis of spinal tumor was established with a reasonable degree of certainty. There was only one exception, a patient who at no time during the three years she had had a tumor had complained of pain. Prior to her admission this patient had been treated for myelitis and operation considered inappropriate largely because of the absence of pain phenomena. But the spastic paraplegia plus the loss of pain and temperature sensations below a given level was considered sufficient evidence to warrant an exploratory laminectomy, at which a large extradural tumor was found (Fig. 4).

Fig. 4.—Extradural tumor removed at operation from a patient who at no time throughout the illness of two and one-half years complained of pain.

Much stress is laid on the presence or absence of signs of spinal block. In this series there were only five patients with the xanthochromia phenomenon, and in these the duration of the lesion was five years, four years, three years, 1 year and 9 months, respectively. Quite recently Queckenstedt introduced a test for spinal block by observing whether the pressure in the lumbar puncture manometer is affected by compression on the internal jugular veins. Had this test been applied in all our cases it is quite possible that the signs of block might have been elicited in a larger percentage than by the xanthochromia test. At all events, a positive finding by either method should be regarded only as confirmatory evidence of tumor, since negative

findings do not preclude the possibility of tumor and positive findings have been noted in lesions other than tumor.

In six cases there was disordered function of bladder and bowel (Cases 1, 4, 5, 8, 9 and 10). In five of the six there was difficulty in urination and in one (Case 9) there was occasional incontinence of urine. There was constipation in three (Cases 4, 5 and 9) and bowel incontinence in two (Cases 8 and 10).

SEGMENTAL DIAGNOSIS

Here may be taken into consideration referred pain, sensory disturbances, muscle atrophy or impaired power and disturbed reflexes. Table 4 gives the relationship between the region to which pain was first referred and the level of the tumor.

From this phenomenon alone accurate localization of the level of the tumor would be possible in the majority of cases. Pain was

TABLE 4.—RELATIONSHIP BETWEEN REGION TO WHICH PAIN WAS REFERRED AND LEVEL OF TUMOR

Left shoulder	C 5 C 6 (left) C 1 C 2 (left)
Right shoulder	C 4 C 5 (right) C 4 (right)
Between shoulders	C 8 T 1 T 2 (right) T 1 T 5 (posterior)
Between angle of scapula	T 7 T 10 (right)
Right and left arm	C 8 T 1 T 2 (left)
Around chest	T 3 T 5 (left)
Back	T 4 T 7 (posterior) T 9 T 11 (right)
Epigastrium	T 8 T 11 (left)
Right leg	Caudal

referred: (1) to the shoulder where the tumor was found in the fourth, fifth or sixth cervical segments; (2) to the upper extremities in involvement of the eighth cervical and first and second thoracic segments; (3) between the shoulders in involvement of the eighth cervical and first five thoracic segments; (4) around the chest in involvement of the third, fourth and fifth thoracic segments; (5) to the epigastrium from the eighth to eleventh thoracic segments; (6) to the back from the fourth to eleventh thoracic; (7) to the leg from the cauda equina.

In one case pain was referred to the shoulder when the tumor was chiefly on the medulla oblongata (Fig. 5), although the uppermost cervical segments were involved. The patient (Case 1) had complained for five years of pain in her left shoulder, and to a less extent in the left upper limb. The left shoulder had become atrophied during three years. Pain is not always strictly confined to the distribution of the nerve or nerve roots irritated; it seems to radiate into adjoining ter-

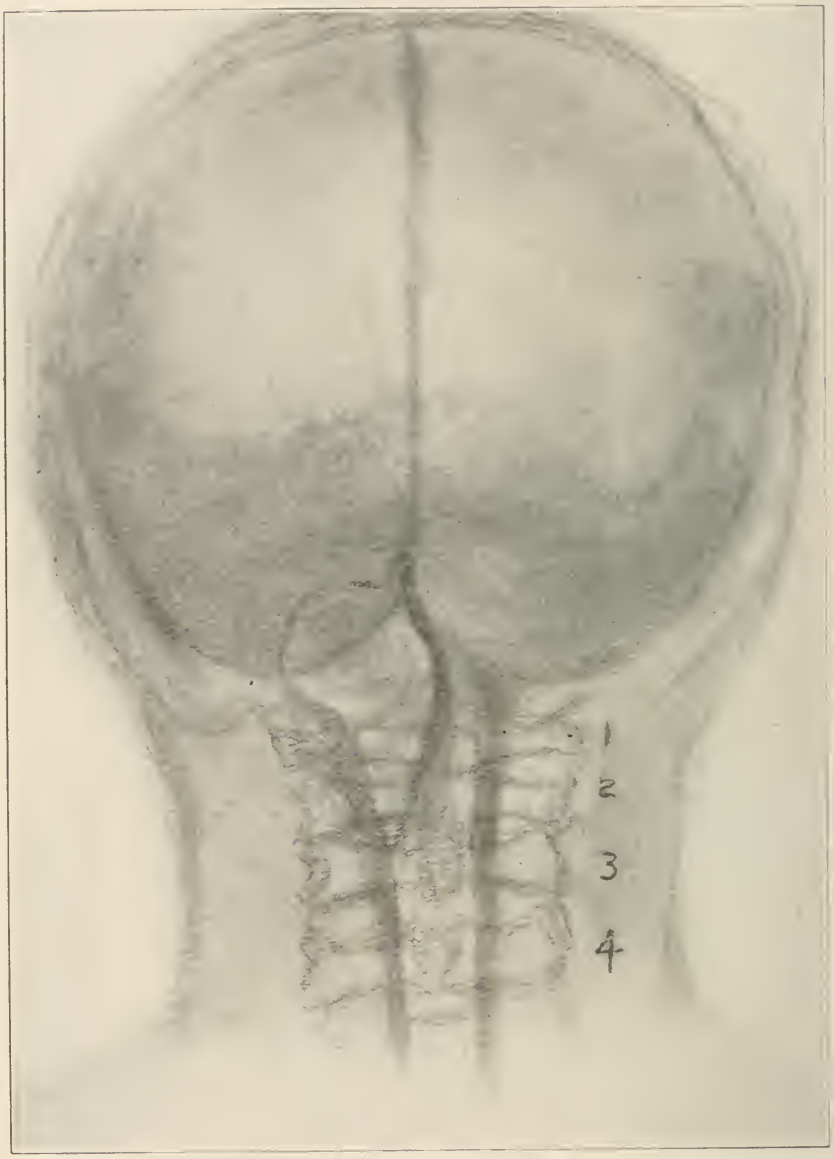

Fig. 5 (Case 1).—Situation of a tumor partly in the spinal canal and partly within the posterior fossa.

ritories, but it is striking that pain should be felt in the shoulder and down the upper limb when the tumor is confined to the first and second cervical segments. The third cervical segment gives pain fibers to the greater part of the neck and the fourth cervical to the upper part of the limb over the shoulder; and a tumor high on the cord possibly may interfere with adjoining segments below by circulatory disturbances, edema or other means. We would raise the question whether irritation

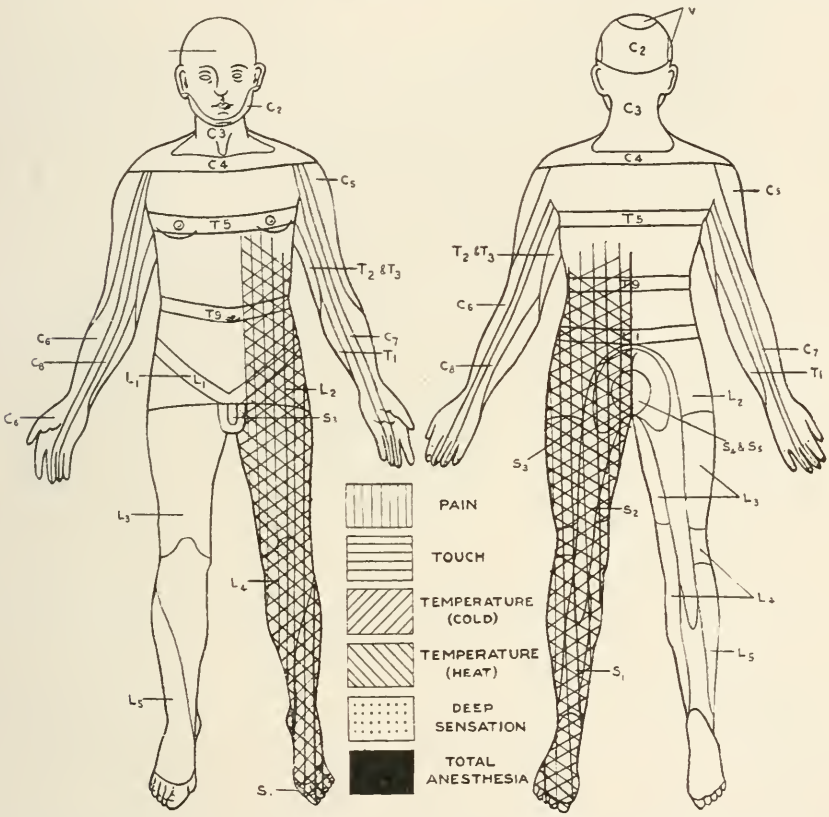

Fig. 6 (Case 2).—Unilateral loss of pain and temperature sense in a case of extramedullary tumor on the right anterolateral aspect of the cord at the level of the fourth cervical segment.

of the spinal accessory nerve in its course upward before leaving the cranium may not be the cause of pain referred toward the shoulder, and whether in the same way atrophy of the trapezius muscle may not be in part responsible for the atrophy attributed to the shoulder.

It is unusual that the level diagnosis is not determined by the upper limits of impairment or loss of sensation and one should be able to chart with great precision the level of sensory disturbance before the segmental diagnosis is made (Fig. 6). In eleven of fourteen cases the

level of the lesion was accurately determined in this way. In segmental diagnosis ocular phenomena are of great localizing importance. There may be some question as to the lowest limit of sympathetic representation for the face, but when the sympathetic phenomena are present one may presuppose a tumor of the lower cervical or the upper thoracic

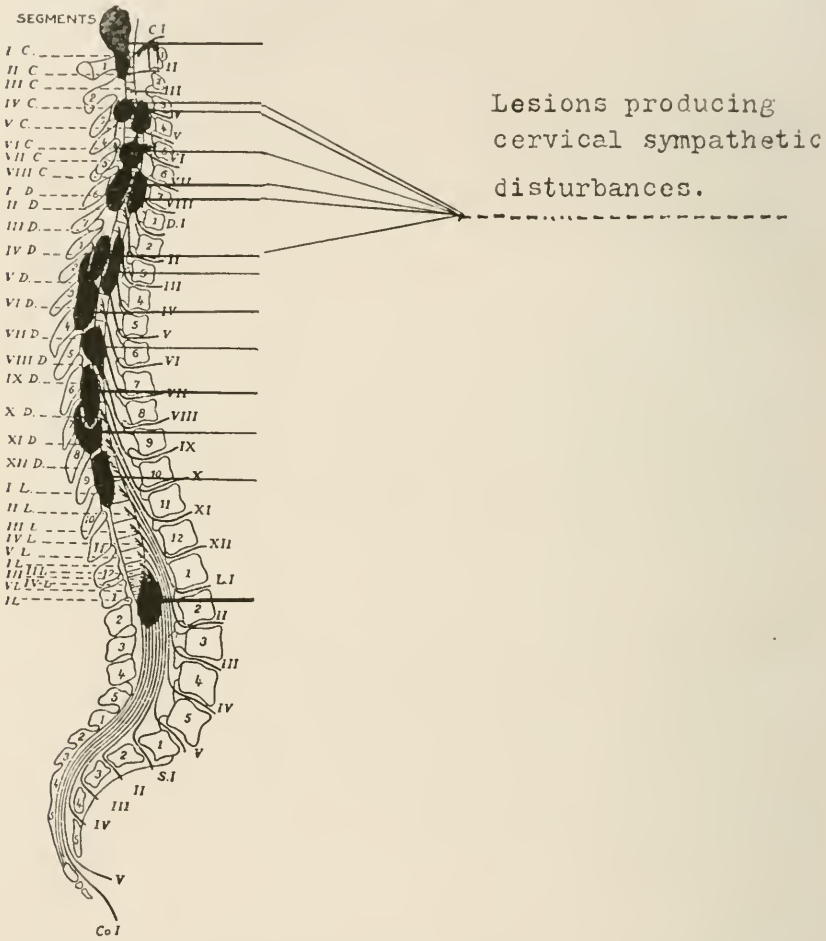

Fig. 7.—Composite diagram showing location of fourteen tumors of the series as to segmental level. Note that all the tumors from the third cervical to the first thoracic segment were associated with cervical sympathetic disturbances.

segments. In all our cases (six) in which the tumor was found from the fourth cervical to the third thoracic segment, these ocular phenomena of sympathetic origin were present (Fig. 7).

There were two instances in which sweating of the face was recorded, in one before and one after operation. In the latter (Case 5)

the tumor was situated in the neighborhood of the seventh and eighth cervical and first thoracic roots; in fact, the seventh cervical root passed over the middle of the tumor. Sweating in the right side of the face at times was marked, and ocular sympathetic phenomena were also noticed. These phenomena must have been traumatic, incidental to removal of the tumor.

In the other case there was almost constant sweating, even in cold weather, over the right orbit. The tumor was situated at the level of the sixth thoracic segment, lower than the segmental representation usually accorded the sympathetic, and sweating was probably caused by implication of the sympathetic fibers within the cervical cord by pressure.

It is a matter of little consequence once the segmental localization is made whether the tumor be intradural or extradural or what its position with relation to the cord, except perhaps an anterior location,

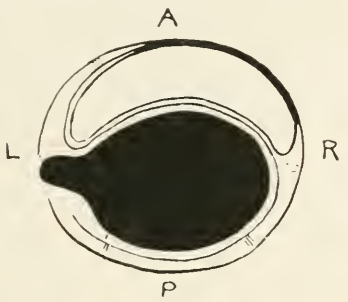

Fig. 8.—Diagrammatic representation of a tumor posterior to the cord in which the first symptom was one of motor impairment, showing effects of indirect pressure.

especially if it be extradural. Unless forewarned, a tumor in this location might be overlooked at operation. The absence of root pains in the early stages of tumor development point strongly to an anterior location. Likewise, early anterior root involvement would be of importance. In the majority of instances a lateral tumor may be presumed by the point to which pain is referred or by the Brown-Séquard syndrome, but contralateral symptoms may be produced as in at least one of our cases by pressure of the cord against the wall of the spinal canal on the side opposite the tumor (Case 13, Fig. 8). Bilateral pain from the beginning, as in Case 9, suggests a median posterior origin for the tumor; in this case the tumor was extradural.

The deep reflexes were almost without exception as one would have anticipated: they were apparently normal above the lesion, although possibly they were exaggerated, absent or subnormal when the tumor pressed on one or more segments corresponding to the level of the reflex

arc, and exaggerated below the level of the lesion. In one case the biceps and triceps reflexes seemed exaggerated when the tumor was at the ninth thoracic segment.

In the following cases the absence of reflexes was noted (Fig. 9): biceps reflex in a tumor at the level of the fourth cervical, abdominal

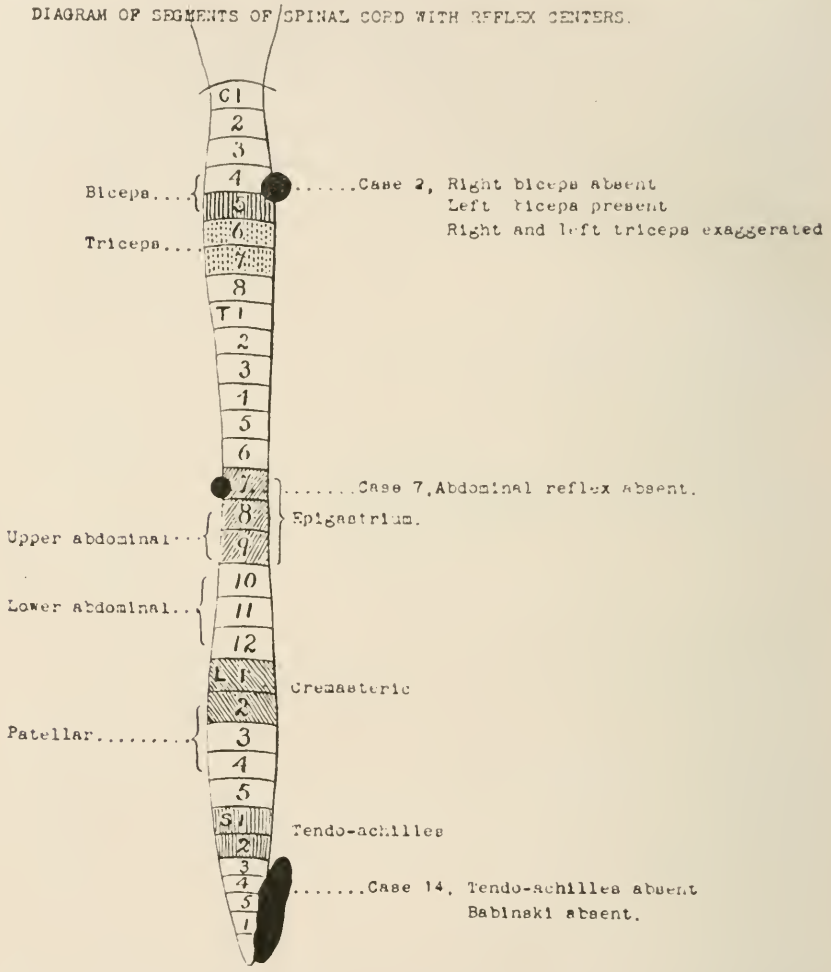

Fig. 9.—Diagrammatic representation of the location of reflex arc to spinal segments. The position of the tumor is indicated in three cases in which the localization was assisted by absence of an individual reflex.

reflex in a tumor at the level of the seventh thoracic, Achilles' tendon reflex in a tumor at the level of the terminal cord and cauda equina.

In one of these (Case 2) the biceps reflex was absent and the triceps reflex was exaggerated so that the localization of the tumor was placed definitely at the fourth or fifth thoracic segment, and at

this level the tumor was found. The reflex in this case was striking. Tapping the biceps tendon produced no flexion but caused pronation of the forearm. The reflex action was below the innervation of the fifth cervical segment, and this segment was incapable of originating a motor impulse; but the afferent fibers distributed to more than one segment were able to exert a functional control over muscles innervated from an adjoining region.

The Babinski reflex was recorded as present in eleven and absent in one of the fourteen cases. In three cases in which it was present on one side, it was always on the side of the tumor. While not of so much importance as the determination of the segment involved, one might state that the tumor is situated on the side on which this reflex is the more pronounced.

Disturbances in the movements of the diaphragm are significant as localizing symptoms. We noted only two instances (Cases 1 and 2). Perhaps others might have been detected had fluoroscopic examinations been made. There were four cases in which the tumor was found at or above the level of the fourth cervical segment, and in two of these the action of the diaphragm was disturbed. In one of these (Case 1) the fluoroscope revealed paralysis of one half the diaphragm and rather full movements of the other half. The tumor was situated at the first and second cervical (Fig. 4). In the other (Case 2) the tumor was found at the fourth cervical segment and "the left diaphragm appeared to move more than the right." Oppenheim thought that the diaphragm occasionally was less implicated than the location of the tumor would seem to make necessary. It seems that the diaphragm is not entirely dependent on the phrenic nerves for its function.

FUNCTIONAL RECOVERY

When there have been no degenerative changes in the cord, complete restoration of function may be anticipated. Considering the duration of the symptoms, one is surprised to see how soon after the operation improvement begins. In one of our series (Case 11) the history of tumor extended over a period of three years; the patient was quite helpless with a spastic paraplegia, and there was impairment of sensation up to Poupart's ligament. Within three weeks of the operation sensation was completely restored with the exception of an area of anesthesia on the left foot and ankle, and the patient could walk unaided about her room. Two weeks later she walked half a mile. In another (Case 5) there was complete paraplegia and total loss of sensation. Within six days of the operation there were signs of returning sensation, and soon after of motion, continuing to complete recovery.

In only two cases (7 and 11) was there absolutely no return of function. In one of these there was complete loss of motor and

sensory function, and the tumor history covered a period of five years. At the operation it was noted that the cord appeared as though degenerated, and an unfavorable prognosis was given. In the other, the result was not anticipated as the cord appeared normal. In this case a favorable prognosis was given, but a year after the operation signs of a complete transverse lesion presented. On the assumption that there might have been a recurrence, an exploratory operation was performed and the conditions presented were precisely those seen at the original operation after the removal of the growth. The cord had remained displaced to one side of the spinal canal, and the space formerly occupied by the tumor was readily recognized.

In the remaining cases, both motor and sensory function were almost completely reestablished within the year, although in some there were certain residual symptoms. For example, in one there was subjective sensory disturbance in the elbow and wrist; in another the grip of the hand on the affected side was weaker than the other, the reflexes continued exaggerated and there was a sensation of tightness about the left forefinger; in another, after a cervical laminectomy the patient complained of inability to hold the head erect. This was believed to be a functional disturbance.

SURGICAL PROBLEMS

Unlike tumors of the brain, exposure and removal of tumors of the spinal cord present simple elementary surgical problems. There are, to be sure, exceptions. But when the tumor is accurately localized, its exposure and removal are not difficult. Tumors anterior to the cord are, of course, less easily exposed than lateral and posterior ones. All of the tumors in our series were extramedullary, and the majority were endotheliomas or fibromas—tumors with definite encapsulation and limited in size by the dimensions of the canal.

In only one of the series was removal of the growth difficult (Case 1), and this was a tumor not only of the spinal canal but of the posterior fossa (Fig. 5). At least two thirds of the growth, a firmly fixed fibroma, was above the foramen magnum. In this case the removal might have been accomplished successfully had the situation not been seriously complicated by respiratory embarrassment. Before the operation the respiratory act was limited to one half of the diaphragm. The patient had had two attacks of respiratory embarrassment on her way to the hospital. The condition was quite desperate; before the tumor had been completely removed there was a respiratory breakdown, and attempts at resuscitation proved unavailing.

Exposure of the tumor was made by removal of three or four spinous processes and laminae, and in only one instance was it necessary

to enlarge the opening because the tumor extended beyond the limitations of our original opening. The cord may be rotated by traction on the dentate ligaments or gently retracted to afford adequate exposure. There is no difficulty in separating cord from tumor or tumor from cord. Only after the pia is divided is the line of demarcation clearly defined. Occasionally one root either anterior or posterior may be so incorporated in the tumor that its removal may seem desirable. In four of our cases (2, 4, 6 and 8) one posterior root was sacrificed and in one (Case 5) an anterior root.

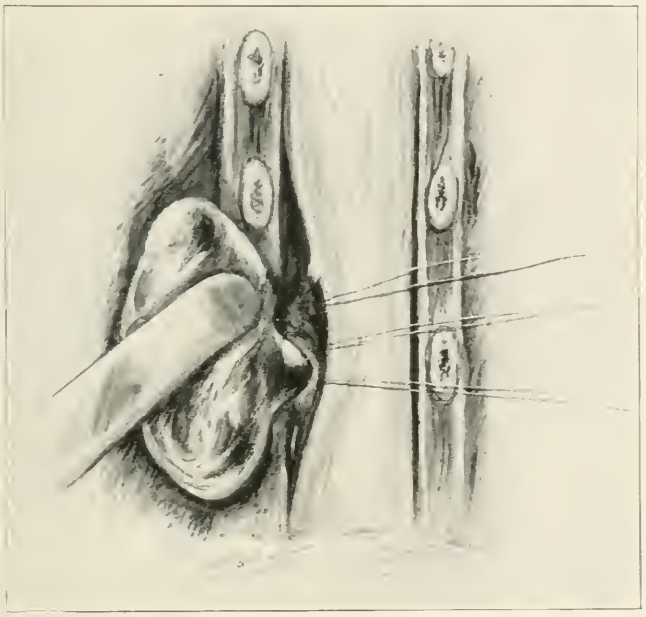

Fig. 10 (Case 9).—Extramedullary tumor in process of removal. Note the stalklike process emerging from the intervertebral foramen.

By blunt dissection the tumor is readily isolated at all points except at its point of origin or attachment. As to the origin of the endothelioma, there is some reason for believing that it originates from the spinal roots. That in some cases the roots had to be sacrificed might be advanced as circumstantial evidence. Furthermore, in two of our series (Cases 9 and 11), while the major portion of the tumor was posterior and extradural, there was a lateral extension, and in one case (Figs. 10 and 11) there was a distinct stalk, which was traced into the intervertebral foramen. In other cases the tumor was adherent to or perhaps incorporated in the dura at the lateral aspect of the spinal canal in close proximity to the point of exit of the roots from

the spinal canal. In one instance (Case 5) the tumor evidently had extended beyond the dura and invaded the vertebra. The close adherence of the tumor to the dura, and possibly the invasion of the dura, makes it advisable to remove that section of the dura to which the tumor is firmly attached. Hemorrhage from this area is quite free

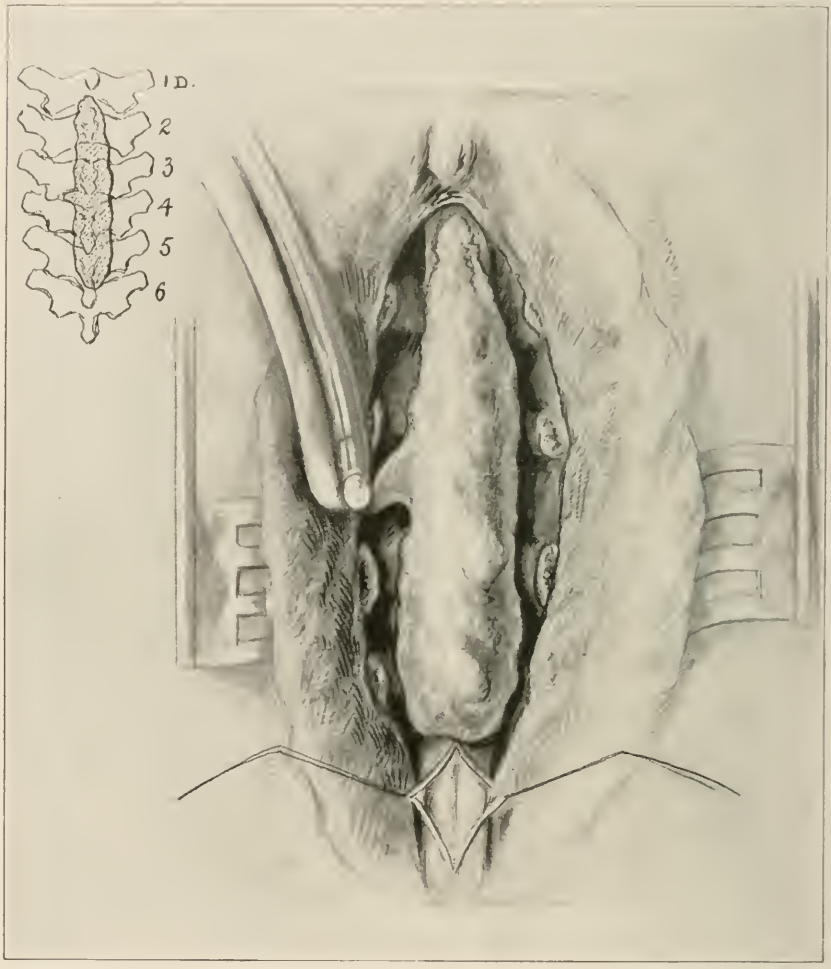

Fig. 11 (Case 11).—Large extradural tumor. Note process on left lateral aspect, presumably the point of origin.

and can be controlled only with muscle grafts. With this exception, the operation should be conducted in a bloodless field. After removal of the growth, the dural wound should be closed with a continuous silk suture, and the muscle-aponeurotic structures, subcutaneous tissue and skin with tier sutures.

REPORT OF CASES

Case 1.—*History.*—Mrs. E. M., aged 47 years, referred to the neurosurgical service of the University Hospital, Nov. 17, 1921, by Dr. Thomas Hale, for five years had complained of neuralgic pains in her left shoulder and to a less extent in her left arm. Atrophy of her left shoulder had progressed for the last three years. For the past two years she has had difficulty in walking and now is unable to use her lower limbs. For the last three or four months she has noticed difficulty in breathing, and at the time of admission she was exceedingly dyspneic and had to be propped up in bed. There was no bladder or rectal incontinence, but some difficulty in urination.

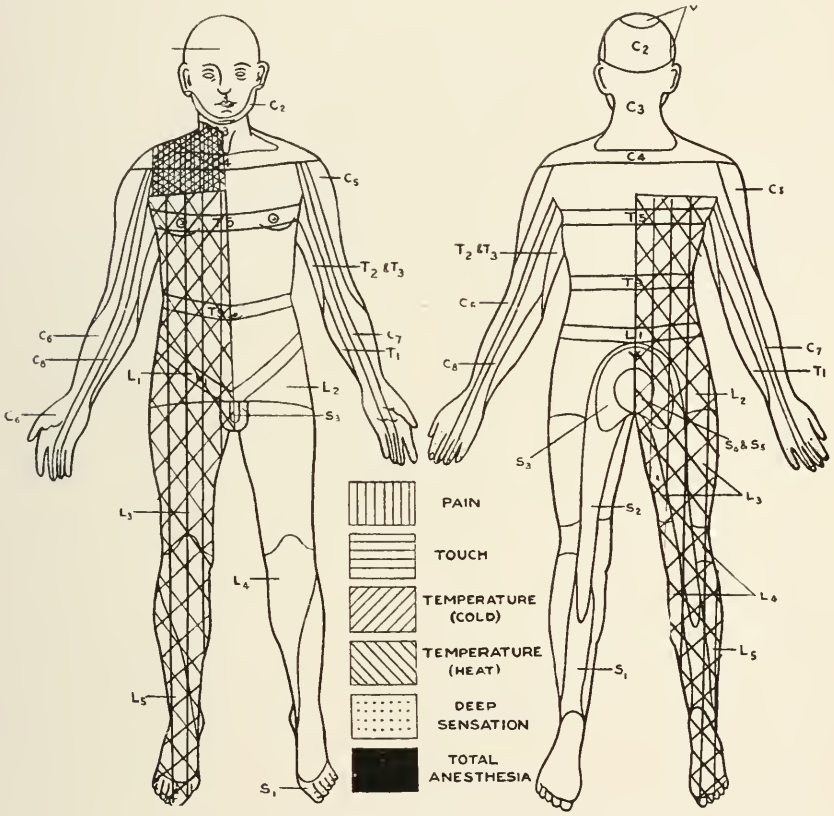

Fig. 12 (Case 1).—Disturbances of sensation.

Examination (Dr. Spiller).—Over the right side of the chest up to the second intercostal space she recognized pin-prick and ice water, but over the right side of the neck up to about 1 inch from the lower border of the maxilla she recognized neither pin-prick, heat nor cold, but she recognized touch in this area as well as over the right side of the chest; i. e., she had sensory dissociation as high as the second or third cervical segment (Fig. 12). The pupils were equal, dilated and reacted promptly. The paralysis of the left upper limb was flaccid. The biceps and triceps tendon reflexes were prompt. They were a little prompter on the right probably because there was less atrophy on

that side. Muscles of the arm and shoulder, including the trapezius, were greatly wasted on the left; much more so than on the right.

The tongue had a marked fibrillary tremor on both sides and was wasted bilaterally. The masseters were normal. The soft palate was equally innervated.

The pulse had been as high as 138, but it was 120 for the last day or two.

The left lower limb was completely paralyzed with the exception of slight flexion in the toes. The left knee reflex was prompt and ankle clonus was distinct. The right Achilles' reflex was exaggerated, with ankle clonus. The right knee reflex was exaggerated. She had distinct power in the right lower limb.

Sensations of pain, heat and cold were distinctly impaired though not lost over the whole right side, trunk and lower limb; tactile sensation was fairly well preserved. The seventh and eighth nerves were not involved.

Examination suggested a tumor high in the cervical cord on the left side close to the medulla oblongata. The dissociation of sensation was of the cord type and was best explained by a lesion of the left anterolateral column at the highest cervical segment, even involving the medulla oblongata. It involved both hypoglossal and pneumogastric nerves.

There was no sympathetic paralysis of the eye. The left side of the diaphragm was paralyzed. Syringomyelia was possible but from the history did not seem to be the more probable lesion.

Operation.—On Nov. 17, 1921, a partial excision of the tumor was performed; also exploration of the upper cervical spine and region of the medulla.

Before the operation, the patient's condition was critical. She had total loss of function of the accessory respiratory muscles; half of the diaphragm was paralyzed, the other half functioning weakly. She was cyanosed and had had two attacks of respiratory collapse on the journey to the hospital.

Ether seemed to be contraindicated. Before the patient was placed on the table, face down, nitrous oxid was started, giving as much oxygen as possible. Should the nitrous oxid anesthesia not prove practicable, chloroform was to be substituted. The anesthesia worked out most satisfactorily, the head being held constantly in the hands of a nurse who could change the position as directed.

Spinous processes and laminae of the first, second and third cervical vertebrae were removed, with the posterior rim of the foramen magnum and the adjacent occipital bone for a distance of about 2.5 cm. As soon as the dural flaps were reflected a firm tumor of considerable dimensions was found, partly below and partly above the foramen magnum. The cord was well displaced to the right. The tumor occupied a left lateral position, and at the level of the foramen magnum there was a sharp indentation of the cord. Little by little the adhesions were freed, first around the lower pole, then working up on either side, and finally on the posterior aspect. The adhesions were so firm and the depth of the tumor such that it was impossible to remove it whole. The lower third was excised first, without difficulty. Another horizontal section was made about two thirds of the distance from the pole, and this second segment was removed without difficulty. While proceeding with the removal of the third section, respiratory failure occurred to which the patient succumbed. It was thought that perhaps by the use of the intratracheal tube the patient might be revived, but after artificial respiration was practiced for a few moments the circulation failed.

The tumor had the macroscopic appearance of a fibroma, but it was much more firm in its attachment to the surrounding tissue than is usual in tumors

of the spinal cord. Had it been as readily removed as the majority of these tumors, there would have been no difficulty in its excision. The method of exposure was well planned, and no time was lost in the detection of the growth. There seemed to be no other way of removing the tumor than segmentally, and the operation could not have been modified except perhaps to have performed it in two stages, rather than one.

Pathologic Diagnosis: Endothelioma.

Case 2.—*History.*—T. J. S., aged 29 years, referred to the neurosurgical service of the University Hospital, Feb. 17, 1921, by Dr. Alfred Stengel, in September, 1920, while engaged in heavy work, noticed a lancinating pain posteriorly on the right side of the neck, extending down to the region of the shoulder. The pain was sharp and was aggravated on movement of the arm or neck or on being jolted as in an automobile. This "knife-like" pain persisted, at times lessening in intensity, but did not disappear. During the early part of 1921 it grew worse, and he was forced to give up work. Since then he has not been able to sleep comfortably because of the painful throbbing in the right shoulder.

In February, 1921, his ankles suddenly swelled, and he developed pain in both legs from his feet to a few inches above the knees. From the point of origin in the neck the pain extended down to the elbow, lower forearm and hand. The pains usually came on at night, as a dull ache, and were relieved by rubbing and by heat. The right hand was numb as well as painful and not fully under voluntary control.

He had had two teeth removed for abscesses, one five years before and one in October, 1920, without relief. There was no loss of weight.

Examination.—The patient held his head and neck stiffly because of pain in the right side of the neck. The muscles on the right side of the neck were rigid and painful on pressure. There was no limitation of movement of the spine. There was some atrophy of the muscles above the spine of the right scapula. Motion of the right shoulder was not free and easy. Motion of other joints was normal.

Feb. 24, 1921: Roentgen-ray Report: Cervical and upper dorsal vertebrae and shoulder were normal.

March 10, 1921: Examination by Dr. Kern: Left Arm: No atrophy; strength fair; grip of hand 95; biceps and triceps reflexes prompt; normal diadokokinesis; no dysmetria. Right Arm: Evident wasting, most marked about the shoulder girdle, supraspinatus and infraspinatus especially; slightly "winged scapula." The deltoid and biceps were wasted; grip 25. The lower extremities were normal. Sense of position, vibratory sense and stereognosis were normal.

The patient complained of subjective sensory disturbances in the legs, particularly the right; the right thigh felt cold. There was no sensory blunting to hot and cold water, pain and light touch. He said that pin prick felt sharper throughout the right side. There was hyperesthesia on both soles extending up over the dorsum of the foot to the malleolar level.

May 7, 1921: Examination by Dr. Spiller: The left side of the diaphragm appeared to move more than the right. The right pupil was a trifle smaller than the left. This had been repeatedly observed and is suggestive of transitory sympathetic paresis. Tactile and pain sensations were acute on the right side of the neck and in the right upper limb, but the man winced more from prick on the right side of the neck than he did from prick on the left as though he had slight hyperalgesia in the distribution of the third and fourth cervical nerves.

Atrophy of the right supraspinatus and infraspinatus muscles was marked; it was less advanced in the muscles about the right shoulder. Fibrillary tremors were pronounced in the right triceps, biceps and deltoid. The right biceps reflex was practically absent. Tapping the biceps tendon produced a paradoxical reflex; i. e., pronation of the forearm at the elbow, which indicates that the irritation produced causes a reflex below the fifth cervical, and that the fifth cervical segment is incapable of responding to reflex action. The right triceps reflex was exaggerated, perhaps a little more than the left. This would indicate that the sixth cervical segment on the right side was reflexly active. The left biceps tendon reflex was a little diminished; the left triceps reflex was a little exaggerated. The right lower limb was a little spastic in walking. Patellar and Achilles' tendon reflexes were markedly exaggerated, nearly equally so. Patellar clonus was present on either side, distinctly more pronounced on the right. Ankle clonus was present on the right side only. The Babinski reflex was uncertain.

Tactile sensation was entirely normal in both lower limbs. Pin prick was not felt in the entire left lower limb and was greatly impaired over the left side of the trunk, with no sharply defined border. Heat and cold sensations were greatly impaired, if not lost, in the entire left lower limb and probably somewhat affected in the left side of the trunk.

Summary.—There was a complex commencing with pain in the right side of the neck, extending to the shoulder. Transitory sympathetic paresis of eye was present on the right side. There were atrophy of the muscles and fibrillary tremors in the fifth and sixth cervical distribution. The biceps reflex was absent on the right side. There was anesthesia for temperature and pain, not for touch, in the left lower limb. There were slight weakness and spasticity of the right lower limb, exaggeration of the tendon reflexes and diminution of diaphragmatic action on the right side.

Localization.—There was a lesion at the fifth, possibly at the fourth, not involving the sixth, cervical segment, extramedullary, on the right side of the cord, beginning probably from the posterior roots and increasing in size. There was probably, therefore, a tumor, likely to be an endothelioma or a fibroma.

Operation and Course.—June 4, 1921, a laminectomy was performed. Ether anesthesia was used, endopharyngeal method. The third, fourth and fifth spinous processes and laminae were removed. The tumor was found on the right side of the cord, half above and half below the point of origin of the posterior root of the fourth cervical segment. This passed over the middle of the tumor (Fig. 13). The tumor extended into the intervertebral foramen, following the course of the root at least 1 cm. beyond the spinal canal. The removal here was attended with some difficulty. Its presence within the foramen would suggest this as its point of origin. The fourth sensory root was sacrificed at the operation, and the anterior root necessarily somewhat traumatized. At the conclusion of the operation the field was entirely dry. The dura was closed with continuous silk sutures, and the remainder of the wound with tier sutures. The naked eye appearance of the tumor was that of an endothelioma.

Pathologic Diagnosis: Fibroma.

The postoperative convalescence was uneventful except for transitory weakness of both arms. The man was discharged from the hospital twenty-two days after the operation and later resumed his occupation.

Case 3.—*History.*—Mrs. H. T. S., aged 33 years, referred to the neurosurgical service, University Hospital, by Dr. Charles K. Mills, Feb. 22, 1910. The

patient had been married eight years, had two children, and had always enjoyed the best of health, except for occasional fainting spells, the last of which occurred eight years ago. Two years previous to admission, pain began in the back of the neck and left shoulder which somewhat resembled rheumatism and was treated as such. Later the pain, which was sharp and shooting, came at intervals lasting from five to twenty minutes, and gradually extended down the arm. There was also a sensation of numbness in the left arm, leg and foot, and later decided weakness on the left side (Fig. 14).

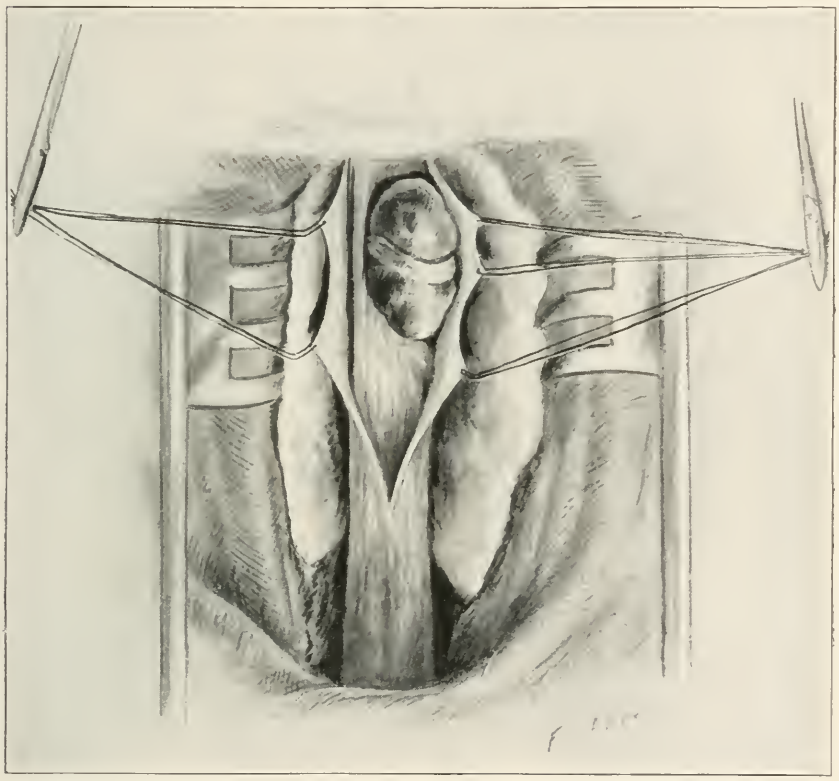

Fig. 13.—Illustration reproduced from drawing made at operation to show relation of the posterior root of the fourth cervical segment to the tumor.

Examination.—Sensation for touch, pain and temperature was normal. There was moderate, inconstant impairment of the sense of position of the left hand. The grip of the left hand was impaired. Amplitude of motion in the left extremities was somewhat restricted due to muscular weakness. The scapulo-humeral reflex was slightly greater on the right, as were also the coracobrachial and the biceps tendon reflexes. In the lower extremities the reflexes were all increased, those of the left side being greater. A Babinski reflex was present on the left only. There was no ankle clonus. Tonicity of the left lower limb was somewhat increased, of the others normal. Electrical reactions in the left arm were normal.

The roentgenogram showed a shadow to the outer side of the fourth and fifth cervical vertebrae on the left. The mass was small and lay in such a position that it might readily press on the posterior roots. The left halves of the fourth, fifth and sixth vertebral bodies seemed a little denser than did the right.

Operation and Course.—Laminectomy was performed, Feb. 25, 1910. A semilunar skin flap was reflected and an incision made to the left of the median line.

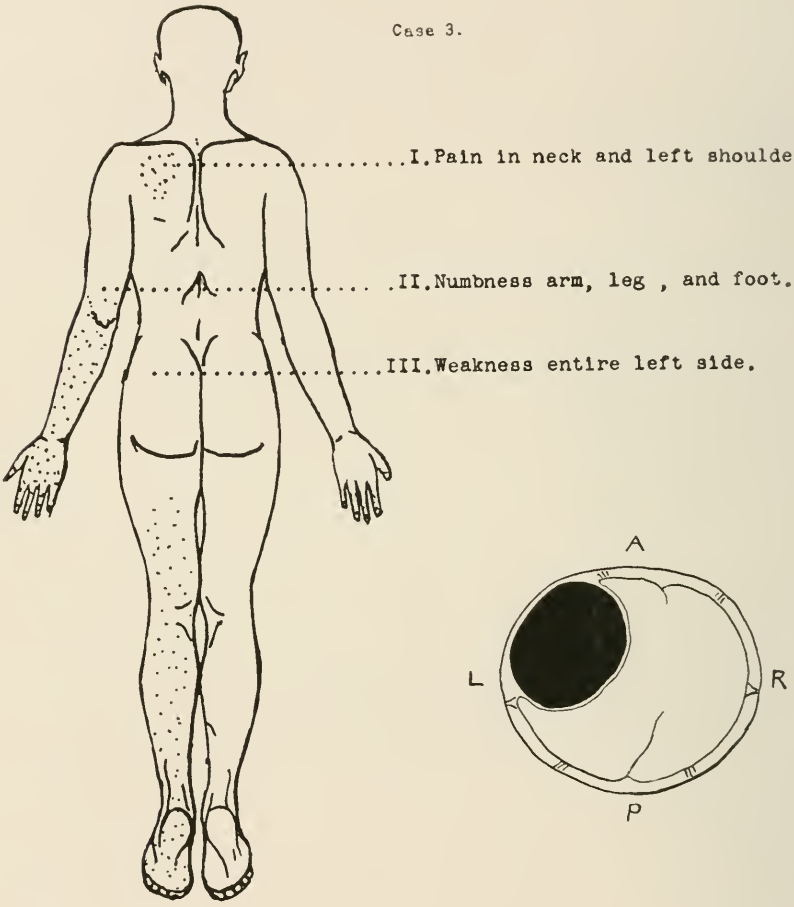

Fig. 14.—Chronologic sequence of symptoms with diagram, showing the relation of the tumor to the cord.

The spinous processes of the fourth, fifth and sixth cervical vertebrae, the laminae of the fifth and a portion of the sixth were removed. There was little hemorrhage. The dura was opened, exposing a tumor about the size of a chestnut, located a little above the level of the fifth cervical vertebra. The sixth posterior root ran over the mass, and it was impossible to say whether the anterior root ran through it. The fifth posterior root was in contact with

the upper end of the mass, which was very friable. In removing it there was marked twitching of the left shoulder. Pathologic Report: Endothelioma.

1918—The patient made an uneventful recovery, and eight years after the operation is practically well. There are no muscular atrophies. The tonicity of the left arm is greatly increased and the reflexes exaggerated. The patient reports that the use of this arm has returned for all practical purposes, cold alone decreasing the freedom of activity. The grip in the left hand is not so strong as in the right. There is no pain in the left shoulder nor on that side of the body below the arm. However, an occasional pain is felt in the region of the scar on the neck, and severe radiating pains, occurring at intervals of two weeks to a month, and being at present of less severity, involve the left arm and forearm and extend into the fingers. Heat and cold sensations are about normal in the arm, forearm and hand, and the patient is able to recognize objects in the left hand. There is still, however, some abnormal sensation in the left forefingers, described as a tight and distended feeling. In the left lower extremity all reflexes are greatly exaggerated and all sensations intensified, while in the right lower extremity all sensations are subnormal and the reflexes decreased. The sphincters are normal. Ankle clonus and the Babinski sign are present and the patellar reflex exaggerated on the left side. The gait is normal, with the exception of a slight spasticity in cold weather.

Case 4.—*History.*—E. M., aged 64 years, referred to the neurosurgical service of the University Hospital, Feb. 21, 1916, by Dr. C. E. Riggs, in November, 1914, noticed a dull aching pain in the right shoulder region just below the clavicle, extending out and down as far as the insertion of the deltoid muscle. Pain was increased for the time by coughing and sneezing, and radiated posteriorly. This condition continued until, July, 1915, when she noticed numbness in the fingers of the right hand. This gradually extended to the wrist. She could handle a knife and fork until August, 1915, but there was progressing disability of the right hand. From this time on the hand has been almost helpless, and the left hand has become weak. The left upper limb, however, is moved involuntarily with ease.

August, 1915, about a month after the fingers were affected, numbness and tingling were first noticed in the toes of the right foot. Following this she complained of awkwardness of the right lower limb, frequently stubbing the toe in walking. October, 1915, she complained of paresthesia in the left hand and arm, but it never progressed as far as it has in the right upper limb. In October she also complained of a girdle sensation. All of these conditions have been growing worse. Her right ankle was weak and frequently turned. She was markedly constipated and could not void while in bed.

Examination.—The patient was a fairly well nourished, white adult female, with a moderate amount of fat. Her skin was sallow. Results of general examination were negative. There was slight tenderness on pressure over the fourth and fifth cervical spines. This tenderness was aggravated by forcibly flexing the neck.

Lumbar puncture: Pressure 6 mm. of mercury. The Wassermann test of the spinal fluid was negative. The globulin test was negative; lymphocytes, 12 per centimeter. A roentgenogram of the cervical spine was negative.

Notes by Dr. Spiller: Heat and cold sensations were probably normal in all limbs though the patient made mistakes. The recognition of heat, cold and pain was prompt on either side of the face. Sensations of pain were normal in the lower limbs and also in the right side of the neck. Tactile sensation was normal in all extremities with the exception of an area on each shoulder anteriorly just below the clavicle where there was impaired pain and tactile

sensation, in the distribution of the fourth cervical roots. Sense of position and of passive movement was apparently disturbed in both hands and much impaired in the right toes. The patient tired quickly and attention flagged.

There was only a little movement in the right fingers, some reflex at the right elbow and some elevation of the right shoulder. The lower limbs were somewhat spastic. There was some power in the right lower limb at the hip and knee but none lower. The left lower limb had fair power.

The biceps and triceps reflexes were exaggerated in each upper limb, patellar reflexes were also exaggerated with abortive patellar clonus on the right. The Oppenheim and Babinski reflexes were distinct on the right; the Babinski sign was uncertain on the left; the Oppenheim sign was not obtained. The reflex of defense was marked on the right; there was an indication of it on the left.

Operation and Course.—On Feb. 26, 1916, a laminectomy was performed. A tumor was found at the level of the fourth cervical segment and removed. The spinous processes of the second, third, fourth and fifth cervical vertebrae and the laminae of the third, fourth, fifth and part of the second were removed. There was no visible pulsation. The dura was incised, and on pricking the arachnoid, the cerebrospinal fluid spurted out 1 or 2 inches and about an ounce escaped. The tumor was found at the level of the third lamina on the right side of the cord, covered by a membrane which, when divided, showed more sharply the differentiation between the cord and the tumor. The tumor, encapsulated, arose from the dura on the right anterolateral aspect of the spinal canal to which it was firmly adherent. Enucleation and elevation from its bed were conducted without traumatizing the cord. Neither anterior nor posterior roots were sacrificed with the exception of the third posterior root. This root passed from its point of exit from the dural sac over the superior aspect of the tumor where its identity was lost; apparently it had no connection with the cord. At the beginning of the operation the blood pressure was 120; it rose in a few minutes to 145 and dropped later to 105; at the conclusion of the operation it was 120, the pulse 134. The wound was closed with tier sutures. Pathologic Diagnosis: Endothelioma.

Convalescence was uneventful. Shortly after the operation the patient began to regain power in the right upper and lower limbs and sensation slowly returned. On discharge from the hospital the grip of the right hand was moderate. The patient could move the right arm quite freely, place her hand on her head and move her fingers in all directions. The areas of anesthesia just above the clavicles on either side had disappeared. There were no disturbances of sensation except pain in the left leg and foot. Strength had increased greatly in the legs; there was no spasticity, and no ankle clonus or Babinski sign. The biceps and triceps reflexes were prompt, but not nearly so prompt as at the time of admission.

The general improvement throughout was most striking. The readiness with which the patient answered the tests for sensation was quite a contrast to the slow, doubtful and often confused way in which she responded before operation. She still complained of slight tightness around the waist.

Case 5.[2]—*History.*—H. B., aged 18 years, referred to the neurosurgical service of the University Hospital by Dr. William G. Spiller, Oct. 7, 1919, about nine months ago had severe pain in both upper extremities, coming on rather suddenly and rapidly increasing in intensity. It was constant with severe paroxysms lasting about half an hour. She obtained greatest relief by standing with her back against a warm radiator. This condition lasted about three months

2. This case was referred to in Am. J. Med. Sc., March, 1920.

with varying severity. There was no paralysis at that time. Then followed a period of about three months in which she was very weak, walked with difficulty and stumbled. While being treated by an osteopath she developed complete paraplegia. At this time Dr. Schwartz found markedly increased reflexes of the lower extremities, ankle clonus and the Babinski sign on both sides. On manipulation she became very spastic. Sensation of heat and cold

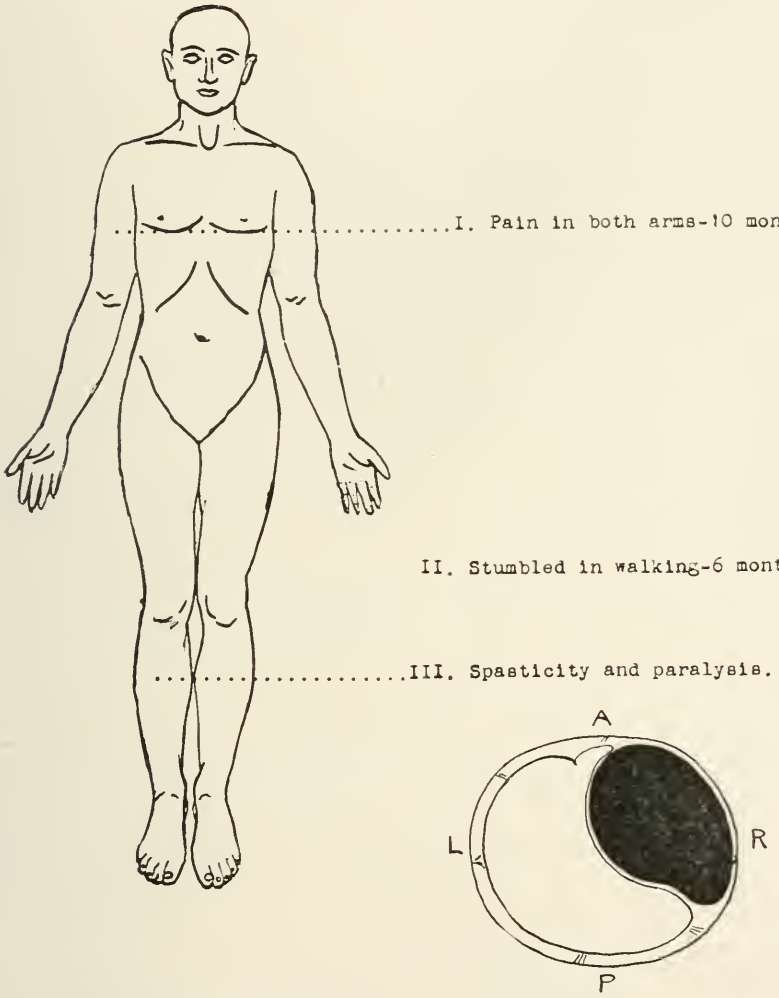

Fig. 15.—Chronologic sequence of symptoms with diagram, showing relation of tumor to the cord.

was absent in the region of the sixth thoracic spine. Pain and tactile sensations were diminished in the same area and slow of recognition. There was difficulty in starting urination but she voided freely; she was never catheterized; there was no incontinence. She was constipated; there was no bowel incontinence. The pupillary reflexes were normal. There had been very little change in the last three months except that she became somewhat less spastic (Fig. 15).

Examination.—The patient was a small, poorly developed, and somewhat undernourished white female. There was a small decubitus in the sacral region covered by a scab. Mentally, she was keenly alert. She lay in bed bolstered up with pillows, with legs partially flexed and drawn up. She moved the upper extremities readily. She could not stand or walk. Results of examination of head, cranial nerves, neck and thorax were negative.

Both upper extremities were rather small and rather weak; the thenar and hypothenar eminences were thin and flattened; more distinctly on the left; there was no atrophy of the forearms or arms. In the supraspinous and infraspinous regions on the left there was some wasting, also of the left deltoid. Flexion of the little finger appeared to be weaker on the left. There were no palsies of any part. The fingers of the left hand were held in partial flexion of the second and third phalanges and extension of the first. Sensation in the upper limbs was normal. There was no dysmetria, adiadokokinesis, astereognosis, or tremor. The biceps reflex was normal (or diminished). The triceps reflex was normal on the right, diminished on the left. The wrist reflex was normal.

In the lower extremities there was no voluntary motion. The legs were spastic and manipulation threw the whole extremity into partial clonus which seemed painful. Manipulation of any part of the body might bring on this spastic condition. Asked if she had pain she answered, "Yes, sometimes, but not always." She said that the pain was not in the legs, but in the shoulders (in the scapular region), more on the left. There was no atrophy or tremor of the lower extremities. Pain and temperature senses were greatly diminished or lost in both lower extremities and extending up the trunk to about the fourth or fifth interspaces. Touch sense was absent over the same area, but deep pressure was felt. There was no vibratory perception when the tuning fork was placed over the malleoli or on the tibia. Sense of position was lost in the toes. There was a very small red spot (hard) on the right upper thigh. The knee reflexes were exaggerated. Even a light tap often produced right or left clonus. The Achilles' reflexes were exaggerated. Tapping of the tendon produced ankle clonus on each side. There was a distinct ankle clonus when tested in the usual manner, greater on the left than on the right. There was a marked Babinski sign, the same on both sides.

Operation and Course.—On Oct. 18, 1919, a laminectomy was performed and an endothelioma was removed. The tumor was believed to be at the level of the third thoracic segment which is opposite the tip of the spinous process of the seventh cervical vertebra. This was identified the day previously by the roentgen ray. With this point approximately as the center of the incision, the laminae of the first thoracic, and sixth and seventh cervical were removed. There was a fusiform enlargement of the contents of the canal as seen by the bulging of the dura. The dura was opened, and the bluish outline of the tumor was seen presenting at the anterolateral aspect of the cord at the level suspected. After incising the pia definition of the tumor became more sharp, and by gentle retraction of the cord it was bluntly dissected from its attachment. The posterior seventh root passed about over the middle of the tumor and had been retracted while the growth was being removed. After the tumor was taken out, there appeared to be a defect in the dura at the point of exit of the anterior division of the eighth cervical and first thoracic. This led to a space anterior to the canal which seemed to be filled with soft granulation tissue or possibly tumor. Apparently it was removed intact. It was thought wise to sacrifice the anterior root at this point as it probably was involved by the

tumor growth. Hemorrhage was controlled, and the wound closed in the usual way. The patient's condition toward the close of the operation was rather serious, although there had been little loss of blood and relatively little trauma. The patient was given 1 pint of saline solution intravenously with appropriate stimulation.

Postoperative Note: There was transitory incontinence of urine and feces. The left palpebral fissure was distinctly narrower on the right, and the right pupil was smaller. Sweating was marked on the right side of the face at times. Six days after operation the sense of position in the toes and of deep pressure in both legs had returned. Three weeks after operation motion was returning to the ankle joints, and the sensory disturbances were rapidly subsiding. Within five months there was almost complete functional recovery of the lower limbs, and later the patient walked five miles.

Case 6.—*History.*—Mrs. W. F. G., aged 60 years, referred to the neurosurgical service of the University Hospital, Feb. 3, 1920, by Dr. William G. Spiller, in March, 1918, first complained of pain between the shoulders, dull in character and observed especially on moving the arms. Later she observed a sleepy feeling in the tips of the right fingers and still later the pain extended to the right arm and elbow. In September, 1919, she complained of weakness and numbness in the right leg. There was loss of temperature sensation in this limb, but touch sensation was preserved.

In November, 1919, she felt as if there were a band about her abdomen; in December, 1919, the right lower limb grew stiffer and jerked, especially when lying in bed. She could not flex the little finger of the right hand, and noticed a stinging sensation in the ulnar side of the right upper limb. The last few days she has had similar sensations in the left hand. She can walk a little with the aid of a cane.

Examination.—The right pupil was slightly smaller than the left, and the right palpebral fissure was smaller. Movement of the head on the trunk was restricted. The left arm and hand had fair power, not so good in the triceps muscle. There was no atrophy. The grip of the right hand was very weak; the right thenar and hypothenar eminences were wasted and the little finger was especially weak. The biceps reflex was normal. Striking either triceps tendon produced no contraction of the triceps muscle, but contraction of the biceps and supinator longus—a paradoxical reflex. The right lower limb was very spastic, the left was normal. Voluntary movements of the right lower limb were restricted, but not of the left. There was no atrophy. The patellar and Achilles' reflexes were much exaggerated, more so on the right. The Babinski sign was present on the right, not on the left.

Sense of position was lost in the right little finger and impaired in the right ring finger and toes of the right foot. Vibratory sense was lost in the right and impaired in the left lower limb. Sensation to touch and pressure was normal everywhere except in the right little finger and ring finger. Touch, pain, heat and cold sensations were distinctly diminished on the inner side of the right arm, forearm and hand. Temperature and pain sensations were lost in the left lower limb to just above the knee and impaired from there up to the level of the third interspace in front and the third thoracic vertebra in the left side of the body. Roentgen-ray examination of the cervical spine was negative.

Operation and Course.—On Feb. 12, 1920, a laminectomy was performed. The spinous processes and laminae of the fifth, sixth and seventh cervical and the first thoracic were removed. On opening the dura a tumor was found

anterolateral in position, having displaced the cord to the left and rotating it on its axis so that the posterior roots appeared to come off on the portion of the cord immediately presenting in the wound. The posterior roots of the eighth cervical and first and second thoracic stretched across the tumor. These roots were all spared but the upper one which had to be sacrificed (Fig. 16). The tumor was firmly adherent to, infiltrated, and had penetrated, the dura

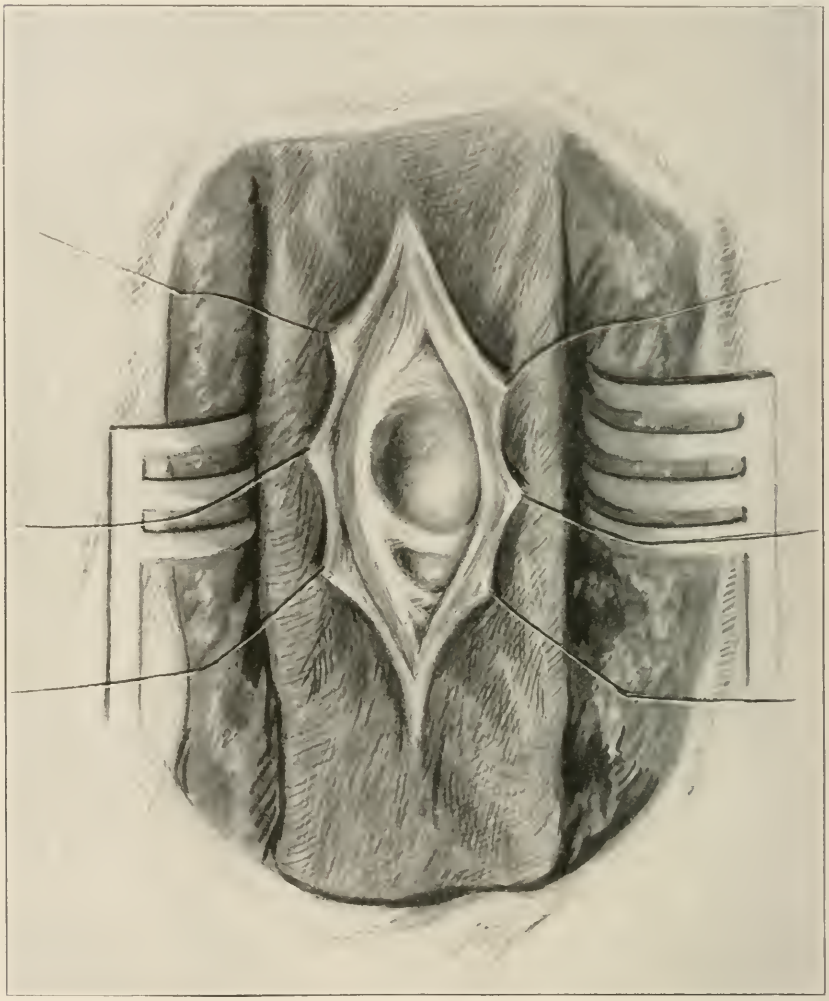

Fig. 16.—Appearance of tumor at operation.

in the lateral aspect of the canal on a level with the anterior root of the first thoracic segment. That portion which had infiltrated the lateral wall of the canal became detached and was removed separately. There was also sharp bleeding from the point of attachment which was controlled with two small muscle grafts. The space left by the removal of the growth appeared to be about two thirds of the diameter of the canal, the cord occupying the remain-

ing third. Hemostasis was perfect at the conclusion of the operation. The dural wound was closed with a continuous silk suture, the muscle and facial planes with tier catgut sutures. Tubular drainage was employed.

Postoperative Notes: The patient made an uneventful recovery, and on Nov. 25, 1921, a year and nine months after the operation, she had some pain in the right upper limb from the elbow to the little and ring fingers, some twitching occasionally in the right foot, occasionally some involuntary contraction in the right hand, and slight diminution of touch and pain sense in the ulnar distribution of the right hand. She was able to walk without difficulty and to use the right upper limb freely.

Case 7.—*History.*—W. S. D., aged 44 years, referred to the neurosurgical service of the University Hospital by Dr. James M. Anders and Dr. Charles K. Mills, about five years ago first complained of pain in the lower sternal region. At first the pain lasted only a few seconds and was brought on by movements such as stooping. Later the patient noticed a sense of numbness in the right leg and foot and right side of the scrotum and in the second and third toes of the left foot. Two years before the patient began to complain of weakness in the left leg. Now his leg becomes stiff if he keeps it in one position for any length of time.

Examination.—The patient showed great unsteadiness on his feet with his eyes closed. This apparently was due to weakness of the legs, especially the left. There was no change in pupillary reflexes or ocular movement. Movements, sensation, reflexes, etc., were normal in the upper extremities. There was marked impairment of power in the left lower extremity, somewhat more marked proximally than distally. All parts of the limb were, however, more or less affected. He could not throw the left leg over the right, nor the right over the left. He could abduct, adduct and dorsal flex the foot, but with feeble movements. He could elevate the left heel somewhat feebly. He had general impairment of power in the right lower extremity, but less marked than in the left. Ankle and knee reflexes were greatly exaggerated on both sides. There was foot clonus on both sides, more persistent on the left. There was a Babinski sign on both sides. Abdominal and cremasteric reflexes were absent.

Examination for sensation was somewhat indecisive, but it was found that there was no loss of the sense of position or of passive movements in either lower extremity. On the right, sense of touch, pain, heat and cold were retained, but they were diminished, comparing the right with the left. The upper limit of the impaired sensations was 2 or 3 inches (5.08 to 7.62 cm.) above the umbilicus, close to the position where he said he had had pain five years before.

Operation and Course.—On June 1, 1919, a laminectomy was performed under ether anesthesia. The spinous processes and laminae of the upper thoracic spine were removed sufficiently to expose the third, fourth and fifth thoracic segments. The tumor was situated on the left side of the cord and had the gross appearances of the more common extramedullary endotheliomas. It was removed intact without difficulty and without traumatizing the cord. The hemorrhage was checked and the wound closed.

Postoperative Notes: Following the operation the patient gradually developed signs of a complete transverse lesion, so that a week after the operation there was complete paraplegia, loss of sensation and of reflexes, with an extensive decubitus and retention of urine.

Eleven months after operation there had been no return of sensory or motor function. With the hope that possibly a recurrent growth might be found, an exploratory operation was performed.

May 4, 1920, a laminectomy was again performed under ether anesthesia, endopharyngeal method. The incision followed the line of the original incision. One spinous process and lamina above the original laminectomy were removed, and from this point down the posterior aspect of the dura was isolated and eventually opened. The dura and the arachnoid were moderately adherent, but the lines of demarcation between these and the cord were readily recognized and separation was made with a sharp knife. The site previously occupied

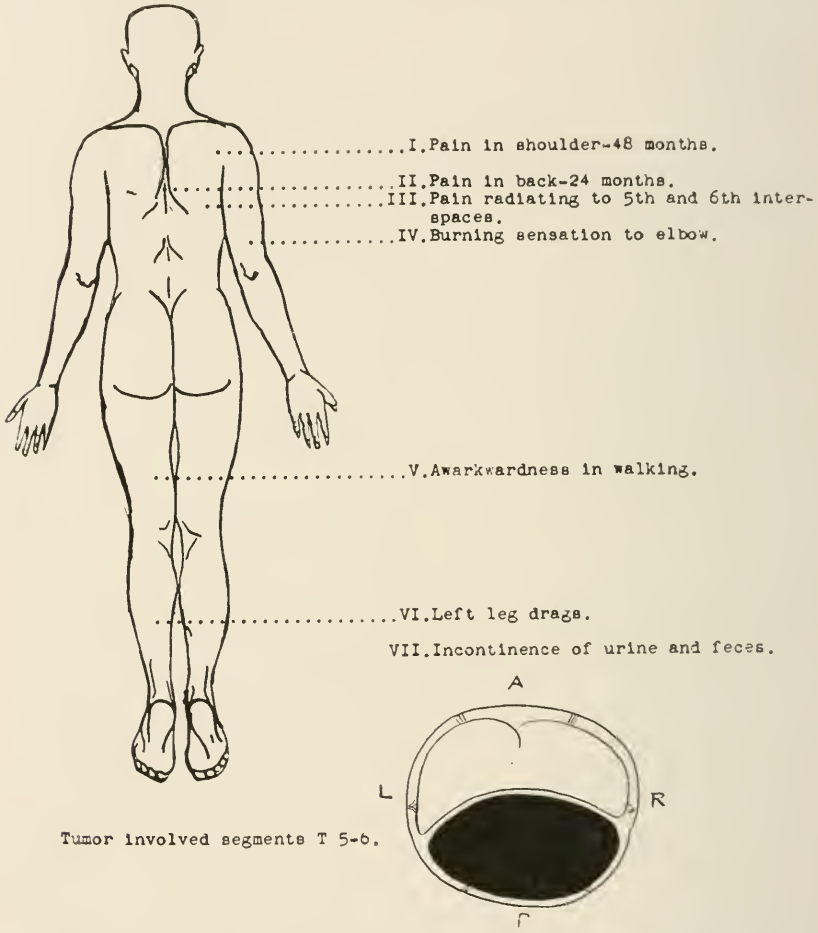

Fig. 17.—Chronologic sequence of symptoms with diagram, showing relation of the tumor to the cord.

by the tumor was readily recognized as a cavity to the side of which were found remnants of cord tissue which had evidently gone on to practically complete degeneration. There was no evidence of a recurrent growth or of any pressure or constriction of the cord by fibrous tissue such as might have formed from the organization of a blood clot.

Case 8.—*History.*—F. S. P., aged 35 years, referred to the neurosurgical service of the University Hospital by Dr. Charles K. Mills, Nov. 10, 1918, four

years before complained of pain under the right shoulder. Two years before she began to have a sharp pain between the shoulder blades. This continued and resembled a throbbing toothache. Then she noted a sharp pain radiating from this region forward along the fifth and sixth ribs to the right, and at times a burning sensation on the posterior and anterior surface of the upper part of the right arm to the elbow. The pains were not constant but were aggravated by motion. She wore a plaster jacket for four weeks. After that she noted that the lower limbs were stiff; for this she received massage but was not benefited. An osteopath did not relieve the pain in the back, but she became less awkward in walking. At present she has a dull aching pain between the shoulder blades, occasionally radiating to the right ribs, fifth and sixth, with an occasional burning sensation along the dorsum of the upper part of the right arm. She says that she can walk only with support as she feels uncertain on her feet. Her lower limbs are stiff, but without pain and the left one drags. She has some incontinence of feces and urine (Fig. 17).

Examination.—The cranial nerves were normal but the right pupil was slightly larger and a little perspiration was almost constant above the right orbit. The patient said this was present even on a cold day.

There was considerable swaying on standing, increased by closing the eyes. The left leg especially was weak and tended to drag. The gait was somewhat uncertain and ataxic. The left leg was more spastic than the right. The power in her legs was more impaired since September, 1919. The upper extremities showed no weakness, atrophy or tremors; stereognosis was good, rapid rotary motions well done; there was no ataxia. There was good muscular power in each. There were no sensory changes. Biceps and triceps reflexes were normal. Both lower extremities were spastic and weak, especially the left. There was no atrophy or palsy of any part and no tremor. The heel to knee test was well done on each side.

Sensation to touch was good in all parts, but more pressure was required in the legs, and there was slight impairment in the lower part of the abdomen. There was no impairment above the seventh interspace. Pain sense was everywhere present but was more impaired than the sense of touch; it was normal above the seventh interspace (more impaired in the right leg?). Temperature sense was markedly impaired in the legs, especially on the right, and there was distinct impairment up to about the sixth and seventh interspace. The sense of position was normal in the feet.

The patellar reflexes were exaggerated and equal; the Achilles reflexes were overprompt and equal. The Babinski sign was present. There was also a marked reflex of defense. Ankle clonus was slight on the left. (Two days before it was persistent on each side.)

Lumbar Puncture: Pressure, 11 mm. of mercury. Five cubic centimeters of fluid were removed. The fluid was clear, yellowish; no coagulum. The cell count was 4 per cubic millimeter; there was marked increase of globulin; the Wassermann test was negative.

Roentgen-Ray Examination: The thoracic vertebrae showed no abnormalitities.

Operation and Course.—On Nov. 11, 1917, a laminectomy was performed. The landmarks on the skin were opposite the spinous processes of the first and fourth thoracic. The incision extended one spinous process above and below these. The spinous processes and laminae of the first, second, third and fourth vertebrae were removed and the dura opened; the tumor immediately presented itself, occupying the posterior aspect of the canal in the lower third

of the opening. The tumor was removed intact, sacrificing only what was identified as the sixth thoracic root, from which the tumor probably took its origin. The stump of the root was ligated to control hemorrhage. The tumor really extended one lamina below the opening, but as soon as its upper half was freed, it popped out like a grape from its skin. On its removal the tumor measured 2 cm. at the widest diameter and 5 cm. in length. The wound was closed with tier sutures and tubular drainage was employed.

Postoperative Notes: There was some increase in voluntary power of the left lower extremity. The right lower extremity showed no change in power. There was considerable impairment of the sense of position, especially in the right foot. Sensory disturbance was the same as at preoperative examination, except less in degree. The recognition of heat and cold, touch and pain was much more acute on the trunk below the sixth interspace than at the preoperative examination. The patient felt considerably better than she had been feeling. Power was returning in the left lower extremity to a considerable degree. She was discharged from the hospital three weeks after operation, and one year later Dr. Mills reported that there were no signs of recurrence.

Case 9.—*History.*—R. C. H., aged 24, referred to the neurosurgical service of the University Hospital by Dr. Alfred Stengel, Dec. 14, 1921, was well until 1920, when her back was hurt in an automobile accident. She later fell while skating and was again in an accident the following year. In November, 1921, she had pains in the back. Following the menstrual period on Nov. 16, 1921, she had occipital headache and was almost delirious. From this time on she had difficulty in walking. Numbness developed from her breast line down. Paresthesias began six months before in the arms, breasts and axillae. The patient was admitted to Dr. Stengel's service on Dec. 14, 1921. She was seen by Dr. Spiller on Jan. 1, 1922, and the condition was thought to be organic. She was again seen by Dr. Spiller on Feb. 28, 1922, and a diagnosis of cord tumor was made and operation requested.

Examination.—The patient was an athletic and well developed young woman. She was very intelligent. There were no gross abnormalities about the head. The eyes were normal; the left pupil slightly larger than the right, the left eyeball slightly more prominent. The irides reacted normally to light and in convergence. All other cranial nerves were normal.

From the fourth intercostal space downward the touch, pain, temperature and vibration sensations were lost except in the soles of the feet. In each axilla and extending down the inner aspect of the arm was an area that had no sensory function.

There was loss of sense of position in the toes and a strong reaction of defense in the feet. Spasticity of the lower limbs was marked. Ankle and patellar clonus were persistent. The Babinski sign was present on both sides. Patellar and Achilles' reflexes were exaggerated and tended to go into clonus. She had some difficulty in starting the functions of the bladder and bowels.

Operation and Course.—On March 3, 1922, a laminectomy was performed. Spinous processes and laminae of the seventh cervical and of the first, second and third thoracic were removed; the tumor was found beginning just below the level of the fourth thoracic segment, or what corresponded to that according to our roentgen-ray identification. The tumor was 9 by 3 mm., and covered the whole posterior surface of the cord. It could be exposed only by removing the laminae as far as the articulations. On the left the tumor extended almost to the anterior aspect of the cord. It was entirely removed although tediously because of its width and length. To control bleeding

silver clips were used, before section of either side, which included the plexus and the veins over the cord. The tumor was entirely extradural.

Case 10.—*History.*—P. E. S., aged 43 years, referred to the neurosurgical service of the University Hospital by Dr. William G. Spiller, July 3, 1918, a little over a year before felt a dull pain 2 inches (5.08 cm.) below the apex of the right scapula, which would come on after hours of rest, usually after midnight, disappearing shortly after the patient arose. Sitting in a chair, walking about the room, or a bath would relieve the pain. The pain grew gradually worse and for the last two months has been boring and radiating, sharp and lancinating. It radiates from the right side, 2 inches below the apex of the scapula, follows the intercostal nerve toward the costal margin and epigastrium, but never extends beyond the midline. There is no pain on the other side and no girdle sensation.

Shortly after the dull pain started in the side, a burning and dry sensation of both feet developed, beginning in the right one. There was no tingling or numbness at that time, but both developed later and extended gradually up to the level of the umbilicus. These were associated with a sense of constriction below the knees. At this time the gait became unsteady, and the patient began to sway from side to side in walking. For the last six weeks he has noticed a gradually increasing weakness of the limbs. His gait is spastic with muscles tense, especially after resting. There is difficulty in starting the stream and after urination there is dribbling of urine. He is unable to control flatus.

Examination.—There were no headaches or dizziness. Vision, hearing, taste and smell were normal. The pupils were normal; there was no intra-ocular palsy.

There was no ataxia, weakness or tremors of the hands, and no paresthesias of the upper extremity. The grip of the left hand was considerably stronger; both hands showed good power. The biceps and triceps reflexes were normal.

The left patellar reflex was greatly exaggerated, the right more so. The Achilles reflex was also exaggerated, but less than the patellar. On striking the right Achilles tendon a slight clonus occurred. There was a doubtful Babinski sign on the right and left. Patellar clonus was present on the right, doubtful on the left. On heel to knee test there was a slight ataxia of the right leg. There was a slight impairment of sense of position in the right foot, none in the left

Touch sensation was acute. The patient said that touch felt different over the tibial region. There was loss of cold and heat sensations over the whole right lower limb and abdomen exactly to the level of the umbilicus and on the left side to 1 inch below this level. On the right side pain sensation was markedly impaired up to the inguinal region and diminished to the level of the umbilicus; on the left side to about an inch below this level. Sensation above the umbilicus was normal.

The Romberg sign was strongly positive on rising; after walking, normal. The gait was a little uncertain, the right lower limb being slightly spastic.

Notes by Dr. Spiller: Heat and cold were not distinguished on the right up to the umbilicus and on the left to 1 inch below the umbilicus. There was a fair but perhaps not entirely normal sensation of heat and cold around the anus and in a small strip down each thigh in the distribution of the second, third, fourth and fifth sacral nerves. The same localization of disturbance of sensation of pain was present. Over the abdomen, pain sensation was diminished, not lost, but it became acute on the right side and at the level of the umbilicus, and in the left side about an inch or more below the umbilicus. At

times the patient recognized the prick of a pin on the outer side of the leg below the knee and on the dorsum of each foot. Over the anterior surface of the thighs pain sensation was possibly more impaired than over the legs.

Operation and Course.—On Aug. 3, 1918, a laminectomy was performed under ether anesthesia, endopharyngeal method. The spinous processes of the ninth thoracic vertebra had been identified with the roentgen ray. The tumor was believed to be at the level of the ninth or tenth thoracic segment. An incision was made extending from the fourth to the ninth thoracic spinous process and before the spinous processes were removed a guide suture was introduced into the aponeurosis at the level of the spinous process of the sixth thoracic vertebra. The spinous processes of the fourth, fifth, sixth, seventh and eighth were then removed, and the corresponding laminae. When the dura was exposed, there was marked pulsation. On opening the dura an oval swelling of the cord was seen at the level of the eighth or ninth segment, probably just between them. This swelling was 2.5 to 3.5 cm. in length. It was thought at first that we were dealing with an intramedullary tumor, but on displacing the cord a little toward the left, a faint line of demarcation could be seen between the cord and the tumor on its anterior or slightly anterolateral aspect. This was covered with pia and arachnoid, and after these were removed the outlines of the tumor were readily recognized. It looked like an endothelioma and when removed measured 2.5 by 2 cm., being of the usual olive shape. The anterior root of the seventh segment crossed the posterior aspect of the tumor. The tumor itself did not seem to be in any closer relation with the eighth than with the ninth posterior root, nor to be attached to the roots but to the dura on the anterior aspect of the spinal canal. From this it was separated and when removed appeared to have a definite capsular covering. There was only one bleeding point where the tumor was attached. Bleeding was controlled with a muscle graft and the wound closed with tier sutures.

Postoperative Notes: One month after operation the patient was discharged. His convalescence was uninterrupted. He was without pain and his gait was constantly improving.

On July 23, the patient, who was a physician, wrote that he could walk straight and was working every day, operating.

Case 11.—*History.*—F. P., aged 52 years, referred to the neurosurgical service of the University Hospital, April 12, 1921, by Dr. A. M. Ornstein and Dr. William G. Spiller, entered the hospital for the first time in September, 1915, and left one month later. At that time she complained of a burning sensation in the epigastrium accompanied by vomiting. Five weeks previous to admission, except for occasional headache, she had been well. At this time she developed cramplike pains in the abdomen about the umbilicus, with a burning sensation in the epigastrium. She vomited persistently, neither the vomiting nor the pain, however, being related to the time of eating. Her appetite was poor, and she was constipated. She complained of shortness of breath on exertion, palpitation and a little swelling of the feet. She had lost 30 pounds (13.6 kg.).

On her second admission, two weeks later, she still complained of epigastric pain, worse at night and radiating toward the angle of the scapula. At this time she vomited every morning, still had some dyspnea on exertion with slight cough, but no expectoration. She still complained of swelling of the ankles as the day progressed. The patient again left the hospital.

Nothing was heard from her until her present admission. She now complains of weakness and epigastric pain. The patient says that about a year ago she felt a burning sensation all along her spine. She would get one of these attacks every week or so. It was not an actual pain but only a vague burning. About three weeks ago some medicine stopped this burning. She had always had slight pain in the epigastrium, a dull boring pain, not related

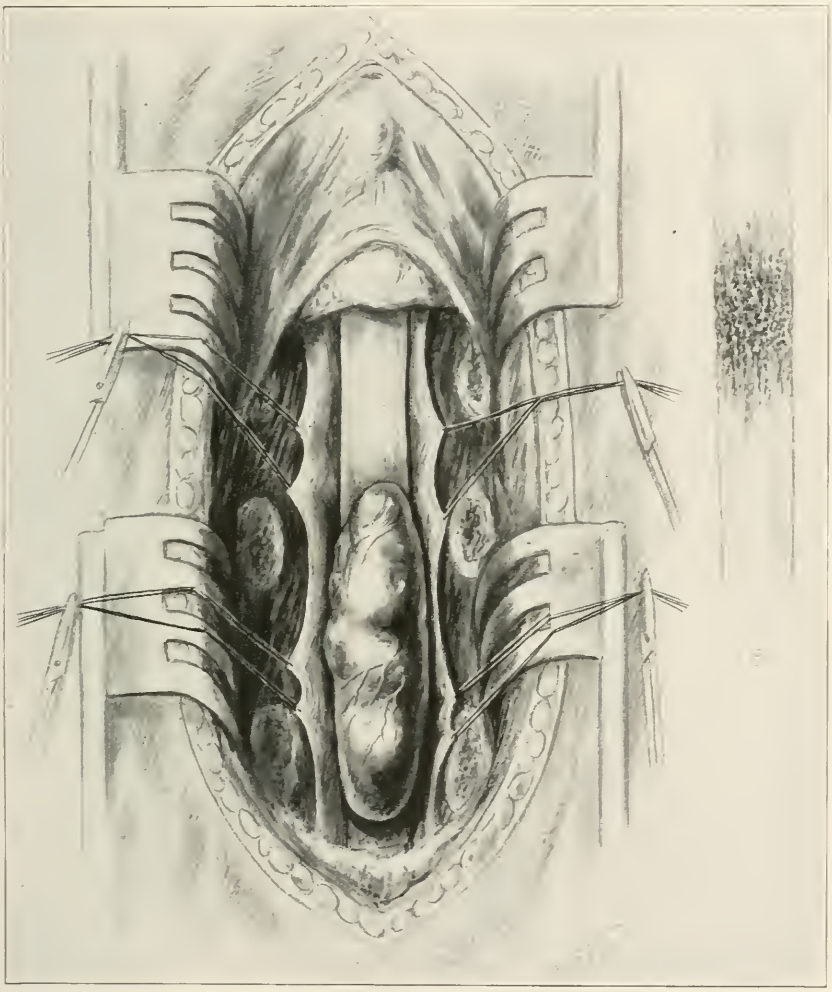

Fig. 18.—Tumor as seen at operation.

to or affected by meals. She had not vomited during the last five years; i. e., since she left the hospital. During the last three weeks, the epigastric pain had become steadily worse, with some radiation to the left, was worse at night, usually beginning about 10 p. m. and continuing all night, with relief toward morning. She was more comfortable during the day when moving about. Her bowels were constipated, sometimes for five or six days without

a movement. She was subject to severe headaches. She had lost about 15 pounds (6.8 kg.) lately. At the present time her appetite is poor; she does not sleep well and groans most of the time.

Examination.—There was some edema of the feet and ankles. Both legs were very spastic and were drawn up on the thighs.

Touch, temperature and pain sensations were lost over the lower extremities and up as high as 2 inches above the umbilicus; it was about equal on the two sides. Posteriorly, the border was at the level of the twelfth thoracic vertebra. Vibratory sensation was lost in the lower extremities and sense of position in the great toes. There was no dysmetria in the finger to nose test; no astereognosis and no adiadokokinesis. The biceps and triceps tendon reflexes were markedly exaggerated. Patellar reflexes were exaggerated but rather hard to obtain on account of the spasticity. Attempts to cause the Achilles reflex caused continuous ankle clonus. There was a positive Babinski sign on both sides.

Roentgen-ray examination of the thoracic spine was negative.

Spinal Fluid: Five cells; pressure, 8 mm. of mercury; the fluid was yellow tinged. The Wassermann test was negative; globulin test, positive; sugar was present. The blood Wassermann test was negative.

Operation and Course.—On April 12, 1921, a laminectomy was performed. The spinous processes and laminae of the fifth, sixth and seventh thoracic vertebrae were removed, and on opening the dura there appeared at the level of the spinous process of the seventh thoracic vertebra a tumor on the posterior aspect of the cord, more to the right than to the left. It was 3 cm. in length and had the naked eye appearance of an endothelioma (Fig. 18). It was removed intact. The surface of the cord in contact with the tumor was irregular and gave one the impression of rather pronounced degenerative changes. The wound was closed.

Pathologic Diagnosis: Endothelioma.

Postoperative Notes: The patient's recovery from the operation was uneventful, but a year after operation there had been no recovery of function.

Case 12.—*History.*—G. V., aged 50 years, referred to the neurosurgical service of the University Hospital, Sept. 6, 1921, by Dr. Alfred Stengel, one or two years before was told that she was walking as if very tired and not using the right foot quite so well as the left. She walked little and paid little attention to this condition. On Thanksgiving Day, 1920, while at work, she had pain in the lower right side of the back, which made walking difficult. She was treated for renal calculus. All this time she had a sensation as of a belt or pressure radiating from back around the region of the waist, not crossing the midline. Three weeks later she was taken to the stomach hospital where a diagnosis of neuritis, rheumatism and deep seated lumbago was made. She had pain through the entire lower right part of the abdomen and back. She remained in the hospital three weeks. About this time she began to have increasing pain before bowel movements. The pain started in a spot in the lower right side of the back, radiated around to the front at the level of the umbilicus, then spread up under the right ribs, giving the sensation of a tight jacket and spreading over the entire right side of the back. There was more pain at night; every two hours she was awakened by it. She was relieved by a hot water bag. The pain was less frequent during the day (Fig. 19).

In September, 1921, the patient was readmitted. There had been no change in her condition except that she had more difficulty in walking.

Examination.—It was impossible to obtain an accurate record of the sensory disturbances since the patient's mental condition was such that her answers were frequently contradictory. However, there were times when the sensory findings suggested a Brown-Séquard syndrome and a tumor at the level of the ninth thoracic segment. Patellar and Achilles reflexes were increased on both sides. The Babinski sign was present on both sides. At times there was a nonpersistent ankle clonus.

Spinal Fluid: Pressure, 6 mm. of mercury; no xanthochromia. Five cells per cubic millimeter. The Wassermann and colloidal gold tests were negative.

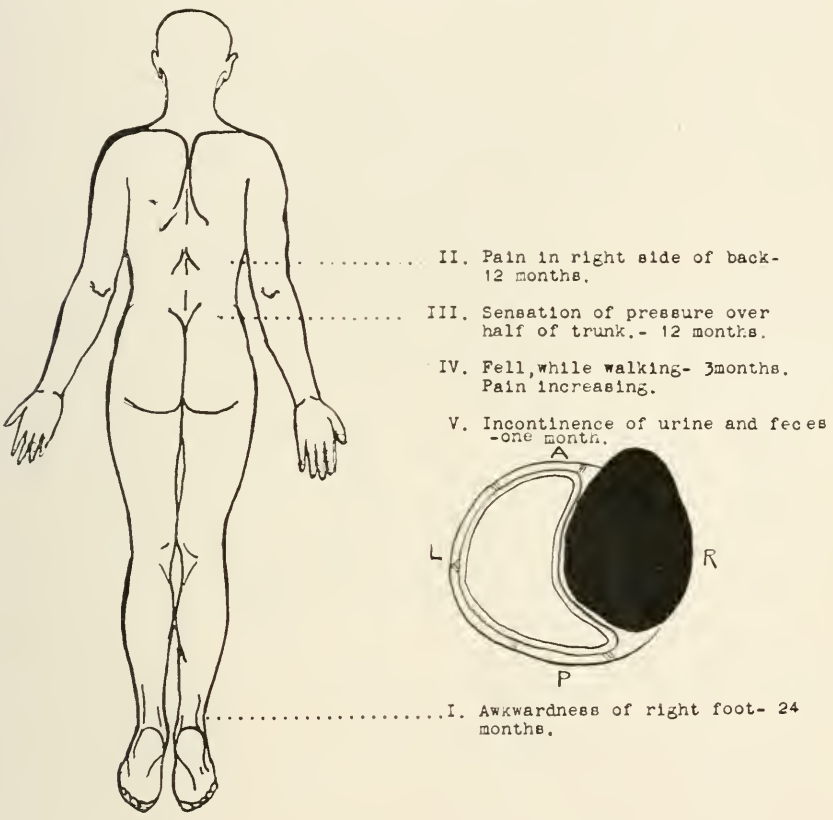

Fig. 19.—Chronologic sequence of symptoms and diagram showing relation of tumor to cord.

Roentgen-ray examination of thoracic spine suggested rarefaction of the fourth thoracic vertebra. It was observed that the slightest motion of the patient caused exquisite pain, as did jarring of the bed.

Operation and Course.—On Nov. 22, 1921, a laminectomy was performed. Spinous processes and laminae of the fifth, sixth, seventh and eighth thoracic vertebrae were removed. At this level, on opening the dura there was no evidence of tumor. On removal of the spinous processes and laminae of the ninth thoracic vertebra an extradural growth was discovered, chiefly on the

right side, having the appearance of a sarcoma involving the laminae of the eighth and ninth thoracic vertebrae. The tumor had compressed the cord on the right side and encroached on more than half of the spinal canal. As much of the tumor as was accessible was removed in order to give immediate relief of pressure. The tumor unquestionably took its origin from the vertebral column, and before closing the wound 50 mg. of radium, in a metal container within a rubber tube, long enough to reach to the surface, was applied about 1 inch above the level of the cord; the tube of radium remained in this position for twenty-four hours.

Report from a frozen section was returned, "sarcoma."

Postoperative Notes: Because of persistence of pain following the operation, it was decided to attempt relief by section of the anterolateral columns of the cord. In December, 1921, laminectomy was performed at the level of the fifth thoracic segment, and the anterolateral columns on both sides were sectioned by our prescribed technic. This operation gave the patient substantial relief. From the time of its performance until her discharge from the hospital, she was comparatively comfortable.

Case 13.—*History.*—A. J. H., aged 37 years, admitted to the neurosurgical service at the University Hospital, Dec. 4, 1920, was well until the summer of 1917, when she noticed that the right great toe was stiff when she attempted to rise on the toes in playing tennis or golf. No pain was associated with the stiffness, which disappeared after a short time. In December, 1917, she noticed that in skating she could not balance properly. During the early months of 1918 there was the same difficulty in skiing. There was no difficulty in walking. In the fall of 1919 there appeared stiffness in the thighs anteriorly. In dancing she could not move with her usual spring. About this time there were occasional cramplike pains in the feet during exertion, relieved by taking off the shoes. She could walk without difficulty on level ground, but going up inclines and stairs was difficult. There was no pain in the legs. Since August, 1919, she has used a cane. In the spring of 1920 there was no voluntary movement of the toes and ankles, knees or hips. There has been no loss of power in the hands, arms or trunk, though movements of the lower spine are sometimes clumsy.

There has been some tingling in both legs. During the early part of the trouble there was hypersensitiveness in the soles. She has no difficulty in appreciating temperature. When the legs are down there is redness, even cyanosis, with cold skin, though they feel warm subjectively; vice versa, occasionally the parts seem cold, but the skin is warm.

Occasionally there have been kicking, jerking movements at the knee. There are no symptoms referable to other organs.

Lumbar Puncture: Pressure, 6 mm. of mercury; clear, colorless fluid; cells, 8 per cubic centimeter. There was a trace of globulin, the Wassermann and colloidal gold tests were negative.

Roentgen-Ray Report: Dorsolumbar spine negative.

Notes by Dr. Spiller: There was considerable spasticity of the lower limbs, more of the right. There was slight voluntary movement of the toes, of both ankles and of the knees and hips. The patellar reflexes were distinctly and equally exaggerated; patellar clonus was persistent on the right and indicated on the left. Ankle clonus and the Babinski sign were present on either side.

Heat and cold sensations were greatly diminished on both sides, almost to Poupart's ligament; they were normal on the abdomen. Pin prick sensation was nearly normal in the lower extremities. Tactile sensation was the same

as that for heat and cold. Sense of position was lost in each big toe. There was perfect control over the bladder and bowels. In the peri-anal region of each side there was slight impairment of touch, apparently none of pain. There was considerable impairment in the peri-anal region to heat and cold. There were no deformity of the vertebral column and no tenderness over the spine.

The symptoms were those of an incomplete lesion of the spinal cord about the first lumbar or twelfth thoracic segment. Control of bowels and bladder indicated incompleteness of the lesion. There had been burning pain in the feet in the early stage of development, during exertion and when in bed. If the symptoms resulted from pressure on the cord, one would expect greater spasticity. The indications were rather that there was an intramedullary lesion, a partial transverse myelitis. A tumor was possible but seemed doubtful. Voluntary movement in the lower limbs had been increasing.

Operation and Course.—On Dec. 14, 1920, a laminectomy was performed. A left, extradural tumor was exposed and removed. Assuming the tumor to be at the level of the first lumbar segment, it was planned to remove the spinous processes and laminae of the eighth, ninth and tenth thoracic vertebrae. This was done, beginning above and going down, and when the tenth lamina was removed there appeared projecting from below a bluish tumor which seemed to occupy approximately three fourths of the spinal canal, the cord being compressed well over to the right side. The tumor began at the lower margin of the laminae of the tenth thoracic and extended down for a distance of 6 cm., necessitating removal of the laminae and spinous process of the eleventh thoracic. The shape of the tumor was rather peculiar in that there projected to the left and forward a tonguelike process like the stalk of a mushroom. So far as could be seen, it was entirely encapsulated, and the tumor was removed intact. Two bleeding points were controlled with muscle grafts. The wound was closed with five layers of interrupted silk sutures. Tubular drainage was employed.

Postoperative Notes: There was an extraordinarily rapid recovery of function. Three weeks after the operation the patient could walk, and sensation was entirely normal with the exception of an area of hyperesthesia over the left ankle and foot.

Case 14.—*History.*—J. G. R., aged 49 years, admitted to the neurosurgical service of the University Hospital, May 18, 1921, was in good health until 1918, when he noticed a sharp pain in his thigh and groin, radiating to the crest of the ilium on the right. This was worse when he stooped, worse one day than another and worse at night. He preferred to sleep sitting. At times it would subside almost entirely, and he continued at work. This condition continued about six months. He then grew a little better. In the winter of 1918-1919 the pain grew a little worse, and his right leg would often tremble when he preached. This pain would be relieved by aspirin. In the spring of 1919 the pain and trembling grew better, and during the whole summer of 1919 the symptoms were mild. In the fall of 1919 the pain grew so severe that he could not lie down. In January, 1920, he was cystoscoped, with negative findings. He also suffered with retention of urine. He had a little pain in his legs at that time. The retention passed off in a month or so, and he was able to return to work in March.

In October, 1920, the trouble returned, and he worked with difficulty until January, 1921, when he stopped work for two months. He then worked throughout April. On May 8 the pain came on again rather suddenly and increased rapidly. On May 12 his feet began to itch and sting. On the

thirteenth he noticed that they were growing weak, and on the fifteenth they became paralyzed. When admitted he had pain in both legs and lower part of his back and a band sensation about his waist. He had lost from 3 to 5 pounds (1360.7 to 2267.9 gm.) since the beginning of his illness.

Examination.—This revealed a man of small stature, in not very robust health and suffering much pain. His mind was clear. There was complete flaccid paralysis of both legs. His head, cranial nerves and chest were normal. There was a mass in the upper left part of the abdomen extending to midline and below the umbilicus. It had a rounded edge but no definite notch.

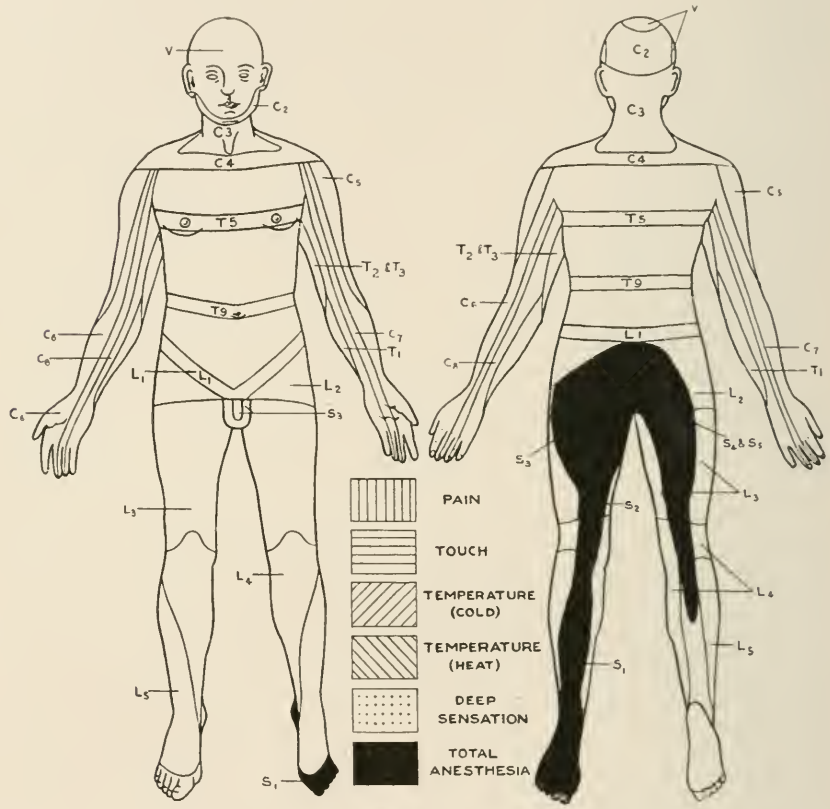

Fig. 20 (Case 14).—Disturbances of sensation.

It moved slightly with respiration. There were no nodules or irregularities. Abdominal reflexes were absent. The genitalia were normal. No cremasteric reflexes were present.

Power was good in both hands. There was no wasting or atrophy. The reflexes were prompt and equal, right and left (biceps and triceps). There was a slight intention tremor in both hands. No adiadokokinesis or dysmetria was present.

There were flaccid paralysis (complete) and some wasting of both legs. There were fibrillary tremors in the calves. No Achilles reflexes or Babinski sign were present. Sense of position in the toes was gone (Fig. 20). Total anesthesia was found in the area shown in the chart. Sensation over the rest of the body was normal. Patellar reflexes were subnormal and equal.

Fig. 21.—Photograph of cord.

The patient said that sexual intercourse was possible until two months before or less, but caused much pain afterward. Erection and ejaculation both occurred.

The spine of the second lumbar vertebra seemed slightly more prominent than its neighbors, but no actual kyphosis was present.

Dr. Pepper: Review of the history elicited the statement that the paralysis came on quite abruptly (six hours) after osteopathic manipulation of the spine.

Examination.—Results of examination agreed with the foregoing except that the cremasteric reflexes were present, and the patellar reflexes were obtained with great difficulty. The mass could be certainly diagnosed as kidney or spleen. The patient was more anemic than the first blood count suggested and the urine contained large amounts of blood. Apparently the pain could be due to the same lesion that had produced the paralysis.

The spinal fluid was bile colored. There were four cells per cubic millimeter; globulin was present; pressure, 4 mm. of mercury. There were 4,720,000 red blood cells, 14,600 white blood cells and 96 per cent. of mercury.

The patient had to be catheterized. The urine was cloudy. Four days later the bladder contained much blood and clots. This continued until May 25, 1921, when the bleeding stopped, and the urine became clear. Urine: Appearance, cloudy red; sediment, granular; specific gravity, 1.021; reaction, acid; albumin, cloudy; sugar, negative; red blood cells, from 30 to 40; white blood cells, loaded; epithelium, occasional; no acid-fast organisms in twenty-four hour specimen.

May 29, 1921: Bleeding commenced again, but ceased June 1, 1921. Hypodermic injections caused a rather large hematoma under the skin. Therefore the large amounts of morphin which were necessary to relieve the patient's pain were given by mouth.

He complained of unbearable pain when he lay down, but if he lay down with his head raised on a pillow and his thighs flexed, he was not quite so uncomfortable. He found it necessary to sleep propped up in bed to almost an erect position. Catheterization twice and sometimes three times a day was necessary.

Operation and Course.—Because of the hematuria and the mass in the left upper abdomen, a provisional diagnosis of a hypernephroma with cord metastasis was made. An exploratory operation was performed by a member of the surgical staff, and the enlarged organ was found to be the spleen. Following its removal the patient died, and at necropsy a tumor of the lower segments of the cord and cauda equina was found. The tumor measured 6 cm. in length and proved to be a sarcoma (Fig. 21).

DISCUSSION

Dr. M. A. Bliss, St. Louis: Did Dr. Frazier fail to find a tumor in cases which presented a typical Brown-Séquard syndrome? I have seen such cases, but the symptom level rose higher in the cord after operation. Did a cyst of the cord appear in any of his cases? In one such case we had brilliant results, with return of sensory function in a few days and return of motor function within a month, and with restoration from a totally paralyzed state, to walking. A year later, recurrence showed epithelioma.

Dr. Julius Grinker, Chicago: I had an experience with a case of spinal cord tumor which leads me to believe that Dr. Frazier need not despair of recovery in some of his operative cases. In that case an operation was done, and for fully a year and a half there was not a sign of improvement, the

patient being completely paraplegic. Then, to our surprise, the nurse noticed that one great toe began to move, and from that time on there was gradual improvement, and within another year and a half the patient had recovered sufficiently to walk with assistance. I have no doubt that there are cases in which recovery does not occur, but we should never despair, for that recovery may eventually take place. I cannot explain why in some cases improvement should be so long delayed.

Dr. F. E. Coulter, Omaha: What has Dr. Frazier's experience been relative to trauma acting as an etiologic factor?

Dr. Leo M. Crafts, Minneapolis: I recall the case of a farmer who, while a group of men were lifting a section of barn floor, reached under it; the workmen accidentally let the section down on him, doubling him over very sharply. When released, he had a sense of discomfort and pain all about the midbody. This feeling continued. A few months later he had developed a typical picture of cord tumor. A laminectomy was done in the middorsal region, and a hypernephroma was found extradurally, postlateral, toward the right. He had a complete paraplegia which showed no improvement for six months or more; then he began to improve, and continued to gain until he had fairly good use of the legs. Some months later the picture recurred and progressed. It would seem that unquestionably trauma was the etiologic factor.

Dr. A. W. Adson, Rochester, Minn.: Dr. Frazier emphasized an important point in stating that pain is a very valuable sign. The tendency has been to wait until the patient developed a level sign in addition to pain, that is, loss of pain, tactile and temperature sensibilities, before we felt free to make a diagnosis of cord tumor. In reviewing 112 laminectomies which were performed at the Mayo Clinic for cord tumor, I find that fourteen were situated extradurally, thirty intradurally but extramedullary, and thirty-one intramedullary; in twenty-seven instances a tumor was not found, the condition being chronic meningomyelitis. In four of this group, tumors were found later—three cases of varicose veins of the cord, two tuberculomas, two gummas, one echinococcus cyst and two cerebellospinal tumors. Root pain was present as a symptom in eight of the extradural group, in twenty of the intradural group, and in twenty-two of the intramedullary group. Of the group in which no tumor was found, pain was present in thirteen patients. This is evidence that pain is a very valuable symptom. During the past year we have explored and removed four tumors from patients who had no sensory loss and who presented a history of pain without any other symptoms, which is significant of pain being an important and valuable sign. When a patient complains of pain, which is aggravated by stooping, coughing, sneezing and when lying down, which is relieved by getting up and walking about, and not by usual remedies, when the pain is in the sciatic nerve, the possibility of cord tumor must be borne in mind.

Dr. Hugh T. Patrick, Chicago: Was any motor loss manifested in those cases in which there was no sensory loss?

Dr. Adson: No, there was no motor loss. One patient stated that for two months he did develop a little patch of anesthesia over the lumbar nerve, but he came primarily for pain and was at first treated for sciatica.

Dr. Patrick: I was surprised that Dr. Frazier's table showed only one case in which pain did not antedate motor loss. I have no statistics to present, but I feel quite sure that my cases show a fair proportion in which motor impairment came before pain. Possibly in interpreting just what pain

is, Dr. Frazier and I may have a little different attitude. Any patient who is spastic (and there are many patients with motor impairment who are spastic) will spontaneously make the statement that he has a pain in the back or between the shoulders or below the small of the back, which, like many other statements of patients with reference to pain, may be shown to be not pain at all in the proper sense; that is, these patients have a distressing sensation, and in their vocabulary a disagreeable or uncomfortable feeling is called pain. This sensation in spastic patients is frequently due to the spasticity—the muscular tension in the muscles of the back. In my opinion that is to be distinctly distinguished from anything like a root pain or pain due to any sort of nerve encroachment. Relative to multiple tumors of the spinal cord, which condition has been one of the disappointing and perplexing features of two of my cases, I should like to ask Dr. Frazier whether he has had tumors which were at first, microscopically and macroscopically, supposed to be the ordinary endothelioma, and later proved to be gliomatous. One patient was operated on with success. There was a recurrence, and we operated the second time with almost as brilliant a result. A third operation was done after recurrence of symptoms, but the surgeon reported that the cord had become infiltrated with a growth and no operation was possible. However, for a long time afterward the patient did very well under roentgen-ray therapy. Dr. Frazier informed me that his one patient who showed no pain at any time was another case in which I failed to make the diagnosis. Fortunately, however, she eventually consulted Dr. Frazier and Dr. Spiller, who did make a diagnosis. When I examined her she had absolutely no pain, as she informed me she had not subsequently. She had no sensory loss of any sort. She had a spastic paraplegia of moderate degree, was serologically negative, and the spinal fluid showed no indications of tumor. As most such cases in young persons (this was a relatively young woman) eventually turn out to be multiple sclerosis, I supposed she had that disease. I did not have the opportunity of following the case, and consequently had the discomfort of knowing that I had not diagnosed it properly. But I had the comfort of knowing that after operation she made a brilliant recovery.

Dr. Charles H. Frazier, Philadelphia: What Dr. Patrick said in regard to the possibilities of misinterpretation of the symptom of pain is very significant. No doubt there may have been cases in my series in which what we termed pain or what the patient thought was pain was not the pain of a root phenomenon. Yet, it is rather significant that the location of pain was found to be constant throughout the history of the case, and was always helpful in diagnosis. I do not think that Dr. Patrick ought to take himself to task for not having made an accurate diagnosis in the case to which he referred, and in which I subsequently operated. He saw the patient at a very early stage of the disease, while I saw her at a late stage, when there was an indefinite level of impairment. And I think it is only fair to Dr. Patrick to make this acknowledgment, that in this case I was unwilling to commit myself, and told the family of the patient the lesion might be of three possibilities: an intramedullary tumor, an extramedullary tumor or a myelitis. I was quite sure of the level of the lesion, but not of its nature. But since the symptoms were progressive and the patient totally disabled, we felt that an exploratory operation was justified. We found an extradural tumor, which was readily removed. Dr. Bliss has asked a pertinent question: Whether or not we have failed to find tumor in cases which presented a typical Brown-Séquard syndrome. I cannot answer this question as accurately

as I would like to do because I have not the details of all the cases in mind. However, I recall one case in which the symptoms of cord tumor, including the Brown-Séquard syndrome, were very definite, when we failed to find any evidence of tumor at the exploratory operation. The patient died about a year later, but unfortunately we were unable to secure a necropsy in that case. Most of the cases in which we failed to find a tumor, at the exploratory operation, are those in which there was not a definite level of sensory loss. Referring to the case cited by Dr. Grinker, I was surprised to hear that recovery of function had been deferred a year and a half after operation. When symptoms are due to pressure alone one would expect recovery of function to be rather prompt and rapid. When symptoms are due to degenerative changes, we would not anticipate recovery of function at any time. As to the relation of trauma to cord tumor, I have no knowledge. In one of the cases of this series there was a very definite history of trauma. However, no particular significance was attached to it. I think it is interesting to note that sometimes those who practice manipulative therapy help to make the diagnosis. There were two cases in our series in which great aggravation of symptoms followed immediately on the institution of such treatment.

THE MECHANICAL EFFECTS OF TUMORS OF THE SPINAL CORD

THEIR INFLUENCE ON SYMPTOMATOLOGY AND DIAGNOSIS *

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NEW YORK

In order to localize accurately a spinal cord tumor—and by "localization" we mean not only the diagnosis of the level of the new growth but also the exact relations of the growth to the cord—a definite classification of the position of such growths with reference to the surfaces of the spinal cord is necessary. We have, for many years, grouped our tumor cases in the following manner (Fig. 1, *A* and *B*).

All growths on the posterior aspect of the cord, whether in the median line or laterally, behind the posterior nerve roots, are classified as posterior growths; those that lie on the lateral aspect of the cord, in front of the posterior roots but behind the dentate ligament, we call

TABLE 1.—RELATION OF TUMORS TO THE SURFACES OF THE CORD (NOT INCLUDING THOSE BETWEEN THE ROOTS OF THE CAUDA EQUINA)

Location	Extramedullary	Extradural
Anterior and median	1	1
Anterior and lateral	5	4
Anterolateral	6	2
Posterior and median	1	0
Posterior and lateral	18	3
Posterolateral	8	3
Lateral and posterior	1	0
Lateral or around the cord	1	1
Totals	41	14

dorsolateral growths; those that lie laterally, in front of the dentate ligament but behind the anterior roots, we call ventrolateral growths; finally, those that lie on the anterior aspect of the cord, in the median line or more laterally but *in front* of the anterior roots, we call anterior or ventral growths. While tumors may occupy more than one of these locations, it is usually possible—excepting in tumors between the roots of the cauda equina—to place them in one of these categories. In our series of spinal cord tumors, 64 per cent. of the growths lay dorsally or dorsolaterally, and 36 per cent. were ventral or ventrolateral (Table 1 and Figure 2, *A* and *B*).

There are, therefore, a considerable number of patients with spinal cord tumors in whom the growth develops in a location away from the posterior spinal roots, and hence a comparatively large group of cases in which early posterior root irritation will not occur.

* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

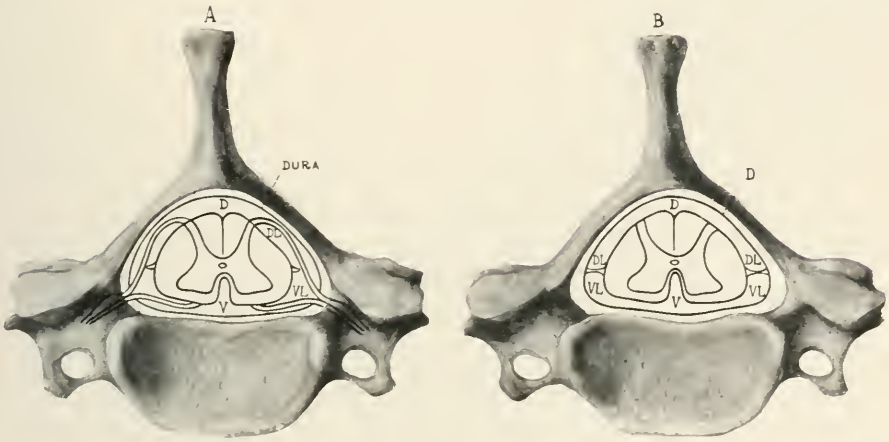

Fig. 1.—Diagrammatic classification of tumors in relation to the cord: *A*, at the level of a nerve root; *B*, at the level of a slip of the dentate ligament; *V*, ventral or anterior; *D*, dorsal or posterior; *VL*, ventrolateral or anterolateral; *DL*, dorsolateral or posterolateral.

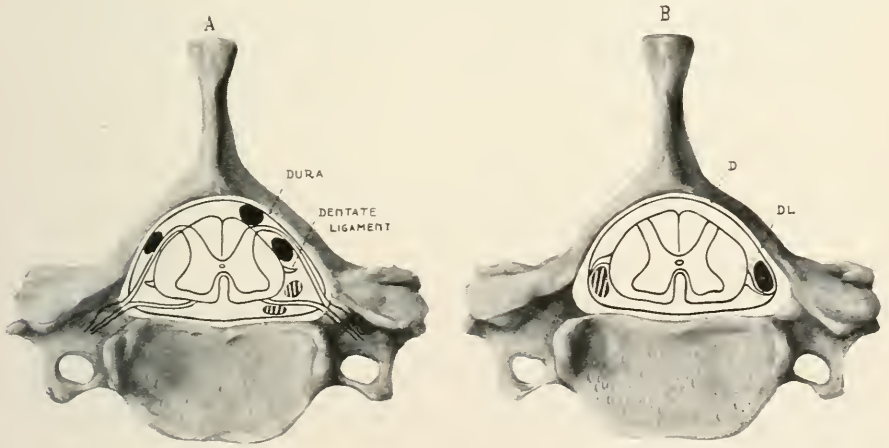

Fig. 2.—Diagrammatic representation of the frequency of tumors in the different locations. The dorsal and dorsolateral growths (in black) form 64 per cent. and the ventral and ventrolateral growths (in black and white) form 36 per cent of the tumors.

THE FREQUENCY OF SUBJECTIVE SENSORY DISTURBANCES

Many years ago, Pearce Bailey and others called attention to the fact that cases of spinal tumors may have a painless onset, and cases of this kind are not rare. A study of our series, however, showed that while pain is often absent there are very few patients who do not have some kind of sensory disturbance as an early symptom of the disease (Table 2).

Table 2 shows that paresthesias of one kind or another were very frequent in the extramedullary tumors in our series. Such paresthesias, especially if they occurred without pain, were formerly supposed to indicate disease within the substance of the spinal cord. The study of our cases, however, has led us to modify considerably our views on this subject. We have learned that in ventral and ventrolateral growths, subjective paresthesias are very frequent.

TABLE 2.—SENSORY SYMPTOMS AT ONSET

	Extra-medullary	Extra-dural	Conus and Cauda	Intra-medullary
Root pains	19	3	0	2
Pain in back or in neck	6	4	1	4
Pain in back, extending down limbs	1	2	7	0
Pain in homolateral limb below level	1	1	0	0
Pain in contralateral limb below level	2	1	0	0
Pain in both legs below level	2	0	2	0
Pain in rectum	1	0	1	0
Pain in chest or abdomen	2	2	0	1
Tingling, burning, heaviness, pin and needle sensation or numbness, homolateral limb below level	1	0	0	4
Tingling, burning, heaviness, pin and needle sensation or numbness, contralateral limb below level	5	0	0	0
Tingling or numbness, both lower limbs	3	0	0	2
Tingling without pain on same side	1	0	0	0
Tingling without pain on opposite side	2	0	0	0
Numbness or heaviness, no pain	1	1	0	0
Feeling of stiffness, no pain	1	0	0	0
No sensory symptoms	1	0	2	2

Table 2 shows that in a number of patients the first subjective sensory complaint was a tingling or burning in the lower limb of the opposite side. We were at first at some loss to explain this contralateral symptom. Five of six patients with ventrolateral growths had this contralateral tingling, and in several recent patients we have been able to localize correctly the tumor from this symptom.

Tumors that lie on the ventrolateral or the dorsolateral aspect of the cord are much more apt to give an early Brown-Séquard type of motor and sensory disturbance than tumors in other locations. If the disease began with root pains, the tumor usually lay dorsolaterally; if, on the other hand, early root pains did not occur, but there were early contralateral paresthesias, the growth usually lay on the ventrolateral aspect of the cord (Figs. 3, *A* and *B*).

Rarely, an extramedullary tumor may develop without causing any pain or any subjective or objective sensory disturbance for a long period.

These patients have, for many months and sometimes for years, a slowly progressing spastic paraplegia without any disturbance of cutaneous or deep sensation. We have seen two patients of this type, and in both of them the diagnosis of spinal compression was made only after a prolonged period of observation. In one of the patients, objective sensory disturbances appeared only after a lumbar puncture had been performed. In the second patient, no sensory disturbance could be detected for several years, although it was repeatedly looked for.

THE MOBILITY OF THE SPINAL CORD AND THE MECHANICAL EFFECTS OF CORD TUMORS

The mobility of the cord, at various levels, has a great influence on the symptoms and signs of an expanding lesion within the spinal canal.

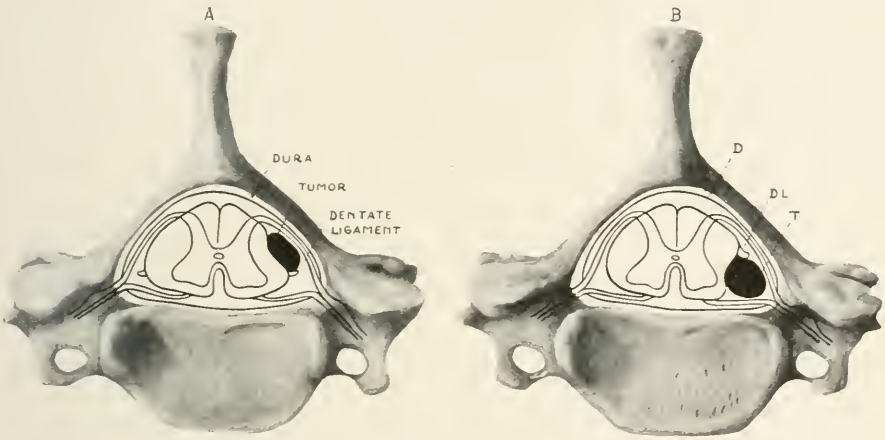

Fig. 3.—Diagrammatic representation of two types of tumor: *A*, tumor on the dorsolateral aspect, and *B*, tumor on the ventrolateral aspect of the cord, that are likely to give an early Brown-Séquard picture. Type *A* usually begins with root pains, Type *B*, often with contralateral parenthesias below the level.

Both from our anatomic investigations and from our observations on the operating table, it may be said that a cord segment is most movable in anteroposterior and lateral directions, at the level of each pair of spinal roots. Our attention was first called to this fact in a patient in whom we wrongly localized a growth on the posterior aspect of the cord on account of well marked posterior column disturbances. At the operation, the tumor was found and removed from the anterior surface of the cord. It had pushed the cord backward so that the posterior columns were pressed against the dura and posterior bony wall of the vertebral canal. There was, in this patient, a complete loss of vibratory and articular sensibility due to this compression of the posterior columns of the cord at the affected level against the bony wall of the spinal canal.

On account of the mobility of the cord, the dislocation of segments of the cord by the direct pressure of a soft tumor may, as in the instance we have cited, cause confusing sensory disturbances.

There is another type of cord dislocation, however, which is not due to direct tumor pressure and the physics of which is not at all clear to us. We first began to investigate this subject some years ago when one of us operated on a patient with an extradural tumor on the lateral aspect of the cord, in whom motor disturbances first occurred on the contralateral side of the body, and in whom, at the time of our first and of succeeding examinations, the most advanced motor disturbances were on the opposite side of the body and the most marked sensory loss on the same side as the tumor. This "reversed Brown-Séquard" syndrome could only be explained on the basis of a greater involvement of the lateral columns of the cord on the side opposite that on which the tumor lay, and an explanation for this condition had to be sought for in the mechanical changes that might be produced by a growing spinal cord tumor. In all, we have observed and operated on six patients with this "reversed" Brown-Séquard picture. Two of the patients had extradural growths, and in four the tumor was intradural but firmly adherent to the inner surface of the dura.

Although we are fully cognizant of the law of physics that in a fluid medium pressure is transmitted equally in all directions, we do not believe that this law can be made to apply fully to the conditions which exist within the spinal canal where there is a fluid medium—the cerebrospinal fluid—and a more solid structure—the spinal cord—which is partly held in place by nerve roots and by the dentate ligament. In addition, it is important to remember that the fluid medium which surrounds the cord is more or less in motion, and that, in general, there is a constant movement of fluid in a downward direction (caudad) on the posterior aspect, and upward (cephalad) on the anterior surface of the spinal cord.

Without attempting to solve the physics of the process, we believe that the following is the only possible explanation for the symptomatology in the six patients above referred to.

In Figure 4, *A* represents an extradural tumor on the left side of the dural sac in the earliest stages of its growth. When the growth has reached a certain size and before actual pressure on the cord by the tumor has occurred, the cord has changed its position and lies against the dura and the bony wall of the canal on the side opposite that of the tumor (Figure 4 *B*). The actual physical condition that now exists is this: The right side of the cord is in contact with a firm bony resistance, while the left side is more or less protected by a fluid water pad, which distributes the pressure over that side of the cord. At this stage,

and as a natural result, the right side of the cord is more involved, and symptoms referable to that side of the cord are more prominent.

A similar condition may obtain in the case of a growth which is firmly adherent to the inner surface of the dural sac and is not yet of large size (Fig. 5, *A* and *B*). If, on the other hand, the growth begins from the pia, or from the arachnoid which is bound to the pia by numerous fine trabeculae, the cord is pushed to the side opposite that of the tumor only by the tumor itself when it (the tumor) has reached a certain size (Fig. 6, *A*, *B* and *C*).

The conditions illustrated by Figures 4 and 5 will explain the contralateral symptoms that we have observed in six of our patients. We have, as a result, arrived at the conclusion that a spinal cord tumor

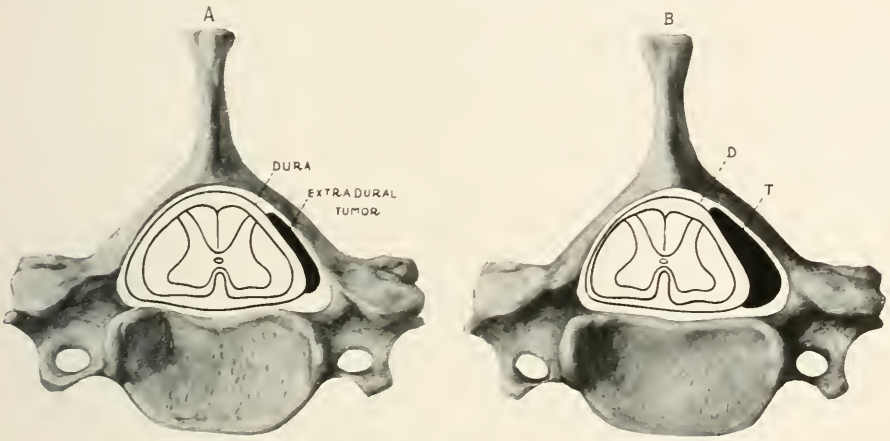

Fig. 4.—Diagrammatic representation of an extradural tumor on the left side of the cord: *A*, an early stage of its growth (to the right in the diagram); *B*, a later stage, when the cord has changed its position so that the right side is in contact with the dura and the bony resistance, while the left side is more or less protected by a water pad of fluid.

which begins with root pains on one side and motor disturbances on the opposite side of the body is probably an extradural or a dural growth.

THE INFLUENCE OF LUMBAR PUNCTURE ON THE SYMPTOMS AND SIGNS OF LOCAL SPINAL COMPRESSION

If the statements regarding the mechanical effects of extradural and of intradural tumors adherent to the dura are correct, then one should expect in these growths a marked influence on spinal cord symptoms after lumbar puncture and removal of the spinal fluid. This is actually the case. In ten of the patients of our series, the symptoms and signs of the spinal compression were aggravated after fluid had been withdrawn by lumbar puncture. Three of the patients had extradural

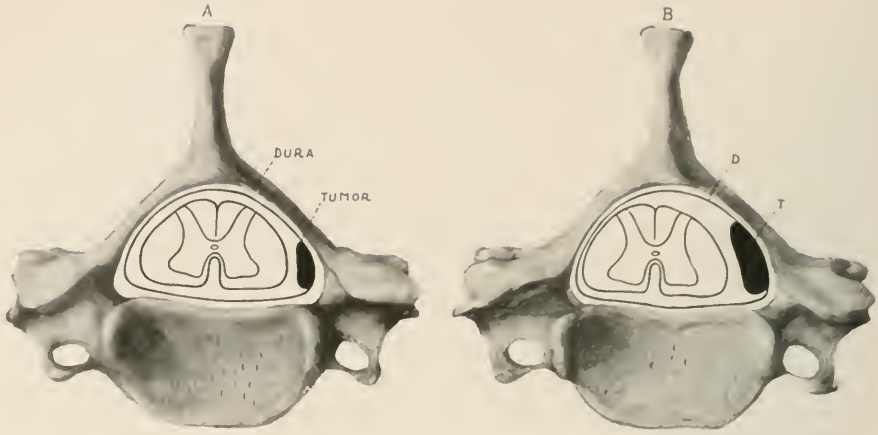

Fig. 5.—Diagrammatic representation of an intradural growth adherent to the dura. The movement of the cord to the right side of the canal (the left side on the diagram) is similar to that which occurs in extradural tumors. Compare with Figure 4.

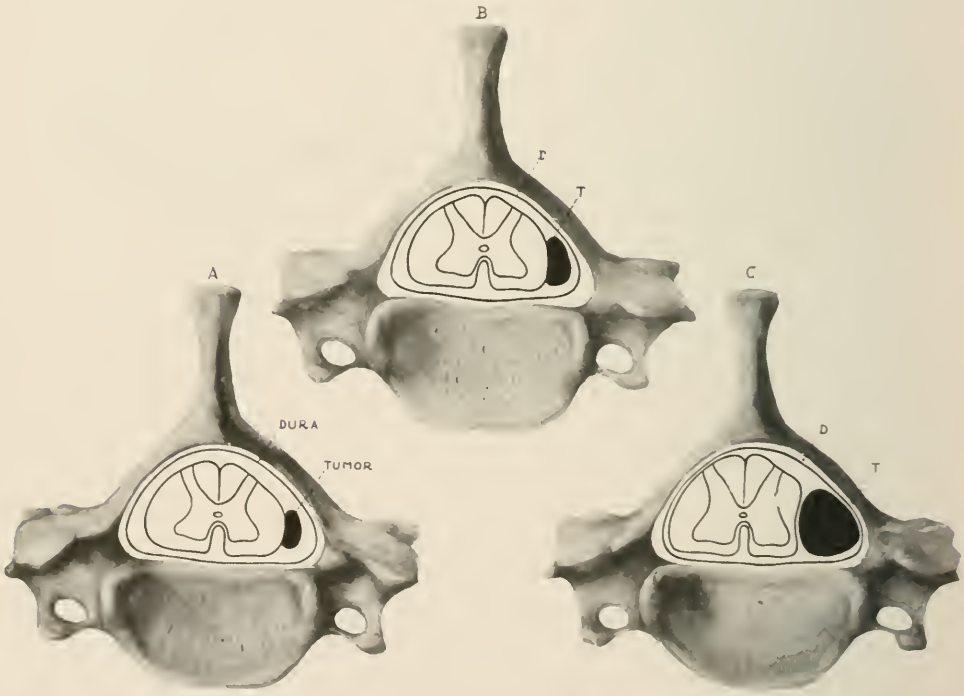

Fig. 6.—Diagrammatic representation of a tumor originating from the pia or arachnoid and adherent to the cord: *A*, *B* and *C*, different stages of growth, showing that the cord is pushed to the opposite side of the spinal canal only by the size of the growth; a different mechanism from that illustrated by Figures 4 and 5.

growths; in six, the growth was intradural but firmly adherent to the dura; in one patient, the record was incomplete. In some of the patients, the root pains became more severe after the lumbar puncture; in most of them, the neurologic signs became aggravated. Several patients who had had only moderately marked motor and sensory disturbances before the lumbar puncture became completely paralyzed soon after the withdrawal of fluid; and in one patient, already referred to, a loss of all sensation below the affected cord level developed within forty-eight hours of the puncture.

It is obvious that a growth adherent to the dura—either on its outer or its inner surface—which had not yet made much, if any, pressure on the cord itself, would exert a greater amount of pressure as soon as a certain amount of cerebrospinal fluid had been removed (Fig. 7). The

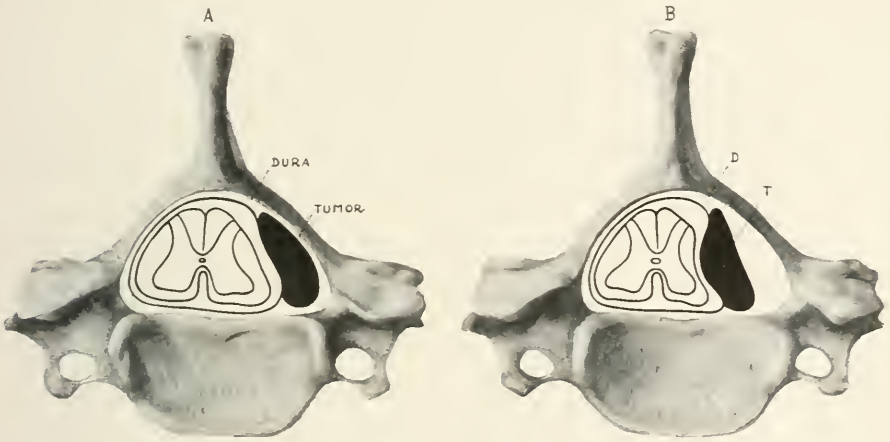

Fig. 7.—Diagrammatic representation of the change in position of an extradural tumor that may occur after lumbar puncture and withdrawal of fluid: *A*, before lumbar puncture, and *B*, after lumbar puncture.

condition would be entirely different in the case of most, or all, growths that were primarily attached to the pia or to the inner surface of the arachnoid, or were fixed against the cord by a slip of the dentate ligament or by a nerve root. In the latter instance, however, in spite of the trabeculae which unite the arachnoid to the pia, the withdrawal of spinal fluid by lumbar puncture might be followed, in the case of a small arachnoid growth, by an increase of preexisting symptoms and signs. In all our spinal tumor cases, we are now keeping careful records of any changes which may occur after lumbar puncture and we shall soon be in a position to state how frequently such changes occur and how often—if at all—they are observed in other than extradural or dural growths. From our experience thus far, however, we believe that if the symptoms and signs of motor and sensory disturbance become more

marked after a lumbar puncture with removal of fluid, the diagnosis that the growth is extradural or intradural, adherent to the inner surface of that membrane, is justified.

THE FREQUENCY OF TENDERNESS OF THE SPINES OF THE VERTEBRAE IN EXTRAMEDULLARY TUMORS AND THE LOCATION OF THE TENDER SPINOUS PROCESSES IN SPINAL TUMORS AND IN MALIGNANT DISEASE OF THE VERTEBRAE

As regards the presence or absence of tenderness of the spinous processes of the vertebrae in spinal tumors, our records are, unfortunately, not complete. In some of the patients, there was no record

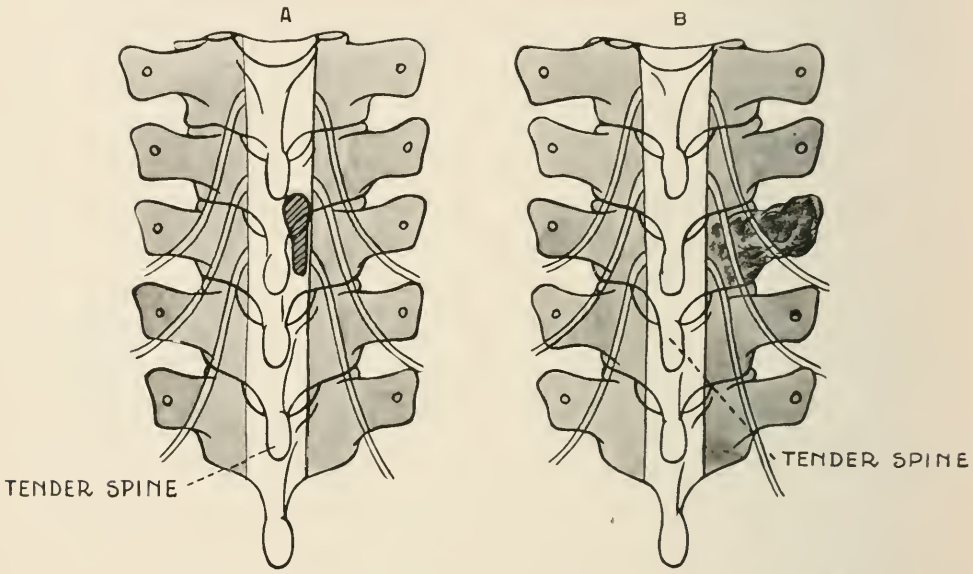

Fig. 8.—Diagrammatic representation of location of tender spine: *A*, the spinous process that is usually tender in an extramedullary tumor; *B*, the spinous process that is tender in malignant disease of the bone.

at all; in others, it was recorded that there was no tenderness. In twenty-four of fifty-two intradural extramedullary growths, one or more spinous processes were noted as tender. Of four patients with large tumors in the upper cervical cord, all of the cervical spines were tender in three; in one patient with a tumor at the second and third cervical segments, the second, third and fourth cervical spines were sensitive. In the large tumors which involve the conus and roots of the cauda equina and which usually filled up the lower end of the spinal canal, most, or all, of the lumbar and often the sacral spines were tender to pressure. In most of the patients with tumors of the thoracic or

lumbar cord, the spinous process that was tender actually corresponded to the segment affected, but not to the level of that segment. For example, with a tumor at the sixth thoracic segment, the sixth thoracic spine was tender, and with a growth at the twelfth thoracic segment it was the twelfth thoracic spinous process which was sensitive to pressure. In other words, in extramedullary intradural tumors, if any spinous process is tender, it is the one which receives its nerve supply from the posterior spinal root of the affected segment of the cord, and the tenderness is probably due to irritation of that sensory root by the manipulation of the spinous process. It is, of course, the posterior root which lies in proximity to, or is actually involved by, the tumor.

The location of the tender spines with reference to the level of the cord lesion is entirely different in malignant disease of the bony spine. In these patients, as we have often observed, the tenderness of the spine corresponds to the actual affected vertebra and is a real bone tenderness from the osseous lesion. This difference between the location of the tender spines in true spinal tumors, as compared with bone disease, is of considerable value for the differentiation between these two diseases. In spinal tumors, the sensitive spine is one, two or even three lower than the spine which is at the actual level of the affected cord segment; in bone disease, on the other hand, the sensitive spine is on the actual level with the affected cord segment (Fig. 8, *A* and *B*).

CONCLUSIONS

1. Tumors on the anterior and anterolateral aspects of the spinal cord are relatively frequent and form about one third of all cases.

2. Although many patients with spinal cord tumors have no pain at the onset, the large majority have some subjective sensory disturbance as an early symptom.

3. In some patients, objective sensory disturbances are absent for a long period and only appear after a lumbar puncture has been performed.

4. Tingling, coldness, burning and other paresthesias are not rare in extramedullary growths.

5. If the tingling occurs in the contralateral limb, below the level of the growth, there is considerable probability that the tumor lies on the ventrolateral aspect of the cord.

6. Intradural tumors adherent to the dura and extradural growths not infrequently press the cord to the opposite side of the spinal canal and cause early motor symptoms on the side of the body opposite that of the tumor.

7. If the signs of motor and sensory disturbances become aggravated after lumbar puncture and withdrawal of fluid, it is probable that the growth is either extradural or intradural, and adherent to the inner surface of the dural membrane.

8. Tenderness of a spinous process at the vertebral level of the lesion points to bone disease; tenderness of spines well below the vertebral level of the growth points to an intradural extramedullary tumor.

DISCUSSION

Dr. Hugh T. Patrick, Chicago: I should like to ask Dr. Elsberg about this tender area three spines below the level of the tumor; whether that applies to all levels, and how this tenderness has been elicited in his technic; whether by light percussion or by heavy percussion with the fist, or by pressure direct or lateral; whether, as his diagram indicated, this, occurring in the dorsal region where the spines descend a considerable distance below their bodies, the tender spine might really be from the vertebral body opposite the tumor

Dr. William G. Spiller, Philadelphia: The difficulty of diagnosis in some of these cases of tumor is extremely great. Where symptoms of root pain and loss of objective sensation in root or segment distribution are present, it may be only for temperature or pain bilaterally or unilaterally, with other symptoms, the diagnosis is comparatively easy.

I am quite in accord with Dr. Elsberg's view that in the absence of pain there is frequently paresthesia of limited or of root distribution, which may be of quite as much value clinically as the presence of severe pain in root distribution.

Dr. Elsberg did not explain the mechanism for his statement that a unilateral growth may produce paresthesia on the opposite side of the body. It is a question whether this is caused by the pressure on the cord by the tumor on the anterolateral column of the side where the tumor is, or is produced by the contralateral pressure on the posterior roots when the paresthesia is in root distribution. Where pain is bilateral from the beginning it seems to be indicative of a centrally situated tumor on the posterior part of the cord, irritating the posterior roots of both sides. Recently in a case in which I made the diagnosis of a central posterior tumor, at operation Dr. Frazier found the neoplasm located directly over the posterior part of the cord.

I have thought that extradural tumors may be less painful than intradural lesions. In two extradural growths that were removed recently by Dr. Frazier, there was a process which seemed to grow down into an intervertebral foramen. I am inclined to believe that these tumors originated probably from a spinal root and grew from and not into the intervertebral foramen, within the vertebral column where the resistance was less.

Pain and atrophy confined to a limb are extremely suggestive of tumor, and yet without other findings they may be most misleading and cause the greatest difficulty in localization. I recall a patient who developed severe pain and atrophy in the upper limb of one side, which I thought might have been caused by brachial neuritis or tumor. I could find no evidence of pressure on the cord and there was no involvement of the lower limb on the same or the opposite side and no sensory disturbances on the lower part of the body.

The patient recovered, the condition probably having been caused by neuritis of the brachial plexus. However, in two other cases in which a similar con-

dition existed, with one of which Dr. Strauss is familiar, it was a question whether the lesion was an extradural or an intradural tumor. In such cases the roentgen-ray examination should be of the greatest value, but the plates were not correctly interpreted at first and it was not until later that they showed the presence of an extradural tumor.

In cases of suspected tumor of the cord in which there are no valuable roentgenologic findings and no evidence of pressure on the cord, even though there may be some focal symptoms, as in the upper limb, it has seemed wiser to wait until we obtain evidence of pressure on the cord or roentgen-ray findings of diagnostic value. In such a case, while it is unfortunate to wait while the tumor may be growing, nevertheless it is also unfortunate to operate too soon.

Where there is complete paralysis or complete loss of sensation of several months' duration in the lower part of the body, we should not be pessimistic for I have seen such a condition disappear entirely after the removal of a tumor on the cord.

The most difficult diagnosis possibly is between tumor and focal myelitis or syringomyelia.

I should like to ask Dr. Elsberg whether the tenderness of the spine to which he referred might not have been caused by irritation of the roots at their exit from the vertebral column.

Dr. Morton Prince, Boston: According to Dr. Elsberg's diagram, his theory is that the extradural tumor presses on the fluid, and that the fluid transmitting the pressure to the cord shoves the latter across to the other side of the canal against the bony wall, with resulting contralateral pressure and contralateral symptoms. It seems to me, unless my knowledge of physics is incorrect, that such an action is an impossibility. As fluid transmits pressure equally in all directions, the pressure from the fluid should be equal all around the cord, from the opposite sides as well as from the side of the tumor. If this is true, the cord should remain suspended equally between the tumor and the opposite bony wall. If the cord were shoved across, it must have been by direct pressure of the tumor on it, and the symptoms should have corresponded.

Dr. Smith Ely Jelliffe, New York: Two series of observations concerning the possible aid that may be offered in the diagnosis of spinal cord tumors deal with alterations of the pilomotor reflexes and with the development of osteo-arthropathies about the joints and bony shafts. The studies, particularly of André Thomas[1] of the pilomotor, sudoral and local muscle reflexes throw much light on spinal cord localization problems, and the observations of Mme. Déjerine and Ceillier[2] on the osteo-arthropathies associated with spinal cord lesions are also of great interest. In two recently observed spinal cord tumors these newer findings were of value in accurate localization.

Dr. M. Allen Starr, New York: I should like to ask Dr. Elsberg whether in these diagrams the relation shown between the size of the cord and the size of the canal is anatomic or theoretical?

Dr. Elsberg, in closing: In the lantern slides that I have shown, the relation between the size of the canal and the size of the cord is neither anatomically nor theoretically correct. It is purely diagrammatic.

In reply to Dr. Patrick's question, the tenderness of the spines below the vertebral level of the disease is not the same at all levels. It is greater in the lower thoracic region than in the upper thoracic or in the cervical regions.

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1. Thomas, André: Le reflexe Pilomoteur, Paris, Masson et Cie, 1922.

2. Ceillier, A.: Para-osteo-arthropathies des paraplegiques, Paris, 1920. Ceillier and Mme. Déjerine: Rev. neurol. 1918, pp. 159, 207, 348; 1919, p. 399.

This is quite different from what occurs in malignant disease of the bone, where the tender spine corresponds to the vertebrae involved, but not to the segment level of the disease. For these reasons we have concluded that the cause of the tenderness of the spinous processes was different in the two affections. In the one it is a nerve root tenderness, the spine being sensitive because it is the one supplied by the affected nerve root or from the affected segment, a true bone tenderness being present. We have kept careful records of this tenderness and on going over them we found the surprising fact which I have described. In several instances we have been able to verify the correctness of our conclusions.

I do not know whether the contralateral tingling and paresthesia about which Dr. Spiller spoke are due to direct pressure on the spinothalamic tracts on the same side or to pressure from the other side. The mechanism is not clear to me and I have only recorded the facts as we obtained them from the study of our records.

In answer to Dr. Prince, I do not understand the physics of the process; theoretically, however, Dr. Prince is correct. I attempted to gain information on this subject from several physicists, but I received unsatisfactory replies. While they all said that the law of physics, as mentioned by Dr. Prince, would hold good, they added that it was perfectly possible with a movable fluid which protected the cord on all sides for the cord to move to the other side of the canal. The condition obtained that on one side of the cord was the resistance of bony wall, while on the other side was a water pad which was protecting the cord. Therefore, it would be possible to have symptoms from the pressure of the cord on the bony resistance.

SHALL WE DECOMPRESS FOR CHOKED DISK?*

B. SACHS, M.D.

NEW YORK

The importance of choked disk as a sign of intracranial disease is all the greater because in many instances it appears early, and in many others the diagnosis is uncertain until this sign does appear. Taken by itself, it is alarming, and the impulse among neurologists and neurosurgeons to do something in order to avert impending blindness is natural and excusable.

During the last twenty-nine years I have been in charge of a very active neurologic service, and during this period brain tumors and allied conditions have had my serious attention. If the tumor (a cyst, neoplasm or abscess) could be reached, a direct attack on the lesion was planned. Not infrequently the growth or abscess could not be localized accurately, but the choked disk, with the fear of impending amaurosis, had to be considered. Decompression was advised and performed many times in the hope of averting blindness, which was almost certain to set in long before the patient's life was in danger. Of late years I have had less and less faith in the efficacy of decompression. Personal impressions of many years had led to a firm belief that often decompression, pure and simple, did not effect what it promised. One neurosurgeon said that he would not perform a decompression for pontile tumors. Then I queried, Is it ever worth while?

So I requested one of my adjuncts, Dr. Wechsler, to whom the records on brain tumor had been entrusted for special study, to analyze these records with reference to decompression operations. One hundred and forty cases of brain tumor from the neurologic and neurosurgical clinics were studied. Many cases were excluded because of unsatisfactory or complicating conditions. Of these 140 cases, forty-five (32 per cent.) were completely unlocalized. Ninety-five (68 per cent.) during the period of examination were localized. Incidentally it may be of interest to note the occurrence or nonoccurrence of choked disk in relation to the site of the tumor.

The table shows that of nineteen cases of cerebellar tumor, choked disk was present in seventeen, and absent in only two. In tumors of the hypophysis, it was present in three and absent in twelve. In frontal lobe tumor it was present nine times and absent four times, whereas in temperosphenoidal tumors it was absent in one case and present in nine; and of eight angle tumors, it was present four times

* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922

and absent four times. Taking the entire list of ninety-five localized tumors, choked disk was present in sixty-four cases and absent in thirty-one.

The large percentage of nonlocalized tumors shows that large growths may develop in a silent area and not cause a single localizing sign until the growth invades a more distant part of the brain. This is particularly true of all frontal tumors. The psychic phenomena, the olfactory disturbances, the special forms of ataxia associated with frontal lobe neoplasms, often leave one in the lurch, and sensitiveness to percussion is not infrequently misleading. But when there is invasion of the parietal areas the symptoms become definite. As a result of this, the diagnosis of parietal tumor is sometimes made when the growth originates elsewhere.

Choked Disk in Various Intracranial Tumors

Site	Number of Cases	Choked Disk	No Choked Disk
Cerebellum	19	17	2
Hypophysis	15	3	12
Frontal lobe	13	9	4
Temperosphenoidal	10	9	1
Cerebello-pontile angle	8	4	4
Posterior fossa	4	3	1
Parieto-occipital	6	4	2
Right hemisphere	7	5	2
Left hemisphere	5	4	1
Third ventricle	2	2	..
Fourth ventricle	2	2	..
Lateral ventricle	1	1	..
Pontile	2	..	2
Pineal	1	1	..
Total	95	64	31

This very uncertainty as to the initial site of the tumor and the still greater uncertainty as to the extent of the growth, in many instances render the neurosurgical problem a most perplexing one. Though the localizing signs may be absent, the general symptoms, and above all, the choked disk demand attention.

In a series of thirty-eight cases decompression was performed for the relief of this special condition. In seven of these cases the site of the tumor remained wholly unknown. Of these thirty-eight cases, which were retained in the hospital and studied long enough to judge of the results, twenty-nine showed no recession. In four cases there was distinct improvement, so that the operation may have been considered satisfactory. Five showed slight recession. In five of the twenty-nine cases which showed no recession, optic atrophy resulted. In others, optic atrophy may have developed at later periods. There

may be some satisfaction if any vision is retained, but it does not prove that decompression promotes recession of choked disk.

Under these circumstances, there would appear to be strong corroboration of the impression that decompression operations, pure and simple, promise little—and let me say that it seems to matter little whether the decompression be of the ordinary subtemporal or suboccipital type—the suboccipital site having been chosen naturally when there was a suspicion of a cerebellar or cerebellopontile angle tumor. One is tempted to ask whether decompression operations really decompress, and whether or not in the presence of a large neoplasm intracranial conditions are improved by this dislocation of the intracranial contents.

Roentgen-ray studies frequently show enormous distortion of the ventricles in the presence of brain tumor; and no doubt intraventricular pressure has some, if not a great, effect on the development of choked disk. Does the opening in the skull and the dura better these ventricular conditions?

If we are not able as yet to answer these questions, we must at least give the facts due consideration. That decompression does in some instances bring about a favorable change in the intracranial relations is evident from the improvement that has been witnessed in many instances, so far as the intense headaches are concerned; and for the relief of this often distressing condition operative procedures are to be urged.

There is one other thought to which I wish to give expression. Those of us who are likely to be somewhat conservative are told that we should not have waited until the appearance of choked disk; that the patient had a better chance if operated on early. Were the results of brain tumor removal more satisfactory, I would be heartily in sympathy with this view. Once the choked disk has appeared, it may be asserted that the tumor is already of considerable size and difficult of removal. It is so often a question of weighing the great risk of operation against the uncertainties of diagnosis.

To make matters still more perplexing, choked disk does not necessarily indicate the presence of a neoplasm, especially in these days of encephalitic lesions; moreover, choked disk does sometimes recede spontaneously and recovery from this condition may ensue without surgical interference. Only recently I had a vivid experience of this kind with a boy, 9 years of age, who presented many of the symptoms of a cerebellar neoplasm, such as weakness of the right rectus externus, nystagmoid movements, slight right facial paralysis, adiadokokinesis of the left side, diminished knee reflexes and Achilles' jerks, slight rigidity of the neck, diminished hearing on the left side and a tendency to fall to the left. With these symptoms was associated bilateral papilledema of 5 diopters. The otologist, as well as the ophthalmologist who

examined him, felt that all the signs pointed to marked increase of intracranial pressure. There was no rise of temperature, the blood and spinal fluid Wassermann reactions were negative, the spinal fluid was under pressure and contained only one lymphocyte. My own conclusion, after a careful examination, was that while the symptoms pointed to cerebellar involvement, the findings were so unusual that it would be well to defer surgical interference until a satisfactory explanation could be found. The boy was in the hospital from Feb. 19, 1922, to March 13, 1922. On March 20, the eyes were examined by one of the capable ophthalmologists, Dr. Schlivek, who found an elevation of only 3 diopters; but he added that "in the macula of the right eye there is a beginning stellate figure. This indicates an old condition." After three weeks, the same oculist reported that "the eyes show evidence that the choked disk is receding; the elevation in the right is 1 diopter, in the left 2 diopters."

What the final diagnosis will be in this case I am not yet willing to state. The point that I wish to emphasize is that in some of these cases the choked disk may recede and go on to spontaneous recovery.

COMMENT

My own view is that the ordinary decompression operation, whether subtemporal or suboccipital, promises little for the relief of choked disk; in twenty-nine out of thirty-eight of our cases it was practically time and labor wasted. Instead of performing this operation, every effort should be made to attack the tumor itself and to remove the neoplasm, provided the patient's life can be spared.

I suspect that in many instances, the decompression operation has discouraged the patient, has made a further operation objectionable, and has often lessened the ardor of the surgeon to get at the growth itself. If we are to go on with the decompression operation, for the relief of symptoms only, it must be made a harmless procedure; harmless as to life and harmless so far as the later successful removal of the brain tumor is concerned.

DISCUSSION

Dr. Hugh T. Patrick, Chicago: I think that a vital point has been omitted in Dr. Sachs' report; namely, the state of vision. Whether one operates for choked disk should depend to a certain extent on the visual acuity of the patient. In many cases optic atrophy has begun and advanced considerably before any material recession in the choked disk.

Dr. Ernest Sachs, St. Louis: The point that Dr. Patrick made is an important one: that if you operate when optic atrophy is developing decompression may not aid at all.

In the cases that Dr. Sachs has cited, it has been a common experience to find that choked disk rarely is present in pituitary tumors, and in some of the other groups of cases, of which he spoke, a similar thing has been known.

In his book, Dr. Cushing has emphasized the fact that in acoustic tumors, until the cerebrospinal circulation is interfered with, often there may not be any choked disk. My experience is absolutely at variance with the figures that Dr. Sachs has given. If decompression is performed at the proper place and while the vision is still fairly good, the choked disk definitely subsides in many instances, and vision is improved and retained.

I do not want to give the impression that I advocate decompression if there is any possibility of removing the tumor. I perform fewer decompressions now than I did several years ago, but I cannot agree with Dr. Sachs' statement that decompression does not make a choked disk subside if it is performed at the proper place and before optic atrophy is too far advanced.

Dr. Harvey Cushing, Boston: I think that Dr. Sachs is justified in his interpretation of his own experience. There are many different ways of doing decompression operations and different things that one may expect from them. It is purely a palliative measure and not a "cure all." Nor does it always accomplish its purpose, but it saves a great deal of suffering, and saves vision in a great many cases for a short time; and that is about as much as can be expected of it.

I am sure all those who have had much neurosurgical experience have seen many cases in which discomfort has been lessened and vision improved. If we could accomplish this with a drug it would seem miraculous. Our methods of tumor localization are improving greatly. We hope ventricular radiography will give us additional aid. Consequently, we resort less often than formerly to simple palliative measures. I shall give an example of relief obtained by palliation. A naval cadet was referred to me last year by Dr. Wilmer with a rapidly advancing choked disk of about 6 diopters, which threatened loss of vision. Localizing symptoms were inconspicuous, but they suggested a cerebellar lesion. A suboccipital exploration was performed, but no lesion was found. The patient made an immediate recovery; the choked disk subsided accompanied by normal vision, and all other symptoms disappeared. Our conclusion was that we had made a mistake in diagnosis, and the case was recorded as a "tumor suspect," probably chronic arachnoiditis. Possibly a ventriculogram might have shown a tumor, but I have grave doubts of this.

The young man returned to the Academy and later was sent to sea on active duty, remaining free of symptoms. However, several months later, while exercising in the gymnasium in Annapolis, he had a return of symptoms. He was sent to Baltimore for further operation. Dr. Dandy reexplored and found a cerebellar glioma, which he attempted to remove in its entirety, without success. If I had been able to identify the tumor at the first session I might have successfully removed it by a lobectomy, but I found no evidence of a growth and would not have been justified in exploring for it, and if I had done so, the young man would not have enjoyed the long period of relief afforded by the decompression alone.

A subtemporal decompression would not have accomplished this result, and I am not sure from what Dr. Sachs has said that he appreciates that in the presence of an internal hydrocephalus a subtemporal decompression is not of much value. But it is true that decompressive measures are being used less often as our ability to localize tumors improves.

Dr. Sachs, in closing: This method has not advanced very far because Dr. Cushing has acknowledged that less decompression is being performed. If the diagnostic ability is developed to a greater extent, less time will be spent on decompression operation for the relief of choked disk. Decompression is never advised if there is the slightest suspicion of atrophy of the optic nerve.

RESULTS OF THE REMOVAL OF TUMORS OF THE SPINAL CORD*

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Results following the surgical treatment of tumors of the spinal cord depend on the duration of symptoms and on the position, level and type of tumor. The histories vary but are suggestive and give the first clue to the diagnosis. The onset of symptoms is gradual; sensory disturbance is usually the first, that is, paresthesia or anesthesia, accompanied by motor disturbances. The condition may improve temporarily; but the symptoms gradually progress to a loss of sensibility and motor function, in conjunction with exaggerated reflexes below the cord segment involved.

About thirty-five years have elapsed since the first tumor of the spinal cord was removed by Horsley. During this short time, many tumors of the spinal cord have been removed; but many have also been overlooked because a definite level of loss of motor power and sensibility was not present or the exact history of motor or sensory loss that was expected was not given.

In our experience, pain in the spine while the patient is lying down, exaggerated by coughing, sneezing, jarring and bending, and often relieved by getting up and walking around, is an early symptom of intradural extramedullary tumor, generally situated in the vicinity of the cauda equina. If pain persists along the sciatic nerves for years without yielding to treatment for sciatica, the possibility of tumor of the cord must be considered. In 1921, we removed four tumors of the spinal cord from patients who complained of very little except the pain herein described.

Spinal puncture is of value in the diagnosis, inasmuch as the presence of yellow fluid, that is, fluid containing xanthochromia, helps to confirm the diagnosis of tumor of the spinal cord. However, it does not differentiate extramedullary and intramedullary tumors. A dry tap in the fourth lumbar space, while fluid is obtained at a higher level, is also of value. The cisterna magna puncture in conjunction with spinal puncture is a valuable aid in confirming the presence or absence of obstruction in the canal, which most often is due to tumor of the spinal cord.

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* From the Section on Neurologic Surgery, Mayo Clinic.

* Read before the Section on Surgery, General and Abdominal, at the Seventy-Third Annual Session of the American Medical Association, St. Louis, May, 1922.

The rate of progress depends on the position and type of the tumor. Soft neoplasms and neoplasms of the intramedullary type usually progress slowly, while hard, encapsulated tumors produce considerable pressure and cause marked paralysis in a few months, the damage to the cord being much more permanent than that caused by soft tumors. Tumors pressing the cord dorsally cause sensory disturbances before

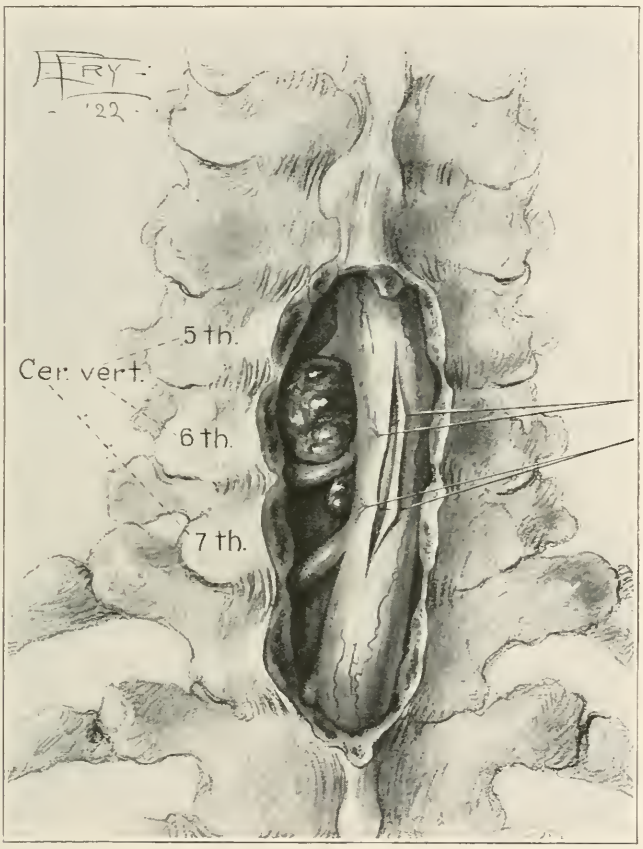

Fig. 1.—Fibrochondroma situated anterolaterally to the cervical cord. This illustration and Figures 2, 3 and 4 represent extradural tumors of the spinal cord.

motor; those situated laterally or anteriorly are more likely to produce Brown-Séquard's syndrome, with motor disturbances before sensory. Tumors of the cervical and dorsal cord cause symptoms earlier than those of the lumbar cord; those arising from the vertebrae or from the meninges, extradural or intradural but extramedullary, produce pressure on the cord without invading it, while those arising within the cord

itself produce destruction of the medullary portion and later destruction of the medullated fibers. Tumors of the spinal cord may occur in any part of the spinal canal or spinal cord; most occur in the thoracic region, fewer in the cervicodorsal, and fewer still in the dorsolumbar.

TYPE OF TUMOR

The character of tumors of the spinal cord depends directly on their origin; those arising from the vertebrae and from the tissues of the spinal canal are bony, cartilaginous or fascial; those arising from the

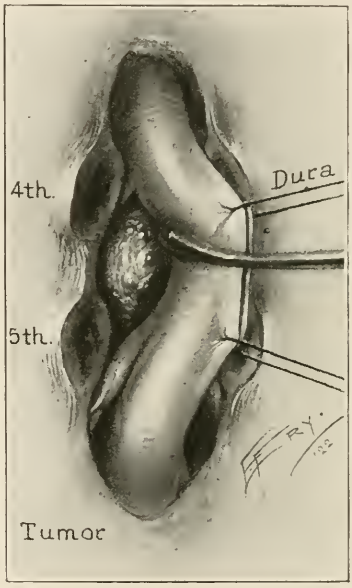

Fig. 2.—Fibrochondroma situated anteriorly to the cord, opposite the fourth and fifth lumbar vertebrae.

meninges are endotheliomas, fibromas, psammomas, and so forth. Such tumors, as a rule, are not very large, are slow growing, and are rarely malignant; their early removal favors ultimate cure.

Tumors of the cord itself are usually gliomatous, and arise around the central canal; some degenerate and become cystic, others remain firm and solid. Ependymal gliomas arise from the conus and extend downward through the canal of the lumbar region, and occasionally to the sacral region. Most ependymal gliomas in the lumbosacral region are encapsulated and not adherent to the lumbosacral roots, but may be situated between them and fill the spinal canal.

TABLE 1.—Findings in Lesions of the Spinal Cord

	Patients	Males	Females	Average Age, Years	Oldest, Years	Youngest, Years	Duration of Symptoms: Average, Months	Duration of Symptoms: Shortest, Months	Duration of Symptoms: Longest, Months	Presence of Root Pain: Patients	Presence of Root Pain: Per Cent.
Tumors: Extradural	14	10	4	42.5	64	16	28	1	132	8	57
Intradural but extramedullary	30	16	14	44.5	61	20	45	2	168	20	66
Intramedullary	31	19	12	44.0	63	12	45	4	156	22	71
No tumor found; meningomyelitis (?)	27	14	13	33.0	50	16	40	3	156	13	54
Varicose veins	3	2	1	27.0	30	22	79	10	204	1	33
Echinococcus cyst	1	..	1	44.0	..	..	7	..	...	1	100
Tuberculoma	2	..	2	45.0	59	32	15	12	18	1	50
Gumma	2	2	..	29.0	34	25	29	25	34	2	100
Cerebellospinal tumors	2	1	1	25.0	48	2.5	25	2	48	..	..
Total	112	61	48								

TABLE 2.—Findings in Lesions of the Spinal Cord

		Paralysis: Motor			Paralysis: Sensory			Paralysis: Bladder			Paralysis: Rectal			Spinal Fluid Findings				
	Patients	Absent	Partial	Complete	Absent	Partial	Complete	Absent	Partial	Complete	Absent	Partial	Complete	Spinal Punctures	Dry Tap	Xanthochromia	Nonne Positive	Average Cell Count
Tumors: Extradural	14	3	4	7	2	6	6	4	4	6	4	4	6	11	1	1	6	6
Intradural but extramedullary	30	3	18	9	3	17	10	4	15	11	4	15	11	21	..	5	11	3
Intramedullary	31	..	24	7	..	22	9	7	14	10	7	9	15	23	1	7	12	5
No tumor found; meningomyelitis(?)	27	..	23	4	1	18	8	3	21	3	2	20	5	18	..	..	3	4
Varicose veins	3	..	3	..	..	3	..	..	3	..	..	3	..	1	..	..	..	5
Echinococcus cyst	1	..	1	..	..	1	..	..	1	..	..	1	..	1	..	..	..	1
Tuberculoma	2	..	1	1	..	1	1	..	1	1	..	1	1	1	..	..	..	2
Gumma	2	..	..	2	..	..	2	..	..	2	..	..	2	2	..	..	..	1
Cerebellospinal tumors	2	1	1	..	2	..	..	2	..	..	2	..	..	1	..	..	1	1
Total	112	7	75	30	8	68	36	20	59	33	19	53	40	89	2	13	33	

MAYO CLINIC SERIES

The records of the Mayo Clinic from January, 1910, to April, 1922, show that 112 patients were operated on for tumor of the spinal cord. Fifteen laminectomies were performed from 1910 to 1916, in six of which tumors were not found. From 1916 to April 1, 1922, ninety-seven patients were operated on for tumor of the cord, in seventy-six of which neoplasms were found; in twenty-one the findings were negative except for inflammatory processes. In four of the twenty-one, later examination revealed the presence of tumors; two of these were intradural but extramedullary, and above the level explored; both were verified at necropsy. One of the patients had two endotheliomatous tumors, about 15 cm. apart. Two had developed huge tumors, arising

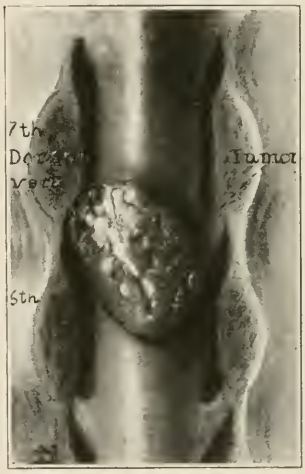

Fig. 3.—Angioneuroma situated dorsally to the spinal cord, opposite the sixth dorsal vertebra.

from the sacrum, posterior to the rectum; these were not palpable by rectal examination before laminectomy. Sixty-four of the patients were men and forty-eight were women. For detailed study, we have divided the patients into nine groups.

Group 1 consists of fourteen patients with extradural tumors.

Group 2 consists of thirty patients with intradural but extramedullary tumors.

Group 3 is composed of thirty-one patients with intramedullary tumors.

Group 4 consists of twenty-seven patients in whom no tumor was found. A few had chronic meningomyelitis, and in four tumors were found at a later date.

TABLE 3.—Findings in Lesions of the Spinal Cord

	Patients	Level of Tumors: Cervical	Dorsal	Lumbar	Sacral	Tumors Removed	Type of Tumor Removed: Lipoma	Fibroma	Angioneuroma	Neurofibrosarcoma	Fibrochondroma	Glioma	Hemangioma	Psammoma	Neurofibroma	Endothelioma	Echinococcus Cyst	Inflammatory Tumor	Tumors Partially Removed	Type of Tumor Partially Removed: Gliosarcoma	Neurofibroma	Sarcoma	Degenerating Neoplasm	Glioma	Endothelioma	Inflammatory Tumor	Exploration
Tumors: Extradural	11	3	8	3	..	10	2	1	1	2	4	..	..	..	..	3	..	..	4	2	..	1	1	..	..	..	..
Intradural but extramedullary	30	7	19	3	1	29	..	3	..	..	..	..	1	12	7	3	..	1	..	..	..	..	..	..	..	..	1
Intramedullary	31	6	25	..	..	3	..	..	..	..	..	2	..	..	..	1	..	..	18	..	..	1	1	2	13	..	1	10
No tumor found; meningomyelitis (?)*	27	..	24	..	24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Varicose veins	3	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
Echinococcus cyst	1	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Tuberculoma	2	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	1	1	..	2	..
Gumma	2	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cerebellospinal tumors	2	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	2
Total	112	18	59	9	3	43	..	..	..	..	..	..	..	..	..	..	..	..	26	..	..	..	..	..	..	..	..	16

* Four tumors were found at a later date, two were endotheliomas and two Mitteldorph tumors.
† Found at necropsy.
‡ Palpable on pelvic and rectal examination after operation.

Group 5 consists of three patients with angiomas of the spinal cord (varicose veins).

Group 6 consists of one patient with an echinococcus cyst of the cord, who had been operated on previously for echinococcus cysts of the lung and the liver.

Group 7 is composed of two patients with tuberculoma of the cord, one of whom had an extensive tuberculoma on the anterior and lateral surfaces of the cervicodorsal cord, associated with miliary tuberculosis. These findings were verified at necropsy. The other patient had a unilateral inflammatory lesion of the cauda equina, resembling tuberculoma without neoplastic cells. The condition had not progressed farther since 1917.

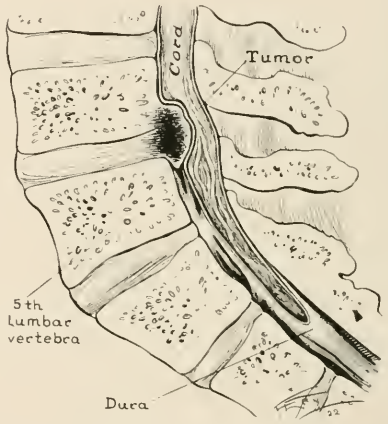

Fig. 4.—Sagittal section of region of fourth and fifth lumbar vertebrae in the case shown in Figure 2.

Group 8 is made up of two patients with gumma of the cord, both of whom gave histories positive for syphilis and presented definite levels of paralysis. In one the meninges were thickened and adherent to the cord in one large mass for 4 cm.; the other, who gave a short history, approximately six months, presented very similar findings except that the dura could be separated from the soft inflammatory mass. We were able to remove part of the inflammatory mass at operation; the wound was closed and the dura left open. The patient recovered his motor power and sensation, and is apparently free from symptoms. It is also interesting to note that one of the patients of Group 5, in whom an angioma was found, gave a positive history of syphilis.

Group 9 consists of two patients with cerebellospinal tumors; one of them was 48 years of age, and the other 2½ years. Both had large

vermis tumors, extending through the foramen magnum into the spinal canal. Only a partial removal was possible, and both patients died soon after operation.

Duration of Symptoms.—The average duration of symptoms in Group 1 was twenty-eight months; in Group 2, forty-five months; in

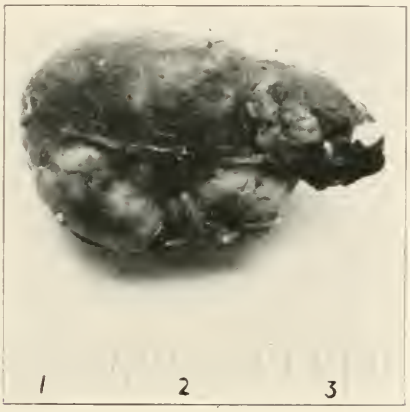

Fig. 5.—Psammoma. This illustration and Figures 6, 7 and 8 represent intradural but extramedullary tumors of the spinal cord.

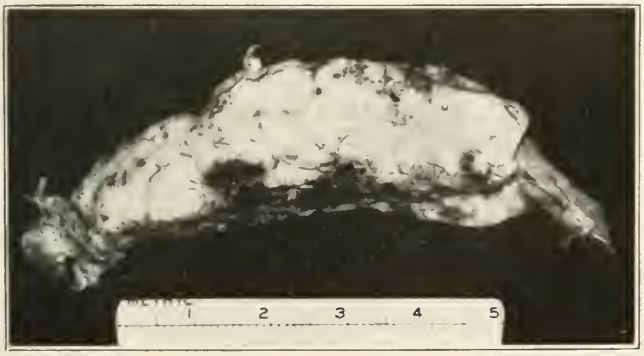

Fig. 6.—Encapsulated intramedullary endothelioma removed from the dorsolumbar cord, extending upward from the conus.

Group 3, forty-five months, and in Group 4, forty months. The other groups are so small that a definite average was not obtained.

Root Pain.—Root pain was present in eight patients (57 per cent.) of Group 1; in twenty (66 per cent.) of Group 2; in twenty-two (71 per cent.) of Group 3, and in thirteen (54 per cent.) of Group 4. In Groups 5, 6, 7, 8 and 9, four patients (44 per cent.) had root pain.

TABLE 4.—Findings in Lesions of the Spinal Cord

	Patients	Hospital Convalescence																Died After Leaving Hospital						
		Died	Average Time in Hospital, Days	Cause of Death														Average Time Since Operation, Months	Cause of Death					
				Pneumonia	Meningitis	Myocardial Degeneration	Uremia	Pyelonephritis	Surgical Shock Due to Hemorrhage	Embolism	Septicemia	Fat Embolism	Intracranial Pressure	Internal Hydrocephalus	Miliary Tuberculosis	Unknown			Morphinism	Meningitis	Septicemia	Pyelonephritis	Unknown	
Tumors: Extradural	11	2	26	1	1	..	..	..	..	..	..	..	..	..	..	..	1	5	..	..	..	..	1	
Intradural but extramedullary	30	4	25	..	1	1	1	1	..	..	..	..	..	..	..	..	12	13	1	..	..	..	1	
Intramedullary	31	3	60	..	..	..	..	..	1	1	1	..	..	..	..	..	8	17	..	1	1	1	5	
No tumor found; meningomyelitis (?)	27	5	21	..	1	..	..	..	..	2	..	1	..	..	..	1	5	43	..	..	..	..	4	
Varicose veins	3	..	21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Echinococcus cyst	1	..	21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Tuberculoma	2	1	13	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	
Gumma	2	..	17	..	..	..	..	..	..	..	..	..	..	..	..	..	1	48	..	..	..	..	1	
Cerebellospinal tumors	2	2	2	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	

Table 1 gives the number of patients with and without motor and sensory paralysis of the bladder and rectal areas.

Spinal Fluid Findings.—These findings (Tables 1, 2, 3 and 4) are of interest, as frequency of xanthochromia, high cell count, globulin and a positive Wassermann reaction are shown. In the 112 patients operated on, eighty-nine spinal punctures were performed. In thirteen instances,

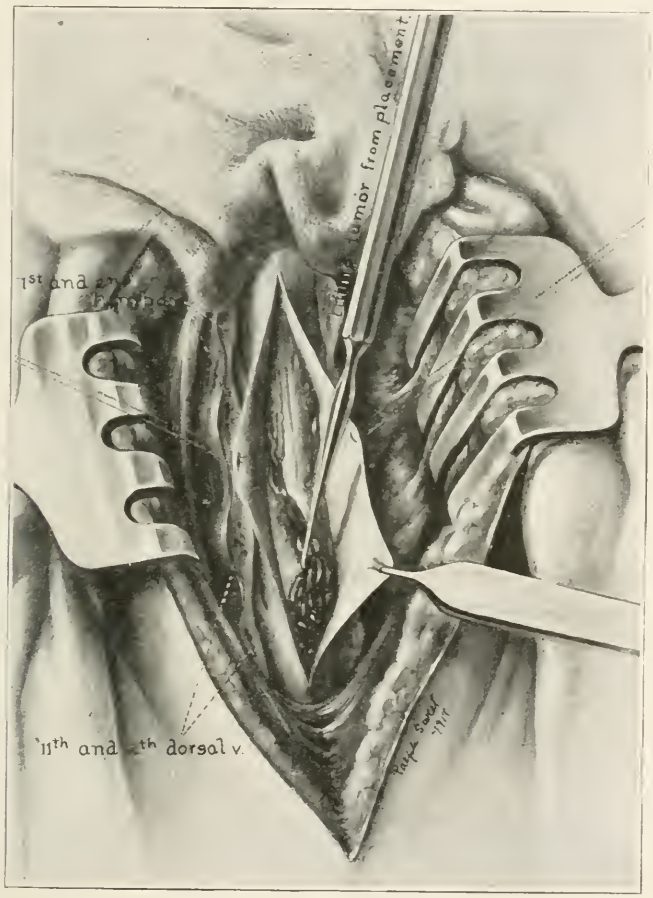

Fig. 7.—Angioma or varicose veins of the cord.

xanthochromia was found in the spinal fluid; in thirty-two the Nonne test for globulin was positive, and in those in which a cell count was made the average count was 3, and the highest count was 18. The Wassermann reaction on the spinal fluid was negative in every instance, even though three patients gave histories positive for syphilis.

Location of Tumor.—In fifty-nine patients, the tumor was in the dorsal region; occasionally, however, it extended into the cervical and

TABLE 5.—End-Results in Treatment of Lesions of the Spinal Cord

	Patients	Living	Average Length of Postoperative Life, Months	Well and at Work	Improved and Working Some	Improved but Not at Work	Improved for an Average of Five Months	Helpless	Not Traced
Tumors: Extradural	14	11	37.5	5	1	3	..	..	2
Intradural but extramedullary	30	24	32.0	13	2	3	..	1	5
Intramedullary	31	22	35.0	1	3	9	..	4	5
No tumor found; meningomyelitis (?)	27	17	34.0	2	1	1	2	9	2
Varicose veins	3	2	75.0	..	..	1	..	..	1
Echinococcus cyst	1	1	21.0	..	..	1	..	..	..
Tuberculoma	2	1	54.0	..	..	1	..	..	..
Gumma	2	1	8.0	1	..	..	..	..	..
Cerebellospinal tumors	2	..	....	..	..	..	..	..	..
Total	112	79	....	22	7	19	2	14	15

Neoplasm found in 85 patients (76 per cent.) of 112 in whom laminectomy for cord tumor was performed.
43 tumors removed completely = 51 per cent of tumors found are removable.
26 tumors partially removed = 30 per cent. of tumors found are partially removable.
22 patients well and working.
7 improved and working some.
19 improved and not working.
48 total improved = {43 per cent. of 112 in whom laminectomy was performed. / 56 per cent. of 85 in whom tumors were found.}

the lumbar areas, but the principal part was in the dorsal region. In eighteen patients, the tumor was in the cervical region, in nine in the lumbar region, and in three in the sacral region. In twenty-three a tumor was not found, or the symptoms were due to an inflammatory process.

Removal of Tumor.—Tumors were removed completely from forty-three patients (39 per cent. of the entire series); tumors were removed partially from twenty-six (23 per cent.).

Fig. 8.—Gumma of the spinal cord and meninges.

End-Results.—Of the 112 patients operated on for tumor of the spinal cord during the period of our study (twelve years), seventy-nine are alive. Twenty-two of the living have recovered completely and are doing their regular work; seven have improved sufficiently to do a little work, and twenty-one have improved, but are unable to work; fourteen are helpless. Fifteen patients did not reply to our letter of inquiry. It is fair to assume that a few of these have improved, since patients who have not improved are more likely to reply than patients who are well and free from symptoms.

Operation.—We employ no special technic in laminectomies for the removal of tumors of the spinal cord, aside from precautionary

measures against traumatizing the cord or permitting hemorrhage within the dura. The spines and laminae are removed; the muscles are closed in two planes with interrupted and continuous sutures of catgut, and the skin is closed by a subcuticular stitch of catgut, besides a dermal suture. If the tumor is in the cervical region, a unilateral laminectomy is performed, with the removal of the opposite lamina and the spine over the tumor. This precaution is taken because one patient had a recurrence of symptoms owing to slipping of the bodies of the cervical vertebrae, causing traction and pressure on the cervical

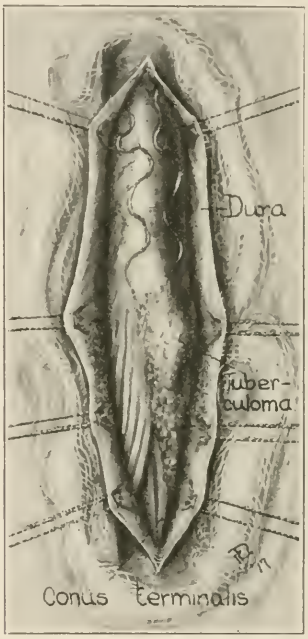

Fig. 9.—Tuberculoma (?) of the cauda equina, unilateral lesion.

cord and resulting in paralysis. While we prefer the one-stage laminectomy, we have found it necessary to perform a two-stage operation in seven of our cases, and a three-stage operation in one, because of the extensiveness of the lesions. As a rule, we remove three spines and laminae before we open the dura; five or six can be removed with little difficulty. Ependymal gliomas of the cauda equina usually extend from the eleventh dorsal to the first or second sacral vertebra, and in such cases trouble will be encountered if too much is attempted at one operation. Otherwise, the one-stage operation is very satisfactory, especially to the patient, and there is danger of infection in opening a recent wound for a second operation.

Ether anesthesia has been employed in the greater number of cases; however, we have found paravertebral anesthesia very satisfactory in obese patients and in patients who are poor surgical risks. It is necessary to apply a 1 per cent. solution of procain to the dura, as it is exposed during laminectomy, since it is not desensitized in the paravertebral anesthesia by procain. A few drops of 1 per cent. solution of procain can be injected into the dural canal above the tumor without danger. Intraspinal anesthesia by procain can also be used in low

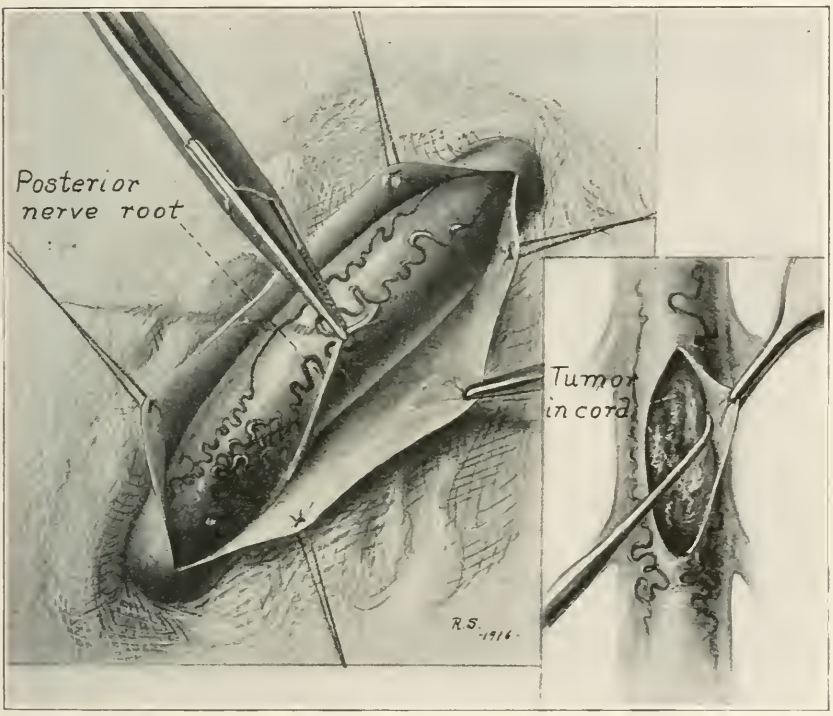

Fig. 10.—Intramedullary degenerating glioma of the dorsal cord.

laminectomies of the lumbar and sacral regions, but should be used cautiously, if at all, in middle dorsal or upper dorsal lesions.

Postoperative Care.—The care of patients after laminectomy differs little from general surgical care. We prefer to keep the patient on his abdomen on three or four soft pillows, with the head slightly lower than the operative field, for three or four days, besides avoiding undue pressure on the bony prominences. He is then permitted to turn on his side, and after ten or twelve days to lie on his back. About the fourteenth day he may sit up in a chair. We have found that he is more comfortable in the prone position, that the wound heals more

rapidly, and there is less danger of drainage of cerebrospinal fluid, especially in cases of intramedullary tumors in which the dura is left open. Provided the patient has not been catheterized previously, the bladder is allowed to overflow. If cystitis is present and the patient has been catheterized previously, a retention catheter is inserted prior to opera-

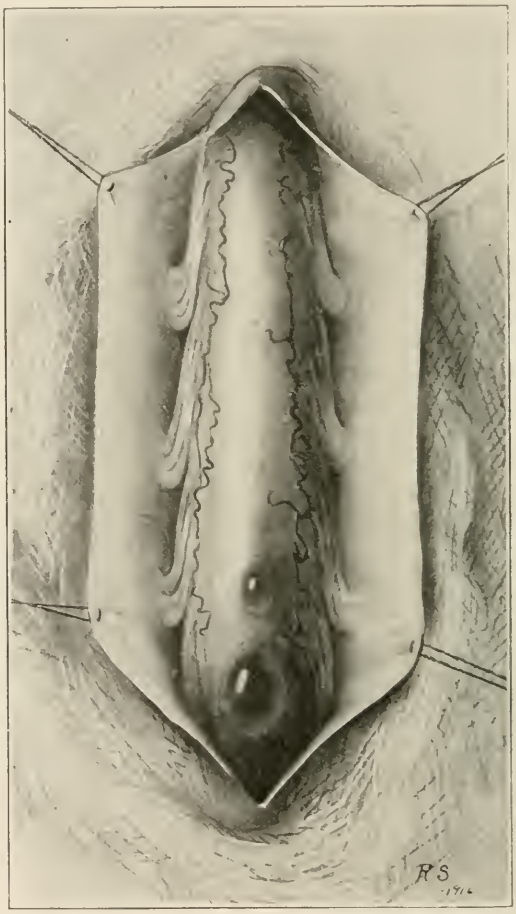

Fig. 11.—Tumor shown in Figure 10, extending down into the conus.

tion, and is changed about once a week. The bladder is lavaged daily with a 2 per cent. solution of boric acid, and about one-half ounce (15 c.c.) of 10 per cent. solution of argyrol is introduced and allowed to remain in the bladder for one-half hour. If there is any evidence of pyelitis, acid sodium phosphate and hexamethylenamin, 7 grains (4.5 gm.) of each, three times a day, are administered. This is followed by a week of rest, and a second course of medication.

Convalescence.—Recovery depends on the duration of symptoms. If the tumor has been removed without trauma, a patient with a duration of symptoms of one year or less may be expected to recover completely; one with a duration of symptoms of not more than three years, to improve markedly. Recovery is more complete following the removal of soft tumors than hard, nodular ones; and, if the same degree of paralysis exists, recovery is more complete if the tumors are in the caudal or lumbar regions, than if in the dorsal or cervical regions. Extradural and intradural but extramedullary tumors can usually be removed completely with very little difficulty, but it is difficult to remove intramedullary tumors. In our group of intramedullary tumors, one endothelioma only could be removed completely. This tumor arose apparently from the pia mater and extended into the cord. We have attempted partially to remove several intramedullary tumors, and sometimes we have split the cord dorsally and permitted the tumor to extrude. The results have been twofold: some patients have been made worse by attempted removal; others have improved for a time and then developed recurrence of symptoms. As a whole, the results of removal of intramedullary tumors are unsatisfactory, and we believe that unless the tumor is very close to the dorsal surface of the cord less damage will be done and more temporary relief afforded the patient by laminectomy and incising the cord dorsally. The administration of radium may prove of some value in this group. One of the patients who were treated by radium apparently improved; another improved for one month following partial removal of an intramedullary tumor and then failed until he was paralyzed completely. If radium is used, it should be screened very carefully and not placed directly on the cord.

SUMMARY

In a series of 112 laminectomies, tumors were found in eighty-five (76 per cent.). Forty-three of the tumors (51 per cent.) were removed completely, twenty-six (30 per cent.) were removed partially, and sixteen were not removed. In twenty-seven cases no tumor could be found at operation; in four of these, tumors were demonstrated later. Seventy-nine patients are living; twenty-two are perfectly well and at work. Seven are improved and doing a little work; twenty-one are improved but not at work, and fourteen are helpless. Fifteen were not traced. Seventeen died in the hospital, and seventeen died subsequently at home, with an average time of two years between operation and death.

Tumor of the spinal cord is more common than is realized; many are overlooked or are found late. The best results are obtained by early operation.

DISCUSSION

Dr. Charles H. Frazier, Philadelphia: I have recently made a very critical analysis of fourteen consecutive laminectomies performed for tumors. The diagnosis is the most important. The surgical problems present relatively few difficulties. Dr. Adson has dwelt very properly on the question of pain as an important diagnostic feature. Not only was pain present in all but one of my cases, but it was a constant symptom in all and was referred to a constant location in all from the time of onset until the time of operation. Pain was present in one half of the cases for three years prior to the onset of motor disability and in at least one third of the remaining cases for two years prior to motor disability. So for these various reasons we lay greater emphasis on pain as a diagnostic feature. In the development of the syndrome I think you will find that, while pain is the first symptom in almost all cases, paresthesia is almost invariably the second symptom. Pain, being a root symptom, is on the side of the lesion, and paresthesia, a cord symptom, may be homolateral or contralateral. Motor impairment has come on comparatively late in my series; it has not been particularly important so far as diagnosis was concerned. It was the principal reason for surgical consultation, which was precipitated because, while the patient had been disturbed by pain and paresthesias, it was not until paralysis developed that surgical assistance was sought. With reference to segmental diagnosis we have placed emphasis on the following signs as of importance in their relative order: the level of sensory loss or impairment; the point to which the pain was referred; the loss of a given reflex; the sympathetic ocular phenomena, which always imply tumor in the lower cervical or upper thoracic region, and lastly muscular atrophy. In twelve of these fourteen cases, we found tumors which were distinctly operable; that is to say, they were localizable, definitely encapsulated and quite accessible, and they presented no great operative difficulties. Of the two exceptions, one was a metastatic carcinoma, involving the vertebral bodies, and the second a large, and, as I thought, an inoperable tumor of the cauda equina. There are two practical points in the surgical aspects of spinal tumors: (1) adequate exposure and (2) prevention of recurrence. In probably forty-nine out of fifty cases in which a mistake has been made the opening was too low rather than too high; to avoid this mistake we have adopted this rule: we select as the lower limit of the opening the spinal process opposite the segment representing the highest level of sensory loss or impairment. In this series of fourteen cases the tumor was exposed in every instance. In two cases, the tumor was only partly exposed by the laminectomy opening as originally planned, and in one of these the tumor extended within the cranial cavity. The second point of importance is the avoidance of recurrence. Extramedullary tumors take their origin invariably from the meninges and almost invariably from the lateral aspect of the spinal canal, and to avoid recurrences we must remove not only the tumor but also that portion of the dura to which the tumor is attached.

Dr. Ernest Sachs, St. Louis: Spinal cord tumors are not rare. Every case of what has heretofore been called transverse myelitis should be potentially considered as a tumor until proved otherwise. That will necessitate a considerable number of negative explorations, but a patient with a transverse lesion of the cord, unless some other etiologic factor has been found, has not been given a fair chance unless every method of diagnosis has been exhausted. A point emphasized by Dr. Adson and by Dr. Frazier, I would not agree with. In my experience with fifty cases, the first symptom was not pain. Very frequently it was paresthesia. Possibly because I live in Missouri, a large

number of these cases had been treated for a considerable time by various types of "adjustment." I know of nothing that is more discouraging than to have a negative exploration, and any method that will help reduce the number of negative explorations should be welcome. I have welcomed the work of Dr. Ayer, of Boston—his combined cistern puncture, which some of us thought rather dangerous, though it has not been so in his hands. Dr. Ayer has shown that if a lumbar puncture is done, and then the jugular veins are compressed, if there is a spinal block the cerebrospinal fluid in the tube connected with the needle will not rise. At least in one case, this method has prevented me from doing an exploration. I think we should keep this method in mind and make use of it and in that way, perhaps, reduce the number of negative explorations.

Dr. A. W. Adson, Rochester, Minn.: Pain is an important sign, but it is not absolutely diagnostic, as many patients have spinal cord tumors without the presence of root pain as a symptom. Puncture of the cisterna magna in conjunction with the spinal puncture is of some value. It is a spectacular procedure when one finds the pressure is greater in the cisterna magna than in the spinal canal, but this does not locate the tumor, and occasionally may give misleading information when adhesions are present between the arachnoid, pia mater, and the dura.

DYSTONIA MUSCULORUM DEFORMANS

WITH ESPECIAL REFERENCE TO A MYOSTATIC FORM AND THE OCCURRENCE OF DECEREBRATE RIGIDITY PHENOMENA. A STUDY OF SIX CASES *

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Dystonia musculorum deformans is not an uncommon disorder. It is well known for its kinetic phenomena, and most, if not all, of the case reports consist of analysis of the peculiar movements which characterize the clinical syndrome. Thus far spontaneous abnormal involuntary movements, torsion spasms, disturbances in tonus and possibly a racial peculiarity have come to be looked on as the criteria for the diagnosis of the bizarre entity. This clinical conception of the disorder, originally formulated by Ziehen and Oppenheim and so closely followed by subsequent observers, stresses only the hyperkinetic phenomena. But we have found cases in which these phenomena are present only to a slight extent or almost entirely absent, and yet we believe that they form part of the disease.

It is the object in this paper, besides recording six hitherto unreported cases of dystonia musculorum deformans with atypical and unusual features, to call attention to the existence of a myostatic variant of the disorder. But far from attempting to create a new clinical entity, we wish to correlate it with the well-known syndrome. This myostatic or postural variant is indeed a part of the disorder and always coexists with the kinetic disturbance of which it is only a complement. It is, in other words, a fleeting postural phase, observed between the waves of movement, become permanent. The occurrence of large and small fragments of decerebrate rigidity in typical cases of dystonia, to which we wish to call especial attention, further emphasizes the postural or myostatic disturbance in the condition. But, whereas in most cases the kinetic disturbance obscures or overshadows the postural element, there are some in which the latter is plainly evident and a few others in which it is dominant to such an extent that

* From the Neurological Service of the Montefiore Hospital, New York.

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one begins to doubt whether the pictures are part of the same syndrome. It is our conviction that they are. The following case reports and their discussion will illustrate these points.

REPORT OF CASES

CASE 1.—*A case of dystonia musculorum deformans of the kinetic type beginning in the right hand and, up to the present, involving the musculature of both upper extremities, neck and head, with a fragment of decerebrate rigidity phenomena.*

Fig. 1.—A case of dystonia illustrating segmental involvement and a fragment of decerebrate rigidity limited to the right upper extremity.

History.—B. M., a boy, aged 15 years, born in the United States, a Jew of Russian parentage, about three and one-half years ago (1918) noticed difficulty in using his right hand, especially in writing. Soon after it was observed that his left upper extremity was held in a peculiar position, namely, flexed at the shoulder and elbow and adducted. About eighteen months after the onset, the patient's head and body began to bend over to the left side. During the course of his illness there gradually developed peculiar defensive movements of his left upper extremity, uncontrollable movements of the head and turning movements of his body.

Physical Examination.—The gait was normal. There was a marked involuntary torsion spasm involving the musculature of the head, neck, chest and left upper extremity. The head was rotated and markedly tilted to the left, the chin almost resting on the left shoulder. On extending the right upper extremity, the hand was turned with the palm outward, that is, overpronated, and the index finger was hyperextended. This constitutes a fragment of decerebrate rigidity, the so-called pronator sign of Wilson (Fig. 1). There was a coarse rhythmic tremor of the extended hand. While these movements appeared to come on in rhythmic waves, they were practically continuous in one part or another.

The spontaneous movements of the left upper extremity consisted of protraction of the arm together with flexion of the forearm; this movement was very similar to that assumed in defending one's face. In the upper extremities the dystonic spasm was revealed in an alternating hypertonia and hypotonia. It is curious to note that walking on all fours was accomplished much better than the motor disturbances of the upper extremities would seem to permit. Further neurologic examination was negative.

Discussion.—The disease began in one upper extremity, which is rather unusual. Other writers, especially Hunt,[1] have called attention to the frequency with which the disease begins in the lower extremity. This patient also shows an exquisite fragment of decerebrate rigidity in the right upper extremity, although the picture is mainly of the myokinetic variety. Finally, the movements are thus far limited to the head and neck, upper extremities and upper part of the trunk. It is quite possible, in view of the comparatively short duration of the illness, that it will extend downward and involve the rest of the trunk and lower extremities; but for the present the disease has assumed a segmental character. Attention is called to this distribution because a segmental delimitation has previously been pointed out in striatal diseases, especially in paralysis agitans.

Case 2.—*A case of dystonia musculorum deformans of the kinetic type with the occurrence of both fragmentary and almost complete decerebrate rigidity phenomena.*

History.—J. L., a boy, aged 11 years, born in the United States, a Jew of Russian parentage, whose parents were first cousins, and who had three other children living and well, had had the disease for three years. It was noted that his left foot gradually began to "turn in" involuntarily when he walked; this became progressively more marked, and one year later his right foot also began to "turn in and to drop." In July, 1921, in the course of two days, there developed frequent spasmodic contractions in the left lower extremity, which made sitting difficult. The spasms steadily increased in severity and frequency. In September, 1921, the patient developed severe spasms in his hands. In August, 1921, walking became impossible on account of the muscular spasms and fatigability. In December, 1921, sitting became impossible, and the patient became bedridden. For the last two months the patient has been lying on his left side with the head turned to the left. Frequent spasms in the left upper extremity and the muscles of the back have also developed. For the last two months the right lower extremity has been held almost constantly in the extended position.

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1. Hunt, J. Ramsay: The Progressive Torsion Spasm of Childhood, J. A. M. A. **67**:1430 (Nov. 11) 1916.

Physical Examination.—The patient was unable to walk or stand. The position of election was the reclining one, with the body inclined to the left and the head bent forward and to the left. The left knee joint was in flexion, the right in extension. Both feet were in hyperplantar flexion, the right more

Fig. 2.—Almost total decerebrate posture in a case of dystonia musculorum.

so than the left. Occasionally the left upper extremity was extended with the palm turned outward. The movements came on in wavelike fashion and seemed to be induced by slight stimulation, such as stroking or pinching the skin. He frequently assumed an attitude of opisthotonos with the right lower

extremity markedly extended and the back in extreme lordosis. The abductors of the thigh, flexors of the leg and to a slight extent the adductors of the right thigh, were in almost constant tonic contraction.

If the boy was suspended by his upper extremities, he assumed a position typical of decerebrate rigidity: the forearms were extended on the arms, the fingers somewhat flexed at the proximal metacarpophalangeal joints, the forearm rotated outwardly (pronator sign), the lower extremities hyperextended and the back lordosed, forming an opisthotonic arc. However, the head was not retracted but hung limply forward with the chin pointing to the left (Fig. 2). There were no movements in the face or head musculature; the sternomastoids occasionally manifested mild tonic contraction. While there was no true pelvic distortion, there was a tendency to torsion toward the left. The erector spinae groups were in a state of constant contraction and occasionally the muscles of the back of the neck participated in the spasm. The muscles were in hypertonic contraction, but this could be overcome by passive movement, even to the point of hypotonia. Both the fingers and the hands

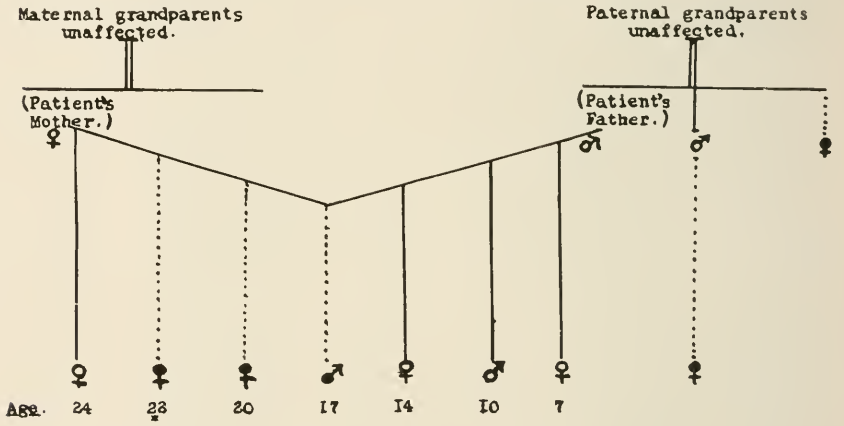

Fig. 3.—Familial incidence of dystonia musculorum deformans in Case 3. The black symbols indicate those affected with the disease. * indicates the patient.

were definitely hypotonic. There was no adiadokokinesis, no ataxia or dysmetria.

The deep reflexes were difficult to elicit. The abdominal and cremasteric reflexes were present. There were no sensory changes. The cranial nerves were normal, except for the existence of a true nystagmus on extreme gaze to the left.

Discussion.—The history of the development, the age of onset, the race of the patient and the abnormal involuntary movements stamp the case as a typical dystonia musculorum deformans, in spite of the fact that there is as yet no torsion of the pelvis. The unusual features are the postural decerebrate rigidity phases. Even as he lies on his back there are rhythmic waves of movement. (We have observed this rhythm in some of the other cases, and it is described in most of those reported in the literature.) The spasms throw the right lower extremity in extension and both uppers in extension, pronation and outward rotation. These movements represent momentary

phases of decerebrate rigidity phenomena. When the boy is suspended, all four extremities and the body assume the typical attitude which occurs on experimental section of the midbrain, with the exception of the position of the head. The occurrence of this phenomenon points to the anatomic delimitation of the lesion in dystonia, even if it does not strictly localize it.

CASE 3.—*An unusual case of dystonia musculorum deformans with (1) a remarkable familial incidence, (2) speech disturbance, (3) a remission of the hyperkinetic phenomena with a resultant (4) myostatic residuum, (5) a hemidystonic distribution, and (6) a fragment of decerebrate rigidity.*

History.—L. P., a woman, 21 years of age, born in the United States, was a Jewess of Russian parentage. A remarkable familial tendency to the disease was noted (Fig. 3). The illness began at the age of 12. Her gait became "dragging" and difficult. Later her upper extremities became involved. There was no history of precedent acute infection. The physical examination recorded by Dr. I. Abrahamson on April 5, 1920, revealed a bedridden patient with a typical dystonia with severe involvement of the body, head and neck and all extremities. The speech was dysarthric, bulbar in nature. In January, 1921, improvement was noted. The patient was quieter and able to take a few steps without support. In August, 1921, it was noted that the left hand still showed the rhythmic clonic movements, but there was a tendency to extension and pronation (fragment of decerebrate rigidity). The patient was able to walk fairly well. General dystonic movements were still in evidence. In February, 1922, there was marked remission of all movements with considerable general improvement (Fig. 4). She showed some dystonic movements in the left upper extremity with the rhythmic flexor-extensor movement of the hand at the wrist. The left foot was in equinovarus contracture and also exhibited movements, resulting in a left hemidystonia. The trunk and right side disclosed no movements but assumed the postural condition momentarily observed in the dystonias during the brief interval between the waves of movement; that is to say, that which is the fleeting static element in the kinetic disturbance has become a permanent postural attitude in this patient's remission.

Discussion.—In this patient, the onset of whose dystonia dates back to childhood, the condition began in the lower extremities and became progressively worse, until she exhibited a violent form of the typical kinetic disturbance. Added to that she showed a rare involvement of speech (bulbar dysarthria). So far as we are aware, only two other cases referred to in the literature reveal this disturbance (those of St. Bernstein[2] and Wimmer[3]). After two years, during which she became bedridden, a gradual remission set in. It may be of interest to mention that in August, 1920, she had a streptococcus sore throat, and in April, 1921, an acute follicular tonsillitis. One may speculate on the possible bearing of these infections on the remission. The quite remarkable familial history is also worthy of emphasis, in view of the familial tendency of some of the other striatal syndromes, especially since recent criticism tends toward the grouping of numerous clinical entities of a supposedly common basal ganglion origin. Further, although only few dystonic elements are left, they are practically limited to one side—hemidystonia. But

2. St. Bernstein: Ein Fall von Torsions Krampf, Wien. klin. Wchnschr. **25**: 1567, 1912.

3. Wimmer, A.: Etudes sur le syndrome extra-pyramidaux. Spasme de torsion progressif infantile (syndrome de corps strie), Rev. neurol. **28**:952 (Sept.-Oct.) 1921.

the striking feature of this residual state is the static or postural attitude, an attitude to which we also wish to direct attention in some of the succeeding cases and which we designate the myostatic variant, or counterpart, of the myokinetic syndrome.

Fig. 4.—Formerly a kinetic type of dystonia, now a myostatic variant exhibiting a hemidecerebrate posture.

Case 4.—*A case of dystonia musculorum deformans, illustrating the myostatic or postural form, with few hyperkinetic phenomena.*

History.—P. T., a man, aged 20 years, born in Russia, a Jew of Russian parentage, whose illness began in 1913, at the age of 11, one year prior to

the onset fell from a height of about 12 feet, alighted on his feet but sustained no injury. One year later there developed a "drop foot" on the right side, associated with a turning outward of the lower extremity on walking. Three years later his hand began to turn outward, and he found difficulty in using it. About three years thereafter the left lower extremity became affected. The condition has remained stationary to the present day.

Physical Examination.—The patient walked with a peculiar gait, in which there was considerable twisting of the pelvis: the vertebral column was thrown forward, producing a marked lordosis; the lower extremities were rotated outward (everted) and in progression the trunk was bent forward and the lower extremities were flung about awkwardly in movements of hyperextension and hyperflexion (Fig. 5). A tendency to hyperadduction produced a scissor-gait effect. The abnormal movements and position of the spine and pelvis largely disappeared when the patient crept "on all fours." Despite the dystonic gait and the tortipelvis, the patient was remarkably free from tonic spasms when at rest. Except for an occasional tremor of the right upper extremity and clonic plantar flexion movements of both feet, there was a paucity of abnormal involuntary movements. There was no play of hypertonia and hypotonia in the affected muscles. A slight degree of hypotonia was present at the wrists.

The patient complained a good deal of various symptoms, was introspective, egocentric and was likely to use high sounding phrases. His attitude at times strongly suggested the functional.

Discussion.—The lack of progression, the atypical bizarre gait and attitude, the want of dystonic movements at rest, together with the patient's psychic make-up, speak in favor of a hysterical condition. But further study of the case convinces one of its organic nature and its relationship to dystonia musculorum deformans. For this patient shows the very postural or myostatic phase which may be momentarily observed in all the typical forms of the kinetic syndrome. But, whereas the postural static component is masked by the hyperkinetic phenomena in the general run of cases, in the present instance it has become the dominant feature. Corroborative evidence of the relationship of this syndrome to dystonia musculorum deformans may be found in the history of its development, the age and race of the patient, the torsion-posture of the pelvis, the lordosis, the clonic movements in the feet and the general attitude. The fact that the static phase is partially present in an undoubted case of dystonia musculorum deformans gives weight to the view that where the entire clinical syndrome is dominated by the postural component we are merely confronted with the complementary side of the same picture.

Case 5.—*A postural or static instance of dystonia musculorum deformans (dysbasia lordotica progressiva) with slight kinetic involvement.*

History.—H. R., a man, aged 32, a driver, born in Russia, a Jew of Russian parentage, four months after a fall began to feel "stiffness and pulling sensation" in the hamstring muscles of the left thigh, followed by a "drawing sensation" in the left arm and forearm, with a tendency to flexion at the elbow and fingers. At the same time the left side of his face became involved in a similar muscular spasm. In 1912, a laminectomy (seventh cervical nerve to fifth dorsal vertebra) was performed, apparently in the belief that some cord involvement was the cause of his motor disturbance. Prior to the laminectomy alcohol was injected into the left elbow region and left popliteal space, appar-

ently with the unfulfilled hope of controlling the abnormal involuntary movements. Both of these operative attempts have left behind physical signs which are independent of the actual condition, yet serve to mask it.

As this case presents almost in its entirety the myostatic variant of dysbasia lordotica progressiva and may arouse doubt as to its proper classification in the group of dystonias, it may be mentioned that Drs. I. Abrahamson and J. Ramsay Hunt independently diagnosed the case (1919) as one of dystonia.

Physical Examination.—The patient was examined in February, 1922. There was frequent play of the muscles of the face, particularly of the upper lip, resembling a slow grimace. There was a slight tilt of the head and overaction of the platysma myoides. The right sternocleidomastoid was somewhat more

Fig. 5.—The lordotic attitude in a myostatic form of dystonia.

prominent than the left. There were few or no bodily movements with the exception of some in the toes, which appeared to be a cross between a dystonia and athetosis. On attempting to walk the movements of the toes gained in amplitude. On the right there was dorsal extension of the big toe and fanning of the others when the patient lifted his foot from the floor; this movement was of a dystonic type. There was a slow turning of both feet, especially of the right, into an equinovarus position. The lower extremities were held mainly in an extended position: the feet especially in plantar flexion. The right big toe was frequently held in spontaneous dorsal hyperextension. On suspending the patient by the arms both lower extremities were hyperextended at all joints.

The gait simulated a spastic walk with bilateral dropped foot. It was slow, wide, swinging and shuffling with a broad base, and appeared somewhat inco-

ordinate (Fig. 6). Yet there were no equilibratory and no deep sensory disturbances. The left abdominal reflexes were diminished, the lower deep reflexes increased. There was no true Babinski sign, but there were a left Mendel-Bechterew and a Rossolimo sign. There was neither hypertonia nor hypotonia in the right upper and lower extremities. A slight hypotonia was

Fig. 6.—A typical instance of the myostatic variant of dystonia musculorum. Note the spontaneous Babinski sign and the grimacing facial expression somewhat like that seen in progressive lenticular degeneration (Wilson's disease).

noted in the left lower extremity. There was flexor contracture of the fingers of the left hand into the palm. The left interossei were atrophied. Marked hypertonia was found in the left upper extremity, which was held flexed at an angle of 90 degrees at the elbow. The speech sounded as though the words were uttered through articulated teeth and partly closed lips. The labials

were especially interfered with because of the overaction of the lower facial muscles and platysma. The face appeared spastic, as if a smile were frozen on it.

Discussion.—There are a few physical findings in this case which complicate the picture, but it appears that they have been brought about by surgical interference and therefore do not form part of the syndrome. The contracture of the left hand, the atrophied interossei and the fixed hypertonic attitude of the left upper extremity are due to the therapeutic attempts which were made to control the abnormal movements. But the general posture and the few abnormal involuntary movements leave no doubt that the patient represents the myostatic variant of the hyperkinetic syndrome. His gait especially resembles to a marked degree that of the patients in Cases 3 and 4, and indeed that of every case of dystonia if one could subtract the abnormal movements. Additional corroborative evidence that the case belongs to the myostatic form may be found in the fact that the lower extremities assumed the hyperextended decerebrate postural attitude when the patient was suspended in the air with support under the axillae.

The speech disturbance was not of a dystonic character, but resembled more that encountered in progressive lenticular degeneration (Wilson's disease). This may be of some significance in linking together the two syndromes. The spontaneous dorsal extension of the big toe, while not a true Babinski sign, is worth remarking, and will be further alluded to in the next case.

Case 6.—*A case of dystonia musculorum deformans of the kinetic type revealing (1) fragments of decerebrate rigidity, (2) a paralysis agitans-like tremor of right thumb and hand, (3) a dorsal extension (Babinski) of the left big toe.*

History.—E. H., a young woman, aged 19, born in the United States, a Jewess of Russian parentage, had had a tenotomy of the left Achilles tendon in 1918. The illness set in gradually at the age of 8, first in the right foot and then in the right hand and upper extremity; later in the right foot; and finally the left upper extremity became affected.

Physical Examination.—The gait appeared somewhat spastic. She walked on the toes of the right foot and on the outer margin of the left sole. Both feet were inverted, the left more than the right. The right lower extremity tended to cross in front of the left. While sitting there were observed involuntary inversion of the left foot and occasional extension of both legs on the thighs. Now and then a spontaneous dorsal extension of the left big toe occurred. On extending the arms forward and above the head, the right underwent alternating supination and pronation with a tendency to eversion of the palm.

There were involuntary flexion and extension movements at the right elbow. At times there were small oscillations of the right thumb and hand in a manner closely simulating the tremor of paralysis agitans. The movements in the left upper extremity were much less marked. At times there was overextension of the left wrist and involuntary flexion of the fingers, together with flexion and extension at the left elbow. There were no involuntary movements of the head and neck and no torsion of the back or pelvis.

The reflexes of the upper extremities could not be elicited owing to the presence of the constant involuntary movements. The knee and Achilles' tendon reflexes were present and equally active. The abdominal reflexes were present and equal. On plantar stimulation there was marked dorsal extension of the left big toe and fanning of the others. This seemed to be an actual reflex response,

although a spontaneous dystonic Babinski movement also occurred. The cranial nerves were normal except for a slight bilateral horizontal nsytagmus.

Discussion.—The following facts are worthy of note: First, the restriction of the kinetic disorder to the extremities, giving an appendicular distribution. This emphasizes once more the possibility of the segmental involvement in the disorder, a point alluded to in connection with Case 1. Second, the presence of fragments of decerebrate rigidity in the right upper extremity and in the feet discloses the static component. Third, the paralysis-agitans-like tremor of the right thumb and hand is of particular significance, as it indicates a probable involvement of the efferent pallidal mechanism of the corpus striatum. The presence of this tremor may furnish another clue to the localization of the lesion. Fourth, attention should be directed to the presence of the Babinski toe phenomenon, which is even more marked in this man than in the preceding case.

SUMMARY AND DISCUSSION

The six cases summarized in this paper show a number of features which hitherto have not been associated with dystonia musculorum deformans. It is quite difficult to explain the nystagmus in three of the cases, unless it is assumed that the ocular movements are part of the dystonia. Although this is somewhat far-fetched, it may be pointed out that irregular movements of the eyeballs have been observed in violent choreas. So, too, it is difficult to interpret the presence of the Babinski sign in Case 6 without other signs of involvement of the pyramidal tract. Further, the fanning of the lesser toes and the dorsal extension of the big toe is occasionally observed in the same patient during the spontaneous movements. Case 5 also exhibits this spontaneous dorsal extension and fanning. One is tempted to speculate on the significance of the Babinski phenomenon and to question whether it is really primarily a pyramidal tract phenomenon or an unexplained striatal release mechanism.

The speech disturbances in two of the cases are also unusual. Two other cases reported in the literature showed similar disturbances. Wimmer's recent report mentions difficulty in speaking, but the statement is made that this was not a dysarthria. The speech was explosive; there was poverty of words and sometimes echolalia. There is no reason why the speech muscles should not be involved in dystonia in view of their undoubted striatal and cerebellar innervation. In this connection one may again instance chorea in which dysarthria is not uncommon. If an attempt is made to correlate dystonia with lenticular degeneration, it is not surprising that there is speech disturbance, although this is of quite a different type in the latter disease. The speech disturbance in Case 5 was somewhat reminiscent of Wilson's syndrome.

In many of the cases which we have described, and in numerous others reported, there is something wavelike or rhythmical to the movements. Rhythm in general is such a universal phenomenon and

in animal movement so primitive that special emphasis should be given to its presence in dystonia. Very likely it represents a reversion to a lower segmental characteristic of movement. In this connection it may be once more pointed out that two of the cases showed an actual tendency to segmental distribution of the affection.

The racial element, which, though very common, is not universal, was found in all of our patients. So, too, there was an apparent yet noteworthy functional tinge to some of the cases. It is well known that many of the patients in the early stages of the disease are considered hysterical. Case 1 bore the burden of that diagnosis for one year and Case 4 is still reminiscent of it, and yet there is no doubt as to the organic nature of the condition. Wilson's illuminating remarks on decerebrate fragments in hysteria may serve as possible explanations in this connection.

We called attention to the occurrence of decerebrate rigidity phenomena in the cases herein recorded. Wilson [4] made passing mention of them in dystonia, but he did not follow up his observations. His allusion, however, suggests a static component in the hyperkinetic disorder. The importance of the demonstration of this combination, as well as the dissociation, lies in the fact that it furnishes clinical evidence for the accepted notion of the physiologic unity of posture and movement. Conversely, there is sufficient physiologic evidence to support the view that there does exist a closely interwoven static counterpart of the kinetic form of the disease. The conception of movement as recently elaborated by numerous observers [5] permits the inclusion in one entity and proves the basic relationship of two apparently dissimilar clinical pictures, namely, the myostatic and the myokinetic variants of dystonia.

This enlarged conception is not altogether novel, at least from the point of view of correlating several clinical entities which are probably based on one anatomic substratum. Strümpell originally postulated an amyostatic syndrome in which he included Westphall's pseudosclerosis, Wilson's lenticular degeneration and paralysis agitans. At the same time that a special attempt was made to define the clinical syndromes of dystonia lenticularis (Thomalla) and double athetosis, attention was called to their common underlying physiologic mechanism and anatomico-pathologic substratum. The conviction has gradually arisen that the numerous clinical entities are not quite so capable of sharp delimitation as was originally thought. Attention was even drawn to the fact that disease of the liver may occur not alone with

4. Wilson, S. A. K.: On Decerebrate Rigidity in Man and the Occurrence of Tonic Fits, Brain **43**:220, 1920.

5. Goodhart and Tilney: Brady Kinetic Analysis of Somatic Motor Disturbances, Neurol Bull. **3**:295 (Sept.-Oct.) 1921.

lenticular degeneration but with dystonia musculorum deformans as well, thus showing that they are related in another way. Further, it was shown that far from being limited to the corpus striatum, the lesion in dystonia may be very diffuse. A recent review of the clinical syndromes of the corpus striatum by Lhermitte [6] lent but little clarity to the situation and only served to show that the same kinetic disturbance may be due to different lesions and that the same lesions may give rise to different kinetic disturbances. In other words, in the present state of our knowledge, it is futile to attempt too sharp a definition of the clinical or pathologic syndromes.

As few cases of dystonia have come to necropsy, Wimmer's fairly typical case may be cited in connection with the rather universal tendency to consider the disease one of basal ganglion, more especially lenticular, origin. On microscopic study Wimmer found cellular degeneration and neurogliar changes in the caudate and lenticular (putamen) nuclei, in the dentate nucleus of the cerebellum, in the thalamus, pons and cerebral cortex. The changes simulated those seen in pseudosclerosis and those found in the striatum were not more marked than elsewhere. Wimmer further quotes Spielmeyer to the effect that one might regard Wilson's lenticular degeneration, pseudosclerosis and torsion spasm as "variations in clinical expression of a pathologic process which is essentially the same."

Hal. [7] has also pointed out that the pathologic process is not limited to the lenticular nucleus, but involves the pons and cerebral cortex as well. He further states that degeneration of the liver may be found alike in progressive lenticular degeneration, pseudosclerosis and dystonia musculorum deformans. Schneider [8] adds that hepatic cirrhosis may be found in dystonia lenticularis as well as in the syndromes just mentioned. In Wimmer's case, too, the liver was cirrhotic.

It may be of interest to point out that the syndrome under discussion is termed either dysbasia lordotica progressiva or dystonia musculorum deformans. There is no question that they are one and the same clinical entity. And yet one name stresses the peculiar postural attitude in the gait and the other emphasizes the abnormal movements. The important fact is that these two phases have been noted, although they have not been correlated.

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6. Lhermitte, J.: The Anatomical and Clinical Syndromes of the Corpus Striatum, Neurol. Bull. **3**:163 (May) 1921. Translated from the Annales de Medicine of August, 1920, by Huddleston and Kraus.

7. Hall, H. C. (of Copenhagen): La Dégénerescence Hepato-lenticulaire, Paris, 1921.

8. Schneider, Erich: Torsionspasmus: ein Symptomkomplex der mit Leberzirrhose verbundenen progressiver Lenticulardegeneration, abstr., Neurol. Zentralblatt **39**: (April) 1920.

The occurrence of a parkinsonian tremor in a true case of dystonia (Case 6) may serve as a further link in the chain of striatal syndromes. Paralysis agitans may be used by way of analogy to show that it is quite possible for either a kinetic or static phase to dominate a clinical picture. Just as there are cases of paralysis agitans which are characterized by tremor and others by the loss of associated movements and postural attitudes, so there are cases of dystonia which are made prominent by the abnormal movements and others which are signalized by the postural attitude.

CONCLUSIONS

1. There exists a myostatic variety of dystonia musculorum deformans as contrasted with the usual myokinetic form.

2. Phenomena of decerebrate rigidity may frequently be observed in dystonia musculorum deformans.

3. All cases of dystonia have an underlying postural background, one of the manifestations of which are the phenomena of decerebrate rigidity.

4. The myostatic and myokinetic phases of dystonia, which may be observed in all cases, are capable of dissociation. Either the static or kinetic phase may dominate the clinical picture.

5. The involvement in dystonia may be segmental in character.

6. In dystonia there occur not infrequently signs of other striatal diseases which point to a common anatomic and physiologic relationship.

DISCUSSION

Dr. J. Ramsay Hunt, New York: I should prefer to use the terms "rigid or paralytic type" for the group of cases described by Dr. Wechsler. If I am correct in my conception of the efferent system and its division into a kinetic and a static system, we shall in the future recognize groups of symptoms referable to the static mechanism. The corpus striatum is essentially a kinetic mechanism. When there is a striatal paralysis there follows naturally postural fixations, just as after hemiplegia from lesions of the corticospinal system. Therefore, why should the term "myostatic" be applied to express a paralytic manifestation of a kinetic mechanism?

In other disorders of the corpus striatum, for example paralysis agitans, we recognize a tremor type and a rigid type, and this makes a satisfactory clinical distinction. In my experience with dystonia these rigid or paralytic types represent late stages of the disease not unlike the late paralytic stage of paralysis agitans and athetosis when paralysis and rigidity replace the earlier motor disturbances.

I am, however, in entire sympathy with Dr. Wechsler's division of these two clinical groups, but it seems that it would be better to speak of them as a rigid or paralytic type rather than myostatic.

Abstracts from Current Literature

ON DECEREBRATE RIGIDITY IN MAN AND THE OCCURRENCE OF TONIC FITS. S. A. Kinnier Wilson, Brain **43**:3 (Nov.) 1920.

Sherrington has stated that "if in a monkey or cat transection below or in the lower half of the bulb has been performed, the animal . . . hangs from the suspension points with deeply drooped neck and tail, and its pendent limbs flaccid and slightly flexed. On giving the hand or foot a push forward and then releasing it the limb swings back into and somewhat beyond the position of its equilibrium under gravity; and it oscillates a few times backward and forward before finally settling down to its original position.

"To this condition of flaccid paralysis supervening upon transection in the lower half of the bulb the condition ensuing on removal of the cerebral hemispheres (mesencephalic transection) offers a great contrast. In the latter case, the animal, on being suspended in the same manner as after the former operation, hangs with its fore-limbs thrust backward, with retraction at shoulder joint, straightened elbow, and some flexion at wrist. The hand of the monkey is turned with its palmar face somewhat inward. The hind limbs are similarly kept straightened and thrust backward; the hip is extended, the knee very stiffly extended, and the ankle somewhat extended. The tail, in spite of its own weight . . . is kept either straightened and horizontal or often stiffly curled upward. There is a little opisthotonos of the lumbosacral vertebral region. The head is kept lifted up against gravity and the chin is tilted upward under the traction and backward rotation of the skull. . . . When the limbs or tail are pushed from the pose they have assumed, considerable resistance to the movement is felt, and, unlike the condition after bulbar section, on being released they spring back at once to their former position and remain there for a time even more stiffly than before."

Wilson points out the analogy between the foregoing experimental mesencephalic transection and the clinical phenomena observed in man when cortical function is lost. The cases are acute and are commonly the result of cerebral hemorrhage, meningeal inflammation, certain intracranial tumors and also hysteria. There occurs loss of consciousness, more or less complete, together with tonic rigidity of the trunk and limbs minutely resembling experimental decerebrate rigidity. Partial forms of decerebrate rigidity are hypothecated as arising in various organic and functional diseases, for example, in athetosis and chorea.

The author divides the various forms according to the following classification:

(1) Occurring with an associated loss of consciousness
  - (*a*) Cases of decerebrate rigidity or attitude and tonic fits combined
  - (*b*) Cases of decerebrate attitude without tonic fits
  - (*c*) Cases of tonic fits without persisting decerebrate attitude

(2) (*a*) Cases of decerebrate attitude in conscious life
  - (*b*) Incomplete, limited or fragmentary cases
  - (c) Cases of decerebrate attitude in the course of conscious involuntary movement, especially chorea and athetosis

Under 1 (*a*) a case is cited of a young man, aged 19, who suffered four weeks with frontal headache. He fell unconscious, remaining so about twenty minutes, and afterward had intense headache. During twelve hours he had

ten convulsions of epileptiform nature. Later there were vomiting, giddiness and staggering. The left limbs became immobile, and he was drowsy. The left arm was adducted and flexed at the elbow, the left leg slightly flexed at the knee and the hip adducted. Both the arm and leg showed distinct rigidity. The clinical picture then changed. Unconsciousness developed, the arms became extended, rigid, and slightly flexed at the wrist; the legs were also rigid, extended and adducted with the toes pointing downward and inward. Later in the same day the arms rotated internally with palms facing outward and upward, and there was dorsiflexion of the great toes. Tonic fits occurred at intervals, but with no alterations of the decerebrate attitude in the interim. Death ensued seventy-two hours after the beginning of decerebrate attitude and necropsy revealed a vascular glioma on the under surface of the right frontal lobe, with hemorrhage filling the ventricles and extending under the meninges at the base and into the spinal theca.

A second case began with a "stroke" and left-sided paralysis, followed in a few hours by tonic fits and the decerebrate posture. Necropsy revealed an extensive hemorrhage in the right cerebral hemisphere with extension into the ventricles and beneath the meninges. A third patient gave a history of symptoms beginning six months prior to admission. "She lay in bed with face turned to the left, chin slightly up, the occiput to the right and rather down toward the right shoulder. The right arm was closely adducted to the chest, elbow at a right angle, forearm incompletely pronated, wrist extended, fingers and thumb slightly flexed. Extreme hypertonus was present, and voluntary movements were weak. The right leg was fully extended at the hip, knee and ankle, strongly hypertonic and immobile." Four days later tonic spasms set in on the left side, followed by stupor and immobility. Respiration was very much disturbed. Soon, however, she passed into a state of extreme rigidity in the decerebrate attitude. The tonic fits continued. The uvula on the following day contracted and relaxed alternately at a rate of about 120 per minute—a so-called "palatal nystagmus." At necropsy a tumor of the mesencephalon was found, invading the pons.

The fourth patient was a child with suppurative meningitis and an extension of the infection into the temporal lobe with abscess formation, which ruptured into the ventricles. Twenty-four hours before death she was in a decerebrate attitude, and until death exhibited tonic fits more severe on the left—but during which the decerebrate posture was more pronounced.

The fifth case was that of a child over 2 years of age, who assumed a marked flexor position with flexor hypertonus. Her attack began with an epileptic seizure after which she was apathetic, irritable and inattentive to excretory functions. Three days later the legs extended fully, but did not remain constantly so, and in two more days the arms extended also. The characteristic decerebrate posture was now present, and tonic fits supervened which accentuated the attitude. At postmortem examination a typical tuberculous meningitis was found with moderate internal hydrocephalus.

In each of the five cases, the decerebrate posture was found duplicating closely the experimental type. Extension-pronation of the arms and extension of the legs with the toes pointing downward was present in all. The tonic fits always accentuated the posture, and the author calls them "attacks of decerebration." Clonic spasms were never present, but respiratory disturbances were.

A child aged 15 months entered the hospital after a six weeks' illness characterized by vomiting after meals and an occasional stiffness and trembling

of the limbs. On admission the child was unconscious and the decerebrate attitude was present. The posture became intensified during the remaining nine days of the patient's life. Necropsy was not obtained.

(*c*) Cases of tonic fits without persisting decerebrate rigidity are less frequent than the foregoing types. The decerebrate rigidity attitudes are present only during the fits. Hughlings Jackson once described these tetanus-like seizures, calling them "cerebellar fits," and little has been added to his description. The author says that "it is possible to resolve these complete seizures into component elements . . . partial, incomplete, even segmental tonic attacks may be met with, and . . . some at least of the more or less fixed attitudes of the head and neck, trunk and of one or other limb, or part of a limb, encountered in certain basal, subtentorial and other lesions, are in reality functional fragments, so to say, of a non-cortical motor mechanism which finds its full expression in decerebrate rigidity and in complete tonic fits." Instances of both hysterical and organic types have been observed.

The case cited is that of a boy, aged 18, who complained of pains in the head, shakiness and drowsiness, after receiving two injuries to the head followed by unconsciousness. Two months later he had influenza and in two days his first fit. The fits recurred three or four times a week and were not amenable to treatment. During a fit the arms were extended and hyperpronated, hands clenched, wrists flexed, eyes rolled up and eyelids closed. The face appeared to be in a tonic spasm and the limbs stiff. Then he would slowly and seemingly deliberately turn the body around so that he lay on his face, the turning movement being accompanied by slow sterterous respiration. The body curved anteroposteriorly. In a few seconds he relaxed and the limbs could be moved like flails. After being turned on his back a second fit came on; the left arm went out in a tonic spasm in hyperpronation, the body arched backward in a powerful tonic contraction, the right arm extended and rotated internally, and then the body turned as before, following the left arm; this time he made a complete rotation, coming onto his back again. Relaxation and atonia followed. A third fit came on with contraction of the recti abdominis, bringing the body forward, but later there was opisthotonos and the arms went away from the sides followed by rotation of entire body, as before. The author comments on the purity of the tonic fits, the postures assumed being those of decerebration. He says that in persisting decerebrate rigidity the posture may be in part compounded of mutually antagonistic couples, which may be dissociated in the course of an actual tonic fit, one overbearing the other. "Where there is no persisting structural cortico-mesencephalic separation there is less likely to be fixity of posture."

Another case is cited in which a glioma was found, after death, in the middle lobe of the cerebellum and part of the left lateral lobe. There was also blood in the left lateral ventricle. Here tonic fits came on during a dressing of the wound after operation had been performed. Decerebrate posture was present with each fit. The author believes that the intraventricular hemorrhage and not the tumor was the causative factor of the fits and posture.

Comparisons between the arc de circle assumed in hysterical fits and decerebrate rigidity attitudes are mentioned. The author finds instances of decerebrate rigidity, though not diagnosed as such, in cases reported by numerous observers—notably Bastian, Hughlings Jackson, Dreschfeld, Drummond, Bacon, Stewart and Holmes, Douglas Firth, Eskridge, Turner and Bruce. Two cases by Bruce are mentioned, in one of whom an aneurysm of the anterior communicating artery had burst, filling the ventricles and sub-

arachnoid spaces, and in the other an aneurysm of the left anterior cerebral had ruptured, ploughing through the corpus callosum into the ventricles. Turner's case is recalled in which there was a tumor, at the level of the corpora quadrigemina, which had produced the typical rigidity of decerebration. This patient had a pyrexia of 111 F. (by rectum) and lived four weeks. The same posture occurs in certain instances of organic nervous disease, namely, Little's disease and forebrain aplasia.

2 (*a*). In hysteria the decerebrate posture is assumed but not held indefinitely, as in those cases in which cortical control and consciousness are cut off. The tonic spasms of tetanus are likewise somewhat similar, though parts of the attitude taken are seen in "cerebellar fits."

Cases of more or less complete decerebrate attitude are reported, the following case record illustrating the point. A child normally born did not walk or talk at the usual age; he did not use the arms freely and was stiff at the knees. There was some spasticity of the legs and rigidity of the trunk. When lifted up vertically the arms were adducted at the shoulders, fully extended at the elbows, powerfully inverted and hyperpronated with wrists extended and hands closed in flexion—a case of cerebral diplegia. A second case given showed a mixture of other symptoms with partial decerebrate attitude.

(*b*) The group of incomplete, limited or fragmentary cases includes types of decerebrate rigidity occurring in one limb or a segment of a limb, and depends on a complete corticospinal interruption of that fraction of the system. Hemiplegia is mentioned as showing a unilateral decerebrate attitude "only in a sense," namely, the adduction at shoulder, pronation of forearm and flexion of wrist and perhaps fingers. Sherrington is quoted as follows: "If instead of both cerebral hemispheres, one only, say the right, be ablated, the decerebrate rigidity appears though not with the same certainty as after double ablation, chiefly on the same side as the hemisphere removed. The monkey, when slung after ablation of one, for example, the right hemisphere, exhibits generally the following attitude. The right limbs are extended in the pose described as characteristic for decerebrate rigidity; the tail is strongly incurvated toward the right, that is, its concavity and tip are toward the right. It resists passive movement to the left, and if displaced thither, immediately on being released flies back. The head also is pulled toward the right and retracted. The left forelimb . . . is sometimes distinctly more flexed than would be expected in the paralyzed condition of the animal; the left knee likewise. . . . The contrast between the attitude of the crossed and homonymous sides is very striking. . . . Homonymous extensor rigidity . . . is neither so constant . . . nor so persistent . . . as the rigidity following bilateral ablation. . . . It may totally subside and again reappear . . . as though a tonic influence from the still intact crossed hemisphere at times overcame and at times was overcome by another opposed influence from a lower center."

A case in point is that of a child aged 2 who, at the second or third month "lay like a doll" in bed. Use of the right arm began at six months in a jerky way and kicking movements of the legs followed. He had never held up his head nor talked. From the 18th month to two years, restless and jerky movements were more obvious. On admission emotion was shown only by crying. The power of the limbs was feeble and volitional control erratic. When lying on his back he kept the right arm level with the shoulder and flexed to a right angle at the elbow, the forearm midway between pronation and supination, the wrist somewhat overextended and the fingers and thumb flexed; the left arm was usually fully extended and close by the side or slightly adducted, the fore-

arm pronated and the hand closed in a fist. The right leg was flexed at the hip and knee, everted and abducted, with heel drawn upward and toes pointing downward; the left leg was like the homolateral upper limb—extended in full and sometimes slightly abducted. The head was usually turned to the right and somewhat retracted. Moderate muscular tonus was present. Choreiform movements interrupted the posture described and were particularly noticeable when the child was suspended by the axillae. Hughlings Jackson, in 1872, mentioned that "in some cases of cerebellar disease there is only a fragment of the tetanus-like condition" which is significant in the light of recent interpretations of lesions in the brain stem or hind brain. In unilateral cerebellar disease the head is tilted back and the occiput turned to the side of the lesion. In bilateral cases the one tendency neutralizes the other but the retracting element brings the head back, which is the condition found in decerebration. The opisthotonos of decerebrate rigidity is explained on the same basis, the one rotating element neutralizing the other and the curving of the trunk and spine combining in both. Such conditions are probably not brought about by cerebellar conditions as most of the cases in the author's experience have shown mesencephalic lesions at necropsy.

The "pronator sign" is pointed out as characteristic in cases of decerebrate rigidity affecting one limb or a segment of a limb. The case of a child aged 12 is given. This patient had all the general symptoms of an intracranial tumor, which was clinically localized in the left cerebellum by a somewhat indefinite reeling gait. Operation was performed, and removal of a part of the left lateral lobe disclosed a small tumor at the left edge of the middle lobe. During the operation skew deviation developed, and ten days later when the left arm was extended it assumed an attitude of marked pronation and inversion. The left leg likewise was held extended and inverted at the foot, and the head assumed the posture of occiput to the left.

(*c*) In cases of partial decerebrate attitude occurring as involuntary movements in the course of chorea and athetosis, the "pronator sign" is observed during the movements in chorea. In athetosis, pronation is a most frequent posture. Both argue for a mesencephalic disturbance. A child of 3½ years was microcephalic and diplegic. When placed on his back and the head turned to the left the limbs were in moderate flexion, but on turning the head to the right an immediate extension of the left arm into the decerebrate attitude was always obtained.

In dystonia musculorum deformans, or torsion spasm, one or other of the limbs may assume the decerebrate posture.

Pathogenesis of Decerebrate Rigidity: Clinical evidence of transection at the mesencephalic level is not lacking, but the anatomic details must be supplied, for the present, from the experimental side. Attention is called to the disturbance in respiration which has occurred both in experimental and actual cases of removal of cortical control. The author suggests that there is herein evidence of a respiratory tract and a center which is situated near the nucleus ruber, and not in the cerebellum.

Hughlings Jackson's early statements concerning the "co-operation of antagonism" between cerebrum and cerebellum is set forth in his studies on hemiplegic rigidity. He says that there is present normally a positive and negative condition. "Negative states of the nervous centres cannot *cause* positive states of muscles, they may *permit* them." He speculates believing that the "rigidity is owing to unantagonized influence of the cerebellum. The cerebellum is the centre for continuous movements and the cerebrum for

changing movements. The former are tonic, the latter clonic." In walking, the cerebellum maintains the posture while the cerebrum initiates the changing movements. The unimpeded cerebellar control which occurs when the cerebrum is cut off gives rise then to rigidity. This condition accounts for the "negative and positive conditions in the contractures of hemiplegic children, in the athetosis of Hammond . . . rigidity and propulsive walk in paralysis agitans; temporary removal also for tetany and certain hysterical attacks and also for some post-epileptic conditions of movements." It cannot be said, however, that the chief rigidity-producing influence lies in the cerebellum, and it does not mitigate against the facts proved by decerebrate rigidity, that the lower centers are released when the higher are abandoned.

For the development of decerebrate rigidity the lesion is of necessity limited to the mesencephalon, cerebellum and pons, although certain influences arising in the basal ganglions cannot be denied. Granted that the spinal proprioceptive centers are intact, rigidity arising from mesencephalic transection can be abolished by section of afferent roots. Sherrington has said that ascending impulses to maintain tone are not transmitted through the dorsal columns, as section of these has no effect, whereas section of the ventrolateral cord abolishes rigidity. Weed believes Gowers' tract is the path and not the dorsal, since section of the inferior cerebellar peduncles does not influence the rigidity. Excitation of the anterior (superior) surface of the cerebellum from near the midline outward to near the lateral border of the cerebellar surface abolishes rigidity, as observed by Sherrington, Lowenthal and Horsley, Weed and others. From this it is argued that destruction of the same area might produce rigidity, and this has been observed by Sherrington and Thiele, though not constantly. Rigidity has persisted after removal of the cerebellum, and has been produced by stimulation of the midbrain after total removal of the cerebellum. It is concluded therefore that the "functional integrity of the cerebellum is not a condition sine qua non" for the appearance of rigidity after mesencephalic transection.

The real origin of decerebrate rigidity is placed by Weed in the region of the colliculi, particularly in the red nucleus. The red nucleus is of prime importance for the "reflex of standing," and the afferent impulses from the spinal centers stimulate it to tonizing functions. When the cerebral control is removed the tonizing effect goes on unchecked, the cerebral inhibiting fibers being found, according to Weed, in the frontopontocerebellar pathway. Stimulation of this pathway experimentally always inhibited decerebrate postures. The connection of this pathway traced by Weed to the anterior portion of the superior vermis suggests the explanation for the inhibition of rigidity when the anterior (superior) surface of the cerebellum is stimulated.

The mechanism of decerebrate rigidity is shown in the work on monkeys by Graham Brown. Points of stimulation, that is, "focal points," in the midbrain, which produce the phenomenon, are located by him on "either side of the midline at the level of the colliculi some millimeters ventral to the aqueduct, thus corresponding to the red nuclei (and possibly also, with that of the posterior longitudinal bundle)." Stimulation of one area produces a flexion of the arm of the same side and extension of the opposite, these postures remaining after cessation of stimulation. The tail bends to the same side, the homolateral leg extends and the contralateral leg flexes; the head is turned away from the stimulated side. "A successive compounding of the two focal points has produced bilateral extension, and bilateral flexion."

The elements of decerebrate rigidity are mutually reinforcing and mutually antagonistic. The extension of all limbs is due to influences from the red

nucleus, or is affected by them. The unisegmental attitude, such as the pronator sign, is supposed to arise from partial red nucleus activity. The large type of cells in the red nucleus may represent combinations of anterior horn cell groups of the cord, a re-presentation. The antagonism between the red nuclei lies below the midbrain, as low as the spinal centers. Therefore the section of the mesencephalon allows uncontrolled innervation of the anterior horn cells by the centers which influence them in the red nuclei, thereby producing the attitude of rigidity. The tonus produced, is, according to Sherrington, "reflex standing."

It is probable, however, that the red nucleus is not alone responsible for postural activities, and the author mentions "Edinger's nucleus motorius tegmenti, which consists of associated motor-cell groups scattered through the pons and mesencephalon to the level of the neutral optic thalamus, including Deiters' nucleus," and it is not likely that the effect of stimulation is limited "to one descending rubral path, the rubrospinal." Thiele has stated that Deiters' nucleus and not the red nucleus conducts the impulses of decerebrate attitude to the lower centers. Magnus and de Kleijn support a labyrinthine agency.

The author closes by mentioning the connection of the red nucleus and involuntary movement, quoting Jackson as follows: "tremor differs from rigidity not fundamentally but in degree."

PATTEN, Philadelphia.

THE ANATOMIC CONDITIONS OF BINOCULAR VISION. M. MINKOWSKI, L'Encephale **17**:65 (Feb.) 1922.

The author's contribution is based on a study of secondary degeneration in the optic nerve, chiasm, the optic tracts, the primary visual centers and the cortex, following enucleation or loss of one or both eyes. His own work was done on tissues of the rabbit, cat, goat, monkey and man. The chief contribution to the anatomy of binocular vision is a study of the structure of the external geniculate bodies and their afferent and efferent tracts.

By the time they leave the chiasm the fibers of the optic nerves have a definite arrangement which persists in general throughout the optic tract. In man three zones are distinguishable: a ventromedial composed chiefly of crossed fibers, a central composed of direct and crossed fibers and a dorsolateral composed chiefly of direct fibers. The author believes that the central zone probably contains fibers composing the macular bundle.

The optic fibers enter the anterior corpora quadrigemina. In the lower mammals they enter by the peduncle and terminate in the periphery, thus forming a superficial mesencephalic root of the optic nerve. In the macacus monkey there is an interesting bundle composed of crossed optic fibers which reaches the inner portions of the anterior corpora quadrigemina. These fibers separate from the medullary capsule of the external geniculate body, passing first into the arcuate fibers which surround them, and then continuing in a distinct bundle located internally and posteriorly to the medial side of the internal geniculate body, reach the anterior part of the anterior corpora quadrigemina. They finally pass with the ribbon of Reil and probably terminate in the gray and white layers of the anterior corpora quadrigemina. On this account the author feels justified in designating this fiber system the deep mesencephalic root of the optic nerve or dorsal ribbon of Reil.

As for the pulvinar of the thalamus, the author holds that the total number of fibers terminating in it is small and probably composed equally of crossed and direct fibers.

After loss or enucleation of one eye there appear in quite different parts of the two external geniculate bodies, a reduction of the intercellular molecular substance and diminution in quantity of the ganglion cells and neuroglia reactions. From this the author concludes that the direct and crossed optic nerve fibers have each their own terminations, whose limits correspond to the areas of degeneration shown in the external geniculate bodies. The latter are divided into a certain number of cell layers by medullary lamellae; this stratification is evidence of the existence of separate fields for crossed and direct optic nerve fibers. In an animal with one eye destroyed, the atrophy occurs in particular cell layers of the external geniculate bodies and alternates in the external geniculate bodies of opposite sides in such a manner that the layers atrophied on one side are normal on the other. In general, the crossed optic fibers end in the external part of the external geniculate bodies. In the posterior portion of the external geniculate body the cells diminish in number, whereas the geniculocortical fibers, which originate as the axis cylinders of the cells of the external geniculate body, increase. Thus, the external geniculate bodies serve as the chief relay station of the subcortical optic pathways. The author says that the external geniculate body plays the most important part of all the primary visual centers of higher animals and man in transmitting retinal stimuli to the cortex. It is through it that the cortex is activated and also by means of the corticofugal paths extending to the corpora quadrigemina and transmitting stimuli to the oculomotor nuclei that the simple visual reflexes such as those of convergence and accommodation are controlled.

The author could not settle the question of the existence of a reciprocal relation between the two chief fields of distribution in the external geniculate bodies, especially between the portions receiving stimuli from corresponding or slightly different portions of the two retinas. He points out that the atrophy of particular layers in the external geniculate bodies after enucleation of one eye is more marked than after destruction of both eyes. This suggests that in a one-eyed animal or man, stimuli going from the normal eye to the external geniculate bodies have an inhibitory rather than an excitatory influence on the elements derived from the destroyed eye, and thus favor the atrophy of these elements. If this is so in the blind, the author suggests that in normal binocular vision there also exist reciprocal relations both of excitation and inhibition between the elements of central representation for the corresponding parts of the two retinas. Central representation of the various sectors of the retina in the external geniculate bodies has not been dealt with by the author.

In man and monkey there is an accessory nucleus of the external geniculate body, the gresium praegeniculatum, which has been described as a part of the reticular zone and thalamus. From a study of secondary degeneration, the author classes this nucleus among the primary visual centers. The gresium praegeniculatum commences a little anterior to the anterior portion of the external geniculate body in the dorsolateral angle of the optic tract. Its internal portion passes to the subthalamic region and lies alongside the ventral nucleus of the optic thalamus. Its cells are extremely small. After enucleation of one eye the contralateral gresium praegeniculatum shows partial atrophy, thus indicating that the crossed optic fibers and possibly some of the direct fibers end in it. The function of the gresium praegeniculatum is not definitely known. Lesions about the calcarine fissure or of the optic radiations produce secondary degeneration in it.

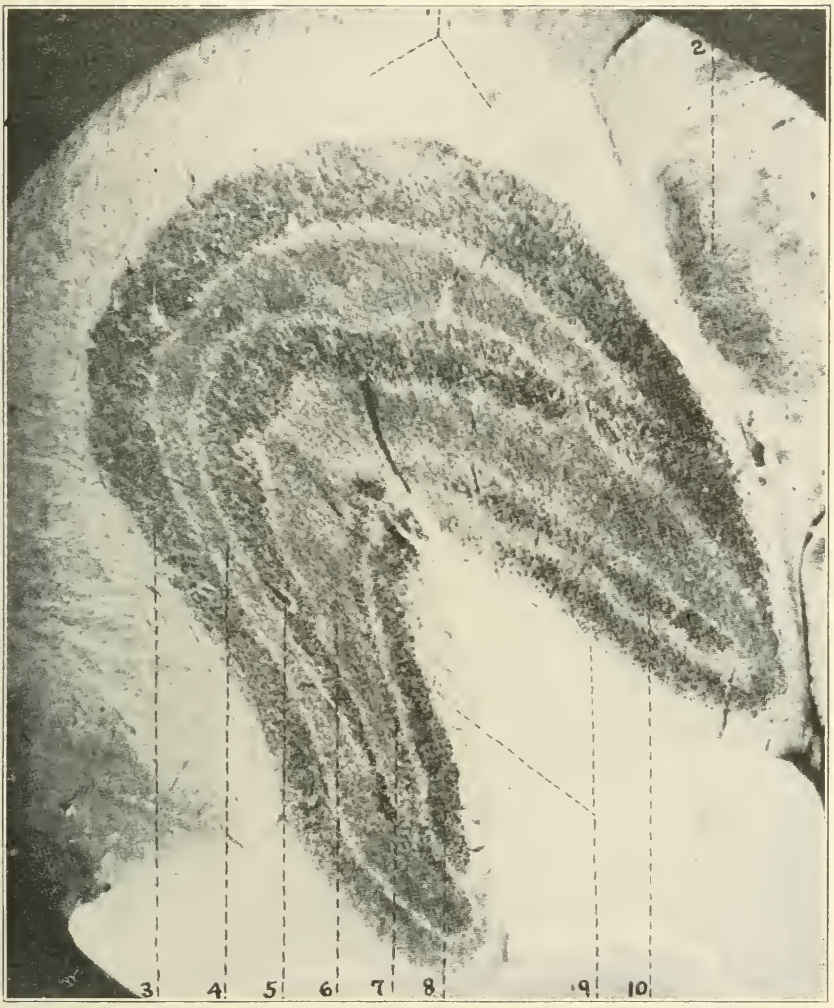

Fig. 1.—This illustration shows how the degeneration affects particular layers of the external geniculate body. The section is frontal, through the middle left external geniculate body, eight months after enucleation of the left eye. *1*, medullary capsule of the external geniculate body; *2*, external geniculate body; *3*, normal peripheral stratum of the medium size cells; *4*, atrophied intermediocentral stratum; *5*, normal intermedioperipheral stratum; *6*, atrophied central stratum of the medium size cells; *7*, atrophied central stratum of the large cells; *8*, atrophied peripheral stratum of the large cells; *9*, normal basal medullary lamina with its small cells; *10*, degenerated medullary lamina between the central strata of the large and medium size cells.

Since loss of an eye produces distinct atrophy in certain definite portions of the external geniculate bodies, we can assume that the axis cylinders of these cells which comprise, as geniculocortical fibers, a large portion of the sagittal radiations of the parietal and occipital lobes (Meyer's bundle—radiations of Gratiolet) also undergo an alteration, at least when the cellular atrophy is at

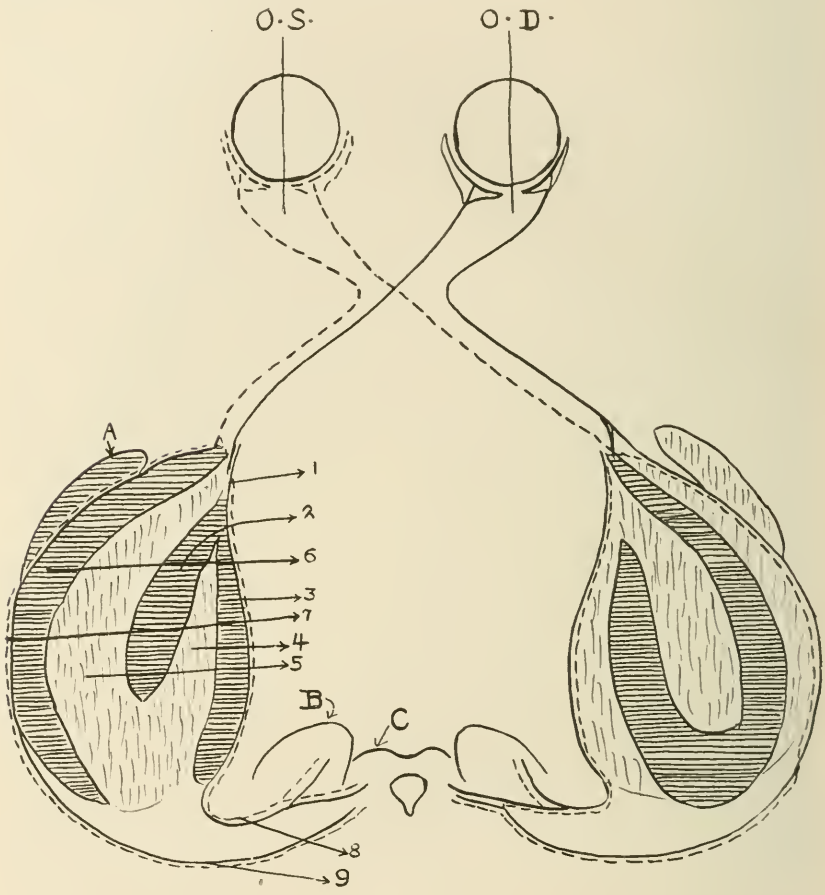

Fig. 2.—The right eye has been destroyed. The heavy lines denote degenerated areas in the external geniculate bodies. *A*, griseum praegeniculatum; *B*, pulvinar; *C*, corpus quadrigeminum anterior; *1*, medial basal lamella; *2*, intermedioperipheral stratum; *3*, large cell peripheral stratum; *4*, large cell central stratum; *5*, central stratum; *6*, peripheral stratum; *7*, medullary capsule; *8*, superficial optic fibers to pulvinar and anterior corpora quadrigemina; *9*, deep optic fibers to anterior corpora quadrigemina.

all advanced. This is the case in the monkey. This alteration is more or less uniform throughout these radiations, and suggests that the fibers coming from the homonymous portions of the two retinas are more or less intermingled. After partial lesions of the optic radiations and calcarine cortex, both in monkey and man, secondary degeneration of the external geniculate body usually occurs, without any alteration in the different layers of the external geniculate

bodies related to these radiations. On the other hand, this degeneration often spares almost indentical portions of two adjacent cellular layers. From this the author concludes that the fibers of the radiations are not only intimately intermingled, representing both crossed and direct optic fibers, but that they are also distributed in such a way that the fibers originating from adjacent cellular fields of the external geniculate body occupy adjacent positions in the radiations, and represent, as do the cells of origin, corresponding or slightly different parts of the two retinas.

The representation of the external geniculate bodies in the cortex corresponds to the area striata, and lesions of this region alone can produce degeneration in the external geniculate bodies. The author's researches show that the intracerebral subcortical neurons re-represent in the calcarine cortex the arrangement of fibers described for the external geniculate bodies.

Although one may admit in principle the existence of special fields of representation of the homonymous portions of the retinas in the cortex, the author does not believe that the conditions are precisely analogous to those existing in the external geniculate bodies. In the cortex there is no need for a distinct limitation of any two fields, and the possibilities of correlation and association between them are infinitely greater than in the external genicular bodies. In any event, these fields are connected with the retina by means of the external geniculate body. The frequency of stimulation of a given neuron determines to the same extent the selection of associated pathways being used. Two stimuli of monocular origin, which are alike but not identical, probably exert a reciprocal influence on the external geniculate bodies, but it is only in the cortex itself that these two stimuli fuse into a single binocular sensation. The associative connections favoring the fusion of stimuli of monocular origin are developed between portions of the visual cortex and are frequently called into play by similar and synchronous stimuli. Different portions of the two retinas, as well as of one retina, are capable of numerous functional correlations, and the author believes that for each different element of the single retina there are in the cortex anatomic and functional connections with different parts of the same and the contralateral retinas. Thus, in speaking of the field of representation of the two homonymous portions of the retina, one has in mind not a fixed and rigid geometrical scheme of representation but rather a complex and variable scheme in which the physiologic law of habit exerts its influence and which thus makes possible combinations which vary from one moment to another, under the influence of different physiologic factors—such as the flow of stimuli, as well as memories of previous stimuli.

The various fields of re-representation in the cortex constitute a step in the organization of visual stimuli coming from the two eyes. The question of the re-representation of the crossed and direct fibers in the cortex has been studied by different authors. The author believes that the theory of Wilbrand and Saenger, which is also adopted by Henschen, is well founded clinically. According to this theory, the central fibers serving for the representation of the homonymous portions of the retinas terminate in small adjacent fields of the cortex, which are placed like squares on a checker board, one field representing crossed and the other representing direct fibers, composing in this fashion a mixed field with a single physiologic function. Wilbrand and Saenger hold that there is a special field of representation for the internal portion of the retina present in the contralateral hemisphere only. In any event, it must be remembered that there is some reorganization of stimuli from the retina when they reach the external geniculate bodies, and whatever the cortical representa-

tion may be, it is dependent on the function of the external geniculate bodies as relay stations. The simple visual stimuli acting on the retinas are first organized in the external geniculate bodies. Then through cortical activity, more complex organization results.

Hyslop, New York.

THE PATHOLOGY OF THE PSYCHOSES OF SENILITY. Francesco Bonfiglio, Rev. sper di fremiat. **45**: Pts. 3 and 4 (Jan. 31) 1922.

This sterling worker in the field of neuropathology and psychiatry reviews the whole question of the psychoses of old age, reaching the following conclusions:

1. There are two distinct groups in the psychoses of advanced age: the arteriosclerotic and the senile dementias.

2. Cerebral arteriosclerosis is characterized by alterations in the large and small vessels, both meningeal and endocerebral, which frequently produce focal symptoms due to hemorrhage or softening. Besides these purely vascular conditions, there are definite changes in the brain parenchyma which, however, are always secondary to the former and are to be found in circumscribed areas of the brain which are supplied with blood by the affected vessels. So that alongside of areas of the brain gravely altered by this process are to be found well preserved areas. Therefore, the characteristic findings in arteriosclerotic brains are the more or less numerous, smaller or larger areas of altered brain tissue. The histopathologic complexes are at least two in number. The most common, described by many authors and summarized by Alzheimer and Rossi, shows sclerosis of the cells, deposits of lipoid pigment, necrosis, destruction of nerve cells and degeneration and destruction of nerve fibers. Also, according to the stage and severity of the lesions in the nerve elements, one finds proliferation of the neuroglia with formation of glia scars or frequently ameboid degeneration of the glia cellular elements. Hand in hand with this, there is an abundant accumulation of products of decay with consequent infiltration of this material into the neuroglia and vascular elements.

The other less frequent picture is the so-called productive form, described first by the author in cases of grave intoxication, and later by Gerletti and Livi in cerebral arteriosclerosis. This process is found in the ischemic areas or in their limiting zones and is characterized by intense global degeneration or even necrosis of all the ectodermal elements and active proliferation of the cells of the walls of the blood vessels—so much so that the chain of vessels in the affected area appears to be composed of large impervious cellular cords.

3. Senile dementia has a definite anatomic picture of its own, easily differentiated from that of cerebral arteriosclerosis or for that matter from any other picture already described. The cortex is diffusely affected by a primary degeneration or destructive process, involving the nervous elements, with infiltration of lipoid pigment and regressive or in part proliferating reactions in the glial elements. Especially characteristic findings are the "senile plaques" of Redlich and Fischer and the change into large "fibrils of Alzheimer." The plaques are constantly found, but the "fibrils of Alzheimer" are not. They, however, are more frequently present in the older and more advanced cases. The lesions in the blood vessels when there is no real arteriosclerosis complicating, are secondary to the processes of degeneration or caused by the atrophy of brain tissue. The later changes are the vascular nodes and grooves described by Gerletti.

4. Senile plaques and the large fibrils are never found in any other condition. Despite much work, the origin and nature of these specific pathologic changes are still obscure. Perusini, who first described them in the entity which Kraepelin designated "Alzheimer's disease" (presenile dementia) thinks that the "plaques" are due to the deposit in the neuroglia syncitium of special pathologic products. As to the large fibrils, the author thinks that, in part at least, the change is dependent on the neurofibrils. They have the same characteristics as the changes found by Donaggio in the neurofibrillar elements of animals exposed to cold and hunger. They are not identical with the changes found by Cajal in rabies, but somewhat similar. It is of interest to note that Gerletti has found these changes only in certain groups of cells in the hippocampus. The author thinks the plaques and fibrils have a common origin.

5. While the process in senile dementia is diffuse, it especially attacks the frontal lobes and the cornua ammonis in the vast majority of cases.

6. In a small number of cases which were grouped with the senile psychosis after the typical pathology was found, other portions of the cortex were found involved—the temporal lobes, the parietal and occipital (causing the aphasic, agnostic and apraxic symptoms of Alzheimer-Perusini's disease). In fact, the presence of aphasias and asymbolia and other focal signs in these cases differentiates them from true senile dementias, especially as they occur in persons who are chronologically not senile (30 to 50 years). They should be grouped and called "the senile dementia of Alzheimer-Perusini."

The cases of senile circumscribed cerebral atrophy described by Pick have not been well studied histopathologically. One can say, therefore, that they are or are not cases of cerebral arteriosclerosis or of Alzheimer-Perusini's disease.

7. The distinction made by Fischer between simple senile dementia and presbyophrenic dementia is not valid either from the clinical or the pathologic standpoint. Clinically, the cases described by Fischer as presbyophrenia are the senile dementias of other psychiatrists, while pathologically his simple senile dementias present the same characteristic pathologic findings mentioned in the foregoing.

8. The question of whether the basis of the pathology found in senile dementia is an accentuation of the same process occurring in ordinary old age or whether it is to be considered as an entity is a problem which must be left sub judice. The finding of the same histologic picture in the normal aged (80 to 100 years) by Oppenheim, Gerletti, Constantin and the author, seems to give some weight to the contention that we are dealing with a normal involution process which, becoming accentuated, finds its most favorable soil in senility. On the other hand, the fact that the senile plaques and fibrils are not found in the simple senile atrophic processes of other organs and further that they have been searched for in vain in the brains of old animals, would seem to show that neither of these processes is caused by the simple senile involutive processes of the brain.

9. The two diseases—cerebral arteriosclerosis and senile dementia—being clearly distinct entities, the remaining psychoses of old age may be subdivided into two further groups: (1) one with a pathologic picture not well individualized but different from either of the foregoing, and (2) a group whose histopathology is not known. To the first must be added all those cases described by Kraepelin, Alzheimer, Ziveri and Spielmeyer, most of which begin in the presenile age, have a varied symptomatology and course (paranoid

pictures or katatonic syndromes of the manic-depressive, agitation types, etc.) but which have in common the same unhappy ending with great mental degeneration. They present profound histopathologic changes which are not, however, specific. For this reason it is impossible to say that the same cause underlies all of these cases or that the morbid process is varied. Neither is it possible to say what connection they have with senile involution. It is certain that these cases, however, must be kept distinctly separate from the cerebral arterioscleroses and the senile dementias.

In the second group we must place all those cases which are still called "functional" and which are grouped according to symptomatic criteria, which are frequently varied to suit the views of various authors; as, for instance, the Kraepelinian conception of involution melancholia, the presenile depressive deliria, the presenile delirium of persecution and late catatonia. It has not been proved that all of these forms are related to senile involution. The article is written in a scholarly, concise way and is worth reading in the original.

OSNATO, New York.

TRANSORBITAL PUNCTURE OF THE GASSERIAN GANGLION.

CHESTER M. VAN ALLEN, Ann. Surg. **74**:525-545, 1921.

The author, in his discussion of transorbital puncture of the gasserian ganglion, gives an excellent review of the various technics employed in alcohol injection, and describes briefly the Harris and Hartel technics of ganglion injection. He reviews the bibliography, and presents the anatomy of the orbit and of the middle cranial fossa, illustrating clearly the particular points involved in the transorbital puncture of the gasserian ganglion. He describes his own technic, stating that a small incision is made just below the pulley of the internal oblique muscle, the periosteum leading into the orbit is loosened, the needle is inserted underneath the periosteum against the pulley and is passed underneath the optic nerve through the sphenoidal fissure into the gasserian ganglion.

The results of a laboratory investigation on twenty-four cadavers available in the dissecting rooms of the department of anatomy, Yale School of Medicine, are reviewed. Bilateral gasserian punctures and injections with methylene blue were carried out. After each injection a strand of wire was inserted in the needle bore and allowed to remain as an indicator of the pathway followed. Careful dissections were then made in each case to study this pathway and to determine the behavior of the injected fluid. Of fifty-two consecutive punctures, forty-three were shown to enter and successfully to infiltrate the ganglion root. Of the remaining nine, two on a microcephalus and two on a child of 8 years may be eliminated, as the anatomy was not that of the normal adult skull. Five punctures were failures—four because the needle terminated within the cavernous sinus, and one because, for some unascertained reason, the sphenoidal fissure could not be found. From an anatomic standpoint, the technic shows an efficiency of 90 per cent. In view of the experimental evidence, the author felt justified in trying it on a few patients on whom general anesthesia was not indicated and on patients suffering from trifacial neuralgia when it was advisable to make injections into the gasserian ganglion. The results obtained in five cases are reported. In three cases local anesthesia was employed for blocking the fibers of the fifth nerve in order to permit operative procedures on malignant lesions in aged patients. A few drops

of alcohol were injected into two patients who were suffering from trifacial neuralgia. In four cases anesthesia of the entire trigeminal field was produced. In one case the needle failed to reach the ganglion, and this can be ascribed to only one cause—some slight variation in the bony contour of the skull. Whether successful or not, the passage of the needle in these instances caused no serious damage to the patient. The orbital portion of the route was entirely painless; the passage behind the orbit intensely painful. In two of the cases the fact that the cavernous sinus was transfixed was demonstrated by suction of the needle during its entrance; in two cases no effort was made to determine whether or not the sinus was injured; and in one it was self-evident that the needle had entered the sinus. Yet in no instance were there symptoms to indicate intracranial or retrobulbar hemorrhage. The subcutaneous ecchymosis that followed puncture in three cases was of no greater extent than could be attributed to any such traumatism to these tissues; and the orbital edema in one case was probably induced by a few drops of alcohol left in the orbit by the retiring needle, a complication preventable by negative pressure exerted on the needle during its withdrawal. In three cases, when the bony terminus was reached and the stylet removed, cerebrospinal fluid flowed from the needle; venous blood exuded in one case, and in one case the puncture was dry.

The presence of cerebrospinal fluid at the end of the passage indicates that the cave of Meckel is reached and that injection of solution will involve the ganglion root; the presence of blood indicates clearly that the needle has stopped within the cavernous sinus and that further attempt to reach the ganglion should be abandoned. A dry puncture means that the needle has entered the lower part of the ganglion below Meckel's cave and an injection of solution will flow upward into the cave and thereby infiltrate the nerve root, or that the needle missed its mark and has come to lodge in some nonvascular tissue. The author says that in his experience with the injection of stain in cadavers, if more than a few drops of fluid are placed in Meckel's cave, it will discharge posteriorly into the basilar cistern. The cave is apparently in free communication with the subarachnoid spaces at the base of the brain.

The author feels that the results of his work, both anatomically and clinically, lead him to believe that transorbital puncture of the gasserian ganglion furnishes a relatively simple means of securing block anesthesia for operations in the territory supplied by the trigeminus, and is fully justified in cases in which general anesthesia is contraindicated.

Adson, Rochester, Minn.

A PSYCHOLOGIC INQUIRY INTO THE NATURE OF THE CONDITION KNOWN AS CONGENITAL WORD BLINDNESS. Lucy G. Fildes, Brain **44**:286, 1921.

The author feels that there may be some analogy between the cases of congenital word blindness and the alexias acquired as a result of morbid processes in the brain. The theories previously set forth to explain the condition are: (1) the assumption of definitely localized circumscribed visual and auditory word centers in the brain, destruction of which destroys language in its auditory or visual aspects, or (2) word blindness, which is only one symptom of a general lowering of mentality, and (3) a condition that is due to a special lowering in the primary visual centers, making visual perception of words and other "sense data" difficult.

The psychologic problems are two: Is inability to learn due to a general or specific defect? If the former, does it show itself only in reading, or is there a general lowering of visual power?

The subjects used for the investigation were twenty-six children, between the ages of 9 and 16 years, four attending ordinary elementary schools and twenty-two, schools for the mentally defective. They all had difficulty in reading. According to the Terman scale, the intelligence quotients varied from 50 to 111, as follows: The intelligence quotient in one was 111, in four from 82-88, in eight from 70-79 and in thirteen from 50 to 69 (morons). The interesting fact is mentioned that the fifth boy of the first two groups was in a school for mental defectives and fell below all the other four in general ability—but, in reading ability, he was better than the boy with the highest intelligence quotient who was poorest in this respect.

All these children had great difficulty in reading—some could not recognize letters, words or figures with certainty; some could read simple words and knew all the letters and figures well. No child was retarded less than four years in reading. Even the children who could read best had great difficulty in writing and spelling words. It was found in the experimental work that these children failed to retain what had actually been taught them. The tests calculated to show this fell into three groups: 1. Rapid visual discrimination of forms together with the ability to retain these without undue repetition. The forms closely resembled each other or differed only in the arrangement of their parts; for example, ran, ram or god, dog, saw, was. 2. A similar rapid and easy discrimination of sounds. 3. The possibility of establishing readily an association between a given form and a given sound. The experiments are arranged in three groups to suit these aims. The results are compared with those of a group of children able to read of equal age and mental ability. The exact number, age and intelligence quotients of these children are not given.

The experiments are carefully explained and the results tabulated. After each tabulation certain inferences are drawn which serve as a basis for the conclusions. Some of the tests appear to the reviewer to be rather stiff, and in many of them the control readers apparently had as much difficulty as the subject readers did in their successful accomplishment. Particularly difficult were the experiments used to test the power of making auditovisual associations. In these, a given form was exhibited for two seconds (hieroglyphics or Greek letters or shorthand symbols) and a common name given it by the examiner, then the children were asked to write the associated names after the examiner reversed the order of the name association for the various forms. Even more difficult than this was the experiment associating words and Greek letters. These visuo-association tests led to the following conclusions: 1. Nonreaders as a group make associations between dissimilar and characteristic forms and words with meaning as readily as do the readers. Their difficulty, however, is increased at a rate in excess of that of the readers, with the increase in similarity between the forms and sounds presented. 2. In all cases, the ease with which association is made between a form presented visually and a given name depends on the nature of these. 3. The facility of association is greatest when they are readily distinguishable and have a meaning apart from that inherent in their actual presentation; in other words, they must be symbols and must have the ordinary symbolic significance which

comes from their common interchange and use in the general environmental experience. It seemed to the reviewer that some of the author's tests lacked precisely this essential.

It is now possible to estimate the bearing of the experimental work which has just been described on the theories commonly held as explanatory of the condition having as its most obvious symptom failure to read or to learn to read. Three points are important.

1. It is clear from the facts: (*a*) that nonreaders are found among children showing all degrees of intelligence; and (*b*) that the degree of failure in reading, at least among normal children and high-grade defectives, shows little correlation with the degree of so-called general defect, and (*c*) that the underlying inability to read is to a certain degree specific in nature. The idea that deficiency in reading power is always an indication of a deficiency of a more general kind, is, therefore, by no means supported by the psychologic facts. Of course, the condition known as general defect is more frequently accompanied by loss of power in this particular, as in all other abilities, in these children than in children of normal mentality.

2. Yet there is nothing in the results of the experiments to indicate the existence of any such region as a visual-word center, the absence of, or injury to, which will make the visual recognition of words impossible. The defects found are not so strictly localized as such a hypothesis would demand, for the word-blind individuals reveal special difficulties in dealing with material other than words. Further, the implication of this theory that ability to read depends on the power to store up images of words has no psychologic support; the recall of images is not in question.

3. The theory that the experiments do support is that word blindness is only one aspect of a more general, yet still in itself specific, defect in either the visual or auditory regions or in both. All the nonreaders examined showed a reduction of the normal power in dealing with forms visually presented, especially when these forms were very much like each other, their defect being shown most definitely in their failure to remember such forms. Further, certain nonreaders showed corresponding defects in the auditory region—they could not readily discriminate or retain similar sounds. Some of the worst cases had defects of both kinds. Taking the group of nonreaders as a whole, however, no correlation could be found between auditory and visual ability; that is, these defects appeared also to be specific, although occasionally found in one subject.

Certain experiments indicate that the cause of the failure to associate, as well as to retain, sounds and forms, lies to some degree in this primary disability of the auditory or visual regions, resulting as it does in the failure of the forms or sounds presented to gain any meaning. Whether there is also a failure in primary retention, showing itself in the failure to form memory images to a normal degree, is not known. An inquiry into the use of imagery, depending as it does on the introspection of the subject, is difficult with defective children. Many of them used visual imagery in other matters, but they may, nevertheless, have been unable to visualize forms which had no meaning for them.

The author has done an immense amount of ingenious, careful psychologic investigation. Her investigation was made along lines calculated to yield just as good results in clinical cases, particularly the aphasias, which have hitherto been approached, it seems to me, in the wrong way.

Osnato, New York.

Society Transactions

AMERICAN NEUROLOGICAL ASSOCIATION

Forty-Eighth Annual Meeting, Washington, D. C., May 2-4, 1922
ADOLF MEYER, M.D., *President*

VENTRICULAR RADIOGRAPHY IN THE DIAGNOSIS OF BRAIN TUMORS. DR. WALTER E. DANDY.

A series of slides was shown, demonstrating the localization of tumors in the various parts of the brain by cerebral pneumography. Tumors anywhere producing symptoms of intracranial pressure should be localized in this way. If there are localizing symptoms there is no necessity for the injection of air. The dangers of the procedure were indicated and emphasized as serious and only to be assumed by one with experience in intracranial work; but it was pointed out that these dangers were small compared to the dangers of futile operations in attempting to find a tumor not previously localized. The indicated treatment for any brain tumor is a precise localization, and an accurate treatment rather than one of guesswork.

The extirpation of gliomas in the cerebral hemispheres and cerebellum was briefly outlined. The treatment consists of extirpation of the tumor together with a zone of healthy brain tissue around. The ultimate results of such treatment must await the verdict of time. The operation itself entails only a small mortality and there is no mental or physical defect produced which was not previously caused by the tumor's growth. Such resections, of course, are restricted to silent or nearly silent areas of the brain and are not indicated in the left temporal lobe.

DISCUSSION

DR. ERNEST SACHS, St. Louis: I have followed Dr. Dandy's work with great interest and have used his method since 1918. In my limited experience with the method, there have been few cases in which it has been of any value.

I reviewed my last fifty cases of tumor and found that I had exposed the tumor at operation in 70 per cent. of the patients. There is a great discrepancy if Dr. Dandy is able to localize every tumor with this method. However, I note he states that, in his experience, but 50 per cent. of the tumors can be diagnosed neurologically. Since he has pointed out that the method is of real danger, it seems that we ought to emphasize the importance of very careful neurologic study, with a view of making use of this method only in those cases in which localization is absolutely impossible.

I am inclined to take exception to Dr. Dandy's statement that the removal of such enormous areas of the brain can be accomplished without shock to the patient or without mortality. In my experience, such a procedure has been attended by considerable mortality. One other point which we shall have to determine is whether life is prolonged by a palliative rather than an operative procedure in the case of an infiltrating tumor.

DR. ISRAEL STRAUSS, New York: I believe all neurologists feel that any method which will assist in the localization of brain tumors is of great importance. All of us probably have had difficulty in differentiating between a

tumor in the cerebellum and a tumor in the frontal lobe. Dr. Dandy's method would offer the hope of surmounting that difficulty. If a tumor in the frontal lobe showed an involvement of the ventricle, there would be no hesitancy in discarding the possibility of a tumor in the cerebellum. Likewise, if we suspect that a tumor is in the cerebellum and find no involvement of the lateral ventricle and no internal hydrocephalus, it might aid us to reach the conclusion that such a neoplasm is present in that posterior fossa.

Regarding the operation on infiltrating gliomas, a neurologist must not be too conservative in the presence of these growths. I recall an instance in which the neurosurgeon removed practically the entire hemisphere of a patient, who afterward died. It is true that we found this tumor going over to the opposite side. This was a "chordotomy" of the cerebrum. If any of us were asked our choice as to whether we wanted to live with an infiltrating glioma or be relieved by a cerebral "chordotomy" we probably would choose the latter.

Dr. M. Allen Starr, New York: There are two methods of approaching this subject. The first is the neurologic. We need aid in operating on brain tumors because those who have had large experience are less encouraged at the present time than they were twenty years ago. The larger proportion of brain tumor operations are failures. The second way of approach is the surgical. We have something offered to us by Dr. Dandy which is epochmaking, if it can be executed properly.

Dr. Harvey Cushing, Boston: We all differ in our degree of conservatism about disease and the methods which are justifiable for purposes of diagnosis and treatment. I wish that Dr. Dandy would state specifically the number of tumor cases he has investigated in this manner. I believe that he has tended to be overenthusiastic about the procedure and to belittle the risks. He speaks of 300 cases in which he has used the method, and I hope he will tell us how many of these actually proved to be tumors that could not have been localized by the usual neurologic studies.

Dr. Dandy reports only three deaths in this series which contained, if I understood correctly, 100 tumors which could not be localized by other means. The subject was under discussion at a recent meeting of the Neurosurgical Society, and I should judge from the returns that the mortality in other hands has been very much higher, though that may be explained partly by our inexperience. Moreover, the information which has been given by the plates was perhaps not as dependable as Dr. Dandy has led us to hope it might be. Time will settle these matters, as it has with the use of the roentgen ray in localizing and diagnosing lesions of the pylorus, for example. We gradually have learned what filling defects are, and so we may learn also what filling defects are in the case of the ventricles. However, I am quite sure that, as we see such cases earlier, it will become even more difficult than it is to recognize cases in this way, because a tumor, unless it happens to arise in the ventricle, must attain considerable size before it can change the configuration of the ventricles in such a way, or to be of localizing value.

My small experience, together with what I have gathered from others, leads me to believe that the risks are no less than those we assume in doing a lumbar puncture and withdrawing fluid in the presence of a cerebellar tumor. We believe that it is hazardous, though we perhaps may have overemphasized them. One cannot withdraw fluid from the ventricles without dislocations which may be serious and may accentuate greatly preexisting pressure symptoms; nor do I understand how these symptoms can be set aside by the

reinjection of fluid. Certainly, if one had respiratory difficulties after drawing off fluid by lumbar puncture, he would not venture to attempt a replacement of the fluid.

I hope that Dr. Dandy will give us additional information in regard to his view of replacing the air by fluid, if hyperthermia supervenes. If there is any way of checking hyperthermia, I shall be glad to know of it.

In Dr. Dandy's enthusiasm, he has led many to believe that a shortcut to the localization of brain tumors has been discovered and that all such patients should be subjected to it. I may be unduly conservative, but I have grave doubts of this. If the procedure has been so successful in Dr. Dandy's hands, it is incumbent on him, for the sake of others, to be less general and more specific in regard to removing tumors that could not otherwise have been detected and removed, or those which may have been shown by the method to be unsuited for operation. Even if this should represent only a small percentage of brain tumors, instead of the majority he claims, we must eagerly accept the procedure as a very important contribution.

Dr. Bernard Sachs, New York: I have been thoroughly impressed with the dangers and limitation of the method. It should be applied only in cases in which the ordinary neurologic examination fails to disclose the probable site of the tumor. Dr. Dandy has emphasized that the procedure has to be applied with extreme care and that the surgeon should be present at the time the roentgen-ray plates are applied to the head.

Dr. Lewis J. Pollock, Chicago: I should like to ask Dr. Dandy whether any extensive studies have been made on normal lateral ventricles and whether any definite study has been made on the influence of lesions in certain parts of the brain in specifically changing the mechanics of the ventricular system. Dr. Loyal E. Davis and I have studied a number of normal brains fixed in situ; and, although we have had only thirty-six cases, I can readily see that there are a great number of variations which should be definitely noted. This is particularly true in reference to the posterior horns, which in some instances are exceedingly asymmetrical, very often quite blunt, so that one may be likely to misinterpret from a ventriculogram of such a horn, as impinging tumor.

Dr. Charles H. Frazier, Philadelphia: I believe that the discussion on this subject will be more interesting a year hence, when we shall have had a larger experience and shall be able to present statistics more accurately with regard to the helpfulness in diagnosis, the risk of the method and the increased percentage of the cases in which tumor may be removed radically. As Dr. Cushing has said, we have been handicapped by the lack of specific information in regard to technic. As to the propriety of endorsing what might be said to be a blocked section of brain tumors, comparable in a way to a blocked section of tumors of the breast where one would block out the mammary gland, the underlying muscle and all tissue adjacent to the tumor or possibly involved by it, my opinion is that this should be regarded as an extremely hazardous procedure. I should be disposed to look on these deepseated infiltrating gliomas in which the definition is not sharp, in which the tumor tissue shades off into the neighborhood, as inoperable from the standpoint of eradication and of making a rapid recovery. I should be in favor of resorting to removal by decompression, followed by radium therapy by direct implantation and later by the indirect method.

Dr. Charles A. Elsberg, New York: I have done about forty ventriculographies, a number in hydrocephalus of infancy and childhood and a number

in brain tumors. In two cases of the latter, the ventriculogram was of great aid in localizing the growth. One of the patients was a young woman. It was not certain whether she had a cerebellar or frontal tumor, and the ventriculogram contributed considerably to our arriving at a correct conclusion: that the patient had a cerebellar tumor.

I have been very conservative in making ventriculograms on account of the dangers of the procedure: but I have been fortunate in not having had any deaths, although in one of my earliest patients there were very severe symptoms after the air injection. In one of the institutions in which I am working, about 90 per cent. of brain tumors were correctly diagnosed and localized before the operation, during the past year.

I should like to know Dr. Dandy's point of view regarding the following question which concerns the removal or attempted removal of large infiltrating growths: Presuming that an attempt to extirpate a large infiltrating tumor is justified, how is one to know after beginning whether the entire growth with surrounding brain can be removed? It is impossible to foretell how large a tumor is. If one is dealing with a cystic glioma the size of which has been determined by air injection and radiography of the air in the cyst, a fairly correct idea of the size of the growth is obtained. It is an entirely different matter when one is dealing with a solid infiltrating tumor whose extent cannot be judged. The excision of small infiltrating growths, especially if they lie in or near the cortex, is of course justified.

Dr. Howard C. Naffziger, San Francisco (by invitation): I have had experience with approximately forty cases since the latter part of 1919, of which about fifteen have been cases of tumor. I have been fortunate in not having any deaths and only one severe reaction. Possibly because of my lack of ability in interpretation, I have not received help in localizing growths which lay between the foramen of Monroe and the foramina of Magendie and Luschka. The cases in which I have received aid have been those in which there has been some uniform enlargement, which caused deformity of the lateral ventricle.

I agree with Dr. Strauss that one does not explore a normal cortex with much feeling of security unless there is definite evidence that there is a lesion beneath.

Recently, I had a case of endothelioma such as springs from the base of the middle fossa, in which the inferior horn was obliterated and a portion of the superior horn reduced to a narrow canal on the right side. I believe that in less than half of the cases I have received help.

Dr. Colin K. Russel, Montreal: We want to know what actual risk is entailed and the reasons therefor, so that danger may be avoided, if possible. Dr. Dandy has reported several cases, but until we have actual statistics we must take the risk blindly.

Dr. James B. Ayer, Boston: I agree with Dr. Russel that even those who claim a large percentage of accurate diagnoses made by clinical examination will admit that there is still a residuum of cases in which any measure which will bring light will be welcome, and such a measure is pneumoventriculography. To my mind the discussion turns chiefly on the question of the safety of the procedure.

As I understand his technic, Dr. Dandy inserts a needle into the ventricle, draws off a considerable amount of fluid, and then replaces it with air. In such a procedure, there can be no doubt that a rapid, perhaps sudden,

reduction of cerebral pressure occurs, followed by a rapid increase of pressure which may be greater or less than that originally present. It seems to me that the ideal to be approached would be substitution of air for fluid, with no change of pressure at all. If that could be done, dangers incident on change of pressure could be eliminated.

Recently Dr. Mixter performed pneumoventriculography with a two-way needle which I had made experimentally as follows: Two lumbar puncture needles were soldered together in order to make one needle with two bores. To one was attached a glass manometer which ran up to about 350 mm. the height, being varied, however, by means of rubber tubing between the needle and manometer. The upper end of the manometer was bent over to allow fluid to be collected in a test tube. The other needle was connected with a syringe. As air was introduced from the syringe, fluid was slowly forced out, the whole procedure taking place under the same pressure as originally found in the ventricle. It seems to me that modifications of the procedure along such lines should make the technic safer.

Dr. Harry Hyland Kerr, Washington, D. C. (by invitation): In my experience with twenty cases of ventriculography, I have had no deaths. In two, the procedure helped materially, though neurologic examination gave a presumptive localization. In two cases, I was misled. In both of these, the roentgen-ray evidence pointed to posterior tumor. I should like to ask Dr. Dandy whether the normal variation referred to by Dr. Pollock has ever caused him to make a negative exploration.

Dr. Adolf Meyer, Baltimore: A series of observations that I made years ago in current necropsies corroborates Dr. Pollock's findings that in the occipital lobe we must use caution not to consider any asymmetry of the posterior horns alone as an indication of any disturbance in the structure of the brain, because asymmetry occurs exceedingly often. Therefore, in that region at least, there is very definite necessity for additional symptoms, and we are able to obtain those, because the occipital lobe after all is one of the most sensitive areas on account of the visual field interferences.

Dr. Charles E. Dowman, Atlanta, Ga. (by invitation): I have used Dr. Dandy's method in all suspected tumor cases when neurologic examination failed to give an accurate localization. It has been of value in two respects; namely, in localizing cerebral tumors and in excluding tumor. One tumor of the anterior part of the corpus callosum involving the third ventricle was accurately localized by the method. This unfortunately was inoperable, proving to be a rather large glioma, which was confirmed at necropsy. Another case was one of frontal lobe tumor in which there was a certain element of doubt as to the localization. It was accurately located by air injection and later was removed with success.

There were four or five cases of questionable tumor, cases in which there were papilledema and increased intracranial pressure, with no localizing findings or symptoms whatsoever, in which air injection seemed to exclude tumor, in that we obtained fairly normal appearing ventricles with no filling defects.

I believe that the method is more or less dangerous, although personally I have had no fatalities. I have always accompanied the patient to the roentgen-ray room, have manipulated the head myself and have immediately withdrawn the air after the examination. I have noticed that in inserting the needle in order to withdraw the air, a large amount of serosanguineous fluid escapes in addition to the air. This would seem to indicate that the air acts as an irritant and produces an oversecretion of ventricular fluid. I

wish to emphasize the importance of withdrawing this fluid and the air immediately after the roentgen-ray study. I believe such a practice will prevent to a large extent the element of danger.

Dr. Dandy, Baltimore: I did not mean to give the impression that this was not a dangerous procedure, for I have tried to emphasize the dangers in every publication. In fact, the danger is so great that, even with my enthusiasm for and confidence in the method, I have often wondered whether it has not done more harm than good because of indiscriminate use without judgment.

The procedure is one which must be handled with great caution, and the surgeon must be willing to observe the patient with care; for the dangers can be eliminated by very close after-care of the patient.

A few years ago, we analyzed a series of cases from the hospital which had been thoroughly studied. We are fortunate in that we have had the experience of Dr. Thomas in practically all of the brain tumor cases and in some that of Dr. Meyer. Therefore, in giving the statistics of 50 per cent. localization of brain tumors, there are no apologies due because many of those cases were verified only after two and sometimes even three operations.

If one's experience is largely with pituitary tumors or those which are self-localizing, the percentage of necessary uses for ventriculography would be very much less. I am sorry that I have not the accurate statistics, but I can assure you that the percentages which I have given are correct.

I can readily see why everyone does not obtain results from the use of the procedure; for one can be misled easily in the interpretation of the plates, unless he has had sufficient experience in differentiating the phantom from the real shadows, and unless he knows every step taken in placing the patient's head correctly. The results which I have obtained will substantially bear out the successful use of the method. If one can localize a tumor as small as a hickory nut, 7 cm. below the surface of the brain in a lateral ventricle, or precisely locate a tumor the same size in the third ventricle, and remove them at operation, it is sufficient proof that there is objective evidence of the merits of the procedure.

MENTAL HYGIENE. By Stuart Paton.

The permanence and progress of civilization depend primarily on success in educating the public in questions of hygiene, both physical and mental. It is foolish and disastrous to try to teach the two divisions separately. The old superstition that the body and mind should be considered independently should not be perpetuated. A campaign to prevent physical disease would be far more effective if it were associated intimately with mental hygiene.

Mental hygiene can be of great assistance in pointing out the kind of mental processes favorable for taking the first step in all sciences, i. e., the ability to draw distinction between appearance and reality. The greatest obstacles today preventing improvement in public health service are: obsessions, fixed ideas, prejudices, beliefs in mysticism and various other forms of irrational beliefs. Probably these forms of alienation are responsible for conditions that cause more deaths than all the infectious and contagious diseases combined.

Until mental hygiene plays a more important rôle in organizing the campaign to improve public health conditions, the effectiveness of physicians' efforts in this direction will be very much less than they should be. To

arouse people to the necessity of improving personal or community hygiene and of getting rid of flies, mosquitoes and other disease-bearing insects is first a question of mental hygiene.

There is another and more important reason for asking assistance of mental hygiene in an effort to increase the effectiveness of public health campaigns. Mental hygiene is a very effective means of diminishing the chance of war. It assists people to recognize early in their development the kind of mental processes involved in belligerent attitudes, or those that may easily become belligerent. The chief hope for the future is mental hygiene, as a means of preventing the form of insanity which leads to aggressive war. If not successful in preventing another war, then the public health campaign will be of little use to civilization.

Scientists who are familiar with progress made in the art of destroying life, since the armistice, say that one more world war will permanently cripple our civilization. Unfortunately, it cannot be said that we have been as intelligent in preparing for peace as for war. No organization of scientific men to establish and maintain peace exists today that is comparable in extent or effectiveness with the organization effected to wage war. We showed more organized intelligence in waging war than in preserving peace or fighting disease.

During the war, the intimate relations between body-mind problems were forced on our attention. Now we have relapsed into the old indifference. Attention has been directed persistently to the old superstition that interest in mental hygiene should be cultivated after physical hygiene is firmly established. One reason for this assumption is that the modern physician is trained almost exclusively in analytical methods. He does not realize that synthesis is as important as analysis. It is of immense practical as well as philosophic importance to the world that physicians realize that, as Dewey has said, it is "almost a truism that knowledge is both synthetic and analytic; a set of discriminated elements connected by relations." There is plenty of scientific curiosity in regard to analysis about the function of parts, but not about synthesis or human behavior. We study the action of separate organs but we should also study the machine as a whole—its activities as they are represented in behavior.

DISCUSSION

Dr. Foster Kennedy, New York: Dr. Paton's generalizations are the result of his desire to synthesize. He should analyze his generalization and explain the meaning of the words "mental hygiene." We understand how a community can be clean in a sanitary and physical way and know the mode of attack. I doubt if many have a clear understanding as to how to start psychical community cleansing. Undoubtedly, it must be accomplished by education, and the physician should be an educator; but I think Dr. Paton should state as precisely as possible the lines along which that education should go.

Dr. Paton has stated that mental hygiene, properly applied, could stop war. Is it not true that one of the causes of war is that every man who has been through one afterward forgets the unpleasant part? One never sees three old soldiers together, talking of their campaigns, without realizing that they are giving the impression that they had a splendid time. That impression is passed on to the youth of the generation and each generation must have its war in order to see what it is like. I believe that if those who were

uncomfortable for a few years in France were to make it clear that war is an exceedingly muddy, bloody affair, instead of being amusing, we might do something to correct the bias of the oncoming generation.

It is a little difficult to see what more can be done for this specific end. Every child of course ought to be told at an early age that every act he undertakes carries with it reward or punishment; and that every issue ought to be dealt with instinctively. It should be possible to inculcate, at an early age, a decent regard for the other man's rights and point of view. If Dr. Paton can tell us how to make a living force of a good system of ethics (Christianity has scarcely failed but has never been tried), then possibly he may succeed in a campaign of mental hygiene to prevent future war. The root of the matter is character and not intellect.

Dr. Joseph Collins, New York: Probably the members of the Association agree with every statement that Dr. Paton has made, but his communication disappoints me because it is not specific. There is no one who has more native ability and talent and time to outline and develop a scheme, than Dr. Paton. He knows that we agree with him as to the urgency of this matter. Therefore, I construe it to be his duty to present a scheme rather than a plea.

Dr. Paton has said that it is much more important to teach men how to think than what to think. Is there any way of teaching men how to think? Is there a psychologist who has formulated a plan or a definite rule as to how to think? Does not the organism, constituted physically and chemically different, think in different ways?

It is an individual reaction whether you will agree with Dr. Paton that a campaign of mental hygiene will eliminate war. The "mental hygiene" that Dr. Paton has in mind may "cure" man of his cravings for superiority and power, and if so, it may prevent wars. I do not believe that it would; nor do I believe that it is our duty as physicians to try to eliminate war.

Nothing has brought us into such discredit as our medicolegal conduct, because we have never been willing to take the time to teach the public the meaning of personality and behavioristic psychology. There is not the slightest effort being made to convey to the public that there are as many different types of psychologic, mental and emotional reactions as there are different types of facial lineament. We do not make the smallest endeavor to point out to great organizations and to the public in general that the paranoic type of mind is just as prejudicial before it displays symptoms of mental unbalance as it is afterward. We do not make the slightest attempt in our conjunction with pedagogues to make a differentiation of the different forms of mentality in their budding. These are all problems of mental hygiene. We do not do it because (1) we do not construe it to be our duty; (2) there is no incentive for doing it, and (3) there has never been any incentive or force from behind by the profession or force from in front by the public.

Up to the present, we have been content to instruct, to enlighten, to orient; we must arbitrate and judge as well; we must get our "feelings" into the case; we must be partisans. That is what has brought such infamy on us as expert witnesses. We do not take the verdict of the jury with the equanimity that Socrates displayed after his fellow Athenians had judged him; nor, unfortunately, do we appear to be willing to instruct, which he did all his life. But finally we shall content ourselves in so doing, when the insensate sense of our own dignity and importance has been eradicated and destroyed.

The aim of mental hygiene is to prevent or delay the development of so-called functional nerve disorder, to thwart potential mental disease, to equilibrate and aid the growth of every individual's instinctive, emotional and intellectual equipment, but especially those who are handicapped by inheritance or accident. To accomplish this, we must have a plan, for it cannot be done haphazard.

Dr. Bernard Sachs, New York: I am in sympathy with any movement for the improvement of the mental condition of the people of this country. Dr. Paton has endeavored to develop altogether too large a program, and he will completely fail of any success in this movement unless he limits it.

We have all believed that the idea of mental hygiene was not so much to improve the intellect as to prevent the development of unfortunate conditions of intellect. I do not agree with Dr. Paton that it is our function as physicians to teach the public how to think. The large majority of people do a considerable amount of thinking. Educational institutions are concerned with the problem of teaching persons how to think.

There are many other problems in the world that are of greater importance, and as far as making the mental hygiene movement responsible or in any way sufficient to influence future wars, I agree with Dr. Collins that we need not assume that enormous responsibility. I believe that there is need of psychiatrists and alienists in this matter, but there is also necessity for common sense men and women.

Dr. Edward B. Angell, Rochester, N. Y.: Ouizon, in his History of Civilization remarks that "common sense is the genius of humanity." If we could eliminate the word "mental," as Dr. Paton is endeavoring to do, we should be able to teach the important points in the development of mind in a better manner.

The primary requisite, in my opinion, for the development of mind is a well-developed brain, which we can obtain by proper training; and a well-balanced brain will give common sense, which is a primary requisite if we want to make mental hygiene of value to the public at large.

Dr. Colin K. Russel, Montreal: When one considers the history of the world and the disasters that have occurred at various periods, completely destroying the existing population, I sometimes wonder whether the present civilized world is not rushing on to its own destruction, and it is a question whether Dr. Paton's proposed campaign is not too late. In the report of the psychiatrists of the United States Army, one finds that more than 75 per cent. of the young men of this country (and probably this is true in other countries) had the mental age of 14 year old children, and more than 66 per cent. had the mental age of 12 year old children. If one questions the men of this country, the answers will be that of a boy 12 years of age, and this is the voice of the majority of voters. In the United States, with its hundred million population, about four million have real intelligence, are fitted to be leaders.

Dr. William A. White, Washington, D. C.: I think that it is too much to ask Dr. Paton to present a finished, well-worked out, thoroughly practical scheme for the proceeding which he advocates. We may have some moral responsibility as physicians, or if not we perhaps have some responsibility as citizens to bring to bear upon some such scheme as this.

As an administrative officer, I have never seen a situation that was so hopeless that it could not have been made better. If 75 per cent. of the people have intellectually the minds of 13 year old children, I am satisfied that there is some way of dealing with that problem.

Dr. C. Macfie Campbell, Boston: It is very difficult to eliminate words and to think in terms merely of concrete facts, actual reactions. There is not much difficulty in knowing what is meant by the term "mental hygiene." As the term hygiene has already been trademarked by those who have been working with infections and nutrition, we are compelled to use another term. Social hygiene is used by those who have found that public opinion prevents them from talking about venereal disease, so that we have been barred the use of that term. Therefore, I believe we have adopted in mental hygiene a term which is perfectly adequate for our practical purpose.

Psychiatry deals with the health of people, taken not merely as a problem of symptoms, but in relation to their adaptation to situations in the problems of life. In regard to these problems, the first important one is with regard to the tremendous number of gross mental disorders as ordinarily understood, the hundreds of thousands of insane people who are in the United States. We have assumed too fatalistic an attitude with regard to these disorders. If a person with a mild depression is mildly suspicious or is beginning to have disturbed sleep and peculiar impulses and odd speech, the common attitude is concealment. We should institute treatment at the earliest stage, but that can be accomplished only by wide community education.

In the average community, there are not the efficient facilities for treating an incipient stage of a mental disorder. The majority of practitioners have not been trained in the medical school to examine the patient and his reactions to his environment. After a thorough examination, including that of the central nervous system, and finding no definite cause, the practitioner states that the patient has "neurasthenia." Probably it is weeks, months or years before the patient with a mental disorder finally obtains adequate treatment. Is there, in every fair sized general hospital, an attempt to see that, in a special department, that aspect of the patient's disorder is observed? In medical schools, every medical practitioner realizes that it is part of his job, with regard to disease, to pay attention to emotional reactions, instinctive reactions and situational difficulties. We must be positive that there are proper opportunities for the early treatment of disorders in the state hospitals. As such problems begin in childhood, we should appoint school physicians and nurses who are alert to the necessity of giving attention to the emotional disorders of the child. This means that the teachers are not untrained and irresponsible individuals who have had a meager education, but in their training schools they have had impressed on them the necessity of recognizing these factors.

By laying adequate stress in the universities, in the medical schools, on an adequate department of psychiatry; by seeing that in all the health work of our state and municipal departments the foregoing factors are recognized; by seeing that in all our nursing organizations the nurse is trained not merely to look after individual organs but also to care for sick people, we shall be dealing immediately and in a practical way with the problems of the actually existing disorders of the community

Dr. Hugh T. Patrick, Chicago: I am most sympathetic with Dr. Paton's comprehensive and ambitious program. I am also exceedingly sympathetic with Dr. Campbell's program, which may be municipal, may be in relation to the commonwealth, and might be national in its scope. Part of our responsibility, aside from that to the public at large, either as physicians or as citizens, is our responsibility to the patient, to the patient's relatives and to the practitioners who bring these anomalies of behavior to us. Our duty is to help to educate the patient and the relatives and friends of the patient, and

to educate the medical profession. Dr. Paton's program is a very small, perhaps an entering wedge, which I hope will be realized ultimately, but I conceive it to be a serious responsibility. Of course, it involves (1) an adequate understanding of these peculiar behavioristic anomalies; (2) the capacity to impart to the general practitioner and to the lay mind a clear and concise conception of it, and (3) the time and trouble constantly to practice it.

Dr. Joseph Collins, New York: If anything is to result from this discussion, Dr. Paton should tell us whether he agrees with Dr. Campbell, whose conception of mental hygiene is that we may eliminate the five or ten millions of potentially insane in this country. Dr. Paton's conception of mental hygiene does not seem to be the same, for he has brought in the entire field of education.

Dr. Paton, Princeton, N. J.: I agree thoroughly with Dr. Campbell and think that he agrees that education assists an individual to adjust his life. I have brought this subject before university presidents, professors and school teachers and should like to tell Dr. Collins that he is the only person who has disagreed with that view.

CHICAGO NEUROLOGICAL SOCIETY

Regular Meeting, April 20, 1922

Lewis J. Pollock, M.D., *in the Chair*

A CASE OF BILATERAL SERRATUS MAGNUS AND UNILATERAL RADIAL NERVE PARALYSIS. Dr. G. B. Hassin.

Bilateral serratus palsy is a rare condition. Only two cases have been recorded (by Bramannin, 1888, and Sperling in 1891). Bramannin's case proved to be one of progressive muscular dystrophy, Sperling's of bilateral brachial plexus paralysis. It is almost generally admitted that a bilateral serratus palsy is a manifestation of progressive muscular dystrophy (scapulohumeral type of Erb).

The patient presented, 23 years of age, a repairer of typewriting machines, consulted me for weakness in the left wrist, inability to extend or abduct the left thumb and to extend the left index finger. The weakness was first noticed about three years ago, was gradually growing worse, but did not interfere with his work.

Examination revealed an oblique position of both scapulae with the lower angles projecting and approximated to the vertebral column; marked "winged" scapulae when the patient extended the arms at right angles to the body; inability to raise the arms to a vertical position unless he threw them up; atrophy of the pectoral muscles, especially the right; atrophy of the left supinator longus; slight drooping of the left wrist, which he extended with difficulty and with marked ulnar abduction; inability to extend the left index finger and thumb; absence of atrophy in the small muscles of the hands; absence of atrophy in the entire right upper extremity; asymmetry of the abdominal muscles with displacement of the umbilicus to the right and a mild scoliosis with curvature of the spine to the right.

The electrical examination revealed no response to the faradic or galvanic currents on the part of both serrati, lower third of the trapezius (both sides) and pectorals, but a good response in the muscles of the forearm and hand of both sides; the anodal closure contraction was somewhat stronger than the cathodal, especially on the left. The tendon and periosteal reflexes in the upper and lower extremities were brisk, without a Babinski sign. The abdominal reflexes were present. Sensibility was normal throughout. The lower extremities showed no muscular or other abnormalities. The pupils, mentality and genito-urinary organs were normal.

The patient thus showed a peculiar combination of scapular atrophy with paralysis of some of the muscles supplied by the left musculospiral nerve. Such a combination is rather unique and entirely foreign to the dystrophies, some features of which this case possessed. It is remarkable that the very muscles the patient used in his occupation showed the atrophy most. He was left handed, and began his present work at the age of 17. He had to move from the shelves a great number of heavy typewriting machines; in carrying them he pressed them closely against the chest and had to lift them to put them back. In using tools he made innumerable turning movements with his left hand and forearm and he used his left thumb and index finger in handling such instruments as screw drivers, etc. It is quite probable that the constant strenuous muscular efforts led to the atrophy, which is thus most likely of the occupation variety.

DESENSITIZATION AS A METHOD OF TREATMENT IN EPILEPSY AND MIGRAINE. Dr. Joseph L. Miller.

The accidental discovery that epilepsy and migraine are relieved by the intravenous use of various foreign proteins and by peptone has led to the view that both of these diseases may be anaphylactic in character. There is considerable evidence to support this view.

Asthma and hay-fever, recognized sensitization diseases, are both definitely hereditary. Heredity is evidenced in 90 per cent. of cases of migraine and 20 per cent. of cases of epilepsy. Their frequent temporary, and occasional permanent, disappearance after severe acute infection might be accounted for by desensitization. Frequently, bronchial asthma disappears during pregnancy; attacks of migraine, as a rule, are less frequent, or entirely absent, during pregnancy; epilepsy is often favorably affected by pregnancy. Anaphylactic shock in animals is always associated with eosinophilia, and Gansler reports eosinophilia of from 5 to 15 per cent. in 74 per cent. of migraines. Excitement or worry is an important factor in exciting migraine or epileptic seizures, and we have an analogue in nervous asthma.

We know little of the nature of the sensitizing agent—perhaps as in asthma a great variety of proteins may be responsible. Gowers refers to a patient who always had an epileptic seizure after eating beef, although other meats could be taken with impunity. If the manifestations are really anaphylactic we must assume that desensitization, or an antianaphylactic state, can be developed by nonspecific agents. In support of this assumption is the demonstration by Dale, Krause, Biedl and others, that animals sensitized to horse serum may be partially desensitized by peptone.

There are some interesting clinical observations on the results of treatment with protein. Spangler's use of snake venom in epilepsy was one of the earlier

observations. Crocket's results obtained by giving epileptic patients tuberculin are most interesting. Boehnstadt's treatment of 100 patients with migraine with a placental extract is suggestive in the results obtained.

Drs. Thomas, Raulston, and I have treated eighteen patients with migraine by intravenous injection of from 5 to 20 minims of a 5 per cent. solution of Armour's peptone, with great relief in all but four. There is little danger of anaphylactic shock with peptone given in such small amounts, and we have never observed any untoward results or febrile reaction, provided the peptone solution has been sterile.

POSTENCEPHALITIC MENTAL DISORDER; A CASE FOR DIAGNOSIS. Dr. Clarence A. Neymann.

A girl, 13 years old, was admitted to the Cook County Psychopathic Hospital, March 16, 1922, having been referred to this hospital by the Illinois Institute for Juvenile Research. They gave us the following history:

The patient was normal until an attack of epidemic (lethargic) encephalitis in November, 1920. She was at St. Luke's Hospital for five weeks. Since that time she has not been able to get along and has practically drifted from one institution to another. She was at the Wesley Hospital, the Detention Home, St. Mary's training school, the Mary A. Club, the House of the Good Shepherd, the Detention Home, St. Francis Hospital, Evanston, the Detention Home, the County Hospital, the Detention Home, and finally reached the Cook County Psychopathic Hospital.

Her mental age was 10 years with an intelligence quotient of 83.3 in January, 1921. The tests were repeated in January, 1922, when she showed a mental age of 10 years and 2 months with an intelligence quotient of 78.3. It is thus apparent that she suffered an arrest in mental development at about the 10 year level. In the Detention Home and other institutions, the patient was very quarrelsome, bit the other children, cuffed them, knocked them down and finally put pins in the tips of her shoes and kicked them. She was an inveterate liar, extremely incorrigible and accused every one of picking on her.

Physical examination revealed the usual findings of an old encephalitis; the pupils were irregular and reacted somewhat sluggishly to light and accommodation. There was a decided enophthalmos, and the facies had a parkinsonian expression. The knee and ankle reflexes were exaggerated, especially on the left side. Babinski, Gordon, Oppenheim and other pathologic reflexes were absent. The hands were held in a typical position folded in the lap. The patient was inclined to sleep a great deal while in the hospital.

Thus the case was rather typical of a postencephalitic dementia, but the active assaults on other children have not been explained. A further psychiatric examination is interesting. This showed that she was emotionally quite indifferent to her situation; threats of punishment did not affect her, and she showed no signs of regret for her actions. She had definite ideas suggestive of dissociation of personality. She said that sometimes she felt funny as if she were changing. At these times there was something in her head which argued with her and said all kinds of words. This happened whenever she thought and this thinking went back in her head and started talking and arguing. The patient also had definite hallucinations, both auditory and somatic. She said that when she lay down to sleep at night she believed some one was talking to her; she could not say just where the voices come from or whether they were those of men or women since they talked very fast

in her head. At other times she had feelings like electricity which shot through her body. All these things had been noticed by her since she had sleeping sickness. Paranoid trends were also present, especially against the people in the Detention Home, who, she said, picked on her, teased her and treated her with every conceivable meanness.

A diagnosis of a schizophrenic reaction in a patient with a postencephalitic dementia and psychosis was made. The case is presented because of the unusual psychotic symptoms associated with organic brain disease after epidemic (lethargic) encephalitis.

Book Reviews

SURGICAL AND MECHANICAL TREATMENT OF PERIPHERAL NERVES. By Byron Stookey, A.M., M.D., Assistant Surgeon, New York Neurological Institute. With a Chapter on Nerve Degeneration and Regeneration by G. Carl Huber, M.D., Professor of Anatomy and Director of Anatomical Laboratories, University of Michigan. Cloth. Price, $10 net. Pp. 273, with 225 illustrations. Philadelphia: W. B. Saunders Company, 1922.

The treatment of peripheral nerve injuries has had a varied history, not always happy, and one of the most valuable heritages that has come to us from the great war is the advance that has been made in this field. The abundant material from the war gave opportunity for the testing of different methods in large numbers of cases and for the application of newer theories, up to then experimental, to the human nervous system. The results have been most interesting and valuable, and have proved that the nearer nerve surgery approaches nerve histology the better are the results obtained. To the neurologist, this seems axiomatic, but unfortunately it has not seemed to be so to many surgeons in the past, or they could not have devised joining operations based on tendon surgery without considering nerve fibers as individuals. The modern neurosurgeon is a neurologist, well grounded in the anatomy, histology and physiology of the nervous system. When peripheral nerves are to be treated, the neurosurgeon should be somewhat of an orthopedist as well, for much of the preliminary and after treatment is orthopedic.

In this book, the author quite satisfies the foregoing requirements. His approach is primarily anatomic and histologic. To a neurologist, the book contains much of interest. Each nerve and plexus is considered first from the point of view of its embryonic development, with many clarifying references to the phylogenetic, and these points are then collected to form the basis for surgical principals. Operations are described in detail, and considerable space is given to the expectation of results. In places, one could wish that the author's material had been larger, but this is in good measure offset by an extended review of the literature and a compilation of the experience of others. The numerous illustrations add a great deal to the book both in enhancing the appearance and in supplementing the text.

The book opens with a chapter on the anatomy of the spinal nerve, in which is reviewed much of the newer work on development. Dr. Huber's chapter on nerve degeneration and regeneration contains a wealth of material in surprisingly compact form. The reviewer does not know where in English one may find a better exposition of the subject, for the knowledge of which we owe so much to Dr. Huber's original work. The following chapters on surgical methods would interest the surgeon more than the neurologist.

Following these chapters, the author considers in detail the various nerves and nerve plexuses in which injury is likely to occur, and methods of their repair. Never does the author wander away from the anatomic and histologic features of his problem, and one is impressed that he approaches his surgery with the histologic eye. His plan of presentation is consistent throughout. A point of interest to neurologists and neuro-anatomists is the description of an anomalous nerve distribution and supply as explaining atypical paralyses and failures of operative results. The author describes and pictures in diagram many of these anomalies which have been described by others. The

chapter on nerve tumors seems somewhat sketchy. Causalgia and amputation neuromas form the subjects of the last two chapters.

From the point of view of the neurologist, this book contains much that is of interest and of value, which lies in good measure in the author's clear presentation of the anatomy and development of nerves. It should serve as an easy reference book for the anatomy of peripheral nerves and for the indications in and prognosis for nerve injuries. It is likely that the general surgeon may glean from it more than would the neurosurgeon, and one may feel glad that it will carry to the general surgeon the neurologist's point of view, which considers the peripheral nerve as a histologic structure. The general makeup of the book is pleasing, and the diction is clear and makes for easy reading.

PSYCHIATRIE DU MÉDECIN PRATICIEN. Par M. Dide and P. Guiraud, Médecins de l'Asile d'Aliénés de Braqueville. Paper. Price, 20 francs net. Pp. 416, with 8 illustrations. Paris: Masson et Cie, 1922.

The various types of mental disorder are described in simple language under titles which conform in the main with those in conventional use. The style is didactic and consists largely of short paragraphs under appropriate captions which are practically definitions. The grouping of the material is founded on anatomopathologic concepts, the various clinical pictures being described as syndromes resulting from location and not from the nature of the lesion. Etiologic factors are therefore refused consideration in classification, with the consequence, for instance, that there is no group of alcoholic psychoses though the common clinical types are briefly described.

The disorders are divided into five main groups, the first two dealing with developmental defects or the results of damage in early life and the last three with the results of lesions acquired at a later period: 1. Defective mental development including idiopathic epilepsy, which is said to result chiefly from alcoholic intoxication in the ascendants. 2. Constitutional deficiencies of two kinds (*a*) pathologic constitutions such as the cyclothymic, neurasthenic, psychasthenic, hysteric, paranoid, etc., and (*b*) constitutional psychoses which develop on a basis of structural deficiency which is apparently comparable with the abiotrophy of Gowers. Here are included the manic-depressive psychoses, paranoia, paranoic states and dementia praecox. 3. Syndromes without damage to the fundamental mental framework, chiefly brought about by intoxications, include acquired neurasthenia, manic excitements, depressions and paranoid conditions. 4. Syndromes with temporary impairment of fundamental mental activity—deliriums and dreamlike states. 5. Syndromes associated with permanent damage of brain function—the dementias, focal and diffuse.

In most instances there is no attempt to define the anatomic localization of the lesion, except in the gross organic brain lesions, and the damage is merely referred to some psychologic system. Under the heading of dementia praecox the authors are more precise. The fundamental and hereditary, constitutional deficiency lies in "the nerve cells which preside over coenesthetic synthesis and instinctive vital activity," and this mechanism is possibly located in the subthalamic region, especially the locus niger. In view of the essential constitutional deficiency one wonders why "the most rational indications" for treatment should be "opotherapy, especially cerebral" and "remedies which provoke a general reaction of the organism," such as colloidal gold and nucleinate of soda.

There is increasing accord in recognizing that many of the conventional reaction pictures are not disease entities, and the authors are entitled to credit

for this effort; but it is at least doubtful whether much is to be gained by dogmatic assertions concerning syndromes in the present state of knowledge. The importance of affectivity and especially of instinctive and unconscious mechanisms is well emphasized in the opening paragraphs, and it is unfortunate, especially in view of the present trends of psychiatry toward preventive work, that more use is not made of the fact of conflict between these factors and a social mode of life. Furthermore, the emphasis on hereditary constitutional deficiencies is liable to assist in maintaining the pessimistic attitude toward mental disorders which has so long obtained. This work describes faithfully and well the end results of these still unknown deficiencies but tells little of the mechanisms involved or the means of combating them. It would seem especially desirable that such matters be given prominent place in a work designed for the use of the general practitioner, for the reason that it is on his knowledge and cooperation that we must depend largely for the practical application of psychiatry.

MALADIES DU CERVELET ET DE L'ISTHME DE L'ENCEPHALE. (Pédonucle, Protubérance, Bulbe). Par Henri Claude, Professeur a la Faculté de Médecine de Paris, and Lévy-Valensi, Ancien Chef de Clinique de la Faculté de Médecine de Paris. Paper. Price, 35 francs. Pp. 439, with 104 illustrations. Paris: J.-B. Bailière et Fils, 1922.

This is the thirty-second fasciculus of the encyclopedic "Traité de médecine et de thérapeutique" of Gilbert and Carnot. It begins with a consideration of the anatomy, histology, connections (six and one half pages) and physiology (fifteen pages) of the cerebellum, followed by an excellent exposition of cerebellolabyrinthine disorders. Sufficient mention of anomalies and atrophies of the cerebellum is succeeded by twenty-nine pages on cerebellar tumor and fifteen pages on cerebellar abscess. Lesions of the cerebellum in infections, intoxications and other diseases are briefly treated, and then Friedreich's disease and hereditary cerebellar ataxia receives twenty pages.

Then nine pages on diseases of the corpora quadrigemina leave the reader in a state of even greater embarrassment than this difficult subject warrants, but the section on diseases of the peduncles (twenty-eight pages) is excellent. Diseases of the pons are as well discussed as is possible in fifty pages, the symptomatology being particularly well presented and illustrated.

Only thirty-four pages are devoted to the medulla and its diseases. Then are presented "complex syndromes of the brain stem," namely, poliencephalitis, acute ataxia, epidemic encephalitis, tumors of the fourth ventricle, tumors of the pontocerebellar angle, vascular syndromes, scleroses of the midbrain and myasthenia gravis.

The entire work is decidely meritorious. Little is omitted, various opinions are freely cited, and the literature is adequately considered. What one misses is authoritative or judicial discrimination between the essential and nonessential, eventful and casual, determinative and contributory. The illustrations are well selected and the diagrams helpful, but the book lacks an index.

UEBER DIE BEDEUTUNG UND ENTSTEHUNG, DER STEREOTYPIEN. By Dr. Jakob Kläsi. Pp. 109. Price, 30 marks. Berlin: S. Karger, 1922.

Under the general title of stereotypies have been included a heterogeneous group of movements, attitudes or utterances, recurring in identical form often

over long periods, loosely bound together by the fact that they appear to be meaningless and purposeless under the circumstances in which they occur. In this monograph, Kläsi reviews the somewhat scanty literature, details the study of a series of cases and then draws conclusions which will go far toward bringing order and precision into this obscure field. The facts are presented in simple form, and the author carefully refrains from dogmatic conclusions or fanciful speculations. The book is well written and constitutes a real contribution to psychopathology.

Kläsi reserves the term stereotypy for recurring acts or attitudes which are autonomous, do not express a mood and are not consonant with the facts of reality. They are thus essentially schizophrenic. To be differentiated from them are: (1) Repetitions which merely illustrate a belief (e. g., puffing, under the belief that the person is a steam engine) for which the title "hermenia" is suggested. (2) Repetitions which express a mood such as melancholia. These are strictly movements of expression. (3) The swaying and rocking movements of the feebleminded, and the "vocational" and other originally purposeful movements observed in organic dementia. For these the name "monotypies" is proposed.

Kläsi finds it possible to outline from his material four groups of true stereotypies: (1) defense reactions against bodily hallucinations, (2) ceremonial movements or attitudes, (3) autistic acts, and (4) residua of movements originally purposeful but now more or less distorted and abridged. Contrary to the definition of Neisser, the first three are closely related to hallucinations and delusions.

The fourth group is of special interest because those stereotypies differ from the other varieties of stereotypy and also from the monotypies which, at first glance, they resemble because they are readily influenced and altered by experimental interferences such as time and change of place. Such experiments have no effect on the monotypies, and thus they give valuable aid in the recognition of the existence of an organic lesion even when associated with schizophrenia. The character and modifiability of stereotypies are also of value in prognosis. Finally, it may be noted that the analytic studies were carried out by simple conversations, made possible by the assiduous cultivation of a state of friendly rapport with the patient, which in many instances assisted materially in therapeusis.

INSTINCT AND THE UNCONSCIOUS. A Contribution to a Biological Theory of the Psycho-Neuroses. By W. H. R. Rivers, M.D., DSc., LL.D., F.R.S. Ed. 2. Pp. 277. Cambridge: University Press, 1922.

Accepting without question the concept of human instincts and emotions enunciated by McDougall, Dr. Rivers has here formulated a tentative explanation of the various phenomena of suppression, suggestion, dissociation, and other phenomena, which play so large a part in the psychoneuroses. Such phenomena are "regressions" or reversions under stress to primitive (instinctive) modes of reaction in a manner comparable with the "devolution" of Hughlings Jackson. The experience of the author has been limited largely to the neuroses of war and for this reason doubtless the danger instincts and reactions are especially prominent while the "appetitive" instincts, so much emphasized by the school of Freud, drop into the background. The modifying influence of reactions belonging to the sphere of the gregarious instinct is also a dominant feature. Two factors are alleged to explain the great frequency

of war neuroses—stimulation of instincts by the conditions of war and diminution of the force of controlling factors as the result of fatigue, illness and military training.

The great merit of the book lies in the strikingly simple and lucid manner in which the material is presented. The greatest care has been exercised in defining terms which are often used so loosely as to be almost meaningless. The references to and comparisons with facts of physiology and biology are excellent and afford much food for thought and further study. The absence of any trace of mystic neologism and animus in the discussion of Freud's psychology is extremely refreshing, and the physiologic concept offered as a substitute for the anthromorphic "censorship" of Freud is well worth consideration. Whether or not one accepts in toto the conclusions reached, the book contains so much of really constructive merit that it should be read by every one interested in the study and treatment of human behavior.

THE PSYCHOLOGY OF MEDICINE. By T. W. Mitchell. New York, Robert W. MacBride, 1922.

The physician who desires a short and pleasant review of present day notions concerning various forms of psychanalysis will find this book of 180 pages worth while. It adopts the attitude that there is something to be said on both sides. There is a review of the origin of present-day psychanalysis and a review of its development in the French school, led by the two pupils of Charcot—Janet and Freud. There is also a good outline of the development of the school of hypnotism. Mitchell emphasizes, among many other things, the essential differences between hypnotism and psychanalysis: one seeks to impose the personality of the physician on the patient, the other seeks to permit the patient to invoke the full content of his personality in the cure of his condition.

The style is pleasant and easy. Extremely technical terms are avoided and when inserted are well defined. The analysis of psychologic mechanisms is well carried out. After finishing, one feels "up-to-date," and able to converse with dignity and effect with any lay convert to the doctrines of Coué or Freud.

The book can be read to advantage not only by physicians but also by others interested in psychologic matters.

ÉTUDES NEUROLOGIQUES. Par Georges Guillain, Professeur agrégé à la Faculté de Médecine de Paris. Paper. Price, 25 francs net. Pp. 469, with illustrations. Paris: Masson et Cie, 1922.

This is a collection of fifty-six papers previously published by the author, generally in collaboration. They cover a wide range of subjects and are grouped under Fixation of Poisons of the Nervous System, Pathology of Cranial and Spinal Nerves, Muscular Atrophies, Spinal Fluid, Epidemic Encephalitis and Intoxications. Some of the articles are of especial value, and many are interesting. One might mention The Meningeal Form of Brain Tumor, Argyll-Robertson Pupils in Non-Syphilitic Lesions of the Cerebral Peduncles, Compression of the Cord in a Case of Recklinghausen's Disease, An Apnoeic Form of Tabetic Crisis, An Infectious Disease Characterized by Icterus and a Meningeal Syndrome, and The Medullary Form of the Sleeping Sickness (Trypanosomiasis).

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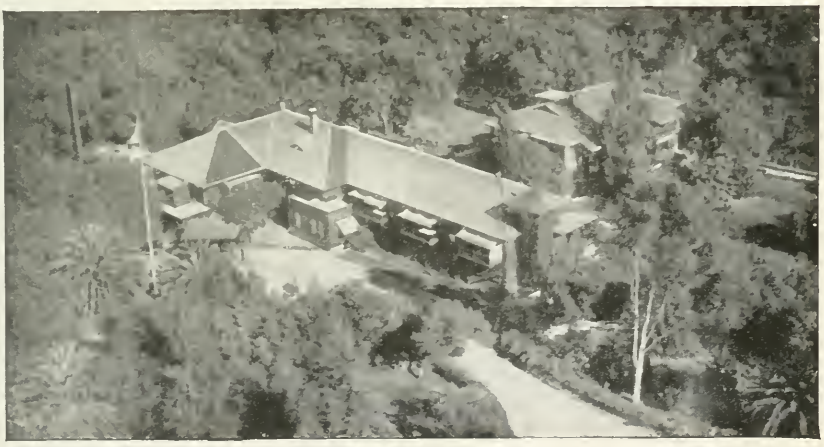

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STEPHEN SMITH, Medical Director, Las Encinas, Pasadena, Calif.

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RECENT STUDIES ON SPIROCHETES IN GENERAL PARALYSIS *

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WARD'S ISLAND, N. Y.

During the last five years a number of important articles dealing with the location of spirochetes in general paralysis have appeared, especially in the German literature, and I wish to try to summarize briefly the main facts, comments and theories that have resulted from the studies of three of the best investigators, namely, Jahnel,[1] Sioli [2] and Hauptmann.[3]

Jahnel [4] of Frankfurt has devised an excellent silver stain for spirochetes in the central nervous system. This stain brings out the organisms with great sharpness on a yellow, or yellowish-brown background; it usually leaves unstained those elements of nervous tissue (axis cylinders, etc.) that have heretofore been so troublesome to all who have tried to study spirochetes. It is largely due to the excellence of this stain that others, besides Jahnel himself, have been stimulated of late years to study the position, the distribution and the activity of these parasites in the brain and spinal cord.

SPIROCHETES IN GENERAL PARALYSIS; PARTS OF BRAIN MOST LIKELY TO SHOW THEM

By Jahnel's method spirochetes have been found in from 25 to 50 per cent. of the cases studied. Still higher percentages have been obtained by brain puncture during life and dark field illumination

* Read at interhospital meetings held at Hudson River State Hospital and Utica State Hospital, March, 1922.

1. Jahnel, F.: Ueber einige Beziehungen der Spirochäten zu dem paralytischen Krankheitsvorgang, Ztschr. f. d. ges. Neurol. u. Psychiat., Orig. **42**:21-88, 1918. Die Spirochäten im Zentralnervensystem bei der Paralyse, ibid., Orig. **73**:310-335, 1921. Das Problem der progressiven Paralyse, ibid., Orig. **76**:166-182, 1922.

2. Sioli, F.: Die Spirochaete pallida bei der progressiven Paralyse, Arch. f. Psychiat. **60**:401-464, 1919.

3. Hauptmann: Spirochäten und Hirnrindengefässe bei Paralyse, Ztschr. f. d. ges. Neurol. u. Psychiat., Orig. **57**:122-173, 1920. Klinik und Pathogenese der Paralyse im Lichte der Spirochätenforschung, ibid., Orig. **70**:254-299, 1921.

4. Jahnel's method is described by Stevenson, George S.: Two Recent Improvements in the Staining of Spirochetes in Nervous Tissue, Arch. Neurol. & Psychiat. **7**:349 (March) 1922.

(Valente, 70 per cent.). Spirochetes are believed to be present in all cases of general paralysis, and the longer one hunts and the greater the number of areas studied, the smaller is the percentage of failure to find them.

Spirochetes may be found in any region of the brain, but all of the authors agree that the frontal lobes, especially the anterior parts of these where the changes in the tissues are greatest, offer the best opportunities for finding them. They are seldom seen in the pia mater; seldom in the outer layer of the cortex; almost never in the white matter. As a rule, they are most abundant in the middle and deeper

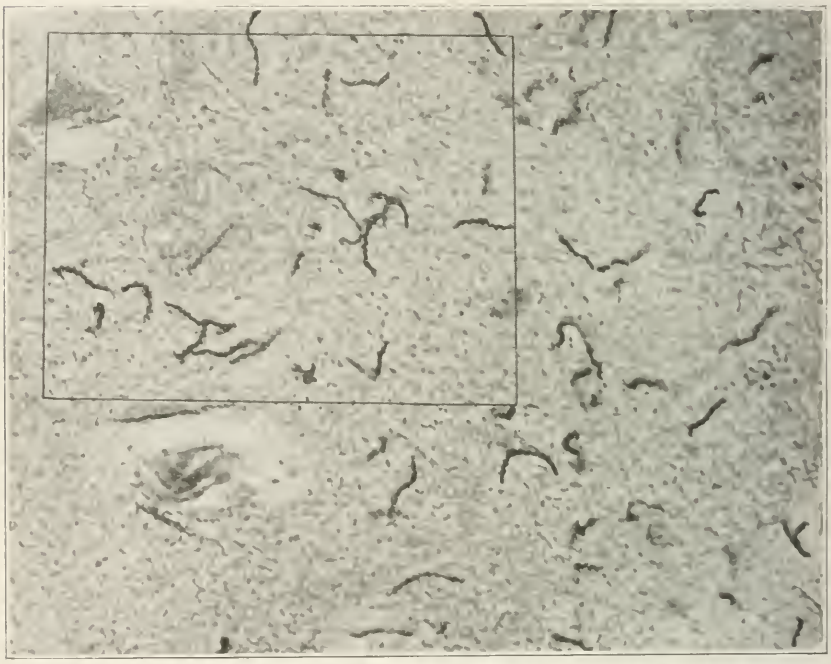

Fig. 1.—Photomicrograph of spirochetes in diffuse distribution; 4 mm. Zeiss objective, ocular No. 6. This field is from a part of a section in which spirochetes were abundant; in many other parts of this section none were found.

This illustration and Figure 2 show spirochetes from the left frontal region of a patient with general paralysis, C. D., of the Institute collection; received from Willard State Hospital in 1911. The brain when received showed evidence of partial decomposition; it had been kept in 10 per cent. liquor formaldehydi for about ten years before the sections were removed. They were stained by Dr. G. S. Stevenson by Jahnel's method.

layers of the gray matter, a point of great practical importance in searching for them. They are rather more likely to be found in the gray matter along the fissures than at the tops of the convolutions and

may (rarely) when stained be so numerous as to cause dark spots visible either to the naked eye or on low magnification.

NUMBER OF SPIROCHETES FOUND IN DIFFERENT CASES

In most cases the number found is decidedly small, but occasionally they are found in swarms or colonies in almost uncountable numbers.

CASES MOST FAVORABLE FOR FINDING SPIROCHETES

Spirochetes are most readily found in cases that run a stormy course, with convulsions, sudden paralytic attacks or acute seizures of various

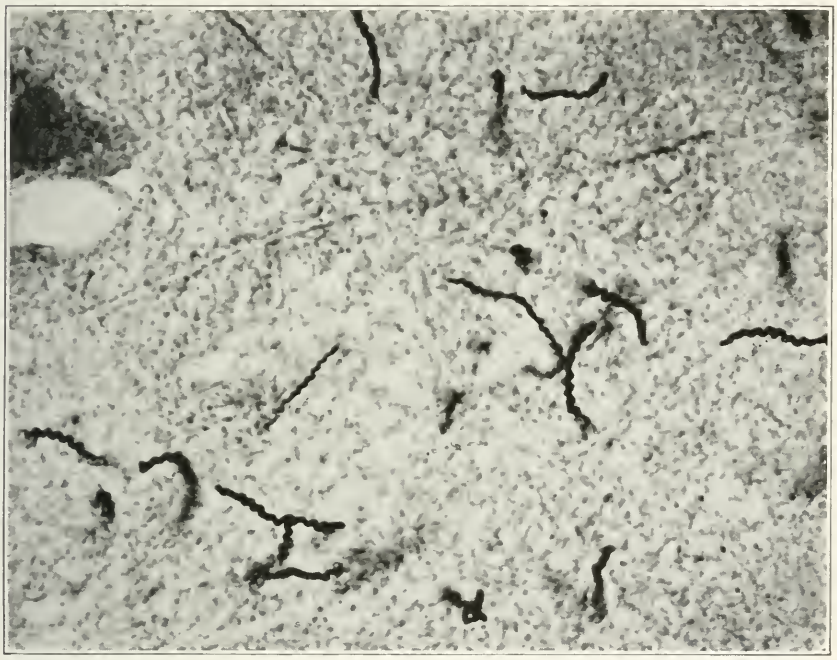

Fig. 2.—Enlargement of that part of Figure 1 which is included in the square. The parasites are not all of the same size. Zeiss one-twelfth oil immersion; projection ocular No. 4.

kinds. If a patient dies immediately after a seizure, the chances of finding spirochetes are greatest, for they seem to be quite fleeting and to increase and to decrease rapidly in successive waves, so that if death is delayed the hypothetical wave may have subsided.

They are by no means regularly more numerous where the cellular exudates are greatest; in fact, the spirochetes often (perhaps most often) lie in places in which the exudate is slight. Here they seem to exist with no special reaction on the part of the tissues to their presence. This fact has led to the hypothesis that it is only when they disintegrate

that they light up a reactive process with abundant exudate and destruction of the tissue.

The histologic changes in the brain tissue must not be attributed to the spirochetes seen with the microscope at the time of death, for these spirochetes form only a momentary picture caught at the time of dissolution of the host; the tissue changes are rather the sum of all the processes that have been going on for months or years, and are not a result of the fleeting spirochete picture seen at the particular time when death arrives. The actual spirochete picture at the time of death is probably different from the one seen at the time of examination

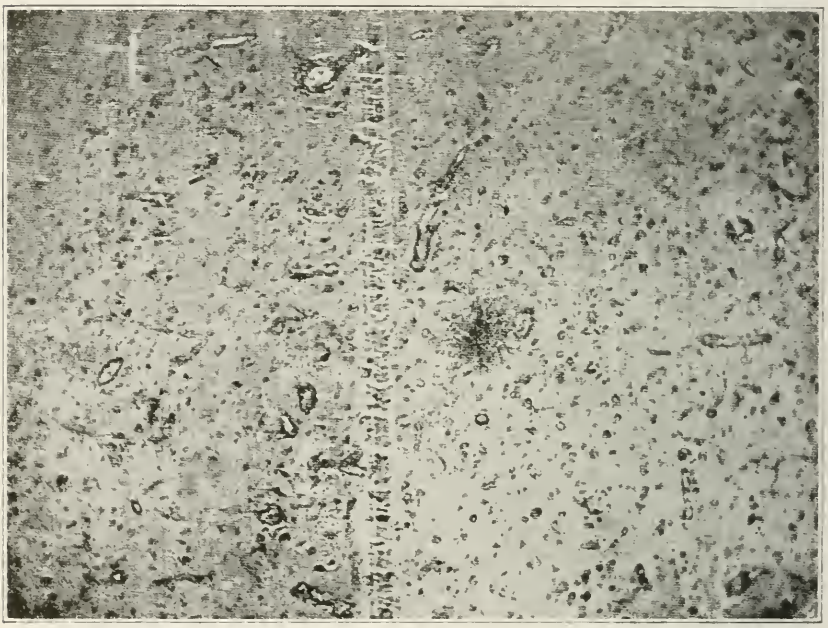

Fig. 3.—General paralysis: This shows, in low magnification, a swarm-like colony of spirochetes just to the right of the center of the figure.

Figures 3 and 4 are photographic reproductions from Plate 4, Figures 15 and 16, in F. Jahnel's article "Ueber einige Beziehungen der Spirochäten zu dem paralytischen Krankheitsvorgang," Ztschr. f. d. ges. Neurol. u. Psychiat.; Orig. **42**:21, 1918. Jahnel's method of staining.

because of postmortem migration of the parasites, possibly into parts that they may not be able to enter during the life of the patient; the blood vessels, for example.

VIABILITY AND RESISTANCE TO DECOMPOSITION

However rapidly spirochetes may increase and diminish during the life of the patient, after the patient is dead they may continue to live

for hours or days. Hauptmann found them actively motile in a case of general paralysis forty-eight hours after death, so that in a reasonably early necropsy one would expect to find their viability little affected, and they would be suitable for inoculation experiments in animals. Owing to their active motion, they are believed to change their position in the brain rapidly after death, as already stated, so that necropsy should be made as quickly after death as possible, and the brain should be fixed at once, if anything resembling true relations is to be preserved. In extremely rare instances some of the organisms, as shown in Figure 14, are believed to have wandered through

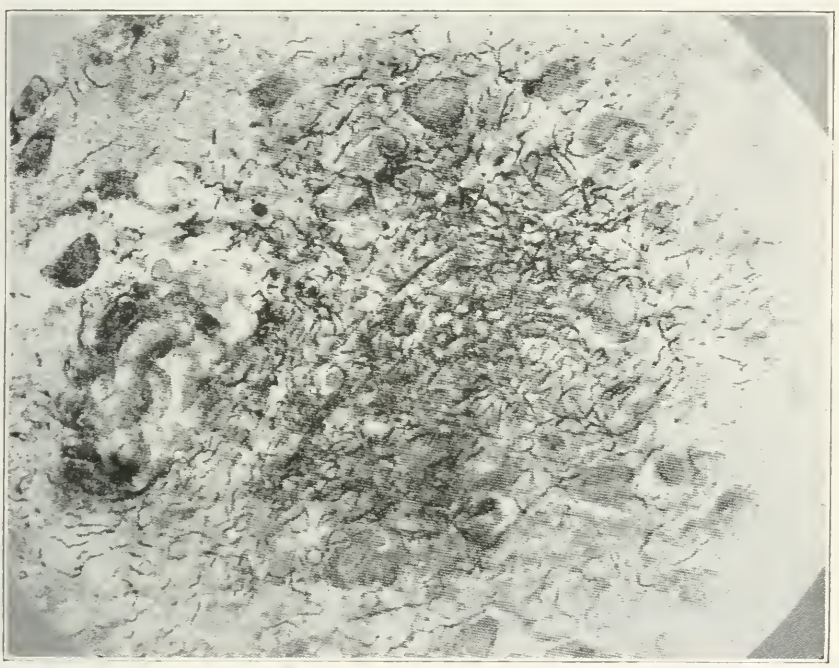

Fig. 4.—The same colony as in Figure 1, more highly magnified. Dr. Jahnel states that such colonies are sometimes visible to the unaided eye.

the walls of the blood vessels, after the death of the patient, and in this way to have entered the blood stream where (I repeat) they have never been demonstrated antemortem with the microscope, although a few of the many experiments with animals have apparently shown that spirochetes may at times exist in the blood of patients with general paralysis.

Spirochetes are strongly resistant to decomposition, and the dead organisms have been demonstrated in the brain about thirty days after decomposition had been allowed to go on.

FORM OF SPIROCHETES IN GENERAL PARALYSIS AND IN SYPHILIS

No difference in form, shape or size has been established between the spirochetes of general paralysis and those found in ordinary syphilis. Noguchi described, in general paralysis, at least three morphologic varieties—small, medium and large—and the same forms are found in ordinary syphilis. Later we shall consider some biologic peculiarities in the two groups of spirochetes, but the individual organisms in each group are alike in shape and in staining reactions.

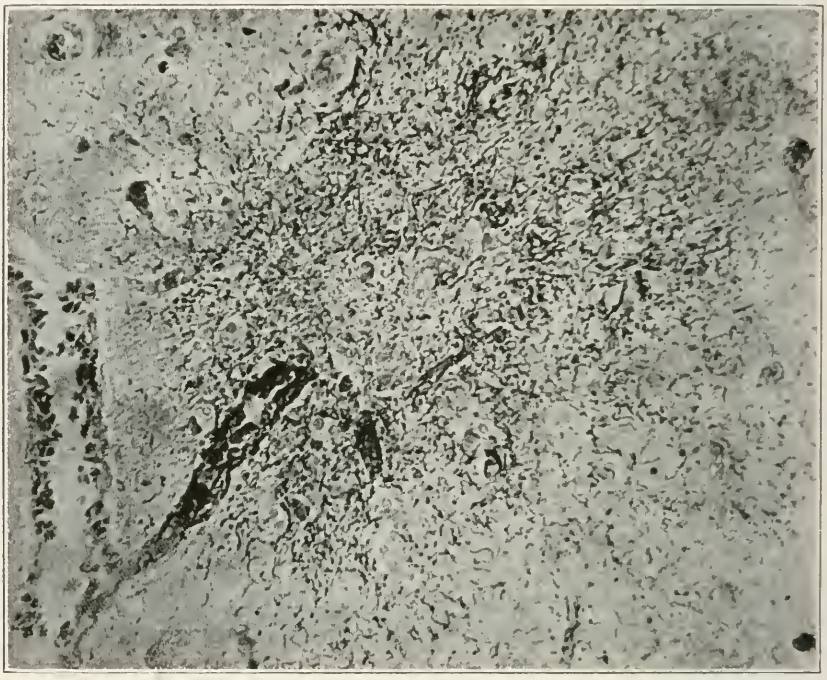

Fig. 5.—A localized collection of spirochetes which are not only within the nervous tissues, but are also within the walls of the blood vessel. This is to be interpreted, according to Hauptmann, as a proliferation of spirochetes in tissues in which the blood vessels do not offer enough resistance to prevent the parasites from invading their walls.

Figures 5 and 6 are photographic reproductions from Figures 6 and 7 in Professor Hauptmann's article, "Spirochäten und Hirnrindengefässe bei Paralyse," Ztschr. f. d. ges. Neurol. u. Psychiat., Orig. **57**:122, 1920.

PECULIARITIES IN GROUPING AND DISTRIBUTION OF SPIROCHETES IN GENERAL PARALYSIS

Three main types of distribution have been described:

1. A diffuse type, in which the organisms are diffusely scattered, without order, usually in small numbers, rarely in large numbers, throughout the gray matter of the nervous tissues.

2. A focal type in which they are grouped together, sometimes in swarms like swarms of bees, often in immense numbers, but with no relation to blood vessels or any other elements in the nervous tissues. These swarm-foci are not common.

3. A vascular type, still rarer, in which they are especially concentrated about the blood vessels, the walls of which they often penetrate. This vascular type is believed by Jahnel to be only a subvariety of the focal or swarm type, for the reason that the vascular type

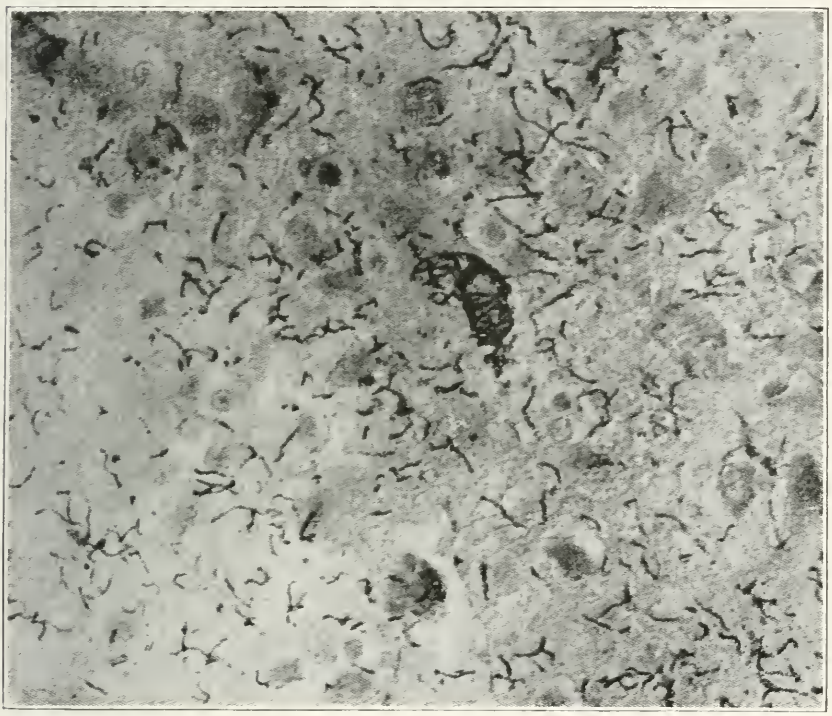

Fig. 6.—Diffuse distribution of spirochetes in combination with blood vessels which contain the organisms; no genetic connection exists between the spirochetes in the vessels and those in the tissues.

occurs in rather sharply bounded foci, and the spirochetes do not stream out along the blood vessels beyond the limits of the focus, nor do they follow the branches of the vessels as they would do if they belonged strictly to the vessels or were derived from them.

Hauptmann has especially studied this vascular form, and believes that the spirochetes here do not, generally speaking, come out of the blood stream to enter the parenchyma, but that they go in the reverse direction, from the parenchyma toward the vessels, and penetrate the latter; how much of this penetration may occur postmortem is not known.

It is in these vascular foci, and here only, that a spirochete has rarely been found in the lumen of a blood vessel among the corpuscles. They have never been seen in the blood stream outside of such foci. None of the authors cited believe that these swarms or focal collections have been directly derived from the blood stream, though this possibility may be left open. They think the best explanation for these masses is that the spirochetes have proliferated in loco, an explanation that seems to be justified by the phenomena observed. It seems to be pretty generally agreed, as previously stated, that the organisms may change their rela-

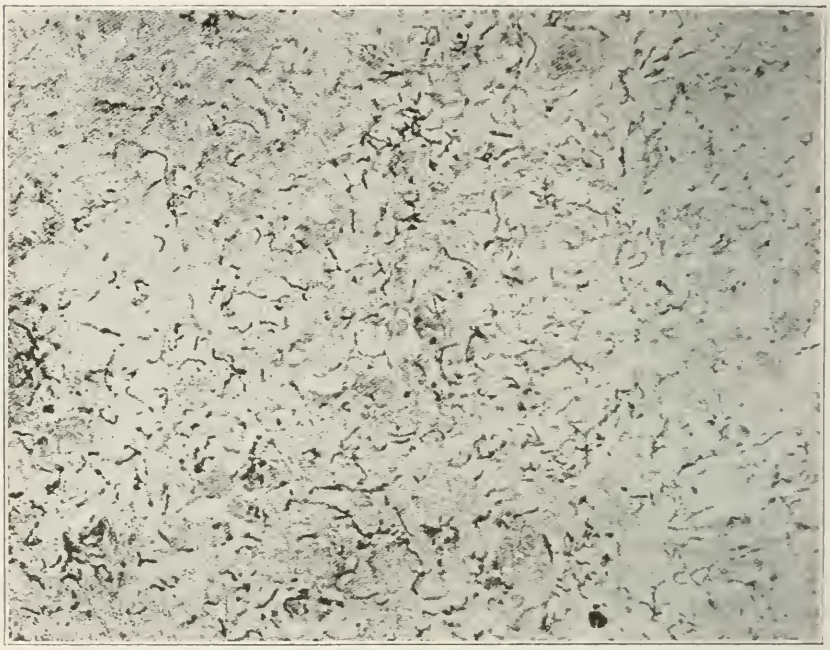

Fig. 7.—Diffuse distribution of spirochetes with no relation to blood vessels.

Figures 7 and 8 are photographic reproductions from Figures 12 and 13 in Professor Hauptmann's article.

tions and position rapidly, receding in one part of the brain and flaring up in another.

RELATION OF SPIROCHETES TO NERVE CELLS, NEUROGLIA CELLS AND EXUDATE

No one has ever satisfactorily demonstrated that spirochetes exist within nerve cells, although they may be grouped around nerve cells. It is questionable whether they have been seen in neuroglia cells. They have sometimes been found among the cells of the exudate, but have not been conclusively shown to lie within the cells themselves.

METHOD OF INCREASE OF SPIROCHETES IN GENERAL PARALYSIS AND PATHWAYS BY WHICH THEY SPREAD

Little is known concerning the method of increase of spirochetes in general paralysis. We know practically nothing of the rapidity of progression of spirochetes and the paths by which they travel. It is considered highly probable that they proliferate and spread locally in the gray matter, but it is not likely that they are spread from place to place in the brain to any great extent by the blood stream, or by the cerebrospinal fluid, for, with the exceptions previously mentioned,

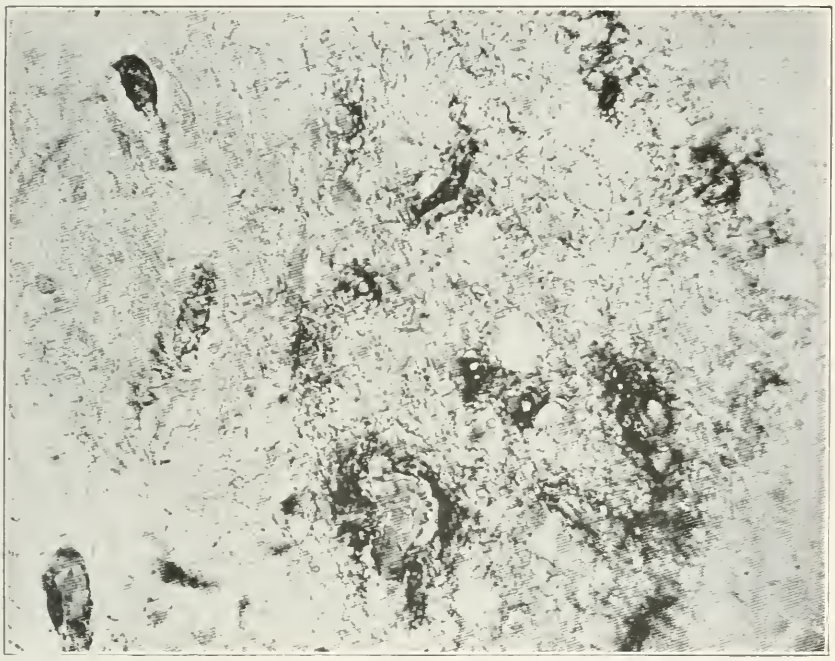

Fig. 8.—Localized massive girdling of the walls of blood vessels (Wallbildung) by spirochetes and invasion of the walls of the vessels by the parasites.

where postmortem migration is probable, they have never been seen with the microscope in general paralysis in blood, cerebrospinal fluid or in the centrifugalized sediment of the fluid.

We must remember, however, that in some instances animals have been reported as infected by injections of blood or of spinal fluid from patients with general paralysis, though many investigators have always failed to obtain results by such injections. Jahnel himself thought he succeeded with one rabbit after seven months of incubation, but he could not keep the strain to study its characteristics. Valente failed utterly in 103 animals, using puncture material from brains of living

patients with general paralysis, also the blood and spinal fluid. Forster and Thomasczewski likewise failed in sixty rabbits, with brain puncture material obtained from fifty-three living patients with general paralysis.

If the apparently successful injections can be trusted, we must assume that, at least sometimes, spirochetes are present in the blood and spinal fluid in general paralysis, but whether the blood and fluid play an essential rôle in spreading them is still doubtful. The undecided question always rises in these cases as to whether the ordinary lesions of somatic syphilis coexist with the specific lesions of general paralysis.

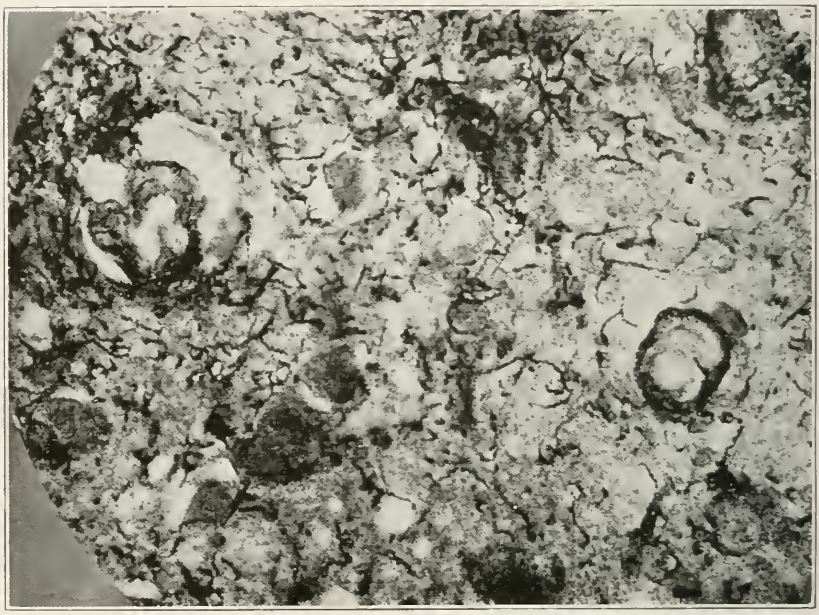

Fig. 9.—Spirochetes in the vessels and in the nervous tissue.

Figures 9 and 10 are photographic reproductions from Plate 3, Figures 11 and 12, in Jahnel's article.

RELATION OF SPIROCHETES IN GENERAL PARALYSIS TO WASSERMANN REACTION

Sioli reports one case of general paralysis which showed spirochetes in the brain although the Wassermann reaction (twice repeated) was negative in both blood and spinal fluid. Valente, a Portuguese investigator, reports three cases with positive spirochete findings but negative Wassermann reactions in the spinal fluid. In my experience I can recall no case of general paralysis, confirmed by the microscope, in which the fluid Wassermann test, if made, was consistently negative. Jahnel regards a positive Wassermann reaction as a probable index of the presence of spirochetes in the body. I think we should look on the

negative Wassermann reactions (not further described especially as to treatment) with some skepticism, as defects in technic or reagents are not rare; the personal equation of the serologist has also to be considered, and it is possible to mix up specimens.

HOW DO SPIROCHETES REACH AND ENTER THE BRAIN IN GENERAL PARALYSIS?

This is still an open question. Some authors, such as Valente, think that spirochetes may enter the central nervous system at the time of

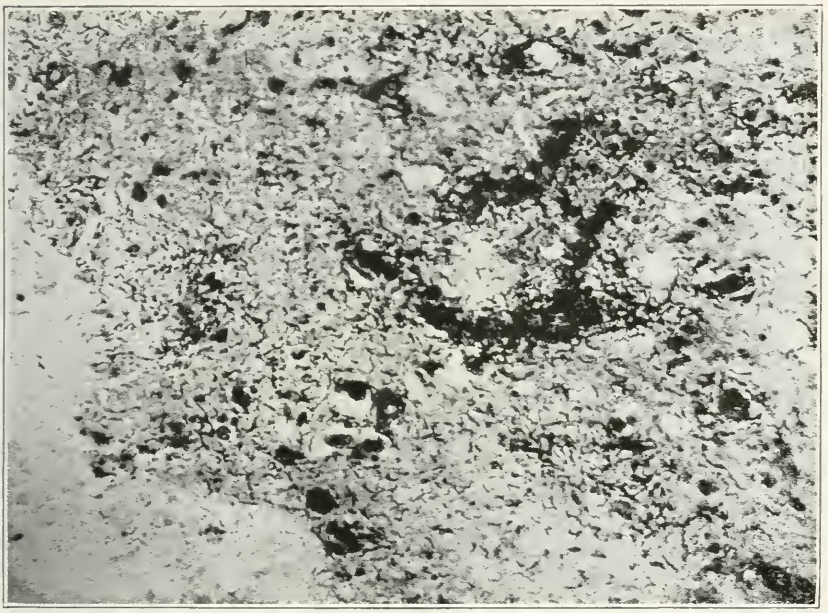

Fig. 10.—General view showing the position of spirochetes in both nervous parenchyma and in blood vessels. The dark masses are due to aggregations of spirochetes in large numbers.

the early syphilitic meningitis, when the whole system is flooded with spirochetes; at this time, under unknown conditions, they "break through the neuroglial boundary membrane." Such views do not seem to account satisfactorily for the long incubation period of ten to twenty years in general paralysis. That spirochetes do enter originally by the blood or meningeal route, however, seems most probable.

LONG INCUBATION PERIOD AND EHRLICH'S VIEWS OF RECIDIVE STRAINS

The neurorecidive theory of Paul Ehrlich does take the incubation period into account, and while admittedly only a theory which is unten-

able at present on the basis of established facts, it is extremely suggestive, although it makes no attempt to show just how the spirochete of general paralysis actually enters the nervous tissue. According to Ehrlich, spirochetes enter the body, including the meninges, at the time of infection, and at first they increase without limit. After a time the body produces a protective material (or antibody) which kills off most of the micro-organisms; but some are more resistant, remain alive and produce a new generation of spirochetes (recidive strain No. 1). Against this new generation of spirochetes the body again reacts by antibody formation; this same cycle is repeated again and

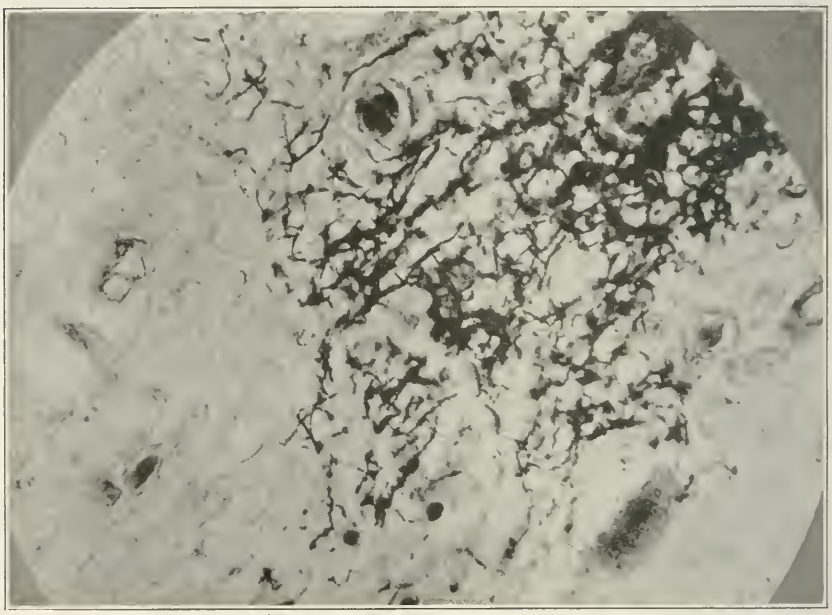

Fig. 11.—Spirochetes in swarmlike colonies. Note the few spirochetes outside of the colony itself.

Figures 11 and 12 are photographic reproductions from Plate 4, Figures 9 and 12, in an article by Dr. F. Sioli, entitled "Die Spirochaete pallida bei der progressiven Paralyse," Arch. f. Psychiat. **60**:401, 1919.

again, always with the formation of higher and higher recidive strains of spirochetes. Such spirochetes as survive in this recidive process (if I understand Ehrlich) would belong to the original syphilitic strain that entered the body at the time of infection, but would be altered biologically—a special selection of those best fitted to survive; that is, a straight syphilitic strain, but modified by the conditions of growth within the host. Moreover, as the recidive strains progress, the places in which the syphilitic organisms can be found grow fewer and fewer;

the parasites seem to retire in the later stages of syphilis to certain circumscribed foci, the central nervous system being possibly one of these foci. It is only in the secondary stages and early stages of syphilis that one finds a general spread of spirochetes and generalized lesions. In the tertiary stages of syphilis the lesions are much fewer in number and more focal in position.

Thus the recidive theory of Ehrlich accounts for an indefinite period of time during which the spirochetes are supposedly undergoing biologic alterations, and are receding more and more from general distribution

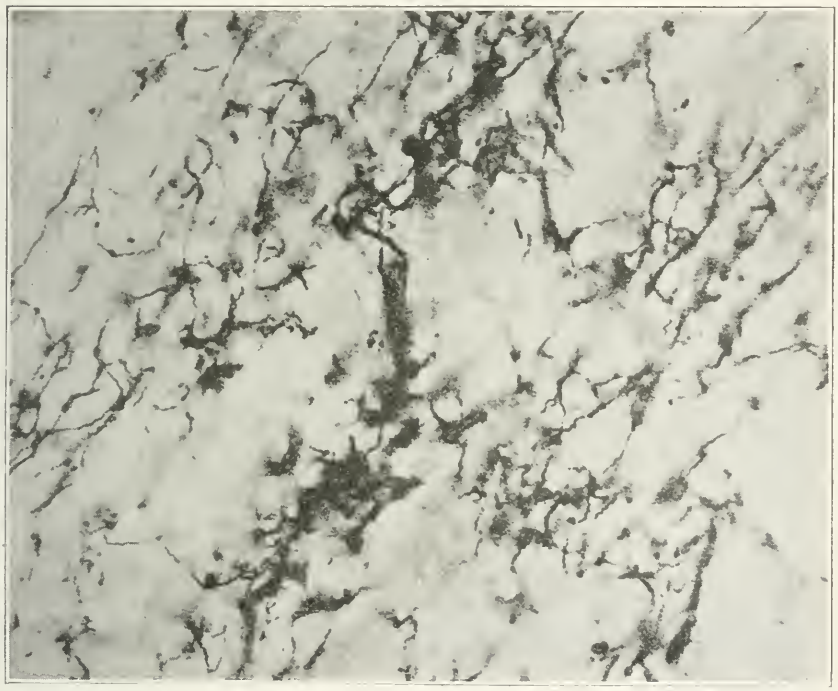

Fig. 12.—A similar swarmlike colony of spirochetes more highly magnified.

to more circumscribed locations, as is the case in tertiary, or late syphilis, and in general paralysis.

This is hardly the place to discuss the many other views and theories dealing with the latent period of syphilis and the habitat of the organisms between the time of primary infection and the outbreak of the symptoms of general paralysis. This subject has been dealt with by Jahnel [5] in a later article.

5. Jahnel: Das Problem der progressiven Paralyse, Ztschr. f. d. ges. Neurol. u. Psychiat. **76**:166-182, 1922.

As long as spirochetes are in the general mesoblastic tissue, they are usually regarded as relatively accessible to treatment. Those that reach the parenchyma of the brain appear to be extraordinarily inaccessible, as even the most diffusible drugs are reported scarcely to enter the brain substance at all, and arsenic, so far as I know, has not been demonstrated in the parenchyma of the brain after treatment with arsenical compounds.

It is recognized that histologic changes in the brain of patients with general paralysis may be advanced, although clinical symptoms are recent. Alzheimer, in patients who had previously had syphilis, not

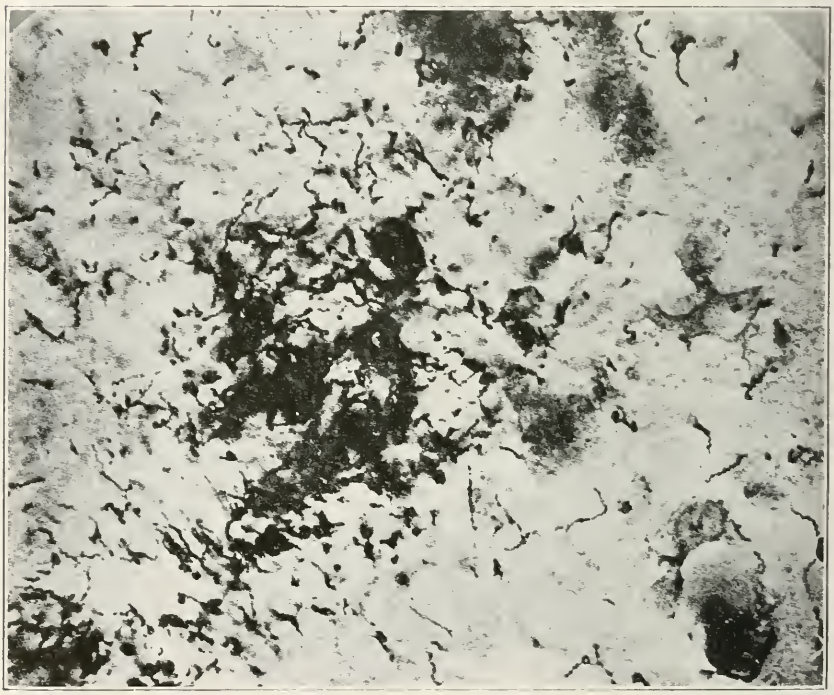

Fig. 13.—Enormous numbers of spirochetes in the blood vessel walls and in the neighboring tissue.

Figures 13 and 14 are photographic reproductions from Plate 7, Figures 1 and 5, in the article by Dr. F. Sioli.

infrequently found considerable collections of lymphocytes and plasma cells in the meninges, without evidence of cortical disease in the brain. It seems highly probable that the spirochetes reach the meninges early in the infection in a large proportion of cases of syphilis, but in most cases they do not get a foothold in the parenchyma. They have been shown, with the microscope, by various authors to exist in the spinal fluid in patients with early syphilis—not in those with general paralysis.

Again in early syphilis, untreated, about 80 per cent. of the patients, according to Sioli, who bases his figures on an extensive material collected from the literature, have shown an abnormal state of the spinal fluid, either in the Wassermann reaction, cell count, albumin content or in some other manner. In the second stage of syphilis only about 33 per cent. of the patients showed similiar changes in the fluid; in the third stage and latent stage, about 23 per cent. So we can say that in the early stages of syphilis changes in the spinal fluid are at least frequent, but that later the changes spontaneously disappear in many cases and persist in others.

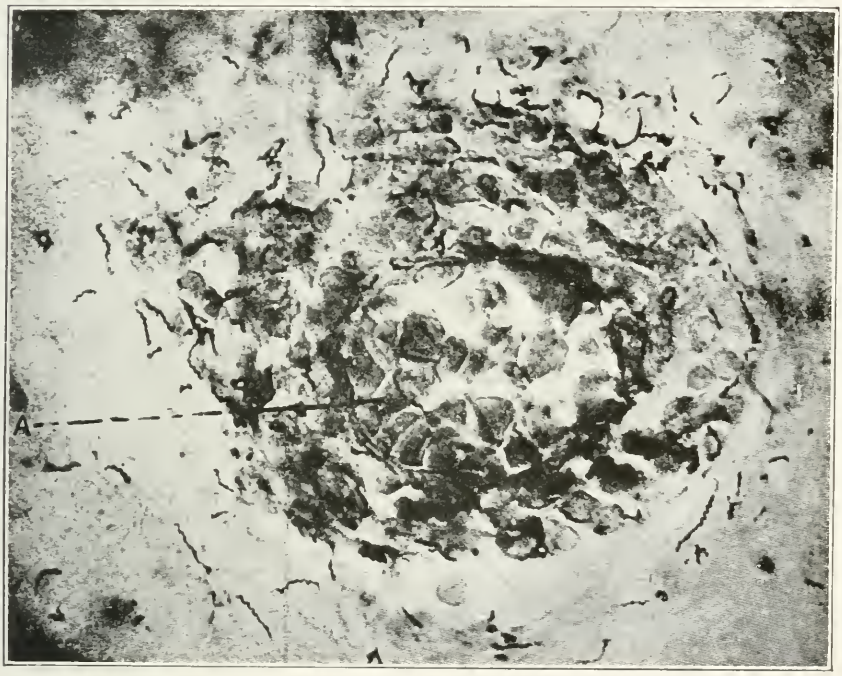

Fig. 14.—Spirochetes in the wall of a blood vessel, also in the zone of the infiltrate, and one (*A*) within the lumen. The latter parasite probably reached its position among the corpuscles after death.

IS GENERAL PARALYSIS CAUSED BY A SPECIAL STRAIN OF SPIROCHETE, A NEUROTROPIC STRAIN, DIFFERENT AT THE BEGINNING FROM THE SPIROCHETE OF ORDINARY SYPHILIS?

In favor of this view are groups of patients with general paralysis and tabes infected from the same source: cases of conjugal infection in which husband and wife both have general paralysis of tabes; infections among members of the same family who develop general paralysis or tabes.

To balance such facts is a report of group infection, likewise from a common source (Eichelberg, reported by Sioli), in which all of the infected members, thirteen in number, developed ordinary syphilis except two; one of these developed general paralysis, the other tabes.

Certain writers, especially Levaditi and Marie, favor the view that general paralysis is caused by a spirochete with special affinity for the nervous system—a neurotropic strain.

Levaditi and Marie inoculated the testes of rabbits with blood from patients with general paralysis. They obtained, in some cases, lesions and a strain of spirochetes which they transmitted to other rabbits; thus they obtained what they regarded as the true virus of general paralysis. They compared this general paralysis virus experimentally with a syphilitic strain of spirochetes that had been transmitted to rabbits about ten years previously from a syphilitic primary sore, and had been carried on from rabbit to rabbit ever since. They found marked differences in the two strains of spirochetes, as shown in the table.

Comparison of Dermotropic and Neurotropic Virus

Dermotropic Virus (Syphilitic)	Neurotropic Virus (General Paralysis)
Incubation: about 14 days	Longer, up to 127 days
Deep-seated infiltration	Superficial changes
Primary lesion lasted about 90 days	Slower, 169-195 days
Pathogenic for rabbits, lower apes, chimpanzee and man	Not pathogenic for apes and man, weakly so for rabbits
Immunity to reinfection with this syphilitic strain after recovery, but still susceptibility to the general paralysis strain	Immunity to the general paralysis strain after recovery, but still susceptibility to the syphilitic strain

Thus a so-called crossed immunity does not exist in animals. In man, however, patients with general paralysis are practically always immune to syphilitic strains, so the foregoing does not apply to man. The spirochete in general paralysis, however, differs from that of syphilis in being only slightly infectious, and incubation is long.

Jahnel says that as Levaditi and Marie, in their experiments, failed to exclude or even to mention an often-described rabbit disease in which spirochetes resembling those of syphilis are present, he cannot accept their results.

The authors we are summarizing agree that a "lues nervosa" is by no means proved. It is not even a necessary assumption; much more attention should be given to the soil, i. e., the individual in which the spirochete grows. Plaut thinks those who have metasyphilis may have from the beginning a special and peculiar reaction toward syphilis; that

is, endogenous factors may be at work. Plaut refers to the mild course and slight reactions to syphilis that some patients show who later develop general paralysis.

SPIROCHETES IN OTHER ORGANS THAN THE BRAIN IN GENERAL PARALYSIS

Until within the last year or so the following statement was considered to be justified: "There is not one well authenticated case of general paralysis in which spirochetes have been found in any organ except the brain" (Jahnel). Jahnel for years had searched, as he said, all possible organs extensively and never found them (one in the lung). Lately he has found them in the aorta. Of course even here a mixture of syphilis and general paralysis cannot be absolutely excluded.

The presence of spirochetes at times in the blood and spinal fluid in general paralysis, as shown by animal inoculations, has already been referred to, though the organisms have never been found with the microscope in either blood or fluid except as a possible postmortem migration into the blood, as already mentioned. They have been found in the meninges (Jahnel) in both general paralysis and tabes, rarely it is true, but sometimes in considerable numbers, so that one cannot say that in general paralysis spirochetes are strictly limited to the parenchyma of the brain. Neither can one say (with facts to support the statement) that in cerebral syphilis spirochetes are limited to the interstitial tissues, or mesoblastic tissues. In a few cases of cerebral syphilis in which adequate search for spirochetes has been made (e. g., Strassmann, Versé), occasionally some of the parasites were found in the parenchyma, though most were in the interstitial tissues. There is, however, almost nothing accurately known about the distribution of spirochetes in cerebral syphilis proper, and the question requires much more study.

General paralysis is, however, essentially, but not absolutely, a spirochetosis of the brain, and the terms "lues parenchymatosa" and "lues interstitialis" are not justified by present knowledge.

With the idea that there must be other retreats in the brain for spirochetes than those so far known, Jahnel searched extensively for a possible place where they could always be found, but without success. He found them in the pia mater of the cerebellum, in the cerebellar veins, in the pia mater of the pons and in the walls of the basilar artery. Immediately underneath a meningeal focus showing spirochetes the brain substance may or may not contain them, and an extensive focus of spirochetes may be present in the brain substance with clear meninges above this focus. He makes no attempt to decide whether they have spread from the meninges to the brain or vice versa.

He believes this meningeal spirochetosis, especially that in the cerebellum, is of great significance for the future, even though this significance is as yet unknown. This meningeal spirochetosis may form a bridge between general paralysis on the one hand and certain forms of cerebral syphilis on the other.

Some years ago I tried to bring out, in a paper read in Baltimore, that histologically there are sometimes all grades of transition between general paralysis and so-called cerebral syphilis, and that general paralysis is only a special form of cerebral syphilis. The foregoing findings of Jahnel, so far as they go, tend to confirm that view which was regarded by Mott at that time as erroneous.

SPIROCHETES IN TABES

In later work on tabes the organisms have been found by Jahnel in the pia-arachnoid and in the connective tissue sheaths of the posterior nerve roots. Jahnel included the dura mater in his sections, as otherwise much of the arachnoid which contains the spirochetes was lost. He warns against associating a chance collection of spirochetes in such places with anatomic lesions that may be present there: for what we see anatomically in these cases is the end result of processes that have lasted for years, and the same is true of general paralysis. Versé found many spirochetes in the posterior nerve roots of a case which clinically had neither tabes nor root symptoms, so the mere presence of spirochetes is not the only thing needed to produce tabes. A text on which Hauptmann writes an article is the following: "The spirochetes alone do not do it." Just as the presence of the tubercle bacillus, which most of us probably have harbored at times, is not the only condition for the production of tuberculosis, so the presence of *Spirochaeta pallida* is not the only condition needed in the production of general paralysis.

SUMMARY AND CONCLUSIONS

1. We have at last, thanks to Jahnel, an excellent stain with which we can really study spirochetes in general paralysis.

2. Spirochetes may be found in any part of the brain in general paralysis, but especially in the frontal parts. They are chiefly in the middle and deeper layers of the gray matter, rarely in the pia mater, almost never in the white matter, and are most often found in cases with a stormy clinical course.

3. Spirochetes may live for many hours after the death of the patient. They strongly resist decomposition, and may change their position postmortem. Therefore, necropsy should be performed as early as possible.

4. Spirochetes in general paralysis are either diffusely scattered or more rarely grouped in foci or swarms. They have no special relation to nerve cells or to other elements in nervous tissue, with the possible exception of blood vessels.

5. The time at which spirochetes enter the nervous parenchyma in general paralysis, and the pathways by which they spread after entrance, are not yet determined.

6. The spirochete of general paralysis is probably a syphilitic organism, altered biologically by various influences to which it is subjected during its long residence within its host. There is insufficient evidence that it is a special neurotropic strain different from the beginning. Experimental work with animals needs to be enlarged and well controlled.

7. Spirochetes are not absolutely limited to the nervous parenchyma in general paralysis; although not found in the general organs of the body, they are occasionally found in the mesoblastic tissues, pia mater and in the aorta.

8. The terms "parenchymatous neurosyphilis" and "interstitial neurosyphilis" seem hardly justifiable in the light of present studies.

9. Spirochetes have been demonstrated in the spinal pia-arachnoid in tabes.

10. A great field is open for further study along these lines, especially in experiments on animals.

11. Treatment of general paralysis need not be absolutely hopeless. Some of the spirochetes, at least, are probably accessible. The modified strain of spirochete in general paralysis with its hypothetical "heightened resistance" may need to be attacked by a modified therapeutic agent different from the one that succeeds with the ordinary syphilitic strains.

AN ANATOMIC STUDY OF THE FAISCEAU DE TÜRCK IN RELATION TO THE TEMPORAL LOBE*

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PHILADELPHIA

An opportunity for further study of the anatomic relations of the faisceau de Türck was afforded in a patient who was admitted to the neuropsychiatric wards of the Philadelphia General Hospital in my service on Nov. 30, 1920, and who died on Dec. 10, 1920. The clinical symptoms began six months before the fatal termination, but having no bearing on the anatomic study, will be omitted.

At necropsy examination, a tumor (Fig. 1) measuring 5 cm. anterio-posteriorly and 4 cm. transversely was found occupying the posterior two thirds of the first and second temporal convolutions. It was adherent to the dura, and a cross section showed marked vascularity. Posteriorly the tumor (Fig. 2) did not extend quite to the anterior occipital fissure. Macroscopically, in its posterior aspects, the tumor was rather sharply defined, but there was evidently some invasion of the adjoining cortex and white matter, that is, of the gyrus between the tumor and the anterior occipital fissure, to the extent of about 2.5 cm. Anteriorly, the tumor was less clearly defined except in its outer portion, where for a short distance beneath the cortex it was rather sharply outlined.

Dipping inward, anterior to the tumor, was a fissure which was believed to be the deep temporal fissure, anterior to which was what was regarded as the deep temporal convolution. This convolution macroscopically showed distinct implication by the tumor process. The tumor extended laterally into the brain tissue as far as the inferior longitudinal fasciculus and the optic radiations but did not appear to involve these bundles. Microscopically the tumor proved to be a glioma (Fig. 3).

The brain was cut in serial sections on both sides from the superior level of the tumor as far down as the pons. The tumor itself, with the

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* From the Neuropsychiatric Department of the Philadelphia General Hospital and the Neuropathological Laboratory of the Philadelphia General Hospital.

* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

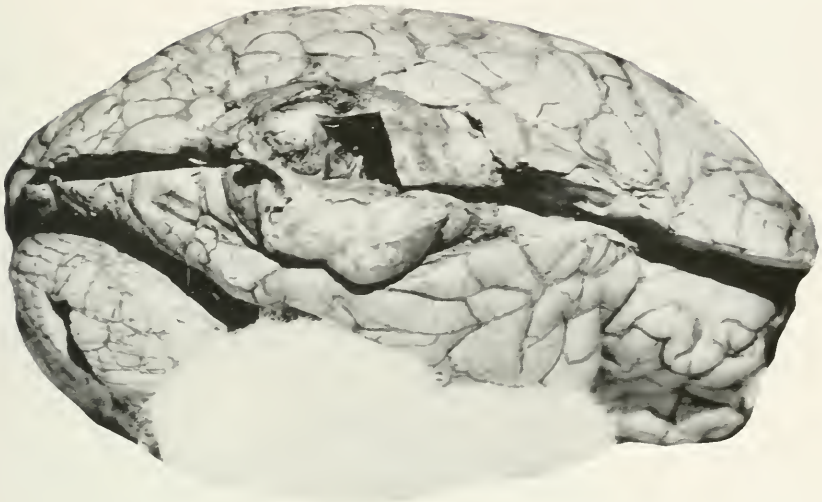

Fig. 1.—Tumor showing its relation to the posterior two thirds of the first and second temporal gyri.

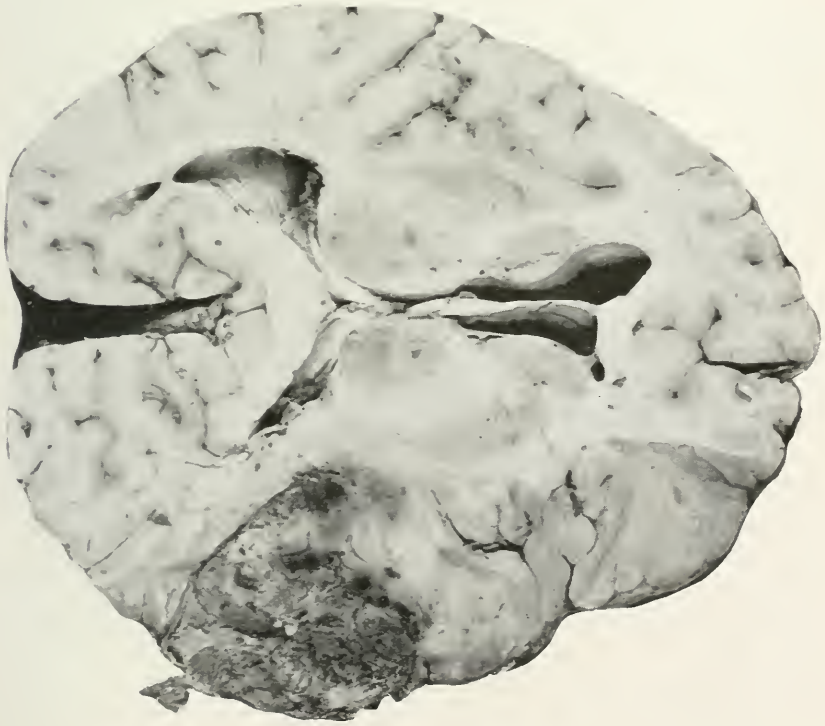

Fig. 2.—Cross-section of the brain showing the extent of the tumor.

adjacent brain tissue, was also cut at various levels in order to study its relation to the adjoining cortex and other brain structures. These sections were stained by the Weigert methods and by hematoxylin and eosin.

The cortex at the site of the tumor was completely destroyed, and nowhere in this region could any cortical tissue or white matter be discovered. The cortical and subcortical layers anterior to the tumor, namely, the deep temporal gyrus which dips normally down almost to the external capsule, the inferior longitudinal fasciculus and the optic radiations were differentiated as to gray and white matter, but in the tissue just adjoining the tumor there was pronounced cellular infiltra-

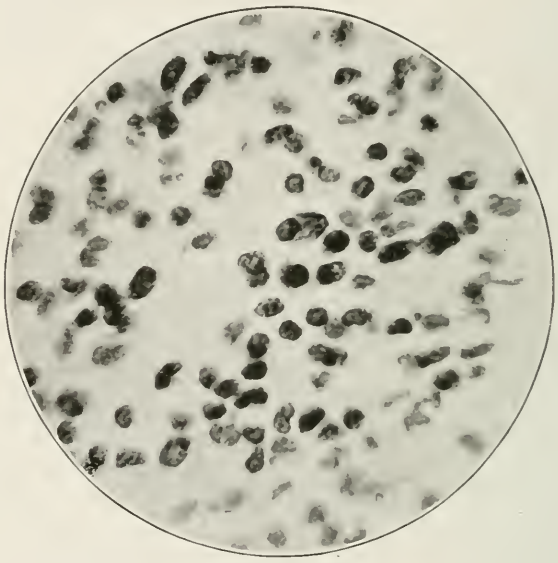

Fig. 3.—Microscopic section of the tumor.

tion with cells having the same characteristics as those found in the tumor.

Posterior to the tumor and between this and the anterior occipital fissure of Wernicke a similar condition could be observed, namely, differentiation of the cortical and white matter and implication of these by the cellular infiltration.

It was possible to conclude from this study that the cortex and white matter of the superior and middle temporal gyri were totally destroyed by the tumor, and the brain tissue anterior and posterior to these regions to the extent of about 2.5 cm. was implicated by a cellular infiltration consisting of cells similar to those found in the tumor proper.

A study of the serial sections of the brain internal to the tumor and the corresponding levels on the opposite side failed to reveal any evidence of degeneration on either side. The faisceau de Türck, at the point where it appears in the retrolenticular region, was intact. The foot of the peduncle stained uniformly and showed an undegenerated faisceau de Türck in this region (Fig. 4).

The duration of the tumor, which showed its first clinical manifestations six months prior to death, justifies the assumption that the degeneration should have had time to appear in the faisceau de Türck, where it appears in the retrolenticular region if not in the foot of the peduncle, if its cortical origin had been destroyed.

In 1912, I [1] read before the American Neurological Association a paper on a study of the faisceau de Türck; and I stated that the

Fig. 4.—Absence of degeneration of the faisceau de Türck.

anatomic relations of the faisceau de Türck were still a matter of dispute. The origin of this tract, according to Déjerine, was the middle portion of the temporal lobe, more especially the cortex of the second and third temporal lobes, which Kann and Brodman believed could be confirmed from their studies. The studies of Kattwinkle and Neumayer placed its origin in the third, second and first temporal convolutions. Flechsig and Van Gehuchten did not agree with this view. Von Bechterew, Flechsig and Meynert and others placed its origin in both the temporal and occipital lobes; Brero, in the parietal lobe; while von Monakow and others asserted that its origin was in the parietal and temporal lobes, von Monakow believing that some of the fibers came from the occipital lobe. Marie and Guillain, from a study of nineteen

1. Rhein, John H. W.: J. Nerv. & Ment. Dis. **38**: No. 9 (Sept.) 1911.

cases, believed that these fibers came from the third temporal convolution. The case of Mills and Spiller, in which the anterior part of the second temporal gyrus and a portion of its upper middle segment were degenerated without showing any involvement of the faisceau de Türck; the case of Löwenstein, in which the anterior half of the second temporal and the anterior two thirds of the temporal were implicated with an intact faisceau de Türck; and a case previously reported by myself in which there was atrophy of the middle portion of the second and third temporal and part of the first temporal convolutions without degeneration of this tract, led me to the conclusion at that time that it could originate only in the posterior part of the temporal gyrus, if at all in the temporal lobes. The case reported in this paper would indicate that the faisceau de Türck does not spring from the posterior two thirds of the superior and middle temporal gyri or the adjacent cortex.

A study of the literature cited demonstrates that the most reliable authorities exclude every portion of the cortex of the temporal convolutions except the posterior part of the inferior temporal gyrus as the origin of this fasciculus. From this, it may be concluded that the faisceau de Türck does not arise from any other portion of the temporal lobe since every other locality may be excluded as a possible origin. I know of no case in literature in which a lesion purely of the posterior portion of the inferior temporal gyrus has occurred and in which studies of the pathology have been made with a view to connecting the faisceau de Türck with this region.

The studies of nineteen cases by Marie and Guillain showed that the region most frequently giving rise to this degeneration is that portion just behind the posterior segment of the internal capsule in the white substance situated between the temporal convolutions and the external wall of the occipital horn of the lateral ventricle, where, they state, the fibers from the third temporal convolution pass. In the second case which I reported in 1912, the findings corresponded to those of Marie and Guillain. In this case, the lesion implicated the white matter of the posterior portion of the posterior segment of the external capsule as well as that of the posterior portion of the temporal lobe and the wall of the descending horn of the lateral ventricle, and the faisceau de Türck was almost completely degenerated. There was a cutting off of the fibers from the third temporal convolution as well as of those from the occipital lobe in part.

I think it may be concluded that if the temporal lobe is the origin of fibers which degenerate in a descending direction, consisting of the faisceau de Türck, they may come from the posterior third of the third temporal convolution.

1732 Pine Street.

DISCUSSION

Dr. Adolf Meyer, Baltimore: It is very important for us to realize that the cases by which these matters can be brought to a test are relatively few. In the first place, the specimens of tumor are always somewhat hazardous on account of the fact that degenerations can be hidden or diffused. For a complete decision of the question we really need experimental material and operative extirpations such as occur occasionally. In that connection the temporal lobe, especially of the right side, may be sacrificed without serious damage. We also ought to use the cases of arteriosclerosis or embolic softening, which are not rare after all, but are unfortunately rarely referred to competent laboratories because most people think that it is old and long settled material. I have personally not had any material so far that appeared to me would throw conclusive evidence on this question. I have not obtained any embolism or softening within the Marchi period, and practically most of the specimens I have are fusions of temporal lobe and occipital lobe lesions.

Concerning the occipital lobe lesions I am absolutely sure of an efferent path to the pons. In a case published in the *Transactions of the American Physicians,* in 1905, an attempt at suicide led to an experimental destruction of the parietal lobe with destruction of the most dorsal parts of the sagittal marrows, with a very definite Marchi degeneration extending into Türck's bundle; but from the point of view of the temporal lobe I do not know of any American material at least that would be absolutely conclusive.

TUBEROUS SCLEROSIS*

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Tuberous sclerosis is a relatively rare developmental anomaly of the brain and other organs, characterized clinically by idiocy and epilepsy, and pathologically by multiple sclerotic nodes over the surface of the brain, multiple subependymal tumors, and multiple tumors of the heart, kidneys, skin and other organs.

Though the disease was described by several authors before 1900, von Recklinghausen reporting a case as far back as 1862, the minute histologic alterations and their significance were appreciated first in 1912 when Bundschuh [1] and Bielschowsky [2] independently gave us very complete and exact studies founded on the embryological concepts laid down by Ranke.[3] But little has appeared in English or American literature on the subject, although Campbell [4] described it in his work on cerebral sclerosis, and Sailer [5] collected twenty-eight cases in 1898. One American writer recently described a case as juvenile multiple sclerosis. It is important that these cases be recognized, for in addition to the epileptic seizures, these patients often present focal symptoms that may call for operation. It is the consensus of opinion, however, that operation has no favorable influence on their subsequent course.[6]

Because of the association of tumors of other organs with the focal sclerosis of the cortex, cases of tuberous sclerosis are recorded under many titles, and a comprehensive review of the literature is therefore difficult. Titular reference is in some instances to the cardiac tumors, as in von Recklinghausen's case; in others to the renal tumors; while

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* From the Laboratory of Neuropathology, Philadelphia General Hospital, and the Graduate School of Medicine, University of Pennsylvania.

1. Bundschuh: Ein weiterer Fall von tuberöser Sklerose, Ziegler's Beitr. f. path. Anat. u. allgem. Path. **54**:278, 1912.

2. Bielschowsky and Gallus: Klinische und anatomische Studien über tuberösen Hirnsklerose, J. f. Psychol. u. Neurol. **20**: Suppl. Erganzungsheft 1, 1913.

3. Ranke: Beitrag zur Kenntnis der normalen und pathologischen Hirnrindenbildung, Ziegler's Beitr. f. path. Anat. u. allgem. Path. **47**:51-126, 1909-1910.

4. Campbell, A. W.: Cerebral Sclerosis, Brain **28**:367-437, 1905.

5. Sailer, J.: Hypertrophic Nodular Gliosis, J. Nerv. & Ment. Dis. **25**: 402, 1898.

6. Volland: Untersuchungsresultate von 50 Schädeltrepanationen bei Epilepsie, Ztschr. f. d. ges. Neurol. u. Psychiat. **74**:505, 1922.

still others, in which the cutaneous tumors were prominent, are found under the name of adenoma sebaceum. On an estimate, about 100 cases have been reported.

ETIOLOGY

Degeneracy in the parents is an etiologic factor. The disease is congenital, but neither familial nor hereditary. Apparently it begins between the fourth and seventh fetal month. Ranke and Bundschuh have pointed out that the primary and secondary fissures which are completed about the fourth month are not distorted by the sclerotic patches, while the tertiary convolutions which develop later are involved. Bundschuh further called attention to the persistence of an external granule layer over the sclerotic areas which disappears in normal development about the seventh fetal month, and which is never present at birth.

CLINICAL COURSE

The disease is characterized clinically by idiocy and epilepsy. Convulsions usually are the first manifest symptom. In Hartdegen's case the attacks began a few hours after birth and continued until the end, two days later. Brückner's patient, on the other hand, was 9 years old when the first convulsion occurred. When once initiated the convulsions usually continue, although they may decrease in frequency or even cease. The first attacks are usually mild, without loss of consciousness, and they may affect only isolated groups of muscles. During a period of years, however, they become gradually more severe and may even be the direct cause of death. The attacks are quite evenly spaced, are not so frequent as genuine epileptic attacks, nor so paroxysmal as those of the atrophic scleroses. At times equivalents of attacks are noted, fainting spells, maniacal attacks and so-called psychic epilepsy.

In cases in which the chief clinical expression is idiocy, development may be comparatively normal for several years. Usually the children are slow to walk or talk, but sometimes they are active and intelligent and may even attend school for a number of years. More characteristic than the cessation of development, however, is the retrograde process which follows it. The child ceases to take interest in playthings, prefers to sit still, loses the power of attention, becomes indifferent to everything which had previously attracted it, becomes untidy and often masturbates excessively.

Focal signs, such as localized pareses and contractures, muscular spasms and speech defects, are frequently present. Bielschowsky has reported a case in which movements on one side of the body were much retarded, with rigidity and tremor limited to that side. He records an area of sclerosis in the opposite basal ganglion.

Although status epilepticus is sometimes the direct cause of death, the patients usually die of intercurrent infection, especially of tuberculosis, or of gastro-intestinal disturbances. Occasionally the renal tumors, becoming excessively large, cause death. Patients with cardiac tumors usually die young.

DIAGNOSIS

Often the diagnosis cannot be made during life. When epilepsy and idiocy appear in a child, especially when they are progressive and when localizing signs appear, tuberous sclerosis should be considered. These signs are uncertain, however, and only when tumors of the skin are present is the diagnosis justifiable. In the Pringle[7] type these tumors grow on the face, are small, firm papillary growths, pale to dark red, vary in size up to 1 cm., and have a "butterfly" distribution over the nose and cheeks. The Barlow type is characterized by larger nodes, sometimes 2 cm. in diameter, usually found on the trunk. They are adenomas of the sebaceous glands. Sometimes there are abnormalities in the growth of the hair. The cutaneous lesions often appear first at adolescence, giving no assistance in diagnosis during the early years of life.

Rarer malformations occasionally found are tumors of the duodenum, spleen and liver; imperfections of the heart, such as patent ductus arteriosus, cardia trilocularis, origin of the aorta from both ventricles; ectopia testis, etc.

REPORT OF A CASE

History.—M. D., Philadelphia General Hospital, service of Dr. Weisenburg, aged 6 years. The father was 29 years of age, the mother 24 at the time of conception. Both were mentally healthy and of good inheritance, but the father was tuberculous and died two months before the child was born. Birth was natural and at full term; the patient was a well developed female child. She was breast fed until 9 months of age. At seven or eight weeks of age she began to have tonic convulsions lasting about two minutes followed by stupor of several minutes' duration. The convulsions increased in frequency for six months, then decreased and ceased at the age of 5 years. During the eleven months she was in the hospital no convulsions were recorded.

Although well formed, the child was backward, could not sit up until she was 2 years old, never learned to walk, talk or feed herself; she did not play with toys until she was 4. Her chief occupation was tearing up her clothing and putting the pieces in her mouth. She masturbated constantly. She could see and hear, but apparently recognized nobody, not even her mother. She would stop tearing her clothes when spoken to, but almost immediately resume it. She was large for her age. The head was slightly enlarged; the skin was without blemish; muscular power and coordination were good. Patellar reflexes were exaggerated. Urine, blood count and spinal fluid were normal. The Wassermann test on the blood and spinal fluid was negative.

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7. Pringle: A Case of Congenital Adenoma Sebaceum, Brit. J. Dermat. **1**:64, 1891.

Before being brought to the hospital, and during her stay there she had occasional attacks of vomiting immediately after taking food, although her appetite was excellent. She became emaciated, and finally died of inanition Jan 21, 1921. She was then 6 years old.

Clinical Diagnosis: Imbecility, hydrocephalus, enteritis.

Necropsy Record (Dr. Morton McCutcheon).—The body was that of a white girl 6 years of age, weighing 40 pounds (18.14 kg.). Bony development was normal; there was marked emaciation; rigor and livor were present. The skull was slightly enlarged and normal in shape; the pupils were equal and regular, the sclerae clear. The thorax was symmetrical, the abdomen retracted. Extremities, external genitalia and hair distribution were normal.

The thoracic organs were normal. The spleen weighed 40 gm., and was normal, as were the stomach and intestines. The liver weighed 540 gm. and was of normal size and consistence. The lower border was rounded. The cut surface showed a number of yellowish white lobules, the other lobules being brown. The discolored areas did not bulge. The pancreas was normal.

The left kidney weighed 60 gm., and was of normal size and consistence. The capsule stripped readily leaving a smooth pinkish gray surface. Striations were normal. Several pale yellow nodules were present in the cortical substance, the largest being 4 mm. in diameter. Some of them bulged distinctly on section although they could not be lifted out, and one bulged through the capsule. The consistence of these structures was that of normal renal substance. The right kidney weighed 50 gm. and resembled its fellow. The suprarenals, aorta, ureters, bladder and internal genitalia were normal.

The brain was distinctly enlarged; it weighed 1,120 gm. The calvarium and dura were normal. The pia was slightly opaque in places but not markedly thickened; it was nowhere adherent to the cortex. The frontal poles of the brain were smaller than usual and unnaturally white. They felt as hard as the normal brain after fixation in liquor formaldehydi. In the temporal, parietal and occipital lobes there were similar hard areas in which the convolutions were larger than normal, projected above the general contour, were flattened or even umbilicate on the surface and unnaturally pale. These areas were fairly sharply circumscribed, irregular in outline and bounded almost everywhere by tertiary fissures. The overlying pia was lightly attached. Except for a small area in the right paracentral lobule, the central convolutions had escaped. Hippocampus, cerebellum, brain stem and cervical cord were normal.

After fixation in 10 per cent. liquor formaldehydi, the usual section was made through the basal ganglions (Fig. 1). The hypertrophic convolutions were broader at the surface than at the base and compressed the normal gyri which lay between them (Fig. 2). The cortex of the sclerotic area varied considerably in thickness; it was distinguished from the underlying white matter, not so much by color as by difference in texture, the cortex being densely hard and the white matter porous. In the fissures the tissue was softer than on the convexity. In the white matter beneath some of the sclerotic gyri were minute areas resembling the overlying cortex. Microscopic examination proved these to be heterotopias of gray matter.

In the right frontal pole, where the area of sclerosis was most extensive, there was a multilocular cyst measuring about 1 cm. in diameter, without softening, pigmentation or obvious degeneration in the neighborhood.

The posterior horn of the left lateral ventricle measured 32 mm. across. Its external surface underlay a large sclerotic area in the temporal lobe. The cerebral tissue was here reduced to 11 mm. At the point chosen for study the

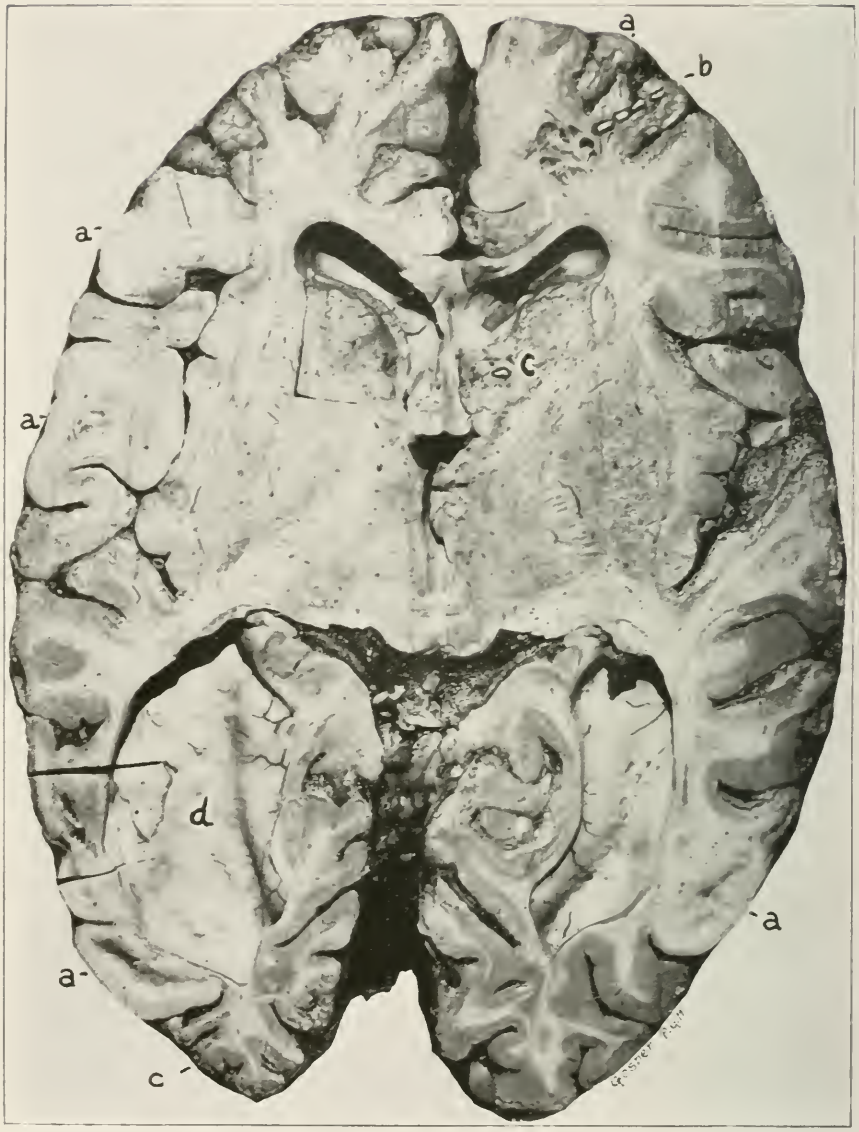

Fig. 1.—Horizontal section of brain: *a*, sclerotic areas of pale color and dense consistency with depression of underlying white matter; *b*, multilocular cyst in right frontal pole formed by dilatation of perivascular lymphatic spaces; *c*, tumor at head of caudate nucleus pressing into foramen of Munro; *d*, dilated posterior horn of lateral ventricle; note the area of microgyria in left occipital lobe.

cortex was narrow, white and hard, and the white matter was soft and porous except where the fibers of the optic radiation ran, skirting the horn of the ventricle. This tract was narrow, but apparently in good condition.

In the right parietal lobe over an area 3 by 4 cm. there were numerous abnormally small and branched convolutions, in which scarcely any white matter could be seen underlying the narrow cortex. The area was not depressed below the general level as is usual in microgyria. While these convolutions were of normal consistence and relatively normal architecture, there was a sharply defined area of sclerosis immediately adjacent. A similar area appeared in the left occipital pole.

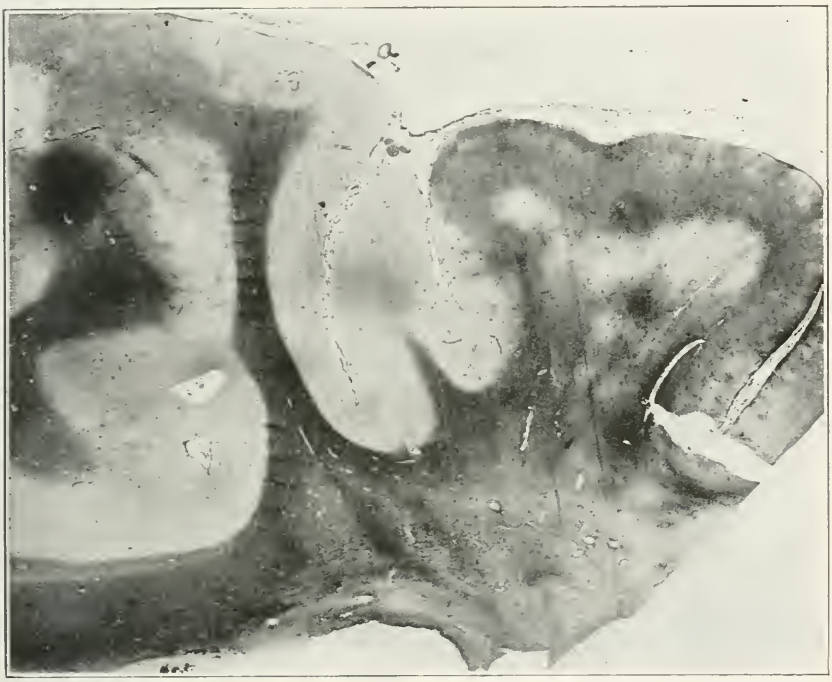

Fig. 2.—Hypertrophic convolution, broadened and umbilicate at surface, due to neuroglial overgrowth. The gliosis diminishes at the bottom of the fissure. Phosphotungstic acid-hematin stain; *a*, patch of beginning sclerosis.

At the head of the caudate nucleus on the right there was a tumor measuring 18 by 10 mm. pressing down into the foramen of Monro (Fig. 1). The tumor sprang superficially from the caudate nucleus, was of soft consistence, rather friable and darker than the surrounding tissue. It was circumscribed though not encapsulated. Its surface in the ventricle was fungoid and irregular, but at the sides it was smoother and apparently covered by ependyma. It did not invade the nervous tissue. At other points on the surface of the caudate nucleus on both sides there were smaller tumors varying from 2 to 6 mm. in diameter. In the third ventricle there were tumors up to 5 mm. in diameter, especially along the striae terminales. These smaller tumors occurred singly and in groups, and between the larger ones the ependyma was raised into cords.

Where a single tumor rose the ependyma was arranged in radial cords, resembling buttresses. The smaller tumors were much harder than the surrounding tissue and grated on the knife on sectioning. Between the tumor and the normal basal ganglion there was a layer of pale, firm tissue encapsulating the growth. In the vicinity of the tumors granular ependymitis was visible (Fig. 3). The fourth ventricle contained no tumors.

Gross Findings.—The gross findings corresponded closely to the descriptions given by Pelizzi, Vogt and Bielschowsky. They describe two varieties of tubera: the hypertrophic convolution and the sharply circumscribed node which has no definite cortical characteristics. These exist in varying proportions in different cases, but usually both are present. I could find none of the circumscribed nodes. Broadening of the convexity of the convolution and dimpling in the center were described by older authors, but Pelizzi was the first to show that the sclerotic process was confined to the external surface of the convolution and seldom or never reached the bottom of the fissure, even where two densely sclerotic gyri lay adjacent.

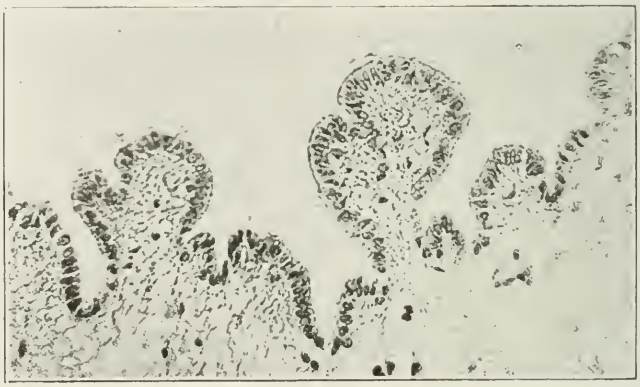

Fig. 3.—Granular ependymitis in vicinity of subependymal tumors.

The cyst of the frontal pole was unusual. Bundschuh found symmetrical cysts in the occipital poles in his case, and others have described them. Localized microgyria was described by Bielschowsky. Ventricular tumors were encountered as frequently as the cortical scleroses and did not vary much from type. They were usually hard, nearly spherical, lay immediately beneath the ependyma and varied in size up to 8 mm. Their usual locations were the caudate nucleus, striae terminales and thalamus, occasionally the fourth ventricle. On account of the persistent and uncontrollable vomiting without evident local cause, the fourth ventricle was examined with particular care but no abnormalities were found. The tumor at the head of the caudate nucleus was exceptional in size and general characteristics. Whether the hydrocephalus was the result of obstruction of the foramen of Munro by this tumor is not certain. Hydrocephalus is present in a minority of cases, and without known cause. The third and fourth ventricles were not dilated.

MICROSCOPIC EXAMINATION

Ranke [3] as a working hypothesis to explain the pathology of tuberous sclerosis suggests that there are two stages of differentiation of cells

of the central nervous system from germinal cells to fully developed ganglion cells and neuroglia cells. First, the cells develop to the point of differentiation when they become either neuroblasts or spongioblasts, and then they ripen into nerve cells and glia cells. This he acknowledges is purely theoretical, since none of the present histologic methods differentiate future neuroblasts from future spongioblasts. If the cells are disturbed at the time of differentiation, a great variety of forms may be produced. "Three extremes are thinkable: first, that the disturbance would result in the production from indifferent elements of nerve cells alone; second, of glia cells alone; and third, that no differentiation would take place. The first two possibilities are extreme one-sided differentiation, and the last, extreme lack of differentiation." Ranke elaborates the theory further by suggesting that harmful influences acting on the neuroblasts and spongioblasts at various periods of their development might produce further anomalies, and also that various combinations might occur.

The so-called "large cells" so characteristic of tuberous sclerosis are believed to be incompletely differentiated neuroblasts. They show the following anomalies (Fig. 4):

(*a*) Position: Some lie next to the surface; many are distributed through the cortex; some lie in the white matter, either singly or in heterotopic groups. They are seldom arranged in laminae.

(*b*) Size: The cells equal or exceed large pyramidal cells in size.

(*c*) Form: Occasionally a cell is seen that would be termed a ganglion cell were it not for its size or location. This is rare. More often the cell is round or oval, occasionally spindle-shaped or snakelike.

(*d*) Processes: There may be no processes or many processes, and they vary markedly in size. The large round cells have no processes as a rule, but some of them have scores resembling a Medusa's head. The spindle cells have two, and sometimes they dwarf the cell by comparison, extending full across the high power field, dividing, and wandering through the layers of the cortex (Compare Figs. 4, 5, 6).

(*e*) Nucleus: Many of the round cells have no nuclei. When present the nucleus is eccentric. Often it is lobed and sometimes two, three or more nuclei may be seen in a single cell. Some nuclei are small, but usually they are large; often grotesquely distorted; always pale and vesicular. Nucleoli are usually absent, and the chromatin network is very loose.

(*f*) Internal Structure: The round cells have neither extranuclear granules nor neurofibrillae, but the snakelike cells have fibrillae in their processes although seldom in the cell body. Sometimes suggestions of tigroid bodies are found in these more perfectly formed elements.

Investigators do not agree that these "large cells" are of neuroblastic origin. Several authors, especially the earlier ones, class them as

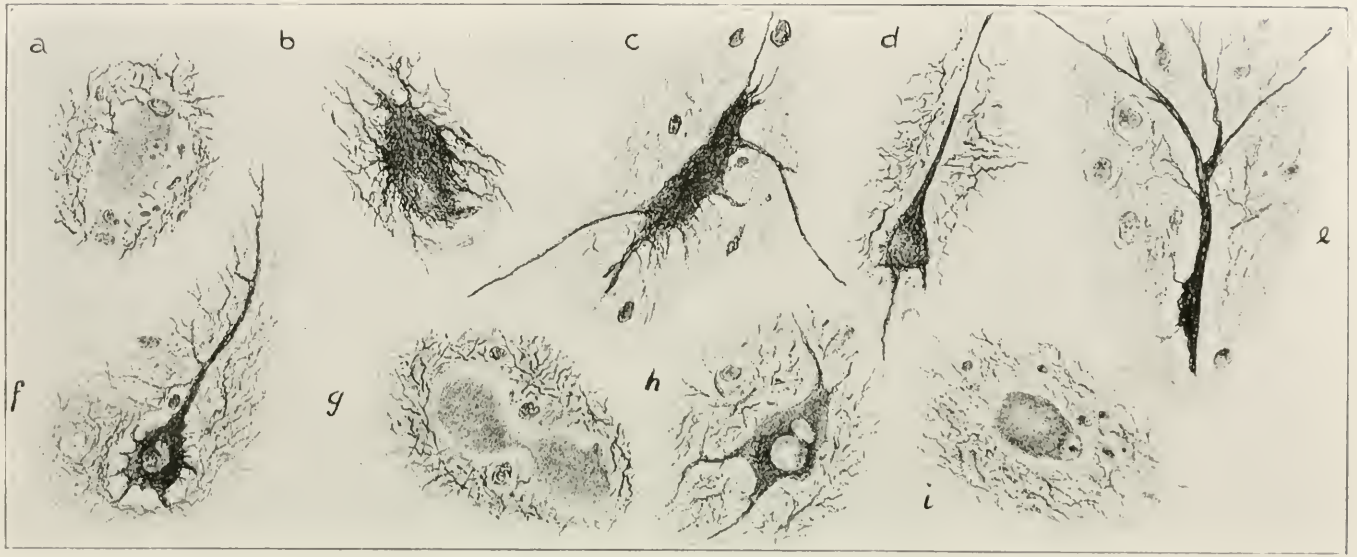

Fig. 4.—Various types of faultily differentiated cells of neuroblastic origin: *a*, simple undifferentiated "large cell"; *b*, Medusa cell; *c*, large grotesquely differentiated ganglion cell; *d*, normal ganglion cell of large pyramidal type; *e*, snakelike cell; *f*, atypical ganglion cell; *g*, twin cell; *h*, "large cell" with bilobate nucleus from heterotopia; *i*, large cell with polar nucleus. Silver diffusion stain; × 1,000.

neuroglia cells. Bielschowsky indicates their neuroblastic origin by pointing out gradations from normal nerve cells to round undifferentiated ones on the one hand and snakelike ones on the other. Their staining reactions and the presence of neurofibrillae as demonstrated by Alzheimer also indicate this origin.

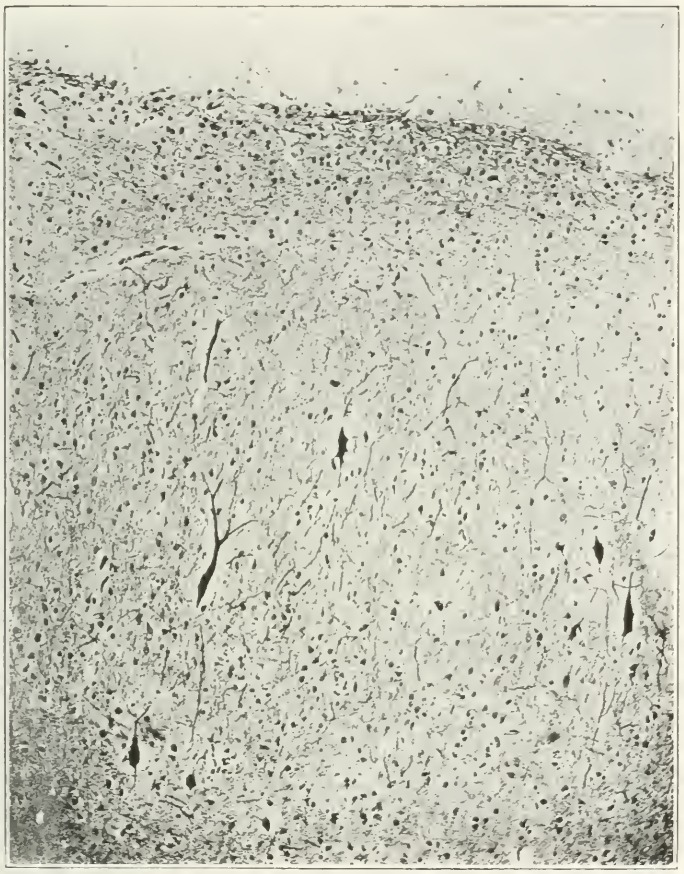

Fig. 5. — Low-power view of sclerotic cortex showing neuroglia margin, external granule layer, and atypical "large cells." Silver diffusion stain.

While these cells occurred usually in sclerotic areas, they were found also in the presumably normal cortex nearby; and they were more numerous in the deeper cortical strata and in the white matter than on the surface. The heterotopias consisted of groups of "large cells" interspersed with a few glia cells and fibers, and more or less perfectly formed nerve cells (Fig. 6).

NEUROGLIA

The density of the sclerotic cortex was due to innumerable glia fibers that intertwined in every direction. At the surface the fibers were sometimes collected into sheaves and bundles and stood on end above the normal margin (Fig. 5) but did not invade the pia. They were everywhere abundant, forming

a band many times the thickness of the normal "Randglia" (Fig. 5). At the surface of otherwise normal cortex, the first sign of sclerosis was thickening of the external glia margin and increase of glia nuclei, with sometimes a few large undifferentiated cells (Fig. 7).

Of more interest from the point of view of development was the external granule layer present in the most densely sclerotic areas. Beneath the broad surface layer of neuroglia lay a stratum of round cells, evidently glial in nature, divided from the deeper lying strata of nerve cells by another band of neuroglia fibers (Fig. 5).

Throughout the sclerotic areas there was a dense feltwork of glia fibers in the meshes of which lay numerous small nuclei. Most of these were in the

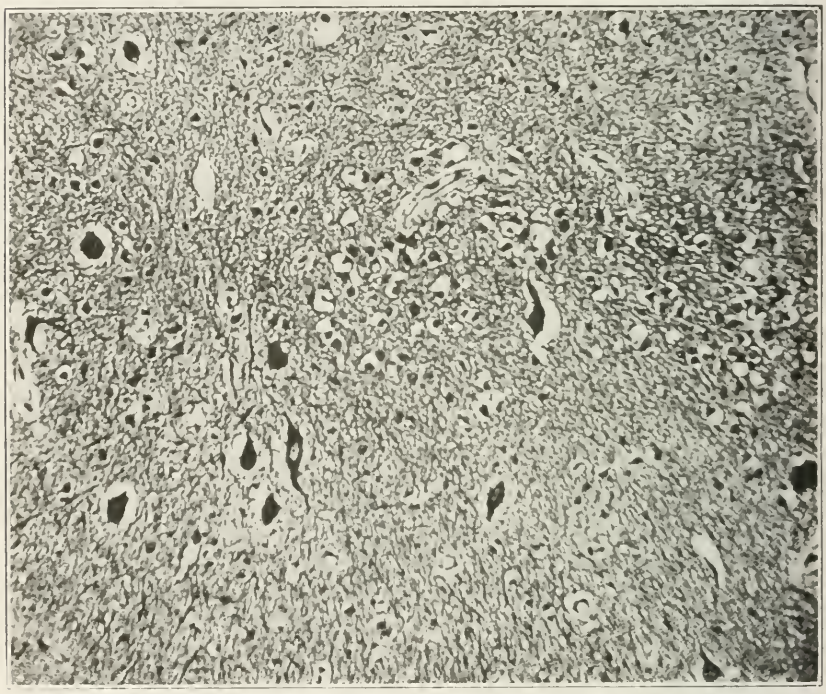

Fig. 6.—Higher power view of one of the heterotopias. Numerous atypical small nerve cells, some large grotesquely differentiated nerve cells and moderate gliosis.

resting stage but many were fiber formers. Where the feltwork was dense, it was impossible to trace the individual processes; but in the white matter where the tissue became spongy, the glia feltwork was much looser, and here the individual cells stood out with greater prominence (Fig. 8). They were larger than normal and possessed fairly definite cell bodies. The fibers were deeply stained, seemed to spring from the periphery of the cell, were heavy, and at a short distance from the cell divided dichotomously into larger and smaller branches which then curved away in easy paths and broke up into the usual glia fibers.

In the hypertrophic convolutions typical nerve cells were few, small and not arranged in strata; their apical dendrites pointed in various directions, and

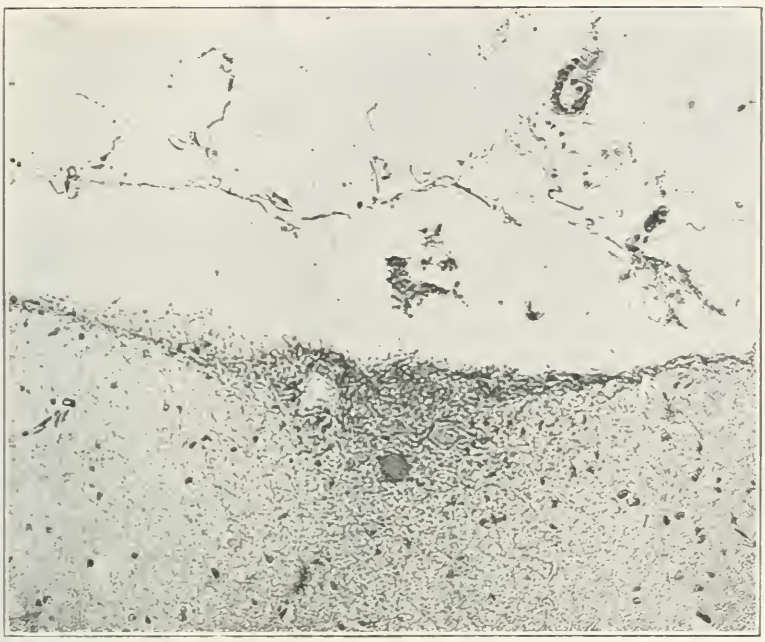

Fig. 7.—Earliest sign of beginning sclerosis. Increase of marginal glia associated with a few large undifferentiated cells. Neuroglia stain.

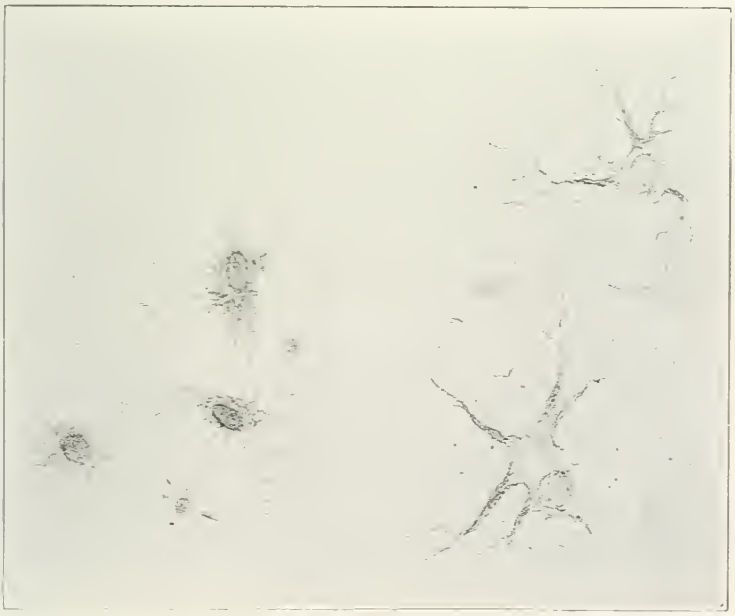

Fig. 8.—Neuroglia cells from loose-meshed white matter: very many processes extending from all points of cells; giant neuroglia cells from junction of white and gray matter; × 1,800.

they contained only remnants of internal structure. Myelin sheaths were almost entirely lacking. By silver impregnation, however, a surprisingly large number of nerve fibers was demonstrated even in the most densely sclerotic areas and the underlying loose-meshed white matter. Moreover, there seemed to be little interference with the projection tracts, for the spinal cord showed no degenerative changes, and such tracts as the optic radiation were well preserved.

Scarcity of myelin sheaths was quite as characteristic as overgrowth of neuroglia in the hypertrophic convolutions, yet in one area studied, nerve fibers appeared to be surrounded by multiple concentric rings, sometimes irregular or oval, depending on the angle of the section. These stain poorly for myelin, but clearly with phosphotungstic acid. They appear to be hyperplastic but poorly differentiated myelin sheaths.

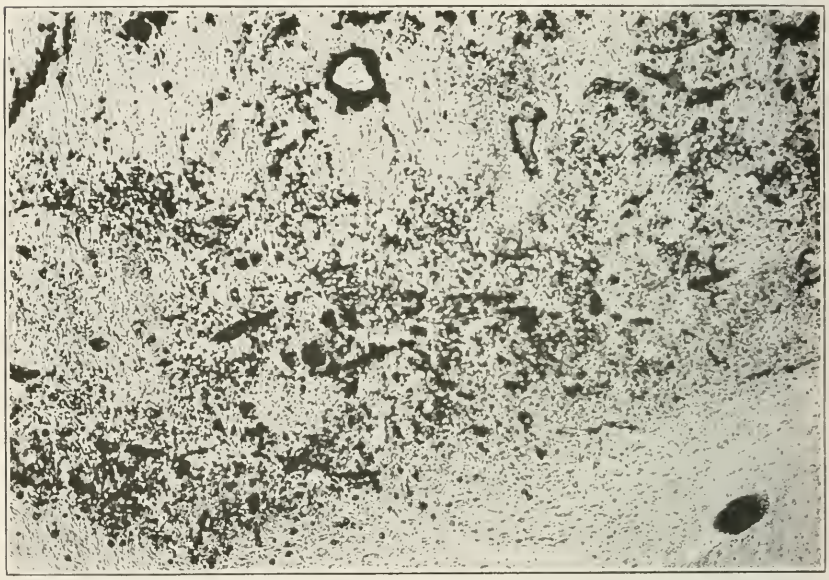

Fig. 9.—Concretions in old compact tumor. They appear to originate from blood vessels.

SUBEPENDYMAL TUMORS

All the tumors in this case except the large soft one were covered by ependyma. They arose from the subependymal glia layer and projected into the ventricle. The process of tumor formation here could be seen by examining the wall of the ventricle. The subependymal neuroglia layer became thicker, the cells developed processes, and a few large undifferentiated cells appeared, thus paralleling the picture seen in the cortical scleroses. At first the tumor was covered with ependymal cells, but as growth proceeded this layer became much flattened and rupture might have occurred so that the ependymal covering was lost. The tumors which had broken through the ependyma were more vascular and apparently of more rapid growth.

The early tumor is merely a collection of large cells with neuroglia fibers running between cells and surrounding it. In the larger tumors the cells are

more numerous and the glia fibers are proportionately diminished. They separate it into cell groups by trabeculae, and wall it off from the underlying ganglion. Many vessels in these moderate sized tumors are infiltrated with calcium salts (Fig. 9). There is granular ependymitis in the vicinity of the tumors (Fig. 3). Whether the cells of these subependymal tumors are of nervous or supporting origin is contested, some authors considering them as large cell gliomas, others as ganglioneuromas, and still others as neuroblastomas. The majority ally them with the gliomas.

The typical cells of these tumors are fusiform or retort-shaped, vary in size up to that of the largest of the Betz cells, have no tigroid bodies or neurofibrillae, and send processes away from one or both ends. Some of the

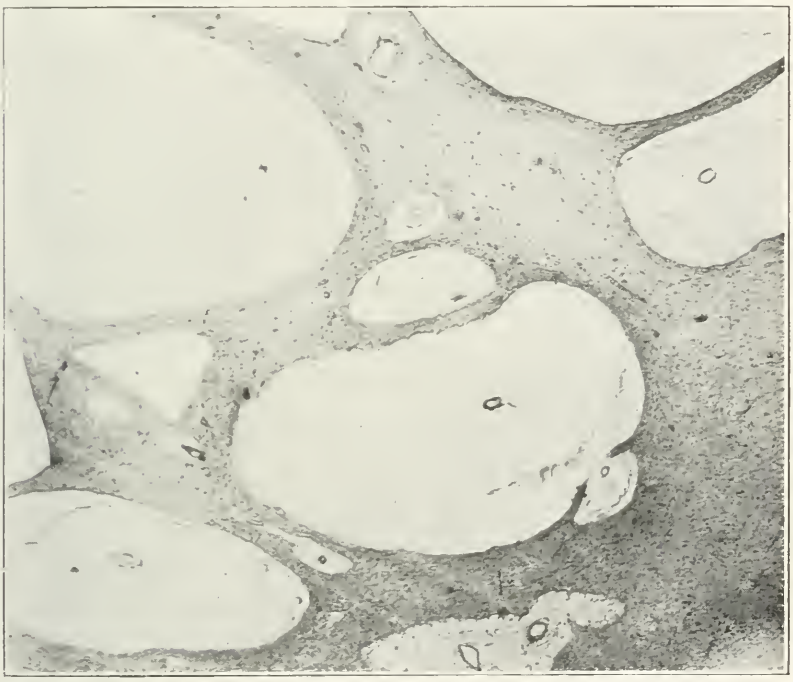

Fig. 10.—Low-power view of multilocular cyst.

cells are almost round and have no processes. The nuclei are usually large, with definite nuclear membrane, delicate chromatin network, and only occasional nucleoli. Sometimes the nuclei are grotesque in size or shape, or two or more nuclei are found in the same cell. Mitotic figures are absent. Many of the larger cells have vacuoles but otherwise do not seem to be degenerated.

The fibers sent off by the large cells run in bundles and separate the cells from one another into groups. Among these fibers lie cells of a different character, usually much elongated, with large distorted nuclei and processes following the cell outline. These take the glia stain typically whereas the large cells stain like ganglion cells.

The large tumor in this case varied in microscopic as well as gross characteristics from the others. The cells were not divided into groups, and glia

cells and fibers were almost absent. The cells were polygonal or spherical and had no processes. They stained more heavily than those of the smaller tumors, were smaller in size, and twin cells and multinucleated cells were more frequent. The extreme edge of the tumor was serrated with cell columns projecting into the ventricular lumen. There was a rich supply of vessels of large caliber and thin walls. In many respects the tumor resembled a malignant growth.

BLOOD VESSELS AND CYST

Many of the pial vessels were thickened by overgrowth of the middle coat, and the elastic lamina was split into two or more layers. There was no perivascular round cell infiltration or other sign of inflammation.

In the cortex of the sclerotic areas the blood vessels were less numerous than usual and many were abnormally thick-walled. The perivascular spaces were increased. In the white matter this increase became striking and was of two forms. In the first the adventitia was increased, filling up the space and giving the vessel the appearance of an enormously thickened wall, although the tissue was loose-meshed and nuclei were infrequent. In the other form there was further dilatation of the space to enormous proportions, without corresponding increase of adventitia, thus forming cavities (Fig. 10). This was probably the origin of the multilocular cyst of the frontal pole. Beneath a densely sclerotic cortex appeared large spaces, vacant except for an extremely delicate meshwork of fibrous tissue surrounding a small blood vessel that ran through the cavity. Between the various cavities ran trabeculae of nerve and glia fibers, with many glia nuclei in the resting stage. These septums varied in thickness down to some so fine that they were formed by only a dozen glia fibers. Moreover, in the walls of the larger spaces there were projections of glia fibers, remnants of septums which had ruptured and retracted. These cysts had no lining, and there were no degenerative changes in the adjacent tissues. They were apparently enormous dilatations of perivascular lymph spaces brought about by disappearance of nervous tissue.

CONCRETIONS

Concretions were numerous in the subependymal tumors. In the sections some of these elements were circular, intensely black spots; others had central areas of lighter color; others had lumina containing red blood cells, and still others were obviously calcified capillaries and small blood vessels. This finding has been recorded by many investigators who agree that some vessels show calcareous degeneration, but the great number and uniformity of these masses in some places has led to the suggestion that some of them are calcified nervous elements. Calcium infiltration was observed in certain large cells in the sclerotic areas. These granules were most numerous in old compact tumors with dense glia capsules and few functioning vessels. On the other hand, there was no generalized degeneration of cells, and some apparently perfect tumor cells were seen lying next the calcareous bodies. Ranke ascribes both a vascular and cellular origin to these bodies.

RENAL TUMORS

These varied in character, some consisting almost entirely of fat, others of spindle cells, others of thick-walled blood vessels. Occasionally all these

elements were found in a single tumor. They were inlaid in the renal parenchyma, compressed it but little, were sharply circumscribed but not encapsulated, and gave no hint of vegetative activity.

There were no sebaceous or cardiac tumors.

SUMMARY

The cerebral changes in tuberous sclerosis are:

1. Abnormal differentiation of germinal cells during the middle fetal months with the production of neuroglial cerebral sclerosis and subependymal tumors.

2. Incomplete differentiation of ganglion cells with the production of bizarre types.

3. Persistence of the external granule layer of the cerebral cortex.

4. Agenesis of myelin sheaths in the sclerotic areas and underlying white matter.

5. Calcareous degeneration of the walls of vessels in the subependymal tumors.

6. Localized microgyria.

In addition, in this particular case there was dilatation of the perivascular lymph spaces with cavity formation. There was no involvement of the projection tracts.

DISTURBANCES OF THE RESPIRATORY RHYTHM IN CHILDREN

A SEQUELA TO EPIDEMIC ENCEPHALITIS

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The manifestations of epidemic encephalitis in children have received attention in this and other countries, and it has been our privilege in the Mayo Clinic to see nearly all the features described by other observers. However, one syndrome in children, which was presented to us more forcibly than the other more common disturbances of function, was a disturbance of the respiratory rhythm and depth, persisting many months after the initial phase of the disease had passed. Seven children and one adolescent came to the Mayo Clinic during the last half of 1921 and the first half of 1922, manifesting, besides the characteristic disturbance of the respiratory function, the now well recognized intractable insomnia and metamorphosis of character seen in children who have had epidemic encephalitis. Six of the patients dated their illnesses from the first three months of 1920.

Disturbances in respiration during the acute stages of encephalitis have already been described by Happ and Mason;[1] six of their eighty-one patients had marked hyperpnea during the early part of their illness. In the 115 cases analyzed by Dunn[2] there were three patients who had hyperpnea lasting for a few days. Epidemic hiccup was a form of respiratory disturbance associated with encephalitis, and later events showed that hiccup might be the sole manifestation of an abortive type. Sicard and Paraf[3] reported the cases of a series of patients who had suffered from various paroxysmal respiratory disturbances in the form of hiccup, yawning, stretching, sobbing and uncontrollable laughing. Aronson[4] observed a boy, aged 8, who during his convalescence from encephalitis had developed a protracted hyperpnea which had lasted for seven weeks. Hass described the respiratory

1. Happ, W. M., and Mason, V. R.: Epidemic Encephalitis. A Clinical Study, Bull. Johns Hopkins Hosp. **32**:137, 1921.

2. Dunn, A. D., and Heagey, F. W.: Epidemic Encephalitis: Including a Review of 115 American Cases, Am. J. Med. Sc. **160**:568-582, 1920.

3. Sicard and Paraf: Fourire syncopale et baillements au cours de l'encephalite epidemique, Bull. et mém. Soc. méd. d. hôp. de Paris, **45**:232-234, 1921.

4. Aronson, L. S.: Encephalitis with Unusual Sequelae, Neurol. Bull. **3**: 113, 1921.

disturbance of a child, aged 2 years, who, without any initial febrile episode, developed insomnia and change of character. The child suffered from attacks of forcible breathing followed by breath holding, cyanosis and unconsciousness. She had had as many as six attacks in one hour. In recent literature cases of disturbed respiration and bizarre performances have been reported.

In nearly all our patients the initial febrile attack was mild; the more severe symptoms followed later in some cases. This is in accord with the experiences of others, Marie and Levy [5] in particular, who gave the name of tardy encephalitis to this type of the disease. The persistency of the syndrome following so slight an onset left, however, no doubt with regard to the nature of the disease. It seems characteristic of the disease in children that the onset is mild, but the sequelae are none the less severe.

REPORT OF CASES

Case 1.—C. P., a thin undernourished boy, aged 14, was brought to the Clinic, May 9, 1921. In January, 1920, he had suffered from pains along the left sciatic nerve, followed by myoclonic jerking of the left lower extremity. Marked insomnia, polyuria and polydipsia had developed, and he had become dull and had lost interest in his studies. Later the right side of his body had become slow, stiff and clumsy. In May, 1921, grunting expirations had developed, and later stretching and bending motions of the trunk and limbs. These had persisted and insomnia had increased.

During a paroxysm the child suddenly rose from his seat and stretched his body so that his back was strongly curved forward and his abdomen protuberant. His chin usually was sunk on his chest and his arms rotated outward in the attitude of an early morning stretch and yawn. He held his breath in this position for about twenty seconds, then dropped back on the seat, thrust his head between his knees, and in a doubled position released his breath in a series of coughing grunts. These attacks might be repeated again and again day and night; in fact, the boy scarcely slept (Fig. 1). The boy had definite nystagmus, horizontal and vertical, loss of speed, and clumsiness in his whole right side. He had a bilateral Babinski sign and definite parkinsonian facies, gait, and posture. He drooled saliva, and he had slight dysarthria and tremor of both hands.

While the child was under observation for two months, the movements were continued and all sorts of therapy including hypnosis yielded no positive results. He was dismissed somewhat improved, but two months later his parents reported that he was as bad as before.

Case 2.—O. K., a girl, aged 12, was brought to the Clinic, Jan. 18, 1922. In March, 1920, she had had what was diagnosed as influenza and had been in bed for four days with a high temperature, headache and general malaise. Marked insomnia with choreiform movements followed; her disposition changed, and she became impulsive, stubborn and disobedient. Often during 1920 she had stayed up all night at her studies, but had made less progress than before. In the first few months of 1921, she began to breathe noisily and rapidly, and

5. Marie, P., and Levy, G.: Le syndrome excito-moteur de l'encephalite epidemique, Rev. neurol. **36**:513-539, 1920.

she later supplemented this with breath-holding attacks in which she stood erect with her head thrown back. By the end of 1921, these attacks became so severe that she lost consciousness at the end and fell, hurting herself on more than one occasion. The attacks often occurred at night, and the patient had to be watched to prevent serious injury.

During an attack the girl suddenly stood erect in the "attention" position with chest fully inflated, head thrown back, arms stiffly at her sides, and hands clinched. She held her breath in this position for from twenty to thirty seconds and became cyanosed, so that when she finally released her breath she staggered or fell, breathing noisily in deep quick pants (Fig. 3). After a few seconds, the head jerked quickly backward again. This was continued until the child became dull and stupid, and sat down unsteadily, breathing imper-

A B

Fig. 1 (Case 1).—*A*, attitude of patient at the height of the respiratory phase; complete cessation of breathing for twenty seconds; *B*, attitude at the end of the expiratory phase. The patient is releasing his breath in a series of coughing grunts.

ceptibly. Later the attacks were repeated for an indefinite period. In intervals between attacks the child breathed noisily, and was disobedient, impulsive and explosive in her speech. She is still under observation and has shown no improvement.

Case 3.—M. C., a girl, aged 2 years and 10 months, was brought to the Clinic, Sept. 14, 1921. After an attack of tonsillitis in January, 1920, she had slept badly, had become backward in development, had ceased to talk or play with other children, and was irritable, fretful and peevish. June, 1920, she awoke one night and went into a series of breath-holding attacks, but the

next day she seemed as usual; every night thereafter these attacks were resumed. Two months before, the attacks had occurred during the day as well. All correction or admonition was useless; even beating during an attack was of no avail, as she did not seem to feel the blows. A few days before, a continued series of attacks had occurred from midnight until 11 p. m.

Fig. 2.—Attitude of patient during the height of the inspiratory phase. Full inspiration with partial and slow escape of pent up breath through clenched teeth.

During an attack the child stood on her cot and ceased breathing for from twenty to thirty seconds, then bent her body far over pressing her hands against her abdomen and giving exit to the pent up breath in a series of noisy grunts, terminating in a whining cry. She then breathed noisily and fast until the next attack a few minutes later.

She was isolated from her parents for thirty-six hours at a time and her noisy respiration and grunts could be heard all over the floor on which her room was situated. The attacks seemed independent of emotion; they occurred when the child was apparently quiet and satisfied with her surroundings. She slept scarcely at all and the persistency of her performances was a wonder to all beholders. She was dismissed unimproved, although all reasonable forms of therapy were tried.

Case 4.—J. L., a boy, aged 12 years, was brought to the Clinic, Feb. 24, 1921. In January, 1920, he had had what was diagnosed as influenza, which was characterized by high temperature, malaise and headache, lasting a few weeks. From that time he had slept badly. Five months later, he had developed attacks of breath-holding with noisy respirations. These attacks usually occurred at night and had persisted up to the time of examination.

During an attack the boy usually stood, took a deep breath, held it with his chin depressed on his chest and waved his arms around irregularly. After fifteen seconds he rubbed his abdomen, released his breath, and fell over on his right side. On one occasion ten attacks occurred in five minutes.

During observation of the boy in the hospital for twelve days he was quiet and well behaved. He repeatedly promised to try to control his attacks, but as soon as the promise was given he went off into another series. He slept badly, and the attacks continued night and day. He was dismissed, little improved.

Case 5.—R. J., a boy, aged 10 years, was brought to the Clinic, July 23, 1921. In November, 1920, he had had what was diagnosed as measles, after which he had become restless and fidgety and had slept badly. A few weeks later, he had begun to have respiratory difficulty during which he had attacks of breath-holding. In December, 1920, he had had a general epileptiform convulsion in his sleep. In January, 1921, just after tonsillectomy, his disposition had changed; he had become rebellious, irritable and intolerable, and attacks of breath-holding continued night and day with little rest.

During an attack the boy suddenly jumped from the place on which he was seated and jumped up and down on his toes, passing his hands through his hair, with his breath held in full inspiration. A few seconds later he released his breath, belched a few times, and sat down. His face twitched in a haphazard manner toward the end of the performance.

In the hospital the child was tied down and isolated; nevertheless he went through a modification of his attack with breath-holding. He was noisy and sleepless and intensely irritable. Communications after his dismissal showed that in October, 1921, he had improved and was only having one attack a week.

Case 6.—R. H. T., a boy, aged 6 years, was brought to the Clinic, November, 1921. One night in January, 1920, he had become restless and had slept badly. In the morning he had definite internal strabismus. His temperature had been 100 for a few days, and then the strabismus had disappeared; from then on he had slept badly, and his character had markedly changed. He sang and whistled all night and slept little during the day. A year before he had developed constant noisy breathing and breath-holding attacks. A few months before, he had begun to fall unconscious, rising, however, almost immediately.

The boy was impulsive, noisy, restless and very aggressive. He panted loudly and from time to time held his breath, became cyanosed, and fell unconscious for a fraction of a minute. Moreover, he often fell down when not holding his breath. He had to be strapped in bed to prevent his falling

out, as when unrestrained he invariably stood to breathe noisily and hold his breath, often toppling over at the climax of the performance. He went into bursts of passion for no adequate reason, was abusive, used bad language and attacked the nurses and physicians with feet and fists. In spite of this he was fairly intelligent. When asleep he breathed normally, but he seldom slept. The combination of an excitable, pugilistic manner, gusty, loud breathing and incessant chatter characterized his daily appearance. He was under observation for four months and was dismissed somewhat improved but liable to relapse under emotional influences.

Case 7.—Miss M. G., a music teacher, aged 20 years, came to the Clinic, Nov. 16, 1921, complaining of drowsiness and difficulty in breathing. In February, 1920, she had had what was diagnosed as influenza. She had been ill for six weeks with moderate fever, diplopia, blurred vision and marked lethargy and prostration; this lethargy had persisted so that recently she slept from 8 p. m. until 9 a. m., and often for some hours during the day; she had extreme difficulty in remaining awake. She felt great discomfort when standing erect

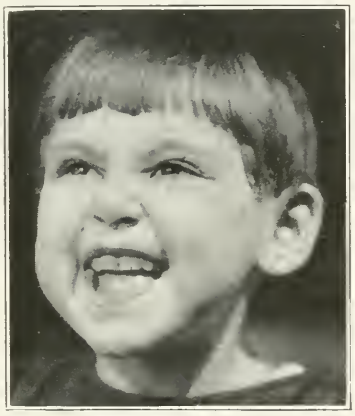

Fig. 3 (Case 8).—General expression of the patient.

or undergoing moderate exertion because of intolerable dyspnea. She spent most of her time recumbent and avoided any exertion. She had gained 20 pounds (9.07 kg.) since her illness.

Respiration and pulse rates varied with sitting, standing and prone positions. When the patient was recumbent and at complete rest, her pulse rate averaged 75 and her respiration 14; when standing or with the slightest exertion, her respirations increased to 30 or 40, her pulse became uncountable, her face became flushed, and all the accessory muscles of respiration, especially the sternocleidomastoids, stood out prominently. There was a parkinsonian appearance in her gait, facies and posture, and she had definite tremor of the hands.

Case 8.—D. F., a child, aged 4 years, was brought to the Clinic, April, 1922. She had had influenza in the spring of 1919, after which she ceased to walk, became backward in development, irritable and noisy, and slept badly. She forgot all speech she had learned; a few months later she began to walk again unsteadily and clumsily. There was little change and no development of mental faculties from the age of 12 months until examination. In March,

1922, she again had a febrile attack associated with cough and malaise. She was ill four days with a temperature of 104 F., and thereafter again ceased to walk. On the last day of her illness she suddenly began to breathe noisily and rapidly and at night had attacks of breath-holding. She began to slobber saliva and developed a habit of constantly sucking three fingers of her right hand.

The child was obviously unintelligent. While observed, without any display of emotion, she puffed away noisily, commencing with a period of apnea and then breathing faster and louder until a climax was reached, after about thirty respirations, when she made a grimace (Fig. 3), held her breath for almost fifteen seconds and made athetoid movements with her hands. She then usually released her breath, waved her arms around aimlessly and panted loudly. This gradually diminished until a period of apnea was reached, when the cycle was again and again repeated for as long as she was under observation. She was dirty in her habits, and unable to walk. Her lower limbs were spastic. She hardly used her left side, and on this side Babinski's sign was positive. Her noisy respirations could be heard at a distance, and these only ceased when she ate and slept. She is still under observation.

GENERAL CONSIDERATIONS

Complete physical, neurologic, and laboratory studies were made in most of the cases, with no more positive results than those mentioned. Attempts to substantiate the suggestion of tetany in a few of the patients by means of blood examination and electrical reactions were unsuccessful. Our first impression of these patients was that their individual performance was a functional disorder of hysterical nature, and the treatment was directed accordingly. As patient after patient showing the same characteristics arrived within a relatively short time, the disease assumed an epidemic character, and we had to seek a different diagnosis. Reviewing the individual histories, we discovered that these patients nearly all dated their illness from the first three months of 1920 and, moreover, some of them had had an initial illness, definitely encephalitic, and some had evidence of gross cerebral damage (Cases 1, 7 and 8). Eventually we had little doubt with regard to the nature of the disease, and its persistency and failure to respond to ordinary therapeutic measures confirmed the diagnosis.

There was a marked resemblance in the paroxysmal disturbances of respiration in the first five patients. Essentially their syndrome consisted of assuming the erect posture, breathing noisily, holding the breath with bodily contortions and releasing the breath in a position best suited for complete expiration.

Cyanosis with partial loss of consciousness, falling, and petit mal-like attacks were common and present in three cases, and all the patients had the marked insomnia and metamorphosis of character so well described by earlier observers.

The only adult of the series (Case 6) had a syndrome observed in no other patient. In many ways her condition resembled that of an

animal with both vagi cut. She had no respiratory reserve to draw on; at rest she was comfortable, but her breathing was always maximal in depth, and exertion could not be tolerated.

Localization of the lesion is a matter of speculation; probably a diffuse process was present. Case 6 was the only one in which one dared to postulate a location of damage as in or around the respiratory center in the medulla.

Endeavor was made to investigate the psychologic mechanism of these patients. Their emotional, rebellious manner was against them, and at times it seemed as if their performances were gone through wilfully, that they themselves could end them if they wished. It seemed that all that was needed was some stern discipline and isolation to produce an amelioration. We soon found out our mistake, as neither of these measures, or any others had the slightest effect. Hypnotism was ineffectual, and direct questioning as to why they went through their movement produced the reply: "Because I want to," or "Because I feel better when I do it."

The lengthy period of the illness, on the average eighteen months, was not more striking than the stereotyped character of the movements which were persisted in day and night with monotonous regularity. The patients were extremely difficult to manage and disturbed all around them.

Two patients, Cases 2 and 8, have been seen recently; they have not improved. The future of the other six patients is as yet unknown; time alone will show whether they will recover and grow into normal adults. The epidemic of encephalitis provided many strange and bizarre pictures, but few surpassed the appearance of these little children at the height of their illness. It is a syndrome that has to be added to the kaleidoscopic picture of epidemic encephalitis.

SUMMARY

1. During the year 1921 eight patients, seven of whom were children, were under observation at the Mayo Clinic, suffering from a disturbance of the respiratory rhythm.

2. While four of the patients had had an infectious illness worthy of the diagnosis of epidemic encephalitis, the remaining patients dated their illnesses from an infectious episode or febrile illness. In seven patients the onset occurred during the first three months of 1920.

3. The main features of the clinical picture in these cases were paroxysmal stretching, breath-holding, grunting and forced noisy respirations. In others there was constant dyspnea associated in one case with posture.

4. The average duration of the illness was seventeen months before examination at the Clinic, and in a few cases there was an appreciable gap between the initial illness and the appearance of the prominent symptoms.

5. The perisistency of the symptoms contrasted with the peculiar nature of the disease which was more manifest by night than by day. It was relatively unaffected by various forms of therapy.

6. Combined with the peculiar paroxysmal respiratory attacks were changes in character. The patients were noisy, disobedient, and passionate, whereas formerly they had been well behaved. There was marked insomnia with inversion of the sleep rhythm in the seven children and abnormal drowsiness in the one adult.

PSYCHOPATHOLOGY AND ORGANIC DISEASE*

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NEW YORK

About ten years ago I first brought to the attention of this body certain reflections bearing on a relationship between neural integrative factors and what in general was considered as disease. Having become saturated with certain conceptions concerning the importance of feeling and thought factors in human pathology, the translation of Déjerine and of Dubois were only natural expressions of my growing beliefs.

But it soon seemed apparent that the intellectual dialectics of Dubois were not quite fundamental enough; without a corresponding personality makeup behind them the principles are insufficient. Déjerine's emphasis on the feeling—the emotional factors—went nearer to the heart of the problem, but here again the emphasis seemed one-sided. The old faculty psychology, as applied in therapeutics, now dealt with the intellectual functions, now with the emotions, and I even took a shy at the will in my translation of Payot's "Education of the Will." Out of all of this we were brought back to the hippocratic doctrine that the organism, as a whole, must be the object of search and portal of entry made where the organism, as a whole, really lived. It does not live in the intellect, it does not reside in the feelings, it is not at home in the will. None of these "belong." And thus our search for a unity led us into the unconscious—that accumulation of life's experiences (engrammes) which in their zoologic synthesis have been accruing during about a thousand million years.

"What are we in fact," asks Bergson. "What is our character, if not the condensation of the history we have lived from our birth, nay, even before our birth, since we bring with us prenatal dispositions? . . . Doubtless we think with only a small part of our past, but it is with our entire past, including the original bent of our soul that we desire, will, and act. Our past, then, as a whole, is made manifest to us in its impulse; it is felt in the form of tendency, although only a small part of it is known in the form of idea."

Life may then be expressed, if I may take a phrase from our President's masterly address, in the form of a fraction in which the numerator may stand for our conscious idea of things, and the denominator for that past of which we have just spoken, the unconscious. Let me put this in the arithmetical form of a proportion, thus: As the numerator—from minute to minute: is to the demoninator—one thousand million

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* Condensation of paper read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

years :: so is our conscious idea as to what is happening in life : to the unconscious forces (phyletic memory patterns) that really permit it to happen.

If this is true, our really ever understanding anything looks hopeless. Yet, with that temerity that has ever characterized my efforts here, I venture to bring to your attention, even if summarily, some reflections that may be of assistance in enlarging that numerator, our conscious control of the hidden factors that bring about disease.

It is because of my belief that within the interests that bind this body into a neuropsychiatric society there is to be found the most hopeful outlook for a neohippocratic medicine that I dare to do this.

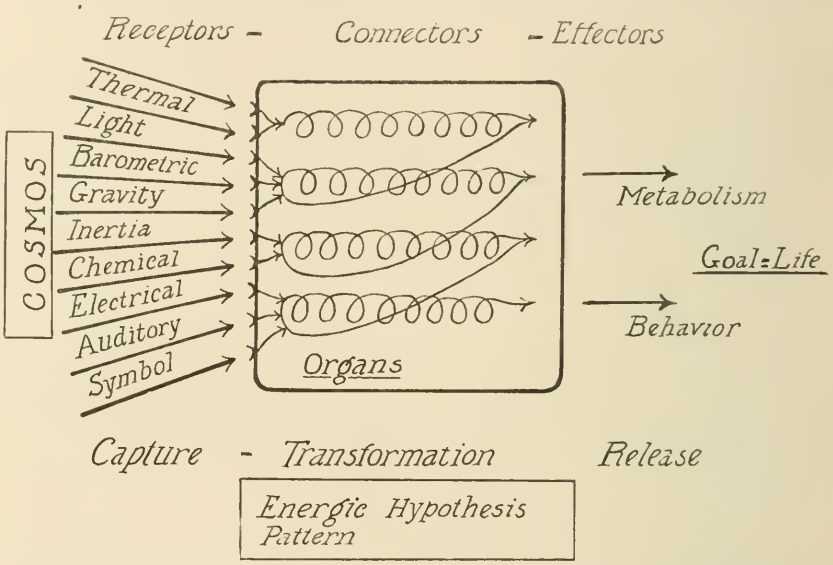

Fig. 1.—Rough schematic representation of the pattern of the organism as a capturer, transformer and deliverer of energy.

It may become possible thereby to understand some of the activities of the organism as a whole.

Permit me to give a rough scheme of this (Fig. 1). The organism, as a whole, carries out its energic program of capturing, transforming and delivering energy. The cosmos is its petrol tank; the organs, its structuralized functional transformers. These are integrated and coordinated to act, as a whole, through its nervous mechanisms, vegetative, sensorimotor, symbolic, to deliver itself in its *metabolic upkeep* and its *behavior*. The goal is the continuance of life; immortality.

EPOCHAL PERIODS THROUGH WHICH ORGANISM PASSES

Also permit me as sketchy a scheme as to the major epochal periods through which each organism passes, recapitulating the history of its

prenatal past as well as its individual participation in that experience which has been molding it throughout its geologic time period. That thousand million years of recapitulation hurries by in the nine months of intrauterine life.

Archaic Period.—Dr. Tilney's time consuming and masterly studies of the developmental history of the nervous system give us an opportunity to peer within some of the things which are so rapidly forming in this period, to which the term archaic may be applied.

In the comparatively insignificant period of nine months, one thousand million years is traversed. From primordial ooze to man, in one majestic sweep, the creative impulse shows its handiwork. If one wishes to call it God, it is only a matter of terminology. No name will ever be adequate to encompass the facts. In the short period I have for this presentation, I cannot commence to touch on the implications which surround the formulation here sketched. So far as human

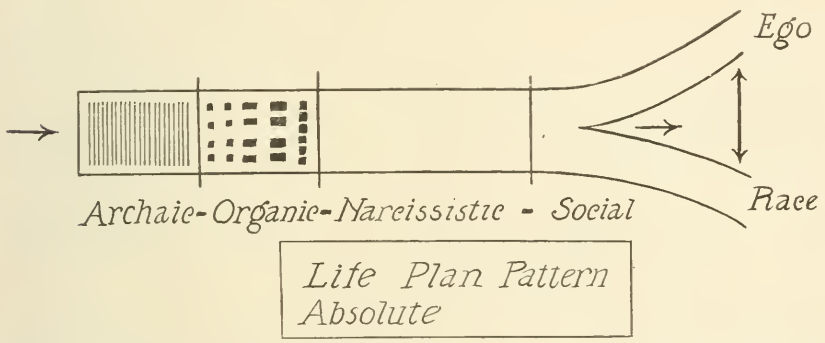

Fig. 2.—Rough schematic representation of the life plan pattern in its phyletic dynamic sense, with division of periods, archaic, organic, narcisistic and social.

pathology is concerned, all that I wish to emphasize at this time is that defects of development in this period are accessible to the newer psychopathologic technics and are integrated into the hypotheses which I would present to you. Man has retained his phyletic theomorphic capacities in the soma. It is here maintained that they are capable of projection into the symbolic sphere in the highest of known animals, man, and if recognizable, may be of fundamental service in the problems of pathology. When our concepts become big enough the material is at hand to be interpreted.

Organic Period.—A further glance at our second diagram shows the next period of development is the organic. By this is meant that man, having been born, commences to use his tools. Individual experiences become more striking and acute, and an important period of organ rivalry sets in. The need of oxygen brings distress; the reflex act is the

cry; this starts the respiratory rhythm. I need not discuss the complicated physiologic hypotheses. Here in essence is to be found the need-oxygen (physicochemical level), the organic act, respiration (sensorimotor level), and the cry (the symbolic level). Crying satisfied a need; it is now used to attempt to gratify all needs. But with the act of nutrition, there occurs to use the vernacular, the first "fifty-fifty" in the child's life. It cannot "holler and swaller" at the same time. Choice must be exercised, inhibition becomes operative—again a full discussion of the problems would occupy the day. In fine, repression has won, in part or completely, and healthy adaptation has taken place. This rivalry goes on among all the organs and has an enormously intricate and subtle history, as will later be discussed in our outline of the mechanisms by which the supremacy of the genital zone craving becomes established. Many problems of so-called constitutional disease, often thought of as congenital or inherited, may be reexamined to

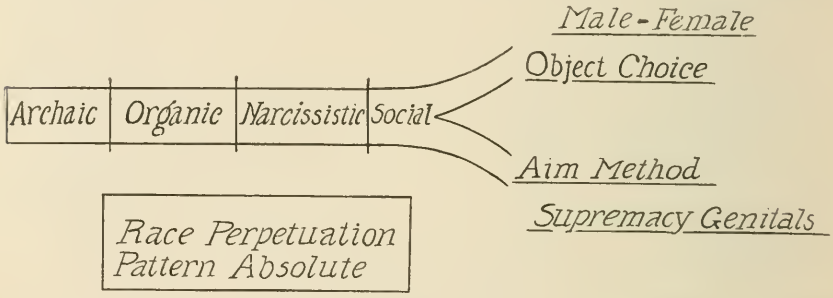

Fig. 3.—Rough scheme of psychosexual stage pattern in terms of object choice and in supremacy of genital zone.

advantage from this standpoint of libido rivalry. The individual's psychologic level mechanism may be of paramount importance in determining structural alterations in this infantile period of adjustment. Here Pavloff's general thesis of the *conditioned reflex* is a conceptual tool of great value in comprehending the symbolic identifications.[1]

Narcisistic Period.—A third and a fourth definition are to be attached to Figure 2. The third period of development posited is the "narcisistic." The individual has become an integrated personality. He passes out of the period of "cylinder adjustments," to his "place in the road." The inner machine now passes to the conception of *my* car: I, John Jones. His cravings are still segmented so far as their somatic activities are concerned. But they are not so radically felt as such. Narcissus has been born. Self love, reflex activities conditioned on the basis of purely egoistic strivings, libido attachments to mirror

1. Freud: Three Contributions to the Theory of Sex, Nerv. & Ment. Dis., Monograph Series 7.

pictures of the self in all of its developmental stages, these are the earmarks of this period. Permit me to emphasize the fact that I am talking now in terms of the denominator, of the phyletic memory patterns, not in terms of the conscious. We are here interested in learning what narcisism is, in the terms of unconscious attachment, and we shall see later that it, too, offers complicated and subtle differentiations.

The Socialized Individual.—Finally, man advances into the territory of a socialized individual. He has left the self, and the values of social integration commence to be those of permanent value. No matter how complexly discussed may be those values which roughly speaking are here termed social, it may be seen that when the individual is subjected to the divesting process of the psychanalytic technic, these goals of his striving stand out in naked relief to his numerator, his consciously adopted, usually quite flattering, estimate of his motives. It is here that the acid test of the psychanalytic technic cuts deep into reality, and one may see almost at a glance the coordination between the individual's various segmental strivings and the stage of psychosexual expression attained.

If life's chief goal is its continuation, then in the phyletic sense, waving aside all the petty conscious notions of what is meant by sex, it may be seen that the urge for continuance has fashioned itself into every structure of the body. And every cell of living matter exists only to carry on the supreme work of creation. That is its fate, if one wishes so to regard it; its promise as well.

Adult, that is, socialized, psychosexual evolution, is, then, the highest goal that man can reach, and falling short of this, his machine lags behind either as a receiver, a transformer or a deliverer of energy. Here again conscious rationalizations as to what constitutes adult psychosexual evolution must be put aside in an application of psychopathologic data to the study of disease and human suffering. In their time and place such ethical systems have had almost sublime values, but like many a goodly apple, rotten at the core, the individuals professing them may be deceiving both themselves as well as others, and the ethical systems themselves have been utilized in a sense negative to their fundamental phyletic values.

In Freud's masterly study, "Three Contributions to the Theory of Sex," we see that, phyletically speaking, object choice and supremacy of the genital zones must be coordinated into a socialized sexual pattern. The object choice pattern has been built up on a heterosexual foundation for millions of years; likewise the germ plasm structuralizations have demanded that they be put to socially constructive utilizations, else the individual, be it lowly plant or highly evolved man, will be thrust aside in the relentless march of progressive,

emergent evolution. The psychanalytic theory maintains that these instinctive patterns are capable of analysis within the individual. Behaviorism, as a fragment of realistic science, it welcomes, but it holds that this highly useful observational science can be aided by intellectual tools through the utilizations of the psychanalytic technic.

Let us turn to our next diagram, Figure 4, and see, roughly outlined, what this technic offers for the comprehension of the instinctive mechanisms surrounding object choice. This has been envisaged by Freud as the Oedipus complex, or Oedipus hypothesis, by the utilization

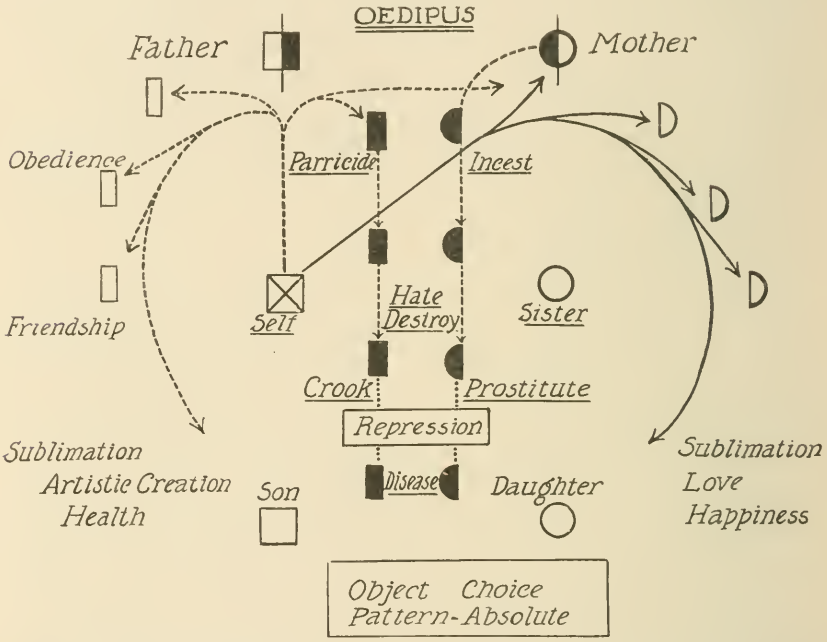

Fig. 4.—Crude diagrammatic representation of the mechanisms by which the adult psychosexual object is reached in terms of the Oedipus hypothesis. The psychologic splitting of the mother-father image is roughly indicated.

of which the unconscious symbolizations throw light on the stage of psychosexual evolution of the individual under consideration. It cannot be too strongly urged that we are dealing with analytic, i. e., individual problems. Their synthetic aspect, i. e., the doctrinal generalizations, must be left outside for the time being.

The diagram is sufficiently explicit, but I cannot forego the observation that this diagram must be read not in the sense of a purely conscious series of behavioristic reactions, but as a representation that must be conceptualized from the standpoint of the denominator, that is, the unconscious in the psychanalytic theory.

Almost all of the misconstruing comments on the Oedipus complex are due to the failure to comprehend this. When in chemical symbols we say that 5 H_2O + 6 CO_2 [+ solar energy + chlorophyl] = $C_6H_{10}O_5$ + 6 O_2; that is, water and carbon dioxid in the presence of solar energy (sunshine) and through the catalytic action of chlorophyl, yield through a series of reactions, starch, oxygen, etc., the nonchemically trained observer is incapable of understanding this simple symbolic statement of vital processes going on in the chlorophyl-bearing leaves of plants. The Oedipus symbolic statement is equally outside the ken of the non-

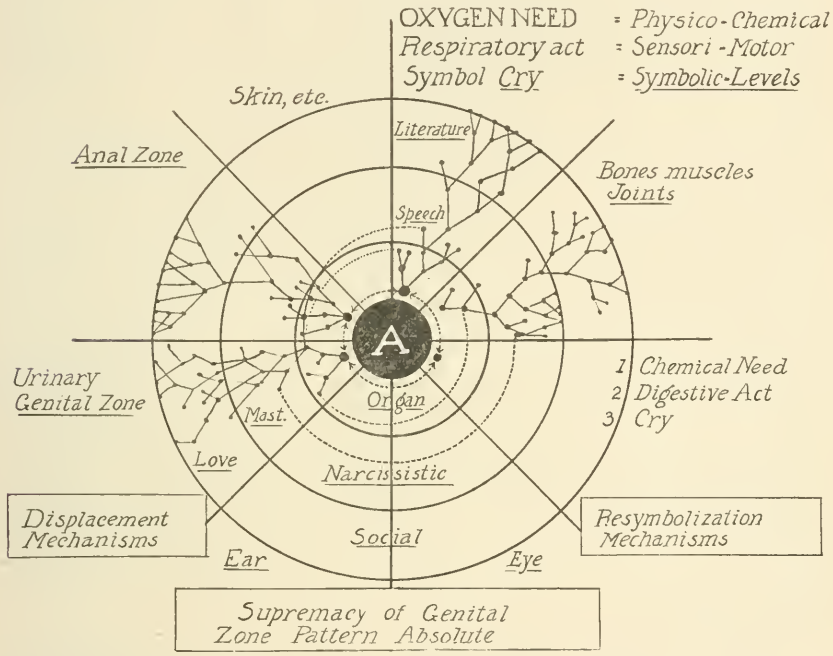

Fig. 5.—Rough scheme of stages in development of socialized psychosexual aim pattern. In this diagram the linear form, as in Figures 2 and 3 is changed. The various stages *A*, archaic, organic, narcisistic and social are represented in widening circles of resymbolized patterns of activity each showing the delivery mechanisms working at more adult levels. Displacement is also represented. The socialized end products which constitute behavior in its various aspects cannot be put in the diagram, but they can be readily conceptualized. Each segment stands for a segmental craving structuralization (schematic).

analytically practiced mind. Hence, most of the footless discussions about the Oedipus hypothesis and its implications, not the least of which was that of Mills at our last meeting.

The rough diagram in Figure 5 attempts to indicate a complex series of mechanisms. If it be conceived in a dynamic sense, it would portray the various physiologic activities of the human body. In terms of

Figures 1 and 2 these are all carrying on (*a*) the function of self preservation (metabolism) and of (*b*) race perpetuation (social behavior) in its various aspects. It has already been indicated how the displacement mechanism under inhibition, or repression, can push energy into this or that channel. With advancing development the simple manifestations of the delivery systems become more and more complex, preparing the organs, the Narcissus, and finally the socialized adult to deliver his energy at more fully integrated and coordinated ethically valuable levels. Thus, out at the periphery of this diagram can be shown how energy deliverable through an organic satisfaction at a more primitive level may be displaced to another area and then resymbolized and gain satisfactory, and hence health giving, expression through another group of organs, at a higher, that is, a more socialized level. When, so to speak, it is said, "One whistles to keep up his courage," the craving to run away, by means of the leg muscles, is satisfied through the whistling. This simple illustration may be amplified a thousand fold, and the Freudian mechanisms of condensation, secondary elaboration, displacement, conversion, substitution, projection, etc., are keenly thought out formulas through which the dynamically thinking observer can come to understand human behavior, either at its metabolic, its sensorimotor or its symbolic level. The organism works as a whole. Physics and chemistry, sensation and motion, thinking and feeling, are all operating parts. Should we seek to grasp the largest of the integrating formulas, that is, a true integral calculus applicable to human behavior, symbolically expressed, such calculus formulas, differential as well as integral, it is here submitted, can be partially glimpsed in the schemes here sketched, when viewed more from the denominator standpoint, quadmillions to one, by means of the psychanalytic technic.

REPORT OF A CASE

I shall present my case in tabloid form. I present the bare outline of a case (Fig. 6), which, permit me to elaborate somewhat.

In 1914, an old friend came to my office and dramatically said, "For God's sake, save my wife! The doctors have given her six months to live, and I am out of my mind." In response to my questions he said "She had kidney trouble, a blood pressure of 240! and according to the doctors, unless she dieted, went to bed, did this and did not do that, she would die in six months."

I assured him that it could not be as bad as he said. He was upset and his fears had magnified what had been told him. I said that I was sorry but did not specialize in kidney disease, etc. His attendant and consultant physicians were the best in the city; in fact, they had national repute and could be relied on. I knew his wife was of a very

active type, but I said it would be better for her if she slowed down a bit and possibly gave up her plan of stumping the state for woman's suffrage, or what not.

He insisted on my doing something. So I told him I would send her to one of the city's best hospitals, to one of the best internists, and get as complete a balance sheet of her condition as I could get, and then, as he was an engineer, I would translate, as best I could, the Greek and Latin terminology of the medical lingo, into mechanical terms with which he was familiar.

So I did. She was examined by all the methods known to internists' lore of the time. She was under observation for two or three weeks. The problems involved were, clinically speaking, quite banal. There was a cardiovascular-renal syndrome known to all medical men, and

A woman, aged 36, married, children ♀, ♂, ♀, ♀, nephritis-hypertension.

Symptoms Headache four years. Blood pressure 240-250 mm. Albumin. Diminished urea output. Retention. Asthenia. Edema. Dyspnea. Constipation +++. Slight momentary lapses.

Behavior Able, energetic, cultivated interests in home, children, society. Two girls in family. Devoted father; beautiful, much admired mother. Large family group of professional people. Never peculiar. No eccentricities.

Unconscious *Oedipus evolutions,* defective. Strong father fixation. Rejection of male. Homophilic. *Supremacy of genital zone,* defective. Urinary fixations. Strong anal erotic components.

Fig. 6.—Outline of Case.

hypertension of from 220 to 240 mm. systolic pressure, with nephritis. The treatment prescribed was rest in bed, plenty of water, a restricted diet, plenty of restrictions. The prognosis was dubious and serious; she might live for some time if she followed the treatment indicated; if not she would probably die within a short time.

I asked concerning the cause of the nephritis. The physician said it was the high tension. I said, "Why the high tension?" "The nephritis," he answered. "And where do we get off this circle?" "We don't," he asserted. And there we were. Of course, I am abbreviating the conversation. A review of the world's literature during the past four or five years on this problem shows that this is its present status. As Widal, in answer to a similar inquiry I made to him last summer, at the close of a brilliant bedside clinic on almost a facsimile of my patient, said, "C'est les mysteres! Internal medicine, so far as it has

gone, cannot break into the circle, and looks, when it looks at all, at the 'mysteries.'"

When I explained to my engineer friend what I had been told, he saw the difficulty, but was surprised at the static position in which the internists left the case. I agreed with him. After much discussion I finally consented to make a tentative appraisal of the intrapsychic situation and try to determine whether, in terms of what has here been formulated, there was any look in on the dynamic side.

Within two weeks it was quite apparent that the unconscious material afforded illuminating glimpses of some of the "mysteries," and told us *why the organism as a whole* was not functioning satisfactorily, although I was not able in that time to determine why the cardiovascular-renal components were the structures which showed the most evident signs of breakdown (that is, from present day clinical criteria).

I then proposed to conduct a research. If, in the crude thought of centuries, the mind was said to influence the body, what could the refinements of analytic technic show as to such influences? Or, since modern psychopathology rejects this setting off of opposites, body versus mind, what could such a technic show as to the mental, that is, the symbolic level activities, going on in the individual? These the internist knows little about, except as he mouths such vague monstrosities as "nervous," or "emotional" or "psychic." The internist is, for the most part, working at the physicochemical level. Like Yank, in O'Neil's "Hairy Ape," he thinks he "belongs" because he stokes the fires. He is iron and steel. Our present internist's conception of the "human machine" is as crude as Yank's conception of the world which broke him. I am not unmindful of the legitimate protest against such a statement, as evidenced, for example, in Kraus' "Allgemeine Pathologie der Person," in which, fortunately, it may be seen that internal medicine is breaking away from the static molds of descriptive science which have been building up too onesidedly for the past fifty years. Nevertheless, I maintain that when the time comes that Claude Bernard dreamed of—"when the physiologist, the philosopher, and the poet would talk the same language, and understand each other"—a true science of medicine will be possible. That time has not yet arrived. We have a few physiologists, but where are the medical philosophers? As for seers in medicine, they are too few and are mostly despised and rejected of men. I need only refer to one medical poet, philosopher, and physiologist, who after thirty years of contumely and most prejudiced criticism, is finally recognized as a genius, and whose illumined hypotheses are making it possible to understand the enormous rôle that psychopathology plays, not only in the neuroses and psychoses, but in what is termed constitutional disease. But to return to our patient:

I cannot recapitulate all the evidence, but the very first finding in the "unconscious" contained some interesting material. While in the hospital she had dreamed the following which was a seminightmare:

"There was a road along which two men were driving like mad in single-horse racing sulkies. As they went by in a cloud of dust, a woman with disheavelled hair came from a house facing the road wringing her hands and screaming at the top of her voice. The men and horses went up a steep hill, and as one reached the top he turned sharply to the left and ran into a stone wall about two feet high and smashed the sulky all to pieces."

Now I know to the nonanalytically trained observer this means as little as the sight of a small red stained rod under the microscope means to one who does not know anything about the tubercle bacillus.

To the patient I said, "What about it?"

"About what," she said?

"Well imagine yourself one of those riders."

"I'd be crazy," she said.

Well, I said, "It looks as if somebody was destroying something, at all events, and maybe the *wish* to destroy has something to do with your own breakdown." "Let us go further." Then her free associations were obtained, and for several sessions we worked on this dream.

To give the results of these investigations in extenso would be as wearisome as to give in minute detail all of the intricate directions for carrying out a Wassermann test. The general findings showed an obvious difficulty in her object choice. According to the principles of the Oedipus hypothesis, she showed a strong unconscious father fixation. He was the man of the sulky. A part of him, the one that ran into the stone wall and smashed up the machine, was related to the incestuous component of an infantile fixation period; but to the student of unconscious processes as modified through the dream work, and as further extended by the technic of free associations, an enormous amount of material may be recorded, just as the physician who finds the tubercle bacillus in a patient's sputum has opened up an enormous amount of material heretofore unknown (Fig. 4).

Here, then, one finds the first obvious failure in the energy delivery system, since it had become fixed (conditioned) for infantile rather than for adult psychosexual functioning. The psychopathologist can envisage some high voltage energy seeking an adequate pathway for discharge (*racing horses on the road*), and not finding the adequate outlet, backfires and creates havoc somewhere in the machine. This is the general rough idea. Can an analytic Franklin conceive, with his kite and string, how to determine the line of discharge? That is, can the analytic technic show why the cardiovascular-renal structures were chosen as the lightning rod for grounding this faultily delivered

energy? If so, then, in general, we have the leading features of our problem laid bare: *faulty psychosexual evolution* in terms of *object choice*, and *supremacy of the genital zones*.

Every psychopathologist working with the analytic technic knows that the stage of the Oedipus formula turns up fairly early in an analysis. It may be that Freud's genius in pointing out the way enables us to recognize the main indicia of difficulties in its development. The traveler from New York to San Francisco recognizes Buffalo, Chicago, St. Paul, Denver, Salt Lake City as stopping places on the road; so the analyst can observe the symbolizations of the *Archaic, Organic Narcisistic* and *Social* stages in the growth of the individual to adult psychosexual development. But there are innumerable stations between these larger more or less arbitrarily named stopping places. The Libido is, however, ever on the go. It stops nowhere. It is the insufficiency of the intellect that creates the need of static stopping places, of giving dead names to dynamic processes.

Psychopathology is still working to analyze the displacements, the side tracking, splittings, and condensations of energy traversing the somatic segmental pathways in the evolutionary urge toward a truly creative use of the segmental structures.

Judging from conscious criteria, the fact that our patient had four children all growing up and free from gross defect would argue that the supremacy of the genital zone had reached an adult stage in the plan of psychosexual evolution. This is the general intellectual conception. But on looking over the accumulating dream material, a sufficient number of reasons are found which tend to explain why the patient was frigid in her intercourse with her husband, even frigid to manual or any type of contact with the genitals. The evidence was plain that a fixation had taken place even before the clitoris could serve as a guide to the zone supremacy. There was plainly indicated in the dream material that vesical and urethral fixations were conditioned and that no supremacy had been reached beyond this stage.

Marked constipation which had resisted over twenty years of attempted treatment by scores of procedures was soon traced to its anal erotic sources—another libido displacement—and was effectively relieved in a few months. One bit of dream evidence bearing on the anal eroticism is worthy of record. After I had known the patient about eighteen months and she had been free from constipation for over a year, she had a short period of relapse. She came in one day and laughingly asked me what I thought of this dream:

She and B. (her maid) were trying to smuggle a couple of boxes filled with long bottles into a small closet on the second floor. It was locked from the inside and she had to descend to the cellar and ascend a circular staircase in order to unfasten this closet door. As she

started going up the circular staircase she noticed a Chinese mask on the wall of the cellar.

"The bottles?" I asked. "Pluto. Isn't the dream a cute one? It looks as if my attack of constipation was hankering for some gratification."

"But why the Chinese mask and the circular staircase"? This was addressed to me.

The Chinese mask was soon resolved as Father. The circular staircase, her intestinal tract. Further analysis resolved the outlines of the pederastic aspect of the anal erotic wish. Whereas it seems a far cry from Fabre's story of the impregnated spider who immediately devours her mate for food for the offspring, it is by no means an unrecognized factor in certain human matings that the "bringing home the bacon" for the sake of support of self and children (often the latter bring but narcisistic replicas of the self) is, if not the chief motive, certainly near consciousness. In this connection the myth of Lot's wife and the story of Sodom and Gomorrah would repay reading in the light of unconscious fixations.[2]

The temporary constipation regression cleared up, and for seven years now there has been no necessity for treatment for constipation. The constipation, that is, the anal erotic fixations also showed on analysis much concealed sadistic material directed toward the homosexual, much envied mother (unconscious), displaced and concealed behind the heterosexual, husband-father image. This mother rivalry also was marked (unconscious) and hidden behind urinary phantasies. In childhood water plays were adored. They were numerous and were followed with fascinated excitement; copious, almost abnormal, water drinking afforded greater somatic outlet as well. The urinary gratifications were all of this intense quality. They thus demanded a large renal output, and they got it. In a complicated and subtle manner from the ages of 3, 4 and 5 years, the unconscious urinary phantasies made use of the cardiovascular-renal mechanism to gratify an almost feverish urge to overcome the mother and later the mother imago (homosexual) substitutes. Hence the constant narcisistic homosexual unconscious symbolizations which thoroughout the entire analysis were persistent sign-posts of the retardation in complete psychosexual development, both as to object choice and to supremacy of the genital zones.

It would take many more hours to present the complete analysis, but I hope I have given a glimpse of the problems as seen from the analytic standpoint.[3]

64 West Fifty-Sixth Street.

2. Compare Jones: The Symbolism of Salt, in the Unconscious, Collected papers, Ed. 2, New York, William Wood & Co., 1921.

3. Jelliffe, S. E.: Paleopsychology. A Tentative Sketch of the Evolution of Symbolic Function, Psychoanalytic Rev., to be published, January, 1923.

POSTENCEPHALITIC DEFORMITIES OF MOTION

A LECTURE ILLUSTRATED BY MOTION PICTURES *

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Two groups of cases each on a separate reel, altogether about 2,000 feet of film, are shown. The first group includes cases showing deformities of motion and representing types of cases with recognized syndromes, that is to say, nosologic entities. After pointing out the varieties of motility defect, I will show the second reel illustrating unusual types of postencephalitic deformities of motion. In all of the cases studied, there are adventitious elements of motion resulting in definite deformities of movement.

A comparative study of these two groups of cases shows that the elements of motor deformity in each are analogous and in some instances identical. Though the histopathology doubtless differs, the localization of lesions must be the same. Indeed it suggests a definite relationship perhaps even between the underlying pathologic etiology.

In the two series of cases we see the motility disorders affecting the static, the kinetic, the synergistic mechanisms and their harmonious activities.

Reel 1.—The initial presentation in this reel shows a group of cases illustrating various types of dystonia musculorum deformans. The first three patients are all members of the same family, two sisters and a brother. The least afflicted of the three was the brother. The motor disturbances began in his thirteenth year affecting at first the finer movements of the right hand. The right leg, including the foot, then showed spasmodic uncontrollable involuntary attitudes in attempts at movement. The sudden flexion at the hip and knee and inward rotation at the hip produced the characteristic attitudes. The peculiar overflow of kinetic energy with the tendency to postural fixation is represented in its incipiency in this case, and the progress of the disease as the kinetic and static mechanism becomes more involved is demonstrated in the more severely afflicted sisters. In these two young women the static mechanism has assumed such control that we have definite postural defects. The associated action of the two systems is defective, producing athetoid movement of the upper extremities in the case of the sister most severely affected.

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* Read at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

* Patients from the Neurological Service of the Montefiore Hospital.

The next case of dystonia shows extreme sustained spasms—kinetic overflow and tendency to temporary postural fixation. The first symptom of the disease showed when the patient was 12 years old and began as a stiffening of the right leg with a resulting rather awkward gait. The picture shows a voluminous musculature. There are present characteristic though only temporary attitudes and poses, but there is a mobile type of spasm with kinetic overflow without static fixation, showing that the static mechanism giving rise to sustained postures is least affected. The muscular group involvement is much more general than in the previous patients.

The next case of dystonia is that of a girl of 17. She presents the so-called dromedary attitude with what has been described as the semilunar foot. The first symptoms appeared in her seventh year as involuntary movements limited to the right foot, spreading gradually to the right hand and arm, then becoming general. This is a case in which the static mechanism was more especially involved so that segmental fixation has given rise to marked deformities. There also appeared sudden ticlike movements of muscle groups of the upper extremities and those of the neck and upper portion of the trunk. These movements have become bizarre and represent almost every type of abnormal motor expression. There are the myoclonia, the tic, the choreiform, mobile spasm, etc., all showing in one patient. Yet with all there are present the distinctive features of both the kinetic and the static types of dystonia. (Drs. I. S. Wechsler and S. Brock[1] introduce an entirely new conception of the several types of dystonia musculorum deformans.)

The dystonia elements in the next case are confined to the upper extremities and the trunk. There is sustained mobile spasm in the sternocleidomastoid and the trapezius muscles of one side with a fixation of the trunk by marked lateral curvature due to the special involvement of the static mechanism (Wechsler and Brock).

This boy of 12 years again presents the mobile spasm type, the kinetic overflow giving rise to constant arrhythmic oscillations of all parts of the body during rest, intensified when effort at voluntary motion is made.

This middle-aged man shows the typical symptoms of progressive degenerative chorea. The hereditary element is absent, but the mental and physical signs began in his forty-fifth year. The features of the case are ticlike movements, involving especially the abdominal muscles, and are identical clinically with the myotonic movements of encephalitis.

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1. Wechsler, I. S., and Brock, S.: Dystonia Musculorum Deformans with Especial Reference to a Myostatic Form and the Occurrence of Decerebrate Rigidity Phenomena, Arch. Neurol. & Psychiat. **8**:538 (Nov.) 1922.

The two cases which I would describe as types of dystonia lenticularis, or better perhaps striatal syndromes, show analogous deformities of motion. The distinctive characters of these movements are discussed in a paper by Dr. J. Ramsay Hunt. Hunt has called attention to the cerebellar elements involved in the pathologic process and in his present paper will discuss the striatal elements involved. These two cases were considered by him in his discussion of a type which he originally described as a progressive cerebellar dyssynergia. The clinical features of the cases consist of deformities of motion suggesting the dyssynergia of multiple sclerosis with tremor-like movements somewhat analogous to paralysis agitans. The one patient, a woman of about 60 years of age, was under observation at the Montefiore Hospital for a long period of years. At her death necropsy showed a fetal adenoma of the thyroid gland with hypertrophy of the gland itself; a large hobnailed liver of the Laennec type and bilateral cystic degenerative changes in the putamen of the lenticular nucleus; also degenerative changes in the vestibular nuclei with softenings in the bulb and cerebellum.

The case of double athetosis shows the universal involvement of the entire skeletal musculature and those of phonation are also involved. The condition is one of congenital origin.

All of those cases have their striking analogues as deformities of motion in those that will be presented in the next reel, and it is for that reason that this first series has been demonstrated.

Reel 2.—The first of the series shows a young girl whose attack of what appears to be a typical chorea came on about three weeks following an acute encephalitis. The movements involving the entire body musculature are, however, a bit more rapid than the usual chorea, and show a tendency to symbolic attitudes indicative of emotion. There is something of a posing and attitudinizing which we sometimes find in cases of chorea. The two latter features, so impressive in certain well recognized organic diseases, suggest a close anatomic relation of these symbolic movements to the basal ganglions of the forebrain. The thalamus and the corpus striatum, which are functionally associated with sensorimotor complexes, serve as the centers especially controlling automatic associated acts and attitudes expressing the fundamental emotions (Goodhart and Tilney). If this case were studied by slow motion photography (bradykinetic analysis), these features would doubtless be brought out.

The case next presented on the screen shows a variety of abnormal movements. Combined with athetoid movements of the upper and lower extremities are ticlike motor expressions of the left sternocleidomastoid with rhythmical oscillations of the head and the trunk. This combination of deformities of motion presents a clinical picture unlike

that seen in any other form of disease. The clinical picture followed within a few months after an acute attack of the infection. As the patient stands supported the movements suggest the striatal type seen in the previous reel and described as dystonia lenticularis.

The following case possesses features of especial interest. The motor syndrome followed about a year after the patient had had an acute attack of encephalitis. The first pictures show her as a young woman apparently in the early twenties. Her face is full of expression, and there is no absence of normal associative movements. There is nothing to suggest a parkinsonian attitude. There is, however, a ticlike movement of the left arm and leg with turning of the head to the right. The movement of the extremities is one of adduction accompanied by a sigh or inspiratory movement. It is distinctly of a unilateral, hemitype. I think it is safe to say that this movement has been seen in no other disease. It suggests the oculo-encephalogyric form, and in a way portrays the agonal, slightly convulsive reaction not infrequently observed just preceding dissolution. It is likewise somewhat analogous to myoclonia; its localization is baffling. I, personally, feel that the pathologic condition lies in the striatum. The left facial paresis is a residuum of the acute encephalitis. As we observe this girl about a year later, the change in her appearance is striking. The abnormal involuntary movement of the head, left arm and thigh has disappeared. Her attitude and posture approach the parkinsonian type. Her face, expression and general appearance suggest maturity—she appears at least ten years older. Another interesting feature is the absence of any rigidity though the familiar posture and attitude are present. It is evident that the latter features giving characteristic design to the pose of paralysis agitans is independent of muscle rigidity. Only later is the latter feature added—the design receives its permanent molding, so to speak.

The middle-aged man next presented demonstrates the champing movements of postencephalitis. The pterygoids are bilaterally involved. The constant chewing movements, here as in other deformities of motion in this disease, cease only during sleep. The patient appears to be ceaselessly chewing.

The next two cases are shown because the parkinsonian design is confined to the typical change of expression of the face, with tremors of the facial muscles and tongue. These common postencephalitic symptoms appeared shortly after the acute illness. Both patients are middle-aged.

In addition to the parkinsonian syndrome, the case next presented shows involvement of the thalamus. Outbursts of spontaneous laughter, uncontrolled, and without attending psychic effect, characterize the illness of this patient.

The young girl with this marked hemiplegia, with the dystonic elements in posture and movement, with the spinal cord involvement as evident by the extensive decubitus, with the cranial nerve symptoms, with parkinsonian tremor, is another encephalitic patient again showing this variety of defect in the kinetic and static mechanisms. The distinctive feature of the case, however, is the peculiar ticlike movements of the left lower extremity. This is induced by lightly touching the extremity at any part. The entire condition may be said to be a residuum of the acute encephalitic process.

This little girl of 7 presents the paralysis agitans facial expression with the rhythmical oscillations of the upper extremities; the lower extremities show a tremor; the latter, however, is of entirely different character and tempo. The lower extremities displaying rigidity, with contracture as well, show no pyramidal tract symptoms, although a spurious ankle clonus can be elicited. When this child is suspended the extremities assume a position of that seen in decerebrate rigidity. A remarkable feature of this case is the spasmodic turning of the head and the eyes strongly to the left. This oculo-encephalogyric movement occasionally persists for several hours. The right sternocleidomastoid in these attacks stands out with remarkable prominence; the mass of muscle has the resistance and the feel of metal. Efforts to overcome the resistance by turning the head to the right increase the already terrific contraction. The unusual posture of the two arms is also strikingly shown associated with the oculo-encephalogyric movement, and is a result of sudden extreme extension of the left arm with strong flexion of the elbow and adduction of the right arm. A study of the remarkable motor phenomena of this case suggests an entirely new conception of associated movements.

That the classical dyssynergic manifestations that characterize multiple sclerosis may have an encephalitic pathology is demonstrated by this young woman. The so-called intention tremor with the muscles of phonation also involved finds its most extreme expression in the wild excursions on any attempt at movement. The disorganization of motor control followed closely on the acute attack of encephalitis.

I am indebted to Dr. Israel Strauss, from whose service at Mt. Sinai Hospital this case was studied and the moving pictures taken. It presents an acute case of encephalitis showing the characteristic myoclonic abdominal movements. Of far greater interest, however, and very unusual are the abductor external rotation movements of the lower part of the leg and foot. They are distinctly of ticlike character and are such as would be expected on the application of an electric current.

The next case is that of a young woman whom I saw in private practice, and the pictures were taken during the attack of acute encephalitis. You will observe a series of myoclonic movements of the muscles

of the quadriceps extensor groups. The movements appear like massive fibrillary tremors. To me they suggest stimulation of groups of anterior horn cells, and from the appearance of this picture of motor activity, I feel that we are dealing with stimulation or irritation, toxic or otherwise, of anterior horn cells of the cord. The same massive fibrillation is seen in the hamstrings and glutei when the patient lies on the abdomen. It is of clinical interest to note that unlike many of the myoclonic movements these were attended by intense pain preceding and during the motor manifestations.

This boy of 12, now in the subacute stage of encephalitis, presents the classic syndrome in every detail of paralysis agitans. During the examination and cinematographic production he fell asleep. Loss of automatic associated movement has resulted in lateral, retropulsion and propulsion, posture, attitude, gait, etc., rarely so complete in a juvenile case of Parkinson's disease.

This little girl of 12 shows bilateral involvement of the pectorals and adductors of the thigh and of the sternocleidomastoid and trapezii muscles. These groups are in bilateral, symmetrical myoclonic movement. The motor phenomena of this case are of a character one may call unique and not seen in any other disease of the nervous system.

The underlying pathology and more especially the localization of the motor manifestations of encephalitis present problems and open an entirely new vista in the realm of deformities of motion.

DISCUSSION

Dr. J. Ramsay Hunt, New York: I should like to say a word about my two cases of striocerebellar tremor which were shown and which will be presented more in detail later.

Some years ago, under the heading of progressive cerebellar tremor, I described a group of cases, the essential symptom of which was a progressive cerebellar tremor. The tremor was sometimes extreme, more so than one usually encounters in such cases. Since my original presentation, which was purely clinical, I have had the opportunity of making studies of the pathology in two cases. In one of these there was primary atrophy of the efferent dentate system of the cerebellum (the dentate nucleus and superior cerebellar peduncles). This type represents a pure cerebellar form of tremor.

In the other case there were symptoms of progressive dyssynergia (cerebellar tremor) associated with coarse rhythmical tremors, which were sometimes spontaneous and occurring at rest. Study of the pathology of this case revealed the lesions of pseudosclerosis, localized in the corpus striatum, the cerebellum and the brain stem. This case also presented the typical lobular cirrhosis of the liver and is, therefore, allied to the group of cases which has been described as pseudosclerosis, progressive lenticular degeneration and dystonia lenticularis. It constitutes a pure tremor type of hepatocerebral degeneration. The tremor in this case is peculiar in that it presents a combination form of the striatal and cerebellar types of tremor, which I would term striocerebellar tremor, the explanation for which I believe is to be found in the simultaneous involvement of the striatal and cerebellar mechanisms.

The second case which Dr. Goodhart has shown is also an example of striocerebellar tremor, presenting distinct evidences of this combined form of tremor. There is the cerebellar tremor of the intention type and in addition spontaneous rhythmical tremor manifestations such as occur in paralysis agitans and Wilson's disease.

Dr. Foster Kennedy, New York: The teaching that has been generally accepted regarding the etiology of tic might well be reconsidered in view of the fact that identical appearing movements are seen as the result of specific midbrain lesions. We have been taught and have accepted the idea that spasmodic tics are invariably of psychogenetic origin. It would seem proper to suggest that these are more probably in the nature of localized release phenomena than the result of a purposive movement, the object of which has been forgotten or lost.

Dr. Charles K. Mills, Philadelphia: I was struck by the fact that in one of Dr. Goodhart's cases double lesions were present, one in the putamen and the other in the cerebellum. I believe when Dr. Hunt first recorded the case it was in a paper entitled "Dyssynergia Cerebellaris Progressiva." It is a question whether the name which Dr. Hunt used was not a misnomer. It gave me the impression that the syndrome of the disease which he was describing was due to a purely cerebellar lesion. To use a striocerebellar explanation may help out a little.

I have one case particularly in my mind, which seemed to me at the time of the reading of Dr. Hunt's paper to be very similar to his so-called dyssynergia cerebellaris. This patient was seen by members of the Philadelphia General Hospital's neurologic staff on various occasions, and I believe that the case was not one of true cerebellar tremor. It is almost impossible in such cases to make any real study of such synergic phenomena as adiadokokinesis and dysmetria.

It is interesting in discussing these questions of movement to remember that the motor symptoms presented are often release phenomena and not due to the direct effects of lesions in the organs affected.

The striatum for instance may be markedly diseased, but the active disorder of movement may be due to the fact that the cortex is no longer held in check by the striatum.

Dr. Adolf Meyer, Baltimore: It is really surprising, after studying serial sections of acute encephalitis, to note how extremely difficult it is to find anything distinctive and localizing, with the hope of obtaining a picture similar to the poliomyelitis symptomatology.

I should like to challenge those who speak so glibly of thalamic and striatic lesions to show evidence of more definitely circumscribed disorders.

One of my standard serial cases is of the dystonia type, without having been able to satisfy myself with regard to the localization of the lesion apart from some diffuse atrophy of the cerebellum. Through this and some other cases of disturbance of that kind, I have reached the conclusion that before I shall accept any definite localizing interpretation of these conditions, I shall want to see accurate serial section material.

With regard to Dr. Kennedy's suggestion, it is very important not to assume that everything resembling actions is going to be psychogenic. Even if we want to explain it in psychogenic formulation, that does not mean that we are actually to handle it as if it were purely and exclusively psychogenic

because it can be formulated to some extent that way. Before we assume a focal lesion in the midbrain accounting for localized tics, we must obtain additional knowledge.

Dr. Goodhart, in closing: My purpose in showing two reels on the screen presenting two groups of cases, was to demonstrate more clearly that the motor phenomena seen in encephalitis bear a striking resemblance, indeed in some cases are identical, in character and form with those observed in familial disease entities.

The revelations of such studies force on the conception that the comparatively minute pathologic changes in structures that studies of the brain in these cases reveal, do not give us the entire picture of the underlying pathology. On the other hand, the varied physical manifestations that we classify as clinical entities must depend on structural changes of a far more diversified nature than the simple and oft-times minutely localized histopathologic findings. For example, I may refer to the case of the young woman in the series demonstrating postencephalitic deformities of motion; not only did we see the typical parkinsonian posture and attitude develop within less than a year in the course of postencephalitic symptoms, but we observed the changes suggesting advanced age in her general make-up, particularly striking in her facial expression. The changes were indefinable but were most instructive in their associative relationship.

It is hardly conceivable that in such cases the whole pathology lies within the basal ganglions. The thyroid and hepatic changes so often found associated with focal lesions of the central ganglions demand a more generalized study of the visceral, the sympathetic and endocrine systems in their relationship to the central nervous system.

As Dr. Kennedy says, a study of the pictures demonstrating the deformities of motion calls for a revision of our conception of the localization of the pathologic area. He refutes the idea that tics are necessarily cortical in origin, and I think our demonstration sustains his contention.

As to nomenclature, it may be recalled that Dr. Tilney and myself, in presenting a series of cases by means of bradykinetic analysis, called attention to the need of a revision in our descriptive terms for recording deformities of motion.

PYRAMIDAL AND EXTRAPYRAMIDAL SYSTEM INVOLVEMENT IN EPIDEMIC ENCEPHALITIS *

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This report is based on an analysis of 100 consecutive cases of epidemic encephalitis from the records of the New York Neurological Institute Dispensary and Hospital and the Montefiore Hospital, New York. A considerable number of these cases were personally examined by the writers. The object was to determine the frequency of the association of pyramidal and extrapyramidal system involvement in a representative group of cases from both dispensary and hospital practice.

TABLE 1.—CLASSIFICATION OF ONE HUNDRED CASES OF EPIDEMIC ENCEPHALITIS

		Number	Total
Basal Ganglion Types:			
Paralysis agitans (basal ganglion involved)		31	
Paralysis agitans with cranial nerve palsies (basal ganglion, midbrain and pontile nuclei)		8	
Paralysis agitans with pyramidal tract involvement:			
Unilateral, left	5		
right	5		
Bilateral	2		
		12	
			51
Cerebral Types:			
Hemiplegic (pyramidal)		3	
Quadriplegic (pyramidal)		1	
Posterior central gyrus type with pyramidal signs		1	
Diffuse cerebral type with bilateral pyramidal signs		2	
Psychotic (no pyramidal signs)		1	
			8
Brain Stem Types:			
Cranial nerve type		3	
Cranial nerve type with pyramidal signs		4	
Choreiform type with no pyramidal signs		2	
Myeloradicular type with pyramidal signs		1	
Miscellaneous group (interbrain and midbrain types; somnolent and mild transient cranial nerve types)		31	
			41

Of the 100 cases analyzed (Table 1), twenty were from the dispensary and eighty from the hospital service. While the dispensary cases were of a milder type, there was little difference between them, and no distinction is drawn between these two types of patients. The time of the examination varied with regard to the duration of the disease. Of the pyramidal group (Table 2), six were examined in the first month, two in the second, three in the third, two in the fifth, one in the seventh, three in the tenth, and one each in the eleventh, fifteenth, nineteenth, twenty-second, twenty-fourth and forty-second months. It will be seen that thirteen of the twenty-four patients

* From the Neurological Institute and Neurological Service of Montefiore Hospital, New York.

TABLE 2.—The Pyramidal Signs in Twenty-Four Cases of Epidemic Encephalitis

Name	Age	Sex	Interval Between Original Acute Onset and Present Examination	Pyramidal Signs	Type of Encephalitis
I. S.	40	M	2 years; late recrudescence 3 months previous to examination	Left Hoffmann Abdominal, R. > L.	Paralysis agitans
R. E.	17	F	1¼ years	Knee reflex, R. ++, L. + Right Babinski	Cranial nerve type and choreiform movements
A. P.	11	F	1 10/12 years	Upper reflexes, R. > L. Knee reflex, R. > L. Ankle reflex, R. +, L. + Right clonus	Paralysis agitans
M. G.	42	F	1¾ years	Right hemiplegia Knee reflex, R. > L. Ankle reflex, R. > L. Right Babinski	Paralysis agitans
M. W.	49	M	7 months	Knee reflex, R. > L. Right ankle clonus Abdominal, L. > R.	Cerebral: central gyrus and parietal region; sensory aphasia
W. G.	33	M	11 months	Upper extremities, R > L. Abdominal dim., L. > R. Knee reflex, R. > L. Ankle reflex, R. > L. Bilateral ankle clonus Bilateral Babinski	Cerebral type
A. F.	28	F	3 months	Knee reflex, R. > L. Ankle reflex, R. > L. Right Hoffmann Abdominal, L. > R.	Paralysis agitans
M. S.	30	F	1 month	Knee reflex, L. > R. Ankle reflex, L. > R. Bilateral Babinski and Bilateral ankle clonus Abdominal and Epigastric absent	Paralysis agitans
F. D.	20	F	1 month	Knee reflex, R. > L. Ankle reflex, R. > L. Babinski, R. +, L. 0 Right abdominal absent	Hemiplegic
E. T.	30	F	5 weeks	Double Hoffmann Knee reflex, L. > R. Ankle reflex, L. > R. Babinski on left, on right ? Abdominal, R. > L.	Myeloradicular type and myoclonia
A. G.	21	F	3 months	Knee reflex, L. > R. Ankle reflex, L. > R. Abdominal, R. > L.	Cranial nerve and somnolent type
E. J.	6½	F	5 months	Right Babinski Abdominal, L. > R.	Paralysis agitans
A. E.	30	M	2 months	Knee reflex, R. > L. Ankle reflex, R. > L. Right Babinski Right abdominal absent	Hemiplegic
T. S.	37	F	1 month	Ankle reflex, L. > R. Knee reflex, L. > R. Left Babinski Abdominal, R. > L.	Paralysis agitans

TABLE 2.—The Pyramidal Signs in Twenty-Four Cases of Epidemic Encephalitis—(*Continued*)

Name	Age	Sex	Interval Between Original Acute Onset and Present Examination	Pyramidal Signs	Type of Encephalitis
M. D.	34	F	10 months	Bilateral pyramidal signs Bilateral Babinski Knee reflex, L. > R. Left Hoffmann	Bilateral optic neuritis cerebral type
I. G.	11-12	M	14 weeks	Knee reflex, L. > R. Left Babinski Left ankle clonus	Paralysis agitans type
I. S.	45	M	10 months	Knee reflex, L. > R. Ankle reflex, L. > R. Babinski, left +, right 0 Left ankle clonus	Asthenia and hemiplegic type
L. R.	19	F	.....	Babinski, left +, right 0 Oppenheim, left +, right 0 Knee reflex, L. > R. Ankle reflex, L. > R.	Cranial nerve type
A. S.	11	M	10 months	Knee reflex, L. > R. Ankle reflex, L. > R. Left Babinski Abdominal, R. > L.	Paralysis agitans
O. A.	37	F	5 months	Knee reflex, L. > R. Ankle reflex, L. > R. Babinski, left −, right 0 Abdominal, both gone	Midbrain cranial nerve type
B. W.	38	M	3 weeks	Knee reflex, R. = L. Abdominal, R. > L. Babinski, left −, right 0	Paralysis agitans and cranial nerve type
S. B.	29	M	2 months	Upper extremities, L. > R. Ankle reflex, L. > R.	Paralysis agitans and slight choreiform
J. B.	..	..	3 weeks	Right Babinski Left ankle clonus Ankle reflex and knee reflex markedly exaggerated	Somnolent, bilateral, pyramidal and cranial nerve
L. R.	25	F	3½ years	Knee reflex and ankle reflex markedly exaggerated Right Babinski Abdominal, L. > R.	Paralysis agitans

(54 per cent.) with pyramidal cases were examined within five months, and six (25 per cent.) in the first month of the disease. These figures seem to indicate that some of the early pyramidal signs disappear as the acute stage passes off.

Not infrequently instances were found in which a recrudescence occurred months or over a year after the original attack. It seems that we are dealing in such cases with an acute lighting-up of a dormant process; or the so-called recrudescence is the result of a functional derangement caused by a gradually developing chronic inflammatory glial reaction.

We have included in the list of cases of the pyramidal tract group only those which showed a number of unequivocal signs of a lesion of the corticospinal pathway (Table 2). Merely the exaggeration of one

knee reflex over its fellow, we did not deem sufficient; but where the corresponding ankle reflex was also increased and the homolateral abdominal reflexes were diminished, we felt justified in assuming the existence of a pyramidal lesion. The great majority of patients also exhibited the extensor reflex of the big toe (Babinski) and its confirmatory reflexes. No use has been made of pathologic associated movements in the detection of pyramidal tract disturbance, because the frequently coexistent striatal lesions have rendered this group of symptoms valueless.

It will be noted that pyramidal tract involvement occurred in twenty-four cases (24 per cent.). In twelve of these (50 per cent.) extrapyramidal involvement coexisted. On the other hand, in the fifty-one extrapyramidal or striatal instances (omitting the choreiform types) twelve (23 per cent.) showed coexisting pyramidal disturbance (Table 1).

J. Ramsay Hunt [1] speaks of this association as the palliopallidal form of paralysis, and in a series of twenty-five instances of striatal encephalitis he noted it in three, that is, 12 per cent., as contrasted with our 23 per cent.

We believe this unusual combination should be stressed. We wish to point out, however, that the pyramidal and extrapyramidal signs do not always appear at the same time. In some of the patients, either after an apparent cure lasting from several months to a year or after an equally long stationary period, signs of basal ganglion involvement made their appearance. In other instances the pyramidal tract signs persisted, and after an equally variable period the extrapyramidal signs appeared. One should, therefore, suspect encephalitis in a young person with a paralysis agitants syndrome which has developed rapidly. If, in addition, there are signs of *pyramidal pathway disturbance*, one is almost certain that the combined picture is one of epidemic encephalitis. As a history of encephalitis is not infrequently difficult to elicit, this is even more important.

Grossman [2] has well said that "barring an occasional case of disseminated sclerosis or of diffuse cerebral arterial sclerosis, encephalitis seems to be the one disease that most frequently shows lesions involving the basal ganglions and the pyramidal tracts," which is explained by the multiplicity of lesions occurring in this disease.

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1. Acute Epidemic Encephalitis—An Investigation by the Association for Research in Nervous and Mental Diseases, New York, Paul Hoeber, 1921.

2. Grossman, Morris: Sequels of Acute Epidemic Encephalitis, J. A. M. A. **78**:959 (April 1) 1922.

THE STRIOCEREBELLAR TREMOR

A STUDY OF THE NATURE AND LOCALIZATION OF THE COMBINED FORM OF ORGANIC TREMOR *

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All forms of tremor movement bear a certain fundamental resemblance to one another, although finer differences are distinguishable. We recognize, for example, tremors which are fine or coarse, rapid or slow, rhythmical or arrhythmical. From the etiologic standpoint many varieties are described by systematic writers, and it is surprising how few disorders of the nervous system run their course without the accompaniment of tremor. Indeed, a physiologic form is recognized, and a slight tremulousness is a common result of muscular fatigue.

In spite of recent advances in neuropathology and a better understanding of the correlation of structure and function in the central nervous system, the anatomic basis of tremor is by no means settled at the present time.

Many organic affections of the nervous system are associated with tremor, more especially those involving the cerebellum, the corpus striatum and their connections with the brain stem. Among these, paralysis agitans, multiple sclerosis, pseudosclerosis and progressive lenticular degeneration are especially deserving of mention because of the constancy and characteristic nature of the tremor and the localization of the lesions.

In the organic group of tremors two distinct clinical types may be differentiated; one, the tremor of repose; the other, appearing only during the course of movement itself, the so-called "intention tremor." In the present study I shall consider more especially the relation of these two forms of tremor to the corpus striatum and the cerebellum and their occurrence as a combined form—the striocerebellar tremor.

CHRONIC PROGRESSIVE CEREBELLAR TREMOR (DYSSYNERGIA CEREBELLARIS PROGRESSIVA)

Some years ago, under the title [1] given above, I directed attention to a chronic progressive tremor disturbance, which I regarded as a definite clinical type of organic nervous disease.

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* Read in abstract at the Forty-Eighth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1922.

1. Hunt, Ramsay: Dyssynergia Cerebellaris Progressiva, a Chronic Progressive Form of Cerebella Tremor, Brain **37**:247, 1914-1915.

The symptomatology was characterized by generalized intention tremors, which began as a local manifestation and gradually extended to the whole voluntary muscular system. Associated with the tremor disturbance were the characteristic manifestations of cerebellar disease: dyssynergia, dysmetria, adiadokokinesis, hypotonia and asthenia. In all other respects the neurologic examination was essentially negative.

Three cases were described in my original communication, all similar in their general course and symptomatology, differing only in degree and the duration of the disease.

The intention tremor, which was the striking and characteristic symptom of the disease, began in one extremity and progressed slowly, involving gradually and successively the remaining portions of the body. There was a coarse, irregular atactiform shaking on attempting any movement. The tremor movement was slow, ranging from three to five vibrations a second. Both the rate and amplitude were increased by mental and physical activity. It was diminished or ceased entirely in a relaxed or recumbent posture and was consequently absent during sleep. After paroxyms of prolonged motor agitation some after-tremor persisted, even during rest.

The whole course of the disease was chronic and slowly progressive, and the motor life became more and more restricted. Once established, the tremor never disappeared except during rest.

The clinical picture in this group of cases was characteristic of a disturbance of the cerebellar mechanism. Furthermore, the disorder progressed gradually, in the manner of an organic degenerative disease, and on the basis of these clinical observations I postulated a progressive degeneration of certain cells or fiber systems of the cerebellar mechanism as the probable pathology of the disease, the exact localization of which must await the results of pathologic investigation.

Since this statement was made my conception of the nature and symptomatology of this group of cases has been considerably enlarged by further clinical and pathologic investigations.

I have had occasion to observe another clinical group which combined the symptomatology of dyssynergia cerebellaris progressiva (progressive cerebellar tremor) and myoclonus epilepsy.[2] There was the progressive dyssynergia and intention tremor characteristic of a cerebellar disorder, in association with epilepsy and myoclonus. In this group, as in the original group of cases uncomplicated by myoclonus epilepsy, the extremities showed the greatest degree of involvement.

2. Hunt, Ramsay: Dyssynergia Cerebellaris Myoclonica — Primary Atrophy of the Dentate System; a Contribution to the Pathology and Symptomatology of the Cerebellum, Brain **44**:490, 1921.

The association of cerebellar dyssynergia and myoclonus epilepsy suggests the occurrence of two independent nervous disorders in one person. Such a combination, however, is rare and shows merely a predisposition to the two disorders in the same person; it does not necessarily indicate any essential relationship between them.

On the other hand, little is known at the present time of the pathology and localization of myoclonus. Its occurrence, therefore, in conjunction with a special type of cerebellar disease, of which I have observed six cases, is not without interest, and may have a deeper pathologic significance than might first appear.

This form of dyssynergia, which I termed dyssynergia cerebellaris myoclonica, was also observed in association with Friedreich's ataxia, a combined cerebellospinal involvement, which is not infrequent in the history of cerebellar system disease. In one of these cases studies of the pathology were made, which throw considerable light on the origin and anatomic basis of the cerebellar portion of the symptomatology. As a result of these investigations, the progressive dyssynergia and intention tremor was referred to an atrophy of the efferent dentate system of the cerebellum, and this system was regarded as the essential neural mechanism underlying the production of the cerebellar or intention tremor.

Pathologic Changes.—The important and essential lesion of the cerebellum was an atrophy of the motor cells of the corpus dentatum and the superior cerebellar peduncles. There was no atrophy of other cerebellar systems, and none of the nucleus ruber. The lesions of the cerebellar mechanism were, therefore, confined to the short and important internuncial common pathway which conveys efferent impulses from the cerebellum to the spinal cord.

The relation of organic tremor to the cerebellar mechanism was emphasized some years ago by Gordon Holmes.[3] He reported a series of cases of organic cerebral disease which, while in many respects dissimilar, had one symptom in common—a tremor, which presented the following characteristics:

> In every case it was found that the patient was unable to voluntarily check the movement for more than the shortest space of time, and often the attempt to inhibit it only resulted in increase or accentuation of the range. In addition to the tremor proper, which may be described as static, as it occurred independently of voluntary or reflex movement of the part, volitional movement of the limb affected was in every case complicated by an irregularity of the intention tremor type, as met with in disseminated sclerosis, that is, the range of deviation from the direct line of the movement increased as the completion of the act purposed was approached.

3. Holmes, Gordon: Certain Tremors in Organic Cerebral Lesions, Brain **27**:327, 1904.

In no case did the tremor persist during sleep. It also ceased when the limb involved lay at complete rest, so that each of its segments was individually supported. The lesions, so far as could be determined, were localized in the dorsal or tegmental region of the midbrain, sometimes extending forward into the optic thalamus. Holmes described in detail the nucleus ruber and its connections and concluded with the statement that "It seems from anatomical and other considerations that it is to some involvement of this system that the tremor above described is to be attributed."

The general resemblance of the type of tremor described by Holmes to that presented by my patients with dyssynergia cerebellaris progressiva (chronic progressive cerebellar tremor) is evident. In the group of cases which I described, however, the tremor was monosymptomatic, while in the group described by Holmes it was one among other organic symptoms.

The coexistence in this group of cases of symptomatic features characteristic of both striatal and cerebellar tremor may be pointed out, and will be discussed more in detail. The following case was originally described in my clinical study of dyssynergia cerebellaris progressiva (chronic progressive cerebellar tremor). Death occurred thirteen years after the onset of the tremor, and opportunity was afforded for histologic study of the central nervous system.

REPORT OF A CASE

Chronic progressive striocerebellar tremor associated with cirrhosis of the liver (tremor type of the hepatocerebral degeneration).

History.—A woman, aged 40, had volitional tremor of the left arm. One year later a similar tremor of the right arm developed, which was followed by gradual extension to the musculature of the head, trunk and lower extremities. The clinical picture was one of generalized coarse, ataxic tremor when the patient attempted to move, which ceased during rest. A study of the motility revealed also a disturbance of the cerebellar function. There was dysmetria, dyssynergia, hypotonia, adiadokokinesis and asthenia; otherwise neurologic examination was negative. The chief symptom was generalized dyssynergia with tremor movements on intention.

Tremor: When the patient lay in the recumbent posture with the body completely relaxed and the head supported by a soft pillow, there was no movement.

The slightest attempt at innervation, such as fixation of the eyes, a movement of the hand, a simple flexion of the extremities, or even attempts to speak or smile, produced tremor, which was increased by any attempt at repression.

Mental excitement and effort also aggravated the tremor. The automatic act of respiration alone, when the patient was quiet and relaxed, did not produce a tremor; however, during the more violent exacerbations of tremor the respiratory movements were sometimes jerky and arrhythmical.

The favorite position of the patient while sitting was leaning forward, resting the head, arms and upper portion of the body on a table. In this

position she often remained for long periods perfectly quiet and relaxed, unless she was questioned or her attention attracted, when more or less violent tremors immediately resulted. While sitting quietly in a chair before the examiner with the arms resting on the lap, the tremor was confined to nodding and shaking of the head, some facial movement and oscillations of the body, but mental excitement or a slight attempt at voluntary innervation, such as speech or movements of the fingers, apparently disturbed the balance and adjustment of the patient, and violent tremors resulted.

There was no true nystagmus. If, however, the tremor was checked by holding the head, tremor occasionally reappeared in the eyes. Such oscillations, however, were not obtained by fixation of an object with the eyes. The overflow of tremor also occurred when movements of an upper or lower extremity were forcibly checked.

The tremor of the extremities was of the volitional or intention type, and consisted of a coarse ataxic shaking and tossing of the extremities rather than a true rhythmical tremor, although in certain positions this ataxic shaking assumed a more or less rhythmical character.

On attempting to place the index finger on the tip of the nose, the arm was jerked and thrown about with ataxic violence, the motor agitation subsiding and becoming less severe when the object of the movement was finally attained. On attempting to place the heel on the knee in the recumbent posture, the same coarse volitional disturbances appeared, and when the leg was elevated, as in the arm, a violent ataxic tremor developed. Closure of the eyes had no appreciable influence on the extent or character of the movements.

Speech was slow and scanning and was frequently broken and interrupted by violent explosive efforts and utterances. Under excitement these brusque explosive discharges rendered it almost unintelligible. The speech disturbance was evidently caused by the same disharmony which characterized the other muscular efforts. During the act of articulation there were associated tremor-like contractions of the facial movements, and the tremor of the head was much exaggerted.

On standing, the general tremor was much increased, the legs shook, the trunk oscillated, the head was in constant movement, and the arms were tossed and hurled about in the most bizzare fashion. Chewing and swallowing aggravated the tremor, which added to the difficulty of taking nourishment. Static equilibrium was well maintained even on a narrow base, and closure of the eyes in this position had no apparent effect on posture or the intensity and character of the tremor. For some years all finer movements of the hands had been impossible, and the handwriting had been reduced to illegible scrawls and scratches. If the patient had had an exciting or fatiguing day, some after-tremor might persist for several hours, even during the period of rest.

Hypotonia: The muscles were well developed and free from atrophy. They were, however, soft and flabby to the touch and there was a definite hypotonia. The joints were relaxed and flaccid and were sometimes overextended. The Stewart-Holmes sign of hypotonia was also constantly present in the upper extremities, that is, the failure of rebound when flexion of the arm was resisted and suddenly relaxed.

Dysmetria and Dyssynergia: There was a distinct disturbance of ability to measure, regulate and harmonize voluntary movements in the extremities.

Adiadokokinesis: This was present in both upper extremities.

Sensation: The general sensations both superficial (touch, pain and temperature) and deep (muscular and articular) were normal. There was no demonstrable defect in the ability to distinguish the relative difference of weights placed in the hands.

Vision, the sense of smell, taste and hearing were normal.

Reflexes: The tendon reflexes of the upper extremities (supinator, biceps and triceps) were present, not exaggerated, and equal on the two sides. The reflex of the jaw was present and not exaggerated. Knee and ankle reflexes were present on both sides; they were of equal intensity and not exaggerated. The abdominal reflexes were present and equal. The plantar reflex gave a normal flexor response on both sides, and the Babinski reflex had not been demonstrable during the many years of observation in the hospital.

Cranial Nerves: The pupils were equal and reacted promptly to light and accommodation; the pupillary skin reflexes were normal.

Ophthalmoscopic examination revealed normal optic nerves; no signs of neuritis or pallor of the disk. The ocular excursions were normal; there was no true nystagmus. The innervation of the facial muscles, the muscles of mastication, soft palate and tongue were normal, but produced marked tremor disturbances.

Course of Illness.—The patient remained under observation in the Montefiore Home up to the time of her death, Nov. 1, 1920. During this period there were no essential changes in the character of the clinical picture as originally described in my paper in 1914. The tremor disturbance, which was the dominating symptom of the disorder, persisted and slowly increased in severity. There were no paralysis, no sensory disturbances, no spasticities or rigidities. At no time did I observe any paralysis of automatic associated movements of the paralysis agitans type—which was in harmony with the absence of all muscular rigidity. The tendon and skin reflexes were normal and equal on the two sides. The Babinski reflex was absent. There were no areas of pigmentation of the skin or of the corneal margin. With the progress of the disease mental deterioration and emotional instability were noted. The mental changes, however, were not of a severe character; memory and judgment were retained, and there were no delusions or hallucinations. In the emotional sphere there was at times depression, and occasionally a slight degree of euphoria was noted.

Necropsy Findings.—Necropsy revealed the typical lesions of pseudosclerosis associated with nodular cirrhosis of the liver, similar in appearance to that described by Wilson[4] in progressive lenticular degeneration.

The central lesions were most marked in the lenticular nuclei, the cerebellum and pons varolii. In all of these neural structures there was some breaking down with cavity formation. There was, however, no evidence of inflammatory reaction. The Alzheimer glia cells which characterize the histologic lesions of pseudosclerosis were distributed extensively throughout the brain. There was no degeneration of the spinal cord.

COMMENT

The character of the pathologic lesions in this case—the nodular cirrhosis of the liver and the histologic changes in the central nervous system—serve to identify it with the group of the hepatocerebral

4. Wilson, Kinnier: Progressive Lenticular Degeneration: a Familial Nervous Disease Associated with Cirrhosis of the Liver, Brain **34**:290, 1912.

degeneraions.[5] The tremor character of the clinical picture, however, distinguishes this from the other recognized clinical types, namely, the progressive lenticular degeneration of Kinnier Wilson, the tetanoid chorea of Gowers, the pseudosclerosis of Westphal and the dystonia lenticularis as described by Thomalla[6] and Wimmer.[7] I would, therefore, regard it as a tremor type of the hepatocerebral degenerations.[8] I have considered this phase of the subject elsewhere, and I refer to it because of the peculiar nature of the tremor, which in the light of the clinical features and pathologic findings may be interpreted as a combined striocerebellar tremor. There were well marked lesions in the lenticular neuclei on both sides and extensive involvement of the cerebellum and midbrain as well. The lesions, therefore, were not only distributed in the corpus striatum and the cerebellum, but also in the region of their connections with important nuclei of the brain stem. The lesions of pseudosclerosis, because of their diffuse character, are not adapted to any exact correlation of structure and function. There can be no question, however, as to the predominating involvement of the striatal and cerebellar mechanisms in this case and to the dominating importance of tremor (striocerebellar) in the clinical picture.

Therefore, the small clinical group which I isolated some years ago as chronic progressive cerebellar tremor (dyssynergia cerebellaris progressiva) may be modified as a result of subsequent pathologic study. In one group, dyssynergia cerebellaris myoclonica, the cerebellar tremor is part of a general cerebellar disorder and may be correlated with an atrophy of the efferent dentate system of the cerebellum. In the other group the tremor disturbance is not purely cerebellar, but is a mixed striocerebellar tremor associated with the central lesions of pseudosclerosis (tremor type of the hepatocerebral degeneration). It is probable that further pathologic investigations will shed still more light on this interesting and comparatively rare group of organic nervous disorders.

THE RELATION OF THE STRIATAL MECHANISM TO TREMOR (STRIATAL TREMOR)

The relation of tremor to the striatal mechanism is now an accepted fact of symptomatology. There may be differences of opinion as to the

5. Hall, H. C.: La degenerescence hepato-lenticulaire, maladie de Wilson-pseudo-sclerose, 1921, p. 160.

6. Thomalla: Ein Fall von Torsionsspasmus mit Sektions befund und seine. Beziehung zur Athetose Double, Wilson's Krankheit und Pseudo-Sclerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **41**:311, 1918.

7. Wimmer: Etudes sur les syndromes extra-pyramidaux, spasme de torsion progressif infantile, Rev. neurol. **28**:952, 1921.

8. Hunt, Ramsay: The Tremor Type of the Hepato-Cerebral Degeneration, Trans Assn. Am. Phys. **37**: 1922.

exact character of the tremor and the rôle of this organ in its production, but practically all authorities agree that a rhythmical tremor is one of the cardinal symptoms of the corpus striatum.

Kinnier Wilson was among the first to establish this relationship in his analysis of the symptomatology of progressive lenticular degeneration.[4] Previous to this, however, a number of isolated reports had shown that rhythmical tremor of the paralysis agitans type occasionally follows striatal lesions (Demange,[9] Rhein and Potts[10]).

According to Wilson, the tremor of progressive lenticular degeneration is slow, consisting of from four to six oscillations to the second, and is increased both by voluntary movement and psychic stimuli. It ceases during rest and is more marked in the distal portion of the extremities. The same character of tremor was noted by Sawyer, Cassirer[11] and Pollock[12] in cases of Wilson's disease. In Stoecker's[13] case, however, while the tremor was increased during movement and was therefore an action tremor, it was also present at rest (tremor of repose). This combination of a tremor of repose and action tremor will be referred to later in the discussion on the combined form of striocerebellar tremor.

In 1915, I described as primary atrophy of the pallidal system[14] a group of cases with characteristic pathologic lesions presenting the symptomatology of paralysis agitans. In one case of juvenile type, in which the disease had existed for twenty years, histologic examination was made of the central nervous system, with special reference to the corpus striatum, the cerebellum and their connections with the brain stem. As a result of these studies, I concluded that juvenile paralysis agitans is a system disease, the essential lesion of which is atrophy of the large motor cells of the corpus striatum (pallidal system).

In this case the lesion was strictly limited to the essential motor system of the corpus striatum. The tremor, therefore, may be regarded

9. Demange: Contribution a l'études tremblements prae et post-hemiplegique, Rev. de méd. **2**:371, 1883.

10. Rhein and Potts: Post-Apoplectic Tremor; Symmetrical Areas of Softening in Both Lenticular Nuclei and External Capsules, J. Nerv. & Ment. Dis. **46**:757, 1917.

11. Cassirer: Ein Fall von Progressive Linsenskern Erkrankung, Neurol. Centralbl. **32**:1284, 1913.

12. Pollock: The Pathology of the Nervous System in a Case of Progressive Lenticular Degeneration, J. Nerv. & Ment. Dis. **46**:401, 1917.

13. Stoecker: Ein Fall von Fortschreitender Lenticular Degeneration, Ztschr. f. d. ges. Neurol. u. Psychiat. **15**:251, 1913.

14. Hunt, Ramsay: Primary Atrophy of the Pallidal System. A Contribution to the Functions of the Corpus Striatum, Brain **40**:58, 1917; Arch. Int. Med. **22**:647, 1918.

as representative of the striatal type of tremor. It was slow and rhythmical with from four to six vibrations a second and was increased by mental excitement and physical activity. It was present during rest and was therefore a tremor of repose. It was increased at the beginning of purposive movements, but was not of the intention tremor type, and ceased entirely toward the end of an intentional movement; and while the tremor was increased during movement, there was not the atactiform uncertainty and other cerebellar components of the true intention tremor.

The tremor disturbance was generally distributed, and all of the extremities were affected, including the head. Typical pill-rolling movements of the fingers were present; if suppressed in one part, the tremor made its appearance in some other part of the body.

In the earlier years of the disease, the tremor was coarse and at times violent, more especially during the stress of emotion or attempted movement. As the malady progressed and the extremities became fixed by postural rigidities, the severity of the tremor gradually lessened.

The clinical characteristics of tremor resulting from a lesion of the corpus striatum may therefore be summarized as follows: Tremor occurs spontaneously and is slow and rhythmical in character. It may be increased by mental excitement and physical activity, and persists during rest (tremor of repose). If checked in one extremity, there is a tendency for its reappearance in other parts of the body (overflow of the tremor). Although subject to variation, it has the same tempo in all parts where tremor is present.

The mechanism underlying the production of striatal tremor is still one of the mooted questions of pathologic physiology. I regard it as a release phenomenon resulting from loss of striatal control and the expression of spontaneous activity in certain infrastriatal centers of the extrapyramidal system. It is, therefore, primarily a disorder of motility in the paleokinetic sphere and in this sense analogous to chorea and athetoid movement.

In a previous study of the corpus striatum,[15] evidence was presented showing that the corpus striatum is a motor organ for the control of automatic associated movement, just as the rolandic area controls movement of the isolated synergic type. Two neural systems were recognized in the striatum: a large cell motor system (pallidal system) controlling movements of the automatic associated type, and a small cell system (neostriatal system) exercising an inhibitory and coordinating function. Destruction of the pallidal system was identified with the

15. Hunt, Ramsay: The Efferent Pallidal System of the Corpus Striatum. A Consideration of Its Functions and Symptomatology, Trans. Am. Neurol. Assn., 1917, p. 10; J. Nerv. & Ment. Dis. **46**:44, 1917.

syndrome of paralysis agitans and loss of the neostriatal system with chorea. The variegated symptomatology of this region was therefore attributed to an admixture of the clinical manifestations of these two syndromes.

The corpus striatum through the medium of its efferent pallidal system has important connections with subsidiary motor centers of the midbrain and hypothalamic region, among the more important of which may be mentioned the nucleus ruber, the locus niger and the corpus subthalamicum. Any break in the striospinal system causes a paralysis of automatic associated movement and releases the infrastriatal motor centers from control, with the development of rhythmical tremor and hypertonicity (rigidity). The mechanism is similar to that of the development of clonus and hypertonicity (spasticity) following lesions of the rolandic area of the cerebral cortex (neokinetic system).

Tremor and clonus resemble one another in many respects, and both tremor manifestations are, I believe, referable to the kinetic system, one due to a release of the paleokinetic, and the other of the neokinetic, mechanism.

Relation of Striatal Tremor to the Kinetic System.—I have already presented at some length my views on the duality of function of the motor system.[16] According to this conception, the efferent nervous system, both cerebrospinal and vegetative, consists of two components which are anatomically and physiologically distinct. One component is the kinetic system, which controls the movement proper; the other is the static system, which regulates the postural function of the contractile mechanism.

According to this conception, the kinetic system controls the disk mechanism of skeletal muscles, and the static system the sarcoplasm. The essential function of the kinetic system and the fibrillar structure of the muscle fiber is movement. The essential function of the static system and the sarcoplasmic structure of muscle is fixation or posture.

In the symptomatology of motor disorders certain manifestations are referable to the kinetic system and others to the static system; and while in any disorder of motility both systems participate, it is usually possible to indicate one or the other as the essential factor involved. These two systems of motility also play a rôle, I believe, in the production of organic tremor. The striatal tremor is related to the kinetic system and the cerebellar tremor to the static mechanism.

Relation of the Cerebellar Mechanism to Tremor (Cerebellar Tremor).—For many years, tremor has been a well recognized, although

16. Hunt, Ramsay: The Static and Kinetic Systems of Motility, Arch. Neurol. & Psychiat. **4**:353 (Oct.) 1920. The Static or Posture System and Its Relation to Postural Hypertonic States of the Skeletal Muscles, Neurol Bull. **3**:207, 1921.

inconstant, symptom of cerebellar disease. Cerebellar tremor is of the so-called intention type, resembling in character the tremor of multiple sclerosis. It is associated with other manifestations of a disorder of cerebellar function, for example, dysmetria and adiadokokinesis, and is only an extreme manifestation in the extremities of the underlying disorder of muscle synergy (asynergia) which is the fundamental symptom of a cerebellar disease. It has the character of a coarse ataxia and in contradistinction to the tremor of paralysis agitans is always absent during rest. It is, therefore, never a tremor of repose. The tremor manifestation is coarse and arrhythmical, beginning with movement and increasing as the object is approached. The latter feature of the cerebellar tremor should be particularly emphasized as an important difference between the so-called action tremor, which is sometimes observed during the movement of the extremity in paralysis agitans, and which diminishes and usually ceases as the object of the movement is approached. This peculiar feature of the cerebellar tremor is, I believe, dependent on the nature of cerebellar function and its relation to the static system.

According to the view which I have previously expressed, the essential central organ of the static component of the efferent system is the cerebellum. All higher impulses subserving the static or posture function of motility pass to this organ for final integration. In this conception the cerebellum is regarded as the great central ganglion for the coordination of posture synergy in contradistinction to motion synergy, which is under the control of the kinetic system.

A lesion of the cerebellar mechanism therefore disturbs the posture function of motility, the symptoms of which are dyssynergia, dysmetria, adiodokokinesis and tremor, and in this sense the cerebellar tremor is primarily postural in its origin. In any series of movement there is an accompanying series of posture which serves to reinforce the stability and accuracy of movement itself. Posture follows movement like a shadow, and without it movement loses its perfection of control and direction. The intention tremor is a particularly exquisite example of a loss of postural control. It is present only during movement and is especially active at the end of movement, when the posture system is more especially called into action. For this reason there is an atactiform tremor disturbance when an attempt is made to place the finger tip on the nose, which increases as the final act of posture is reached.

I believe, therefore, that the so-called cerebellar tremor is related primarily to a disorder of the static system, the coarse tremor movements being simply compensatory manifestations in the kinetic sphere.

Striocerebellar Tremor.—The disorder of motility to which I now direct attention presents the characteristics of both a striatal and cerebellar tremor. There is the spontaneous rhythmical tremor char-

acteristic of a striatal disorder in association with the intention tremor of cerebellar disease. Sometimes one component, sometimes the other, dominates the clinical picture, and there is also considerable variation in the degree and localization of the tremor disturbance.

In the group of cases described by Gordon Holmes, already alluded to, in which the lesions were localized in the tegmental region of the midbrain, both of these components of organic tremor were evidently present. In Case 1, in which symptoms were indicative of a vascular lesion of the midbrain, the description of the tremor was as follows:

> Except when the limb was at perfect rest and so supported that each segment bore its own weight, there was constantly slow clonic tremor of one or other part of it, but more marked at the distal than at the proximal joints. Frequently the adducted fingers were flexed and extended at their basal joints, the index finger rubbing against the opposed thumb, which was in synchronous tremor. Often it was flexion or extension of the hand at the wrist, or flexion and extension, but more frequently pronation and supination at the elbow. Movements were less frequently visible at the shoulder.
>
> Similar tremor was occasionally to be observed in the left lower extremity, and, as in the arm, more frequently at the distal than at the proximal joints. It most often took the form of extension and flexion of the foot.
>
> The character of the tremor was constant, no matter in which portion of either limb it was observed. It was remarkably regular in rate, and varied very little in amplitude, so that the movement of the limb, as long as only one group of muscles was involved, was essentially regular and rhythmical, but as more than one group was frequently at one time in action, the resultant movement was often a compound tremor. It was slow in rate, from two and a half to three oscillations per second, and of considerable amplitude.
>
> It always ceased during sleep and when the limb was allowed to lie at rest, so supported that each portion bore its own weight. If any part of the limb was allowed to hang passively (as the hand when the limb was held up by the forearm), the tremor immediately began at the most proximal joint of the unsupported portion. It was increased by any excitement or agitation on the part of the patient, and by movement of the opposite limb. The movements could only be inhibited for a very short time. Voluntary movements of the limb were complicated by wide irregularities of the intention tremor type, but there was no other affection of co-ordination.

This description is characteristic of a striatal tremor, the last sentence indicating, however, the admixture of a cerebellar element.

In the second case reported by Holmes, in which the clinical diagnosis was vascular lesion of the left side of the midbrain, the description of the tremor was as follows:

> Both right limbs were affected by tremor when they did not lie at perfect rest with their muscles completely relaxed, but it also came on when each portion of the limb was not so supported as to bear its own weight. Thus, it was rarely to be observed as the limbs lay in bed and the patient was quiet and unexcited. It might occur at any joint, but in both arm and leg was more frequent at the distal.

The most constant movement was flexion and extension of the hand or of the fingers at the metacarpophalangeal joints, but there was also often adduction and abduction of the fingers, and occasionally the thumb might be moved against and simultaneously with the forefinger. In the leg flexion and extension of the ankle was most frequently observed, also similar movement of the toes, but various movements at the more proximal joints were often present.

The tremor was generally compound, that is, it was rarely limited to one group of muscles and their antagonists, so that the limb was, as a rule, simultaneously moved at two or more joints. It never persisted long in any group of muscles. The clonic contractions of each group of muscles involved were essentially regular in rate but relatively slow, from 3 to 3½ per second, and the range of the movements was more or less regular but considerable, i. e., the tremor was slow and coarse. It ceased everywhere during sleep and was increased in amplitude but not in rate by excitement or agitation and by forcible movement of the fellow limb. The patient was unable to check it voluntarily except by allowing the limb to fall relaxed in perfect rest. There was marked intention tremor of both right limbs, i. e., abrupt deviations from the direct line of movement increasing toward the completion of the voluntary act.

Here again there is present an admixture of both the striatal and cerebellar elements of tremor.

In Case 3 the diagnosis was a left-sided cerebellar tumor with evidences of extension to the midbrain. The tremor manifestations were as follows:

From this time till his death, about three weeks later, there was almost constantly tremor in all four limbs. It only ceased during sleep, or when the muscles were quite relaxed and the limbs so supported that each segment bore its own weight. The tremor commenced at once when any of the muscles were put in tension or brought into action, as when part of either limb was allowed to hang over the edge of the bed, or when it was held up in the observer's hand. It was easily made out that the series of oscillations were due to alternate contraction of the one group of muscles and its antagonists, i. e., that the movements comprised a true tremor. If the limbs were left in a suitable position it seemed as if the tremor would persist indefinitely. It was forcible and not easily checked, and showed very little tendency to overflow into other groups of muscles when passively stopped in one set. As two or more movements might simultaneously occur, the resultant movementment of the limb was often compound. The upper extremities were more affected than the lower, and the left limbs very much more than the right. In the upper limbs the movements most frequently observed were flexion and extension or pronation and supination of the elbows, flexion and extension of the wrists, and flexion and extension or abduction and adduction of the fingers, which generally remained extended at interphalangeal joints. In the lower extremities flexion and extension of the ankles and similar movements of the toes were the most frequently present, but there were also often similar oscillations of the thigh round the hip joint and of the leg at the knees.

The tremor was in every part regular in rate, about five to six oscillations per second, and the rate did not seem to vary, no matter what part of any limb was affected. It may be described as coarse, i. e., of large amplitude

and the range of oscillation often changed in a more or less rhythmical manner, i. e., the range of successive oscillations would slowly increase to a certain point and then slowly decrease. Consequently the tremor must be described as irregular in range. He was unable voluntarily to inhibit the tremor, and its amplitude was increased by an excitement or agitation, or by forcible movement of the opposite limbs. The finer voluntary movements, too, were complicated by ataxia and irregularity of the intention-tremor type, so that he scarcely found it possible to bring his hand to his face.

The character of the tremor in Holmes' series of nine cases is similar to the tremor disturbance in my case of pseudosclerosis with cirrhosis of the liver. They all show clearly the dual symptomatology of the striocerebellar tremor. Evidences of the combined form of organic tremor may also be found elsewhere in medical literature.

The so-called Benedikt's syndrome [17] is not without interest in this relation. This is a syndrome caused by a lesion of the tegmental region of the crus cerebri, the clinical characteristics of which are third nerve palsy with crossed hemianesthesia and hemitremor of the paralysis agitans type. Pelnar,[18] in his monograph on tremor, states that an analysis of the literature shows considerable variation in the character of the tremor disturbance in Benedikt's syndrome, and that the tremor movements are often more of the intention type.

Pelnar also states that the tremor of multiple sclerosis may occasionally present the characteristics of a tremor of repose in addition to the intention element, and that this polymorphous type of tremor is especially likely to occur in pseudosclerosis. Strümpell,[19] in 1897, analyzed the symptomatology of pesudosclerosis and gave the diagnostic criteria by which it could be differentiated from multiple sclerosis. He stated that the tremor is both rhythmical and of the intention type.

Hoeslin and Alzheimer [20] in their study on pseudosclerosis state that the tremor is of the intention type but that it also occurs frequently during repose.

One of Oppenheim's [21] patients had a tremor of repose in the right hand and a tremor of the intention type in the left. In another case

17. Benedikt: Nerven pathologie **2**:74.

18. Pelnar, Josef: Das Zittern, Ztschr. f. d. ges Neurol. u. Psychiat. **8**: 1913.

19. Strümpell: Die Westphalsche Pseudo-Sklerose und über diffuse Hirnsklerose, insbesondere bei Kindern, Deutsch. Ztschr. f. Nervenheilk. **2**:115, 1897-1898.

20. Hoeslin and Alzheimer: Ein Beitrag zur Klinik und Pathol. Anat. der Westphal-Strümpelschen Pseudo-sclerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **8**:183, 1912.

21. Oppenheim: Zur Pseudo-Sclerose, Neurol. Centralbl. **33**:1202, 1914. Differential Diagnose Zwischen der Multiplen sclerose und der Pseudo-sclerose, Ztschr. f. Nervenheilk. **56**:332, 1917.

the tremor was described as of large amplitude, existing during repose and appearing also on intentional movement.

Nature and Localization of Striocerebellar Tremor.—From the foregoing description and quotations, I think there can be little doubt as to the existence of a tremiform disorder of motility which combines the elements of striatal and cerebellar tremor. The striocerebellar tremor appears in the course of pseudosclerosis, more rarely in multiple sclerosis, and is not infrequently observed after inflammatory, vascular and neoplastic lesions in the region of the midbrain. This is the meeting place of the efferent systems of the corpus striatum (pallidal system) and the cerebellum (dentate system), which converge and terminate in relation to the ganglionic masses of this region, of which the nucleus ruber is an especially important constituent.

Holmes was inclined to attribute the tremor disturbance in his group of cases to a lesion in the cerebellorubrospinal system, and more especially to its cerebellorubral portion. According to the view which I have expressed, this would account only for the cerebellar component. The striatal element I would refer to a lesion of the striorubrospinal system.

In the present state of our knowledge it would be unwise to limit our anatomic conceptions in the interpretation of organic tremor to the rubral connections of the corpus striatum and cerebellum. There are many other important nuclear structures in this region subserving a motor function, which Edinger has grouped under the general term, nucleus motorius tegmenti. The striatum and cerebellum both participate in the control of these subsidiary centers, so that for the present our conception should include both striatal and cerebellar components of this supraspinal mechanism. I would, therefore, modify Edinger's generalization of a nucleus motorius tegmenti to include both a kinetic and static representation—the corpus striatum controlling the kinetic component, and the cerebellum its static counterpart.

In line with this conception I would regard the striocerebellar tremor as representing a disorder of both systems, the striatal component of tremor being referable to the kinetic system and the cerebellar to the static mechanism.

CONCLUSION

In conclusion, therefore, I would postulate the existence of a combined form of organic tremor caused by the involvement of separate neural mechanisms. We recognize combined forms of palsy, central and peripheral, pallidal [15] and pyramidal, as well as combined forms of sensory disturbances due to simultaneous involvement of more than one system. In this category I would place the striocerebellar tremor

Abstracts from Current Literature

CONCERNING MYELINIZATION IN THE CEREBRAL CORTEX.

Goichi Hirako, Schweiz. Arch. f. Neurol. u. Psychiat. **10**:275, 1922.

The work of Meynert, and particularly that of Flechsig, in which the progress of myelinization of various parts of the central nervous system was studied, was very important. Flechsig was able to distinguish about forty-five myelinogenetic centers. Myelinization of the cortex, however, has not, thus far, been very carefully studied. The material on which Hirako's study is based consisted of fifteen brains of persons ranging in age from the new-born infant to the child of 4½ years; each brain was cut in serial sections.

The intracortical myelinated structures can be divided into the tangenital fibers, Kaes-Bechterew's line, Baillarger's and Vicq d'Azyr's line, the interradial network, and the radial fibers. As tangential fibers, only those in the outermost layer, the so-called lamina zonalis of Vogt, or plexiform layer of Cajal, were included. Other horizontally running fibers, sometimes spoken of as tangential, were grouped with the deeper structures. Meynert, in 1869, regarded these fibers as having great functional importance; on the other hand, they are sometimes looked on as phylogenetically old and relatively simple structures.

Tangential fibers were found to be myelinated in the following order:

1. The hippocampus comes first with myelinization begun in the brain of a 3 weeks old child and definitely established by the age of 3 months; it is also present early in the uncus, the substantia perforata anterior, the limen insulae, and the regio olfactorio of Broca.

2. The lobulus paracentralis and upper half of the gyrus centralis anterior, at the age of 4 months.

3. Base of the gyrus frontalis superior and the lower portion of the gyrus centralis anterior.

4. Gyrus frontalis inferior and the posterior portion of the gyri orbitales.

5. The gyrus temporalis superior.

6. The gyri occipitales and cuneus.

7. The upper half of the gyrus centralis posterior and gyrus parietalis superior.

8. The gyri lingualis, temporalis inferior, posterior half of frontalis superior.

9. Gyri fusiformis, temporalis medius, and lower half of the gyrus centralis posterior.

10. In the gyri parietalis inferior, anterior half of the frontalis superior, and frontalis medius.

It will be seen that in contradistinction to the gyrus centralis anterior, the gyrus centralis posterior shows a marked delay in the formation of the tangential fibers. The areas indicated under 1, 2 and 3 belong to the primordial areas of myelinization.

Kaes-Bechterew's Line.—This can be found first at the age of 4½ years, particularly in Heschl's gyrus and its vicinity.

Baillarger's and Vicq d'Azyr's Line.—The former shows definite myelinization at 4½ years of age. At from 6 to 8 months of age, these lines are scarcely discernible. Vicq d'Azyr's line can be seen as early as the sixth month, before Baillarger's line can be found.

The Radial Fibers.—By the sixth month these scarcely approach the inner line of Baillarger, that is, the fifth or fourth cell layer of Brodmann's classification. By the eleventh month they have approached the outer line of Baillarger, or the third cell layer. The radial fibers first approach the culmen, later the sides, and finally the base of the gyrus. The U fibers myelinize at about the same time as the radial fibers.

It is not known what factors are responsible for the early topical myelinization. According to Monakow, those fibers best supplied by blood vessels show the earliest myelinization. The author thinks that this is quite in agreement with his observations. From the phylogenetic standpoint it is interesting to note that in the cat, dog, and other animals the tangential fiber development is as marked, if not more marked, than in the human brain; the author found these fibers well developed in several cases of microcephaly. It is furthermore apparent that the phylogenically older portions of the brain, such as the hippocampus and the uncus, show early myelinization. Whether functional necessity plays a big part in this is still an open question.

In conclusion the writer points out that the tangential fibers myelinize in their own way and are quite distinct from the myelinogenetic zones of other parts of the brain. Not unlike these, however, myelinization begins in isolated areas and comes to completion at about the same time of life, that is, the fourth year. The early myelinization of those areas of brain subserving smell and taste possibly results from proper nutrition and the avoidance of deleterious substances, since these functions are of particular importance to the sustenance and preservation of the individual.

WOLTMAN, Rochester, Minn.

FACIAL PARALYSIS. ALEXANDER GIBSON, Surg., Gynec. & Obst. **33**:5, 1922.

The author gives a thorough exposition of the subject of facial paralysis and calls attention to the gravity of the condition. He says that the psychic effect of the condition aggravates the physical defect. It is a lesion that disturbs the patient's whole social life, especially if it occurs in early life. Facial paralysis is divided by the author into three types: (1) supranuclear, seen so typically in the hemiplegic; (2) nuclear, and (3) infranuclear. In nuclear and infranuclear lesions the upper and lower parts of the face are, as a rule, equally involved.

The anatomy and the course and distribution of the fibers of the seventh nerve are reviewed. With regard to etiology, he considers the different types of paralysis, and in discussing treatment lays particular stress on the cases of facial neuritis or Bell's palsy. This is due to lesions below the nucleus. Active massage or galvanism to the paralyzed muscles of the face following Bell's palsy is not indicated unless they are prescribed for their psychic effect. Operative treatment is not advised for Bell's palsy, unless there is no sign of return of function after several months.

Two types of operative treatment are considered: (1) plastic, by transference of the muscles, and (2) nerve anastomosis. Strips of temporal muscle or strips of masseter muscle may be used, but do not produce as satisfactory results as nerve regeneration. In performing the plastic operations an attempt is made (1) to elevate the angle of the mouth, (2) to assist in closure of the eye, and (3) to enable the brow to be wrinkled and the eyebrow to be raised. On the average, the results may be classed at from 50 to 60 per cent. in elevation of the angle of the mouth, 30 to 40 per cent. in elevation of the lower eyelid, and 10 per cent. in action of forehead and eyebrow.

Plastic operations leave a scar which is likely to be clearly visible, and they are more ingenious than trustworthy. They are more suitable when one branch of the facial nerve has been injured or after an attempt at nerve anastomosis has definitely failed.

He reviews thoroughly the history of nerve anastomosis and gives in detail the procedure employed in a faciohypoglossal anastomosis and prefers to transfer the hypoglossal rather than the spinal accessory.

An incision is made from well up on the mastoid process down to the greater cornu of the hyoid bone. This can be readily made in one of the natural lines of flexure of the neck, and after the lapse of a few months is almost invisible. The platysma is cut through, and the interval between the sternomastoid muscle and the parotid gland is thoroughly opened up. A few strands of fibrous tissue are usually encountered and occasionally a twig from the facial nerve may be found. The nerve itself lies rather deep, a good inch (2.54 cm.) from the surface of the skin, and generally about the level of the tip of the lobule of the ear. Its direction is in general transverse. It is important, if possible, to avoid opening the capsule of the parotid, for the lobules of the gland tend to obscure the view, and there is added oozing. This stage of the operation is at times difficult. There has usually been some removal of the mastoid process, and the scar tissue continues oozing so that the field of operation is difficult to keep clean. If there has been degeneration of the nerve, its pinkish color renders it difficult to recognize, and its soft consistency makes injury easy. It also seems to stain somewhat with the oozing blood, and because of this it is not always easy to distinguish. The nerve has usually been in the field of operation for a short time before it is clearly identified. Next, it must be isolated up to the stylomastoid foramen, which may be difficult. The posterior auricular artery, which runs along the upper border of the posterior belly of the digastric muscle, seems to send off numerous fine twigs which are always ready to shed a few corpuscles in the field, and there are equally numerous venous radicles assisting in the process. Again, the nerve passes in to the deep surface of the mastoid process, and it may be necessary to remove the tip of this prominence in order to make the exposure complete, as was done by Halstead.

Adson, Rochester, Minn.

SOME ASPECTS OF MENTAL HYGIENE. E. Farquhar Buzzard, Ment. Hygiene, **6**:449 (July) 1922.

In the presidential address before the Section of Psychiatry, Royal Society of Medicine, Buzzard presented a well-balanced and logical discussion of the importance and rôle of mental hygiene in the practice of medicine. Particular emphasis is placed on the absurdity of retaining the artificial distinction between "nervous" and mental. Mental illness is a definite understandable term and is equally applicable to functional nervous disorders and to the psychoses. The difference is one of degree. Insanity should be relegated to the police court as it denotes an abnormal state which brings a person in conflict with the law. The confusion between medical and ethical principles should be cleared away. A mentally sick patient should never be regarded as a problem in ethics. At least the elementary considerations of psychopathology and psychotherapy should be taught to medical students. Buzzard feels that freudian analysis has taught some valuable lessons, but he cannot regard it as a successful system of therapeutics. Finally, the recognition of the multiplicity of etiologic factors.

the correct appraisal of fatigue, and the value of teaching constructive thinking to the patient are all stressed as essential parts of a workable doctrinnaire of mental hygiene.

Buzzard's paper is a worth-while example of sound and broad psychiatric thought. Perhaps this is all the more remarkable since his most brilliant efforts heretofore have been in the field of organic neurology. Psychiatrists should profit by studying his attitude, for in psychiatry there is always present the necessity of guarding against the development of that kind of intellectual anopsia which results from fixing the mental vision too narrowly on this or that theory to the exclusion of all other possibilities.

STRECKER, Philadelphia.

A NEW TREATMENT OF SEVERE PARAPLEGIA IN POTT'S DISEASE BY PUNCTURE OF THE ABSCESS THROUGH THE INTERVERTEBRAL FORAMEN. JACQUES CALVÉ, Presse méd. **30**:246 (March 22) 1922.

Besides the more usual orthopedic measures, two surgical methods were devised against the paraplegia in Pott's disease, which is generally caused by pressure of the tuberculous focus on the anterior surface of the cord. This writer finds that the first operative method, laminectomy, has proved unsatisfactory, affording little or no relief to the paraplegic symptoms; and that the second, "costotransversectomy" (resection of the neck of the rib and corresponding transverse process) of Ménard affects the paraplegia favorably but leaves a fistula, a serious complication.

By the new method, a hollow sound of appropriate curvature is inserted through a minimal incision close to the line of spinous processes, in such a direction that it can be made to pass through the desired intervertebral foramen and to penetrate directly into the space anterior to the anterior surface of the dura, that is, into the abscessed body of the diseased vertebra. The intervertebral foramen persisted even in severe deformities, and was sufficiently large to pass an instrument of 2 mm. diameter, avoiding the nerve and vessels. The technic is described in detail, with illustrations.

Ten such puncture operations were performed in a series of six cases. Three patients with paraplegias of long standing were not benefited. Of three patients in whom the onset had been more recent, two were symptomatically cured and one considerably improved. No ill effects were observed in any case.

HUDDLESON, New York.

ANHEDONIA. ABRAHAM MYERSON, J. Psychiat. **2**:87 (July) 1922.

Under the term "anhedonia" Myerson describes a syndrome consisting of a deficit of the normal urge to satisfy hunger, thirst, fatigue and sex inclination, and an absence or distortion of the pleasurable feelings which accompany and result from their satisfaction. There is loss of determining and motivating energy and of life objective. Excitement which may be defined as "an undifferentiated result of stimuli, whether these come from without or within," and which ordinarily has associated with it a pleasurable feeling tone, in anhedonia becomes disorganized and painful. The syndrome has been noted by Myerson after infectious diseases, particularly influenza, as a sequel of surgical operations and pregnancy, during the menopause, in males at the senium, early in dementia praecox and depressions, and sometimes as a result of complete blocking of purpose in one whose interests have been rigidly narrowed and

strongly centralized. There is perhaps some contradiction in describing anhedonia as a loss of desire and satisfaction, which gives the implication of diminished affect, and at the same time emphasizing the increased reaction to "excitement" which may have a strong emotional value as a cardinal factor in the syndrome.

STRECKER, Philadelphia.

THE DIFFERENTIAL DIAGNOSIS OF SCHIZOPHRENIA. E. FRANKHAUSER, Schweiz. med. Wchnschr. **52**:401 (April 27) 1922.

The credit for having coined the terms manic-depressive insanity and dementia praecox belongs to Kraepelin. While much opposition to this new classification was encountered, it has gradually become accepted.

The author attempts to define the term dementia praecox (schizophrenia), and to distinguish this disease from manic-depressive insanity and hysteria. To facilitate his discussion, he briefly reviews the chief symptoms of each group.

Under the heading of dementia praecox, dementia praecox simplex is the most important group. It is characterized by a disturbance of basic functions. Change in character is the fundamental factor. There is confusion of attention, lack of concentration, impairment of volition and absence of sense of duty. There may be dulness, slowness and confusion in reaction ability. Next in importance is the change in emotion, such as an inadequate reaction when sad. These affect disturbances may also be designated as a dissociation of the affect.

In manic-depressive psychosis, affect disturbances, while common, are not fundamental, and present an entirely different character. Thus in mania the entire affect life is of an even nature—the so-called manic feeling tone. It may be transferred into an elevated or jovial state, associated with self-confidence, satisfaction and assurance, but there may also be a misinterpretation of the outer world. In melancholia the affect life is of a depressive nature, with a feeling of disapproval and dissatisfaction. The entire emotional life of the dementia praecox patient is unsystematized, irregular, and seems foreign and not understood; on the other hand, the affectivity of the manic or melancholic patient is more akin to normal reactions and within our grasp.

Next in importance in dementia praecox is the so-called desultory or disconnected thinking, which terminates in a word salad or dissociation.

Among the secondary symptoms of dementia praecox are the catatonic states, practically unknown in manic-depressive insanity. Manic phases of dementia praecox and mania with schizoid tendencies occur, as do also depressions with praecox trends. It is here chiefly a matter of terms, and possibly of prognosis, as in the schizophrenias the prognosis is always of a doubtful nature.

Hallucinations and delusions are present in both manic-depressive insanity and in dementia praecox. In the latter they are more the result of dissociation, and not as in manic-depressive insanity, the expression of a disturbed affect. It is no longer held to be a fact that a certain type of delusion is characteristic of a definite psychosis. The idea of being disliked may be normal; it may be the result of a false impression. In depression, it is endogenous; in paranoias and in other delusional psychoses, it may be the result of compulsion or faulty reasoning.

The differentiation of dementia praecox from paranoia is also considered by the author. Kraepelin has narrowed the term paranoia a great deal. He has taken out the querulous type, but still considers it a form of paranoia.

In this narrowing, the paranoid type of dementia praecox has been greatly enlarged, and here also groups of affect disturbances, catatonic types, even manic reactions, have found their way. Because of the variability of this group, the paraphrenias have not been adopted in Switzerland with any enthusiasm. In the person suffering with melancholia, the cause of the ailment and mental suffering is within, while in the paranoid states the world at large is at fault.

As easy as it may be to recognize the outspoken case of dementia praecox, just so difficult is it to make a diagnosis in the milder forms. Differentiation from normal is especially difficult.

Some of the chief characteristics of the milder types of dementia praecox are: singular make-up; whimsical, shut-in, planless living; inability to use money sensibly; leaving jobs without reason, and the tendency to blame others for ill luck or misfortunes. People with dementia praecox are without any sense of responsibility, do not concern themselves with realities, will not accept facts, are intractable, stubborn, aimless and restless. They may also be depressed. Confusion of thought, attention, interest and volition is not uncommon. Apathy and indifference may be present. Kretschmer has shown that these schizoid natures are markedly inadequate, in contrast to the cyclic make-up of the manic-depressive constitution. He has gone so far as to trace these types back into the normal and determine a schizothymic or cyclothymic make-up.

The differentiation of dementia praecox from hysteria is more difficult. The diagnosis of hysteria is being made more and more rarely. All large institutions have cases of dementia praecox, epileptic equivalents, or organic disease which were formerly called hysteria. According to Aschaffenburg's definition, hysteria is characterized by the failure of stimuli to cause normal bodily reactions. Such states as "Dämmerzustande" and Ganser complex belong to the psychic forms of hysteria; and while they may be associated with organic psychosis, they indicate an hysterical mechanism. It is extremely difficult to define an hysterical character. There is inquisitiveness, lack of understanding of the rights of others, inadequacy or fantasy life. These, while characteristic of hysteria, may be schizoid or schizothymic characters. Suggestibility is always of marked importance. Egotism and untruthfulness are more closely allied to hysteria than to schizophrenia, but are not diagnostic. Pseudologia, on the other hand, is rather a symptom of schizophrenia. In dementia praecox the shut-in life is a means of satisfaction to the patient. In hysteria there is much more concern with the outside world. The emotional reactions of hysteria on the whole are understandable; they arouse the impression of being artificial and untrue. In the schizoid, though changeable, queer and disconnected, the symptoms on the whole seem to be more sincere, though entirely foreign to us. Jealousy and intrigue are as common to schizophrenia as to hysteria; prostitution is more common in schizophrenia and imbecility.

In hysteria everything is overdone, says Bumke; work as well as pleasure, love and hate, fear and anger, joy and pain, sorrow and gladness, enthusiasm and disgust; and every affect, as every mood, can suddenly be replaced by its opposite. Hysteria rests principally on an exaggerated affective basis.

The principal difference between hysteria and dementia praecox is that in hysteria the symptoms are analogous to the normal. In dementia praecox inadequate reactions chiefly associated with catatonic, paranoid or manic depressive reactions occur. A combination of hysteria and other psychoses, especially dementia praecox, presents a difficult problem. One hesitates to

make a combined diagnosis, but frequently enough such a condition presents itself. Psychopathic personalities of various types are also to be considered, especially as they may suggest a schizophrenic make-up. Patients with moral insanities comprise another important group. Here the chief characteristic is an ethical defect, a lack of conscience and duty. Many of these persons have dementia praecox with catatonic symptoms, and belong to the simple dementia praecox group. Lack of ethical qualities is not a necessary characteristic of dementia praecox, though it may be associated with it. It is more frequently seen in the manic type of manic-depressive insanity. On the contrary, it is less frequent in the depressive phases in which a high ethical character is maintained. The occurrence of chronic alcoholism in simple dementia praecox is well known. The differentiation of early general paresis from dementia praecox is not always easy, especially when no serologic data is obtained. It is of importance to note that character alteration alone may for years be the only indication of general paralysis.

In conclusion, the author states that dementia praecox is characterized by dissociation or inadequacy of the emotions. Manic-depressive insanity, on the other hand, is characterized by change of mood. Paranoia is the result of imaginative affect disturbance, and it is in this condition that misrepresentations, grandiose ideas, ideas of persecution and the like arise. The outstanding factor in all forms of dementia praecox is dissociation in the widest sense, that is, the dissociation or inadequacy of affect.

MOERSCH, Rochester, Minn.

CONCERNING DIFFUSE GLIA REACTIONS. J. L. PINES, Schweiz. Arch. Neurol. u. Psychiat. **10**:289, 1922.

There has been much speculation relative to the nature of the glial structure surrounding tumors: Does it signify a reactive process or does it mean actual tumor formation? The question essentially involves the differentiation of hyperplasia from tumor.

The writer reports a case which lends itself to the study of this problem. Complete serial sections of this brain, stained with carmine, the van Gieson, Weigert-Pal and Pal-Karmin stains, had been made under the direction of von Monakow.

A man, 50 years of age, a wine dealer, had had pneumonia at 12 years of age, and had suffered from gastric ulcer for fourteen years, from which he recovered. He was a moderate drinker. He denied venereal infection. About two years before it was noted that he suffered a change in character; while naturally good-natured and optimistic, he became depressed easily, was irritable, and recklessly speculative in business. One day while at a railroad station he suddenly lost consciousness, remaining unconscious for an hour. Following this he could speak, but remembered nothing of the attack. There was ptosis on the right, and his gait was shuffling. He improved slowly, but grew more careless in his business. He was indicted because of a false declaration, and finally was compelled to sell out. One and one-half years previously he suddenly announced that he was going to America, and without baggage departed for Geneva, only to return because he was not permitted to cross the border. One month later this was repeated, with a similar result. He became apathetic, cried a good deal, but at times was hilarious and indulged in fantasy and prevarication. One year previously, he had a second attack of unconsciousness very much like the first, preceded, however, by severe headache, dizziness and fatigue. He developed delusions of persecution; he had

some difficulty in expressing himself, and his speech became monosyllabic and dysarthric; he was disoriented, and at times had involuntary urination and defecation. Deterioration was progressive; he became indifferent to his surroundings, and was at times euphoric.

On examination, he denied ever having been depressed; he said he never drank, and that his memory was always good; he said that he made a great deal of money on speculation and that he was not sick. Calculation tests were poorly performed. He told the fable of the mule as follows: "The story is a mule which went walking, then was laden with sugar and wine. Obviously he did not drink the wine, but in a few words did that, that the water did not become cloudy, but that the whole thing was incompletely obedient. Then the men put the mule away. Ha, that was brilliant."

The pupils were moderately dilated, the right somewhat irregular and reaction to light absent; accommodation could not be tested. His tongue was tremulous and deviated to the right. There was a positive Babinski sign on the right; the left plantar reflex was doubtful. The patient was unable to stand; he had a titubating gait, placing most of his weight on the left heel; there was a tremor of the hands; his speech was dysarthric and slurring. The Wassermann test of the blood was negative. Diagnosis: Progressive paralysis?

He would lie in bed for hours at a time, holding a newspaper, without reading it. He became worse gradually, failed to recognize his relatives, took little food, had dysphagia and involuntary urination and defecation. He developed pneumonia of the right lung and died.

Necropsy revealed pneumonia and mitral insufficiency. Section of the brain showed an easily enucleated tumor, the size of a hen's egg, in the left frontal lobe. The defect caused by the tumor involved the anterior two thirds of the first frontal convolution, the anterior half of the second frontal convolution, and had a total anteroposterior length of 4.2 cm. The convolutions of the anterior half of the left hemisphere were flattened, and the entire hemisphere seemed to be much broader than the right. This swelling began in the region of the anterior third of the tumor and increased posteriorly to such an extent that at the anterior central gyrus this hemisphere was about twice as large as its fellow on the opposite side; posteriorly this diminished to reach the normal configuration at the gyrus supramarginalis. Microscopic examination of the tumor showed it to be an endothelioma. The changes in the brain substance itself involved both the glia and nerve fibers. A dense glial layer surrounded the defect in the anterior and dorsal portions, outside of which was a very extensive etat criblé. This condition became accentuated posteriorly. There seemed to be no definite perivascular edema and no changes in the blood vessel walls. The meshes of neuroglia tissue were thickened. There was extreme parenchymatous degeneration, which in the vicinity of the tumor extended to a point just under the cortex, leaving the short association fibers intact. No changes were noted in the cortical gray matter. The density of the glial structures varied enormously, markedly rarified portions alternating with very dense ones. The corona radiata was moderately degenerated in the region of the anterior central gyrus. Only the posterior third of the left hemisphere was entirely normal. In the degenerated areas were numerous giant cells of glial origin, glia cells of moderate size, cells with a large amount of protoplasm, ameboid cells, spider cells and degenerative forms: gitter cells were present in abundance.

In general, it is to be noted that the glia increase, which must be looked on as a reaction to the dural tumor, in many places partakes of the characteristics of a tumor. The case in this respect resembles one reported by Merzbacher, in which a sarcoma, primary in the pia, was partially encapsulated on the surface abutting on the hemisphere by a secondary tumor, resembling a glioma. The doctrine of reactive gliosis has found few supporters. Pines, however, agrees with Merzbacher that here the glial structure must be looked on as a reaction product, secondary to the primary dural tumor. Obviously, then, it may be quite impossible to differentiate cell structures representing glial reactions from true diffuse glia tumors. Schmaus gives the following criterion for differentiating primary from secondary glial increase: In the latter instance the degenerated nerve fibers follow no definite configuration. Stroebe emphasizes the morphologic approach to normal glia tissue when a reactive gliosis is present. Accordingly, the presence of dividing cells and the variety of cell types would indicate true tumor formation. Bonome states that in secondary gliosis there is no increase in volume, and a disproportionate increase in fibers. All criteria, however, may fail when one tries to distinguish glial reaction from glial tumor.

Cohenheim-Ribbert's theory seems poorly adapted to the explanation of diffuse gliomas. Diffuse gliomas, however, show all transition stages from normal glia cells in the environment to undoubted tumor elements, so that the assumption presents itself that these tumor cells arise from normal tissue. The article is to be continued.

WOLTMAN, Rochester, Minn.

LOCALIZATION OF THE TONE SCALE WITHIN THE CORTICAL AUDITORY ZONE IN MAN. PFEIFER, Monatsch. f. Psychiat. u. Neurol. **50**:7 (July) 1921, and **50**:99 (Aug.) 1921.

Pfeifer presents an extensive discussion of the finer localization within the cortical auditory zone, with a review of the experimental, anatomic and clinical data. It has been fairly proved that the cortical center for hearing lies in the transverse gyrus of the temporal lobe. In a recent paper, the author has made a careful study of this zone and its projection system. In view of its variation in size and configuration, its overdevelopment in the brains of musical persons and its underdevelopment in deaf-mutes, he believes it to be not only a sense center, but a psychic center for musical perception.

The experimental work of Munk and of Larinow on dogs led both these authors to a belief in a finer localization of tones within the cortical auditory zone. Munk demonstrated that the center for lower tones lies posteriorly, the center for higher tones anteriorly. Larinow mapped out the zone still more completely, and attempted to transfer his observations to man. His attempt fell short because he was influenced by the theory of a dual auditory path, Wernicke having demonstrated that the sensory sense center for word perception lay in the posterior portion of the first temporal convolution, and Edgren having stated that the center for music perception lay in the temporal pole.

The author believes that the essential auditory center lies within the transverse convolution of the temporal lobe; that high tones are located in that portion of the gyrus which lies deep in the sylvian fissure, and that low tones are located in that part of the gyrus where it enters the convexity of the first temporal convolution. Owing to the variations in size and shape of the temporal transverse gyrus, these centers are subject to more or less displacement, which makes difficult the interpretation of clinical cases, especially as in most of these cases the finer pathologic studies have been incom-

plete. In the interpretation of clinical cases, he points to the further difficulty that the hearing tests are inadequate. Owing to the fact that most tuning forks have overtones, a patient for whom lower tones only are gone can still hear the low forks through their overtones. Interference with the lower tones leads to a much graver disturbance of musical appreciation than loss of the upper tones.

His conclusions are as follows:

1. Animal experiment, pathologic and anatomic studies of the brain indicate that within the cortical auditory area in man (transverse temporal gyrus) high tones and low tones have a separate localization.

2. The assumption is justified that high tones are situated mesially (root of the transverse gyrus in the depths of the sylvian fissure), and deep tones laterally (where the transverse gyrus enters the convexity of the first temporal gyrus).

3. The variable configuration of the transverse temporal gyrus in man makes it probable that the auditory zone is not simply a sense perception zone, but also a psychic center.

4. This variable configuration would seem to be the morphologic expression for individual variations in auditory perception, especially for music.

5. With total destruction of one auditory zone, the tone series can still be fully perceived by the opposite hemisphere.

6. In order to have the music sense intact, the auditory tract and auditory center on the left side must be intact. Total destruction of the auditory tract or auditory center on the left results in amusia, in spite of the fact that all tones can be perceived.

7. Considering the variability in the configuration and size of the auditory zone and its projection tracts, it is possible to explain many of the facts which led Edgren, Probst and Henschen to assume a music sense center in the region of the temporal pole on other grounds, cortical or subcortical amusia being due rather to involvement of the temporal transverse gyrus or its projection system.

8. Other authors have held that a remnant of the transverse temporal gyrus is sufficient to permit perception of all tones. In interpreting this one must remember two sources of error—the difficulty in testing for partial tone deafness and the difficulty in obtaining sources of tones free from overtones.

9. There is no evidence in the literature that the converse of the author's theory could hold, namely, that low tones are mesially situated, and high tones laterally.

SELLING, Portland, Ore.

COMPARATIVE STUDIES IN THE CHEMISTRY OF BLOOD AND CEREBROSPINAL FLUID. GRETE EGERER-SEHAM and C. E. NIXON, Arch. Int. Med. **28**:561 (Nov.) 1921.

The normal value for sugar in cerebrospinal fluid as determined by the investigators was 0.069 per cent. In cerebrospinal syphilis, tabes dorsalis, syphilis, hemiplegia, disseminated sclerosis, neurasthenia, brain tumor, arteriosclerosis and other non-neurologic diseases, the quantity of sugar was approximately normal. A slight increase in sugar was found in dementia paralytica but not sufficiently marked to be of value in diagnosis. In tuberculous meningitis there was a marked decrease in sugar. In diabetes the spinal fluid sugar was increased proportionately to the blood sugar.

The normal for creatinin in spinal fluid varied from 0.45 to 2.20 mg. for 100 c.c. of spinal fluid, but the ratio between pathologic blood and spinal fluid was not found to be sufficiently constant to be used clinically.

The normal for urea in spinal fluid was 9.87 mg. in 100 c.c. A slight increase of urea in the spinal fluid in cerebrospinal syphilis was found. In diseases of cerebrospinal involvement the average normal ratio of urea of normal spinal fluid and blood, 62.15 per cent., was slightly increased.

Under normal conditions the carbon dioxid carrying capacity of cerebrospinal fluid was somewhat lower than that of blood, while in acidosis it showed a tendency to become greater.

Spinal fluids were also examined for ferments. In two fluids among twenty-six the presence of lipase was merely suggested. Diastase, however, was found in all but two of the thirty cases; the highest diastase content was found in a case of spastic torticollis; low readings were obtained in meningitis. No regularity between the diastase content and sugar was noted. Trypsin was not found in the spinal fluids examined. The specific gravity of spinal fluid as determined by the investigators was 1.086 with no marked deviations even in severe neurologic disease.

With respect to syphilis, the authors conclude that cerebrospinal fluid shows no constant deviation from normal in sugar, creatinin, urea content, acid base equilibrium, enzymatic activity or in specific gravity.

VONDERAHE, Philadelphia.

A CASE OF BILATERAL CEREBELLAR ABSCESS WITH NO LOCALIZING SYMPTOMS. E. C. SPARR, Indian M. Gaz. **56**:12 (Dec.) 1921.

The author describes the case of an 8 year old girl, whose family and personal history were negative. Two months prior to admission to the hospital she was injured in her head and back. There was immediate pain along the spine and in the neck, and she slept for twenty-four hours. In ten days she was about her play as usual, but during the next month she became irritable and cried without cause, showed an aversion to sweets (having previously been fond of them), became seclusive and did not care to eat. Six days before admission she appeared feverish in the evening, had photophobia, supported her head with her hands and said her head was being crushed. She complained of a bitter taste in her mouth, and held her head and spine rigidly. On the day of admission she vomited soon after getting up and then became unconscious. On examination after admission she was unconscious and rigid, her pupils were dilated, there was a tendency to conjugate deviation to the right and external strabismus and slow nystagmoid movements were present. The tendon reflexes were all exaggerated; ankle clonus and Babinski sign were present. Spinal puncture gave a slightly turbid fluid with a few lymphocytes and polymorphonuclear cells, a trace of albumin but no sugar. The following day she had a convulsion. On the third day after admission the nystagmus was absent, the pupils were equal and contracted, and the external strabismus was not marked. On the fourth day athetoid movements of the fingers were present. Death occurred on the fifth day. The case was diagnosed as tuberculous meningitis. Necropsy revealed considerable increase in the cerebrospinal fluid. There were abscesses in both lobes of the cerebellum, the larger one being on the left side. Careful examination of

the lungs and other organs of the body gave no evidence of tuberculosis. Sparr remarks on the lack of symptoms suggesting cerebellar abscess and describes in detail those pointing to tuberculous meningitis.

POTTER, Mercer, Pa.

RECKLINGHAUSEN'S DISEASE: ITS RELATION TO THE ENDOCRINE SYSTEM. REPORT OF AN ILLUSTRATIVE CASE. OSCAR L. LEVIN, Arch. Dermat. & Syph. **4**:303 (Sept.) 1921.

The concept of Recklinghausen's disease is held by Levin to include, not only generalized neurofibromatosis, but incomplete forms, showing pigmentation, psychic, nervous and trophic disorders. A review of the literature bearing on the relationship of the disease to the endocrine glands is given. The first manifestation in Levin's case was a nevoid growth on the neck appearing a few months after birth. Freckles appeared at about the age of 4 and increased rapidly to yellow and brown spots of general distribution. At the age of 8 painful tumors of the scalp and vertebral region appeared and were removed. At the age of 16, other tumors were removed and the pigmented nevus of the neck became dark and covered with small growths. When the case was fully developed it presented the following symptoms, grouped by the author according to their suggested relationship to various endocrine glands:

"Suprarenals: Attacks of weakness, faintness and precordial pressure; hyperesthesia; muscular pains; poor vasomotor tone—diminished skin stroking reaction, low blood pressure; diminished metabolism—low blood sugar (0.07 per cent.) and urea nitrogen (8.0 per cent.); anorexia; nocturnal frequency of urination; insomnia; mental symptoms; abnormal hair growth—hypertrichosis of face, back, axillae, abdomen and between the eyebrows; obesity; dermatologic condition—pigmentation, fibroma, neurofibroma, nevus.

"Pituitary: Periodic frontal headaches; poor vasomotor tone; low blood sugar; nocturnal frequency of urination; insomnia; mental symptoms; low down growth of hair on the scalp; structural defects—short and obese, shape, size and asymmetry of face and head, prognathism, enlarged right ear, spacing and character of teeth, hyperextensibility of the fingers.

"Thyroid: Hyperesthesia, poor vasomotor tone; low urea nitrogen; thinned outer one third of eyebrows; obesity.

"Gonads: Menstrual symptoms; abnormal hair growth; obesity; dull lethargic mentality."

VONDERAHE, Philadelphia.

BISMUTH IN SYPHILIS. C. LEVADITI, Presse méd. **30**:633 (July 26) 1922.

This article is a review of recent literature on the use of bismuth preparations in syphilis, together with new case reports. The conclusion is reached that bismuth is a powerful and valuable antisyphilitic comparable with arsenic.

Some success had been noted with subcutaneous injections of bismuth salts, but the intramuscular route was the more satisfactory; the intravenous and oral routes were contraindicated.

Good results were obtained in primary, secondary and tertiary cases. No patients with dementia paralytica were benefited. A patient with acute syphilitic meningitis was symptomatically cured and became serologically negative in blood and fluid under intramuscular treatment. One observer had demonstrated bismuth in the cerebrospinal fluid during a course of the drug. No case was found in which the spirochete was resistant to bismuth, nor were any relapses observed after its use. It was effective when mercury and arsenic had failed.

HUDDLESON, New York.

MULTIPLE SCLEROSIS IN CHILDREN, WITH A REPORT OF THREE CASES. I. S. Wechsler, Neurol. Bull. **3**:579 (Nov.-Dec.) 1921.

Wechsler reports three instances of multiple sclerosis in children, with the onset placed at the seventh, eighth, thirteenth and fourteenth years of life. The incidence of the disease in childhood is about 2 per cent.

Strecker, Philadelphia.

THE DIAGNOSIS OF TUMORS OF THE CAUDA EQUINA, CONUS AND EPICONUS MEDULLARIS: A REPORT OF NINE CASES. Harry L. Parker, Am. J. M. Sc. **163**:342 (March) 1922.

Nine cases of tumor of the cauda equina, conus and epiconus medullaris are reported by Parker. The slower growing tumors were found to present clear cut signs, while the malignant types gave more diffuse signs. Tumors of the sacral canal were found to be well advanced before giving localizing signs. Of eight tumors, studied pathologically, two were encapsulated—one an endothelioma, the other a glioma; the remaining six showed a tendency to erode dura, bone and muscle. The salient features of the symptomatology of the cases studied are enumerated. Of these, pain is emphasized as being of particular diagnostic value. Pain is noted as occurring months and even years before any sign is established; it is intermittent at first, later constant and often relieved by walking or by rest in a sitting position. Next are mentioned tenderness of the spine, atrophic paresis of the lower limbs, perianal or saddle anesthesia associated with sphincteric disturbances, sensory changes varying from a slight loss of which the patient is unconscious to complete anesthesia of the lower extremities, and alteration of the tendon reflexes. Spinal puncture findings varied: a "dry tap" was obtained in three cases in which the spinal canal was choked by a large tumor; in one case xanthrochromic and massive coagulation phenomena were present; in two cases the Nonne test was positive; in one case, later found to be a glioma, the presence of a large number of pus cells led to a diagnosis of subdural abscess. Edema of the lower extremities was noted in two cases. When the symptoms and signs noted in the foregoing are present, the diagnosis is not difficult, but exact localization is often impossible because the degree of involvement frequently does not correspond to the symptomatology. Parker's ninth case is one of tumor of the pelvis pressing on the emerging trunks of the third, fourth, and fifth sacral and the coccygeal roots with their associated plexuses and ganglions, giving a clinical picture of caudal tumor; the case is cited as emphasizing the necessity of digital pelvic examination in all cases.

Vonderahe, Philadelphia.

CONCERNING THE INFERIOR OLIVE. B. Brouwer and L. Coenen, J. f. Psychol. u. Neurol. **25**:2 (Aug.) 1919.

In this article the authors, after a short discussion of the newer literature on the inferior olive, take up two cases of their own in which pathologic changes in the olivary system were found. In the first case there was a small, fairly well localized lesion in the medioventral part of the cerebellum taking in the caudal half of the tonsil, a small part of the lobus cuneiformis and a small section of the lobus gracilis, while the vermis was entirely uninvolved. In this case there was found a considerable amount of degeneration in the opposite inferior olive, while the crossed pontile nuclei were normal. In

the second case a child had encephalocele in the occipital region which had been operated on and in which there was a unilateral atrophy of the cerebellum with a malformation of the vermis. These changes in the cerebellum caused pathologic changes in the inferior olives.

The authors deduct from these cases, in association with former studies and the facts which comparative anatomy teaches, the following: 1. The cells of the pontile nuclei send their axis cylinders to a part of the cerebellar hemisphere as the phylogenetically younger part of the olivary system. 2. The region of the tonsil and the bordering territory of the hemispheres must represent a rich projection system from the inferior olives. 3. The theory is substantiated that the para-olive and the frontal pole of the main olive are in anatomic relationship with the paleocerebellum, while the greatest part of the main olive is related to the neocerebellum. 4. The medioventral para-olive is in anatomic relation with the pars postrema cerebelli (pyramis, uvula, nodulus, flocculus and paraflocculus). 5. The medioventral accessory olive of water mammals is greatly enlarged, and at the same time the pars postrema cerebelli (especially the paraflocculus) is also greatly increased in size.

WINKELMAN, Philadelphia.

THE TREATMENT OF MENINGOCOCCUS MENINGITIS. KENNETH D. BLACKFAN, Med. **1**:139 (May) 1922.

This is an excellent analytical review of the clinical, bacteriologic and serologic history of meningococcus meningitis with special reference to treatment. Certain practical points stand out: In the premeningitic stage, the disease is a bacteremia although the organisms disappear from the blood soon after fixation occurs in the meninges. At this stage diagnosis, except during epidemics, is difficult, but treatment should be intravenous. There is some danger of precipitating meningeal fixation by lumbar puncture at this time, but the importance of early diagnosis outweighs this danger and can be made with certainty only by discovery of the organism in the spinal fluid. With the development of meningitis the serum must be administered intraspinally, and the intravenous administration may be discontinued. The balance of evidence is opposed to the view that the lateral ventricles are the primary seat of infection, and hence it is well to reserve intraventricular injection for very young children or for patients in whom the spinal fluid is too thick to run through the lumbar needle or is blocked off with adhesions. It should also be used in more severe cases in which there is danger of changes leading to hydrocephalus. The serum should be polyvalent and of good quality, the best test of potency at present available being the agglutination titer. No other mode of treatment has yet been proved satisfactory, although there may be use for vaccines in prophylaxis and as an adjunct to the serum in the treatment of the active disease.

Serum injections should be given at least as often as every twenty-four hours and must be controlled by studies of the spinal fluid, intracellularity of organisms and culturability. They should be discontinued when the fluid becomes clear and organisms can no longer be cultivated. If unduly prolonged, the serum may itself give rise to irritative effects, and if insufficient, the discontinuance may be followed by relapse. Sudden death following injection is probably due to too rapid introduction of the serum, which should be made by gravity very slowly.

SINGER, Chicago.

AN ENDOCRINAL FACTOR IN GENERAL PARESIS. Thomas K. Davis, Am. J. M. Sc. **163**:425 (March) 1922.

Eighty-two unselected cases of paresis were examined by Davis with reference to the degree of trichosis. Of the patients possessing a low or average degree of trichosis, 29.5 per cent. died in less than two years, while 45 per cent. lived more than three years. Of the patients possessing more than average or excessive trichosis, 50 per cent. died in less than two years, while 30 per cent. lived more than three years. Assuming that "hypertrichosis is a symptom of suprarenal hyperplasia," Davis concludes that the course of general paresis varies in rapidity directly with the suprarenal strength of the individual.

Vonderahe, Philadelphia.

THE PRACTICE OF PSYCHO-ANALYSIS IN A PUBLIC CLINIC. P. Lehrman, Neurol. Bull. **3**:362 (Nov.-Dec.) 1921.

In this paper Dr. Lehrman details his two years' experience with psychanalysis in the Vanderbilt Clinic. He treated twenty-seven patients (seven had anxiety and five conversion hysterias, four obsession neuroses, one psychic impotence, six conduct disorders, two cyclothymias, one dementia praecox and one paraphrenia) and apparently succeeded in clearing up the symptoms in seventeen. He also discusses the use of psychanalysis in a clinic for the purpose of diagnosis, claiming that in many instances analysis is the only method for arriving at a correct conclusion.

The author did not completely analyze all his cases; nor would psychanalysts concede that he carried out the accepted method. What he really did was to apply psychanalytic investigation to a number of difficult cases, and he succeeded, in more than a superficial way, in clearing up symptoms as well as diagnoses. In so far his paper is of value, showing, as it does, the possibility of psychanalysis in a clinic—a thing which psychanalysts have hitherto declared to be impracticable.

Wechsler, New York.

NEURINOMA IN RECKLINGHAUSEN'S DISEASE. Eugen Kirch, Ztschr. f. d. ges. Neurol. u. Psychiat., No. 74:379, 1922.

Multiple neurofibromatosis has been investigated a number of times, and the occurrence of nerve fibers in the characteristic tumors has been almost universally denied; but in this case Kirch was able to find them in large numbers. The arrangement of the cells in bundles, so-called phalangiform, also agreed with the description of the true neurinoma according to Verocay. There were no tumors of the central nervous system or of the smaller peripheral nerves, but there were many in the sympathetic plexuses in the walls of the intestine. Besides the nerve fibers, the tumors contained also isolated myelin sheaths, but ganglion cells were almost or entirely lacking. Kirch believes these axis cylinders to be the results of regenerative budding of preexisting axis cylinders. The case, he says, is a textbook picture of multiple neurinoma.

Freeman, Philadelphia.

MENINGITIS OSSIFICANS, COMPRESSION MYELITIS, OPERATION, RECOVERY. L. Pussep, Ztschr. f. d. ges. Neurol. u. Psychiat., No. 74: 415, 1922.

After a fall the patient noted stiffness and weakness of the legs, which increased gradually and in the course of a year resulted in subtotal paralysis.

Level symptoms were indefinite, but at operation in the thoracic region a bony plaque was found in the arachnoid. Eighteen centimeters of the cord was then explored, and six similar plaques found, each about 10 mm. in diameter and 3 mm. in depth. They pressed into and distorted the cord but were easily lifted out, and the deformity soon disappeared. The patient made an uneventful recovery and returned to duty.

FREEMAN, Philadelphia.

LATENT TIME OF REFLEXES. HARRY SCHÄFFER, Ztschr. f. d. ges. Neurol. u. Psychiat., No. 74: 605, 1922.

Schäffer, working in Minkowski's laboratory, has devised a new method of determining the latent period of reflexes through the use of the electromyogram. The results are accurate and easily measured. In discussing the question of the nature of the knee reflex, the author says it is indeed a true reflex, and that the shortness of its latent period is due to the simplicity of the central nervous mechanism.

FREEMAN, Philadelphia.

OBSERVATIONS ON THE ETIOLOGY AND PATHOLOGY OF CHOREA MINOR. LOUIS C. SCHROEDER, J. A. M. A. **79**:181 (July 15) 1922.

The author reports a case of chorea minor in a 20 months old white baby. Blood cultures were negative, but necropsy showed that both heart and pericardium were involved, and microscopic examination of the heart muscle revealed typical Aschoff nodules. These nodules are looked on as strong presumptive evidence of a preceding rheumatic infection.

The author also notes that advances in the study of the physiology of the basal ganglions make it seem likely that the chief pathologic changes in chorea minor occur there.

NIXON, Minneapolis.

CONTAGIOUSNESS OF EPIDEMIC ENCEPHALITIS. GEORG STIEFLER, Ztschr. f. d. ges. Neurol. u. Psychiat., No. 74: 396, 1922.

From eight personal observations and comparison with cases previously reported, Stiefler concludes that epidemic encephalitis is transmissible from person to person by contact and even through the intermediation of a healthy third person. The contagiousness, however, is slight, less than that of infantile paralysis.

FREEMAN, Philadelphia.

ANATOMIC STUDIES OF THE VISCERA IN DEMENTIA PRAECOX. F. WITTE, Ztschr. f. d. ges. Neurol. u. Psychiat., No. 72: 164, 1922.

In the majority of cases there is a decrease in the lipoids of the suprarenals, as is the case in chronic infections such as tuberculosis and some acute septic processes. In the nervous system and bodily organs, no marked alterations from normal were appreciable.

FREEMAN, Philadelphia.

LATENT NEUROSYPHILIS IN EIGHT PER CENT. OF MEDICAL PATIENTS IGNORED OWING TO NEGLECT OF LUMBAR PUNCTURE. H. GRAY, Am. J. M. Sc. **165**:384 (March) 1922.

In sixty-two medical cases, all supposedly nonvenereal, Gray found eight syphilitic patients, only two of whom knew of their disease. Five of these had involvement of the central nervous system. In view of such an incidence

Gray states that a lumbar puncture should be performed on every syphilitic patient, and repeated annually, if positive, until it has been negative for one year; and thereafter every two years, to exclude recurrence.

VONDERAHE, Philadelphia.

A CASE OF TUMOR OF THE SPLENIUM OF THE CORPUS CALLOSUM. G. GUILLANI, Rev. Neurol. **29**:23 (Jan.) 1922.

The case here reported may be summarized as follows: The patient (a man, aged 52) with apparently negative family and early personal history, entered Guillani's service with a complaint of failing memory, headaches and vertigo of seven months' duration. On examination the patellar and Achilles reflexes were found to be absent, as well as the plantar, abdominal and cremasteric responses. There was marked urinary retention. The reflexes over the brachial field were much diminished, and there was a constant coarse tremor of the right arm. The Kernig sign was present, and the pupils were unequal with greatly diminished reaction to light and accommodation. Vision was much impaired and there was evidence of spontaneous nystagmus; but, owing to poor cooperation, no examination of the fundi could be made. Apraxia was characteristically present. On lumbar puncture there were found 32 cells, hypertension and somewhat increased solids with a slightly positive Wassermann and a negative colloidal gold reaction. Mentally there was evident a certain general deterioration with associated alternating agitation and depression and periods of marked hebetude and confusion.

When seen two months later the patient's mental state was one of practically continuous torpor unassociated apparently with any further neurologic change. The spinal fluid at this time showed much increased pressure, 7 cells and a greatly increased amount of solids with again weakly positive Wassermann and negative colloidal gold reactions. Death occurred soon afterward following a period of stupor.

Necropsy revealed a cystic hemorrhagic glioma, apparently primary in the splenium of the corpus callosum, but secondarily involving the internal lateral ventricular wall, the tapetal white matter, the posterior thalamus and thalamic radiations, the inferior longitudinal bundle bilaterally, the white matter of the first limbic convolution and the thalamic radiations, the forceps inferiorly and the cingulum posteriorly.

On the basis of the features presented by this case and others reported in the literature Guillani feels that a definite clinical syndrome may be validly assumed thus as regards callosal tumors:

1. Evidence of increased intracranial pressure.

2. Early and progressive psychic change, that is, deterioration and confusion with alternating agitational and torporous periods strongly suggestive on the whole of the paretic reaction.

3. Frequent motor disorder and apraxia unattended by aphasia and basal cranial palsies.

RAPHAEL, Ann Arbor.

THE TREATMENT OF ANTENATAL AND CONGENITAL SYPHILIS. JOHN A. FORDYCE and ISADORE ROSEN, Arch. Dermat. & Syph. **5**:1 (Jan.) 1922.

The authors recommend a course of treatment for syphilitic women during pregnancy consisting of from six to eight doses of arsphenamin or neoarsphenamin, with mercuric chlorid or mercuric salicylate, 1 grain, once a week

for twelve or fifteen injections. Many infants born of treated mothers are without clinical or serologic evidence of infection, although many of the mothers have postive findings. A hundred and forty infants, with negative reactions but born of mothers with strongly positive findings, were observed for a year and a half. Forty-eight of the mothers received no antenatal treatment; twenty-four received internal treatment only; sixty-one received partial treatment with arsphenamin and mercury; and only six received prolonged treatment with these drugs.

In one case a woman with a negative blood Wassermann reaction but a positive spinal fluid Wassermann reaction gave birth to a child in whom the blood from the umbilical cord was strongly positive although no clinical evidence of the disease was noted in the infant. In another case, a man, aged 35, who acquired syphilis at the age of 18, was treated by inunction for two years and was married at the age of 22; four children were born, all negative clinically and serologically; the wife gave a negative blood and spinal fluid Wassermann reaction, while the husband had an advanced tabetic condition with a strongly positive blood and spinal fluid.

The authors' treatment for congenital syphilis consists of intramuscular injections of neo-arsphenamin in the following dosage: 0.1 gm. for infants from 2 to 12 weeks old; 0.15 gm., from 3 to 9 months; 0.2 gm., from 1 to 2 years, and 0.25 to 0.3 gm. for children 3 years old. Ten or twelve weekly injections of mercuric chlorid are given in the following dosage: 1/10 grain for children from 2 weeks to 6 months old; 1/8 grain from 6 months to 1 year; 1/7 grain from 1 to 2 years; 1/5 grain from 2 to 3 years and 1/4 grain for those more than 3 years old. In eighty-eight children with strongly positive Wassermann reactions, twenty gave clinical manifestations which yielded promptly to the treatment. Fourteen of forty-seven treated patients became negative serologically.

VONDERAHE, Philadelphia.

PSEUDOTUMOR SYNDROME DEPENDENT ON ACUTE SWELLING OF THE BRAIN. C. I. URECHIA, Rev. Neurol. **27**:1185 (Dec.) 1920.

Comment is made on the etiologic and pathologic obscurity still prevailing as regards the so termed pseudotumor syndrome. Particular attention is directed to the possible etiologic rôle in this regard of the acute swelling of the brain (akute Hirnschwellung). The author feels that this is brought about through ameboid changes in the neuroglia cells with consequent increase in gross brain volume.

An illustrative protocol is cited in which the patient (a woman, aged 34) presented herself at the author's clinic with a history of hebetude, general weakness and severe headaches of recent onset and, on neurologic examination, sluggish unequal pupils, exaggerated deep and superficial reflexes, patellar cloni and occasional Babinski reaction. Examination of the spinal fluid was negative except for an indication of increased solids. Death occurred three days later, following a period of stupor, with the neurologic examination indicating profound general motor paresis, strongly positive bilateral Babinski response, patellar and ankle cloni, incontinence, extremely severe headache, slight rise in temperature and, as regards the fundi, evidence of papillitis and optic atrophy bilaterally. Postmortem examination was grossly negative except for an indication of slight congestion of the meninges. Microscopic examination showed profound chromatolytic changes affecting cells throughout the cortex. The neuroglia cells showed in addition marked ameboid change, particularly intense

periventricularly and much less so in the gray matter itself. This change was characterized by swelling of the cells, process loss, hyperchromatic nuclei with halo formation, cytoplasmic, hyperchromism and evidence of severe granular, fatty, vacuolar and cystic degeneration.

RAPHAEL, Ann Arbor.

FRACTURE-DISLOCATION OF THE SPINE TREATED BY FUSION. RUSSELL A. HIBBS, Arch. Surg. **4**:598 (May) 1922.

From a study of twenty-two cases of fracture dislocation of the spine, Hibbs concludes that many injuries of this type are unrecognized. A very thorough roentgen-ray study with lateral, anteroposterior and stereoscopic plates is necessary to confirm the diagnosis and justify operative interference. In spite of the thorough roentgenographic examination in many cases the surgical exposure revealed more extensive damage than the roentgen ray suggested. In his series of cases the fracture dislocation was located once in the cervical region, twice in the dorsal and dorsolumbar and seventeen times in the lumbar region. Of the last named, eleven were located in the fifth lumbar vertebra. He emphasizes the fact that the lumbar spine is most susceptible to fracture and that the fifth lumbar vertebra is the one most frequently injured.

The chief symptoms were deformities of the spine, protective postures, and a sense of weakness in the back. In the cervical case pain in the shoulders, neck and arms, was the chief symptom.

Patients with dorsolumbar and lumbar cases complained of pain in the legs resembling sciatica. Cord or nerve root symptoms were noted in only one case. In all cases the condition was crippling. In only three cases, all of recent fracture, was the diagnosis made; in the other nineteen cases, fractures had occurred from one to twenty-five years previously. An injury in childhood may apparently be of trivial importance yet show severe symptoms in adult life.

The symptoms are caused by the mobility of these altered joints and ununited fractures. Elimination of motion is essential to complete and permanent relief. Operative interference producing a fusion of the articulating bones is the treatment recommended. The surgical technic is described in detail.

GRANT, Philadelphia.

HYPOTHYROIDISM WITH UNUSUAL SKIN MANIFESTATIONS. HARVEY P. TOWLE and E. LAWRENCE OLIVER, Arch. Dermat. & Syph. **5**:88 (Jan.) 1922.

A child, 3 years old, backward in its development, had coarse, dry hair; the hands and fingers were short and pudgy. The Wassermann and von Pirquet reactions were negative, and there was a deficiency of 19 per cent. in the basal metabolism. The skin, with the exception of the face, palms, soles and scattered areas on the legs, was reddened and swollen, and there were groups of eruptive lesions. The primary lesion appeared to be a turbid vesicle which grew peripherally and rapidly undermined and loosened the epidermis as it spread; coalesence took place and the process continued until the disease became universal. Smears and cultures from the lesions were negative in every instance. Various applications to the skin were tried, but with no effect; within two weeks, however, using thyroid extract, the child's mentality improved markedly and the skin was almost cleared.

VONDERAHE, Philadelphia.

INFLUENCE OF HEAD AND BODY POSTURE ON SPINAL FLUID PRESSURE. N. Zylberlast-Zand, Rev. Neurol. **28**:1217 (Dec.) 1921.

The author calls attention to the importance of the hydrostatic factor in the determination of spinal fluid pressure, feeling that its valence in this regard is distinctly greater than 24 per cent. as reported by Pfaundler, 68 per cent. being attributed to blood pressure and 8 per cent. to meningeal elasticity. Thus, Zand found that the pressure in normal persons ranges from 200 to 350 mm. in the sitting position, and in the lateral decubitus from 10 to 100, while in subjects presenting meningeal pathology, a range of from 150 to 200 mm. was determined in the lateral decubitus and a maximum of 400 in the siting position. Frequent inability to obtain fluid on puncture in the reclining position, while probably dependent in part on primary pressure fall in this posture, seems to be due chiefly to mechanical interference from the cauda equina. The author found, through observations on cadaver material, that in the reclining position the cauda equina showed a marked tendency to adhere to the posterior canal wall and in this manner to obstruct free circulation of the spinal fluid. It is of interest also that a rise in fluid pressure was consistently noted to follow head flexion in the reclining position (from 20 to 120 mm.), while in the sitting position this maneuver was productive of definite pressure decrease (— 50). The author regards this as due most probably, in the first case, to venous stasis dependent on disturbance of venous return-flow by flexion at the neck, in the second case (in the sitting posture) being mechanically less effective due to stress dissipation over the dorsal vertebrae.

Raphael, Ann Arbor.

HEMORRHAGIC MENINGO-ENCEPHALITIS IN ANTHRAX. B. Shanks, Indian M. Gaz. **56**:11 (Nov.) 1921.

This is a case report with gross necropsy findings. A man, aged 20, while suffering with a small anthrax pustule on the right malar prominence developed a temperature of 104 F., with signs of meningeal irritation. Examination of the spinal fluid showed the presence of blood, polymorphonuclear leukocytes, lymphocytes, and many typical bacilli. A blood culture was positive for anthrax bacilli. Death occurred in less than twenty-four hours. At necropsy the dura was tense and bulging; there was evidence of hemorrhage into all parts of the subarachnoid space and pinpoint hemorrhages into the cerebral cortex. There were hemorrhages into the small intestine and gross softening of the left parotid gland. Postmortem cultures from the brain and spleen gave a pure growth of anthrax bacilli. Guinea-pig inoculations resulted in death in twenty hours. The author summarizes briefly forty-five previously reported cases and calls attention to the fact that in only 50 per cent. of the cases in which the location of the primary lesion was recorded were they in the head. He concludes that meningo-encephalitis in anthrax is the result of a bacteremia.

Potter, Mercer, Pa.

A STUDY OF THE INCIDENCE OF HEREDITARY SYPHILIS. P. C. Jeans and J. V. Cooke, Am. J. Dis. Child. **22**:402 (Oct.) 1921.

The authors studied the placental changes and the Wassermann reaction on the cord blood in 2,030 infants. The series included pregnant women delivered in eight months in four hospitals caring for those able to pay the fees charged private patients, and the charity cases cared for in two hospitals and two outpatient obstetrical clinics. The blood of 389 infants was

examined, and it was found that the proportion of cases of hereditary syphilis that could be diagnosed by the placental examination alone was 27 per cent., while from the Wassermann reaction on the cord blood 63.6 per cent. of the cases could be recognized. Using this method on the entire series, the incidence of hereditary syphilis in the colored race was found to be 15 per cent., 1.8 per cent. in the poor of the white race and less than 1 per cent. in the well-to-do classes

VONDERAHE, Philadelphia.

AN EXPERIMENTAL STUDY OF METHODS FOR BRIDGING NERVE DEFECTS, WITH A DESCRIPTION OF A NEW METHOD OF AUTOTRANSPLANT (AUTO-AUTOTRANSPLANT). ERNEST SACHS and JULIAN Y. MALONE, Arch. Surg. **5**:314 (Sept.) 1922.

Experimental results with three methods of bridging defects in the continuity of nerve trunks are described: (1) the direct, an anastomosis of the central and peripheral ends of an injured nerve into longitudinal incisions in a neighboring normal nerve; (2) anastomosis of the central and peripheral end of an injured nerve to flaps cut in the same quadrant of a normal nerve; (3) an auto-autotransplant of the central end of the injured nerve, the removed segment being just long enough to bridge the defect between the severed nerve ends.

The ordinary technic of nerve suture was carried out with great care, hemostasis being made as complete as possible. A close approximation of the nerve tissue in the cut ends was obtained, and sutures were passed only through the perineural sheaths.

The results of these experiments show that the axis cylinders of severed nerves will grow down or between medullary tubes of a functioning nerve without interfering with the power of such nerves to transmit impulses or losing their own ability to function. Nerve tissue seems to form unquestionably the best pathway for the regeneration of nerve tissue. The introduction of any foreign material in an attempt to form a pathway down which a nerve may grow is of doubtful value. The method by which the anastomosis is made—lateral, direct, lateral into flaps cut in the nerve trunk, or by auto-autotransplant, seemed to make little difference in the result. All were effective. The lateral direct transplant seemed the most satisfactory. But with a careful suture, the avoidance of scar tissue, and the introduction of nerve tissue as a pathway for the regeneration of the nerve, the chances of a good functional recovery seemed greatly improved.

GRANT, Philadelphia.

OBSERVATIONS ON INFANTILE TETANY. B. KRAMER, F. F. TISDALL and J. HOWLAND, Am. J. Dis. Child. **22**:431 (Nov.) 1921.

The authors emphasize the constancy of a lowered concentration of calcium in the serum of infants affected with tetany and bring forward evidence to support the view that calcium deficiency is the important factor in increasing neuromuscular irritability. In determining the amount of inorganic phosphorus in blood serum in tetany a marked variation was noted, and in about one half of the cases the concentration was found to be normal or slightly above normal; they conclude accordingly that an increase in inorganic phosphorus is not responsible for the characteristic symptomatology of the disease. The concentration of sodium and magnesium was found to be essentially normal and that of potassium slightly increased, so that the increase in the ratio of sodium and potassium to calcium and magnesium is almost wholly due to a decrease in the concentration of calcium.

VONDERAHE, Philadelphia.

NEUROLOGIC SIGNIFICANCE OF THE "NONNE REACTIONS." O. Gallotti and J. Schettino, Rev. Neurol. **27**:1085 (Nov.) 1920.

The authors direct attention to the importance diagnostically of the "Nonne Reactions" so-called in neurosyphilis, namely: (1) phase 1 of the Nonne-Apelt test for globulin; (2) spinal fluid pleocytosis (6 +), and (3) the Wassermann reaction on the blood and spinal fluid.

Phase 1 of the Nonne-Apelt reaction has been found 95 per cent. positive (Nonne) in general paresis, 90 per cent. in tabes and 100 per cent. in meningovascular syphilis.

Pleocytosis (Vianna and Moses) occurs to the extent of 100 per cent. in general paresis, 100 per cent. in tabes and 64 per cent. in meningovascular syphilis.

The blood Wassermann reaction has been found 100 per cent. positive (Nonne) in general paresis, from 60 to 70 per cent. in tabes, and from 80 to 90 per cent. in cerebrospinal syphilis, while the Wassermann reaction on the spinal fluid has been 93 per cent. positive (Vianna and Moses) in general paresis, 25 per cent. in tabes and 10 per cent. in meningovascular syphilis and, respectively, 100 per cent., 100 per cent. and 96.2 per cent., when utilizing the Hauptmann-Hoessli method, that is, use of increasing amounts of spinal fluid in arithmetical progression.

It is of interest that no place is given the colloidal gold and mastic reactions in this serodiagnostic heirarchy.

Raphael, Ann Arbor.

THE TREATMENT OF SYPHILIS BY MERCURY INHALATIONS: HISTORY, METHOD AND RESULTS. H. N. Cole, A. J. Gericke and Torald Sollmann, Arch. Dermat. & Syph. **5**:18 (Jan.) 1922.

The authors review the history of mercury inhalations, describe their own method and record their observations. In five patients with active syphilitic lesions calomel was used in doses of 3 to 80 mg., totaling 225 mg. in two weeks. The weighed amount of calomel was heated in a tube, and the vapor inhaled by the patient as it was formed. In all instances but one bronchial irritation, salivation and tenderness or edema of the gum occurred; but there was no renal disturbance and no therapeutic response. In six cases metallic mercury, vaporized in a similar tube, was used, the patient receiving from 225 mg. in two weeks to 750 mg. in three weeks. No systemic or local effects were noted. There was no salivation, except in one doubtful case, and no evidence of improvement in the disease.

Vonderahe, Philadelphia.

EARLY DIAGNOSIS IN GENERAL PARESIS AND TABES. G. R. Lafora, Rev. Neurol. **27**:1190 (Dec.) 1920.

Lafora emphasizes the paramount importance of early diagnosis in general paresis and tabes, particularly from the standpoint of actual therapeutic prospect, feeling that unless these situations are detected extremely early in their development—in their preclinical phase, so to speak—little essential improvement serologically or pathologically is to be anticipated, even under the most intensive specific therapy. Attention is directed especially to early pathognomonic changes occurring in the spinal fluid in such cases, particularly in those of the paretic order. Illustrative protocols are cited in which there is reported pleocytosis and increased solids, with definitely positive Wassermann

and colloidal gold reactions. There was complete absence of psychiatric and neurologic symptomatology, with the exception of pupillary inequality and partial iridoplegia and negative or weakly positive blood Wassermann reactions.

RAPHAEL, Ann Arbor.

A CASE OF TUBERCULOUS MENINGITIS WITH A DRY SPINAL SUBARACHNOID SPACE DUE TO DIFFUSE TUBERCLE INFILTRATION OF THE SPINAL MENINGES. JOSEPH C. REGAN and G. W. HOLMES CHENEY, Am. J. Dis. Child. **22**:516 (Nov.) 1921.

Seven days before the termination of the illness a lumbar puncture was made and 12 c.c. of fluid were removed. The following day another puncture was made and 6 c.c. of fluid were obtained. Subsequent punctures on the same day resulted in only a few drops of fluid or none. After this ventricular punctures were made. The gross pathologic condition in the cord was essentially an obliteration of the subarachnoid space as a result of intense tubercle formation; the brain showed similar marked tubercle formation over the superior surface, the base and the walls of the lateral ventricles, including the choroid plexus. Microscopic examination confirmed the diagnosis of tuberculosis.

VONDERAHE, Philadelphia.

THE VALUE OF VENTRICULOGRAMS IN THE LOCALIZATION OF INTRACRANIAL LESIONS: THREE CASES OF OBSTRUCTIVE HYDROCEPHALUS AND ONE OF BRAIN TUMOR. E. B. TOWNE, Arch. Surg. **5**:144 (July) 1922.

Towne reports three cases of obstructive hydrocephalus and one of brain tumor in which the diagnosis was made by means of the ventriculogram. One of the cases of hydrocephalus was of the rare type in which one lateral ventricle was displaced and the hydrocephalus caused by a tumor (glioma), blocking the foramen of Monroe on one side. The other two cases of hydrocephalus were apparently due to blockage from unknown cause, probably meningitis about the basal cistern. In the case of the brain tumor a localization in one or the other frontal lobe was made from the neurologic signs, and the ventriculogram determined in which hemisphere the lesion was located. The technic recommended by Dandy was used throughout.

GRANT, Philadelphia.

HYPOPHYSEAL OBESITY AS A RESIDUAL SYMPTOM IN A CASE OF LETHARGIC ENCEPHALITIS. STIEFLER, Monatsch. f. Psychiat. u. Neurol. **50**:123 (Aug.) 1921.

A girl, aged 13, suffered a typical attack of lethargic encephalitis in February, 1920. Convalescence occurred after three months; after five months she was fairly well, except for a little dulness and apathy. After seven months she began to note a gain in weight, polyuria, polydipsia, loss of hair and a tendency to sweat on slight exertion. Growth was somewhat slowed. After fourteen months the condition was about the same except that her weight had increased further, and the polyuria was somewhat more marked.

The author attributes the syndrome to hypophyseal dystrophy. He is unable to determine the actual site of the lesion, whether it is in the hypophysis itself or in the adjacent basal structures of the brain.

SELLING, Portland, Ore.

DIAGNOSIS AND TREATMENT OF INTRATHECAL TUMORS OF THE SPINAL CORD. W. Thorburn, Brit. M. J. **1**:3185 (Jan. 14) 1922.

The author describes a typical case of tumor on the left anterolateral aspect of the spinal cord, at the level of the eighth dorsal vertebra, and a case which he calls "a blurred image of an intrathecal tumor" (probably a localized infection of the meninges producing an obstruction of the spinal subarachnoid space with pressure on the cord). Thorburn urges the careful examination of patients with intrathecal tumors of the spinal cord and the early removal of these tumors, as this increases the probability of complete recovery. He further urges the early exploration of all doubtful cases of transverse lesion of the spinal cord. He is of the opinion that many cases of transverse myelitis may be arrested or cured by incision and drainage of the dura mater, since such myelitis is often due to infection spreading along the spinal nerves and crossing the intradural space before the cord itself is attacked.

Potter, Mercer, Pa.

AN ANALYSIS OF NINETY CASES OF FUNCTIONAL DISEASE IN SOLDIERS. John M. Swan, Arch. Int. Med. **28**:586 (Nov.) 1921.

In Swan's patients, 65.5 per cent. had been recruited from occupations of a sedentary type and 51.7 per cent. had a family history of nervous disease. In 89.6 per cent. of the cases there was a history of subacute or chronic infections while in 87 per cent. there were present complications of an infective character, such as tonsillitis, nasopharyngitis, sinusitis and infected teeth; and in about 50 per cent. of these cases there were physical signs pointing to a disturbance of the endocrine system.

Vonderahe, Philadelphia.

KYPHOSCOLIOSIS AS AN EARLY CLINICAL SIGN IN SYRINGOMYELIA. C. Foix and E. Fatou, Rev. Neurol. **29**:28 (Jan.) 1922.

Foix and Fatou cite in careful detail two cases in which there had existed marked dorsal kyphoscoliosis for many years (thirty and fifty) prior to the development clinically of typical sypringomyelic features. It is of especial interest that in these cases which seem to have been of predominantly unilateral type, the side most severely affected was that toward which the convexity of the spinal deflection was directed, dependent apparently on diminished vector efficiency as regards the vertebral musculature on the affected side. The authors believe that this initial kyphoscoliosis was essentially a manifestation of early abortive sypringomyelia, remaining latent over a long subsequent period with final recrudescence in typical form. This confirms, in a certain measure, the claim advanced some years ago by Leyden as to the frequent congenital nature of syringomyelic change.

Raphael, Ann Arbor.

CONTRIBUTION TO THE STUDY OF LATE HEREDITARY SYPHILIS. Julius Schuster, Monatsch. f. Psychiat. u. Neurol. **50**:152 (Sept.) 1921.

The author reports a case of late hereditary syphilis with necropsy. In addition to the ordinary histologic changes, interesting lesions were found in the Purkinje cells of the cerebellum. Throughout the entire cerebellum these cells were greatly swollen; their dendrites showed patchy balloon-like enlargements, and both cell body and dendrite were packed with a fine brown

pigment. This picture is similar to that described by Straussler, Schobb and others in the group of nonsyphilitic heredo-degenerative diseases, on the basis of which Schaffer propounded his hyaloplasma theory of the origin of the heredodegenerations. The author's case shows that similar changes may occur in hereditary syphilis.

SELLING, Portland, Ore.

CASE OF SPINAL CARIES AND COMPRESSION MYELITIS, LATERAL SCLEROSIS. J. MOORE, Dublin J. M. Sc. **4**:23 (Jan.) 1922.

The author reports the case of a man, aged 41, who suffered with signs of pulmonary tuberculosis at about the age of 22. At 34 he had a tuberculous testicle removed, and at 40 he noted weakness of the lower extremities, followed by loss of power in both lower limbs. Examination showed spasticity of both lower limbs, greater on the left. There was no loss of deep, epicritic or protopathic sensibility. Superficial reflexes (abdominal, cremasteric and epigastric) were exaggerated and later lost. Bone graft to the spine was done after two months' rest in bed. Nine months after operation he was practically restored except that the left interossei did not respond well to faradic stimulation, although the galvanic response was normal.

POTTER, Mercer, Pa.

CONGENITAL GOITER. REPORT OF FOUR CASES. WILLIAM B. PORTER and R. A. VONDERLEHR, Am. J. Dis. Child **22**:477 (Nov.) 1921.

The four cases reported occurred in male children. In no instance were there any toxic thyroid symptoms or pressure symptoms. The goiters in all cases were enlarged symmetrically, the most prominent part being the isthmus. They were soft in consistency and suggestive of goiters of the colloid type. A noteworthy finding was the presence of the ova of *Ascaris lumbricoides* in the feces in all four cases

VONDERAHE, Philadelphia.

A CASE OF SYRINGOMYELIA. W. S. ROBERTSON, Lancet **201**:1272 (Dec. 17) 1921.

The author reports a typical case of syringomyelia, beginning at the twenty-sixth year, which was progressive for a period of four years, two years of which time the patient was bedridden. During the fifth year she began to improve and after about one year was able to do all her own housework. Examination ten years later showed only increased knee reflexes and patches of disassociated anesthesia on the plantar surface of the feet. Robertson remarks on the rare occurrence of such an almost complete recovery in syringomyelia.

POTTER, Mercer, Pa.

Book Reviews

KATATONIE UNTER DEM BILDE DER HYSTERIE UND PSYCHOPATHIE. By M. Urstein. Paper. Pp. 465. Berlin: S. Karger, 1922.

This is the final volume of the series of clinical studies on katatonia by this author, the first of which appeared in 1909. As in the earlier volumes, the material is derived from studies and observations of patients over a long series of years. The records of twenty cases are given in great detail; in eighteen of them hysterical or psychopathic traits, sometimes mixed with manic-depressive features, have been prominent and even predominant for many years before the appearance of katatonia and the final characteristic dementia; in one the katatonic symptoms occurred in connection with a paretic, and in the last with a polyneuritic picture. Following the case records, each accompanied by a critical summary, is an excellent, concise discussion of the general symptomatology, nature, course and outcome, prognosis and diagnosis.

Urstein reiterates his previously published conviction that katatonia is a definite disease entity, the essence of which is some "endocrine, anaphylactic disturbance," and insists that even when the earlier picture has been dominated by hysterical or psychopathic features "this should not be regarded as evidence that the katatonia is an addition, but rather that the condition was katatonic from the start." Further, "While the presence of katatonic features indicates the existence of this disorder, yet their absence does not prove the contrary."

Whatever view be taken of this concept, there can be no question as to the great debt which psychiatry owes to Urstein for the painstaking exactitude of record and keen-sighted analysis of clinical facts which form the basis of the present and preceding volumes. He illustrates admirably the need for such extended observations by giving the further course and outcome of cases which have previously been published by others.

Urstein recognizes several varieties of onset and course: 1. The primary manifestations, often for long periods, are those of hysteria, psychopathic personality, neurasthenia, hypochondria or compulsion neurosis, the katatonic symptoms being added gradually and leading to a typical end-state. 2. Phobias or psychopathic phenomena appear simultaneously with katatonic symptoms. 3. Manic-depressive episodes, mixed with which are katatonic symptoms, with perhaps temporary recovery are followed by hysterical or degenerative features and finally typical katatonia. 4. Rarely, the early symptoms are those of acute katatonia with the later addition of pronounced hysterical or degenerative traits. He maintains, and his records go far to prove, that the evolution from the psychoneurotic or psychopathic picture to final katatonia can be foreseen if careful attention is paid to the presence of evidence of real intrapsychic splitting and disharmonies between thoughts, emotional expressions and acts.

The outcome in all forms is much the same except in degree of dementia which varies greatly with the quality of the material of which the individual is built, the environment and the treatment. Where these are favorable, the final dementia may be long postponed and less severe. Once katatonic symptoms become marked, remissions are rare. When the early stage is dominated by hysterical features, the course is usually progressive; and when they appear late, the prognosis is more unfavorable.

EPILEPSIE UND MANISCH-DEPRESSIVES IRRESEIN. Von Dr. Hans Krisch. Abhandlungen aus der Neurologie, Psychiatrie, Psychologie und ihren Grenzgebieten. No. 18. Price, 36 marks. Pp. 107. Berlin: S. Karger.

That there is no uniform "epileptic character," that psychic epilepsy cannot be demonstrated solely on the basis of mental symptoms, and that essential epilepsy is a tenable diagnosis, are the main conclusions derived by Krisch from his studies of 200 cases of epilepsy. Of these, 140 were of the "genuine" type; the others were largely symptomatic. In a third to a fourth of the essential types a direct heredity was traceable, besides numerous instances of psychopathic manifestations in the collateral branches. The predominant fact in epilepsy is the inherited constitutional factor. Krisch presents detailed case histories of those cases showing interesting affective disorders and compares them with the symptoms of manic-depressive psychosis. The differences are attributed largely to the obscuring of consciousness in epilepsy which prevents the development of the "nuances" familiar in the affect syndromes of the "manic-depressive." The epileptic patient in his depression shows a less coherent picture, is more inclined to be accusatory than self-derogatory, is likely to commit suicide, fight or run, and is abrupt and brief in the onset and termination of his emotional disturbance. During the disorder he contrasts with the manic-depressive in his violence, often in a changed expression of his eye and in his stertorous breathing. Krisch finds that the affect symptoms are in themselves not sufficiently differentiated from manic-depressive reactions to be diagnostic. Unless there is a history of preceding convulsions or a definite obscuring of consciousness during the emotional disorder, it cannot be diagnosed as epileptic. In 317 case histories of manic-depressive psychosis Krisch found that epileptic manifestations were rare. Manic attacks and depression states are rare also in epilepsy; concurrent epilepsy and manic-depressive insanity, extremely rare. A relation between the two diseases is therefore unlikely.

The so-called typical "epileptic character" with his obstinacy, egocentricity, irritability, etc., was by no means common in this group. Except in a third of the patients in whom slowness and dulness appeared to be a common trait, no uniform types were discerned. Classifying 107 cases into personality "types" before the onset of convulsions, sixty-four, a majority, were in normal groups. Moreover, in a mixed group of soldiers, the epileptic men could not be differentiated from the rest by their personality characteristics.

The bibliography is good.

DIE ZERGLIEDERUNG DES PSYCHISCHEN KRANKHEITSBILDES BEI ARTERIOSKLEROSIS-CEREBRI. By S. J. R. de Monchy. Beihefte zur Monatsschrift für Psychiatrie und Neurologie. No. 17. Pp. 84. Paper. Price, 30 marks. Berlin: S. Karger, 1922.

This is a statistical study of mental reaction-types observed in sixty-two clear-cut cases received at the neuropsychiatric clinic in Amsterdam between 1910 and 1920. Condensed histories of the patients are given at the end of the book, and it is noteworthy that, in many, direct mental examination was not possible, so that the analysis is often based on accounts given by relatives. The material includes three classes of cases: cerebral arteriosclerosis, thrombosis and hemorrhage. In the statistical work, when doubt existed as to the proper classification of a case in the following scheme, the author has followed the practice of assigning one half to one group and one half to the other. Two main groups are formed: (1) six and one half without psychic symptoms, and (2) fifty-five and one half with psychic symptoms. The second

group is then divided according to the type of mental picture into (*a*) cases showing exclusively signs of brain damage (irritable weakness, dementia, delirium, etc.); (*b*) depression; (*c*) manic features; (*d*) psychopathic traits; (*e*) paranoid trends. With each group and type contingent correlations have then been determined by use of the formula of Stern: (1) between the particular type of picture and the individual and familial "Anlage" of like kind; (2) between auditory or visual hallucinations and alcoholism, defective hearing or vision, and psychopathic "Anlage"; (3) between precordial anxiety and the existence of cardiac disease or aneurysm of the ascending aorta, and (4) between the occurrence of epileptiform seizures and a specific epileptic tare in the make-up.

The value of the statistical findings is somewhat diminished by the small number of cases in many of the groups, but the work has evidently been done with care. The results support the view that the form of psychosis bears close correlation with the personality of the one affected by the disease. It is perhaps a little surprising to find no mention of schizophrenic pictures, since the figures show no correlation between the diseases grouped as arteriosclerosis and particular types of personal make-up.

The introductory chapters offer interesting discussions of the variety of factors, endogenous and exogenous, which must be considered, and the importance of which can only be evaluated by statistical methods. The precise definitions of the mode of action, pathogenic, pathoplastic, predisposing or precipitating, of various etiologic moments, are especially good, and will do much to help in the standardization of investigations of this kind.

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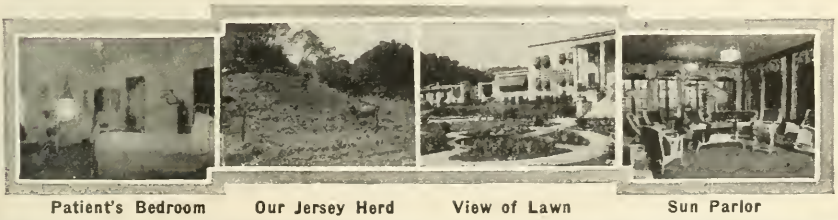

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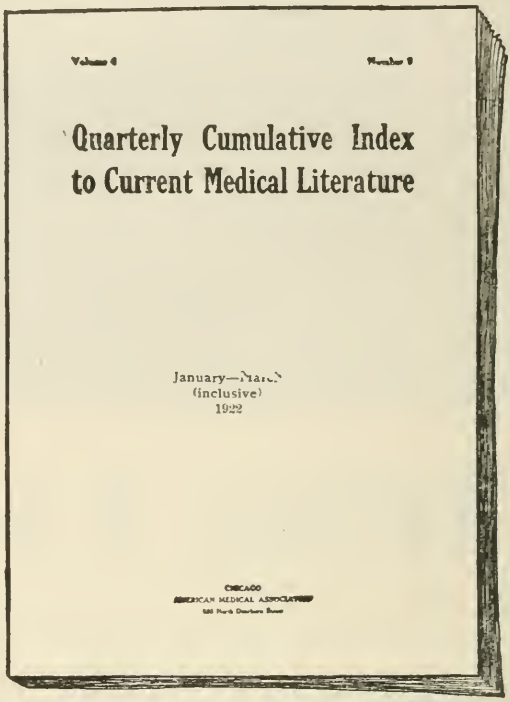

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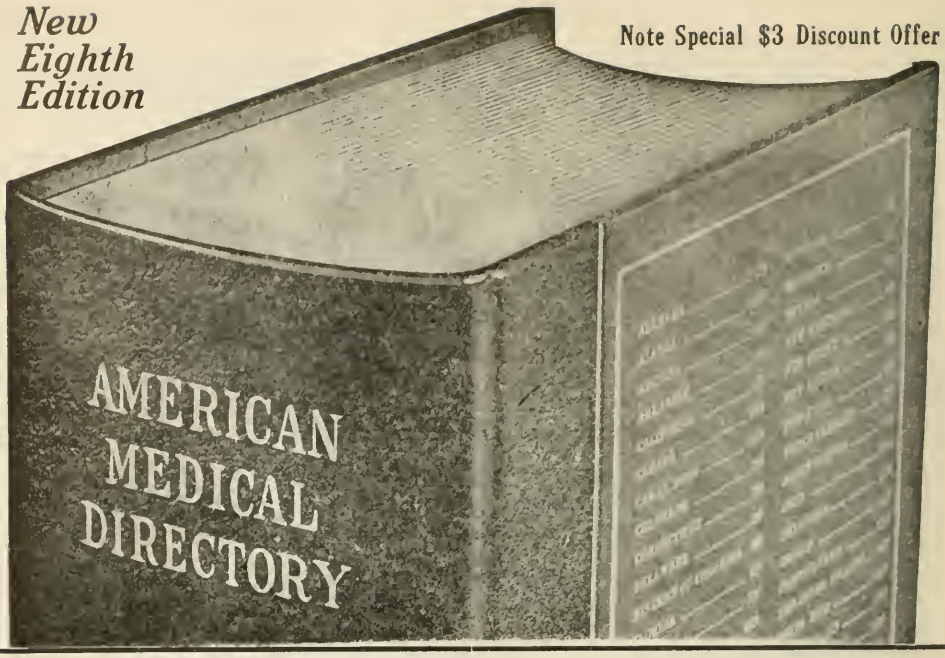

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