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CHRONIC EPIDEMIC ENCEPHALITIS

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

WALTER F. SCHALLER, M.D., AND JEAN OLIVER, M.D.

SAN FRANCISCO

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

* From the Leland Stanford Junior School of Medicine.

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, ameboid 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 subthalamie 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 Economo² 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 Globus³ 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 McKinley⁴ and of Burrows.⁵

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