dimensions. At 37 C. the cultures die out in from three or four to eight days and little or no increase in the size of the embryos can be seen. It may be noted here that the adult worms, both male and female, will live from three to five days in sterile defibrinated dog's blood at 37 C., but, even if fecund females, or both males and females, are included in the same tube no increase in the number of embryos in the medium can be noted. Dog's blood containing embryos, if added to dog-serum, to human serum or to guinea-pig serum, shows little increase in the size of the contained parasites either at room temperature or at 37 C.

Other mediums, such as hemoglobin agar, bouillon, citrated dog and human blood, were less successful than defibrinated blood.

Our best results were obtained with dextrose dog-serum at low temperatures. The cultures were prepared by adding 0.1 c.c. of filarinated dog's blood to 1 c.c. of dog-serum which contained 0.01 per cent. of dextrose. These were placed in the ice-chest at 12 C. Such cultures live from twelve days to two weeks and the parasites become from 2 to 2½ times as long as when planted. The addition of fresh serum after removal of the old (on the eighth day) seemed to aid the growth and vitality somewhat, as such cultures have remained alive over two weeks and the embryos have increased to 2½ times their original length.

It is rather curious that, after the low temperature, the next best temperature for producing growth of the parasites is as high as 40 C. At this temperature, in the medium last mentioned, an increase of growth to 1¾ times the original length of the embryos is seen after eight or nine days.

Cultures which are contaminated with bacteria in many instances give quite as good results as those which are sterile, especially at low temperatures. When incubated at high temperatures such cultures become rapidly overgrown with bacteria and the embryos die, while at low temperatures (12 C.) and even at room temperature (28 C.) they seem to thrive in the presence of certain bacteria. Possibly the low temperature, by allowing the presence of certain bacteria and their products while preventing the excessive development of such organisms, approximates in a degree the conditions found in the mosquito's stomach.

It is probable that we have by the above methods nurtured the microfilariae to a point which corresponds with the limit of their development in the digestive tract of the mosquito, and that a modification or change of the medium in order to approximate their surroundings in the malpighian tubules of the same insect (wherein their subsequent development occurs) will be necessary to carry the parasites to sufficient maturity to make possible the infection of animals from cultures. Further research along these lines is in progress and will be published later.

We wish to acknowledge the help of Mr. Percy L. Quereus, student assistant in the Laboratories of Tropical Medicine, in the routine work of planting and examining the series of cultures studied in the course of the work.

Tongue Sign of Cancer of the Esophagus.—Guarnaccia calls attention in the *Archives Int. de Laryngologie*, 1912, xxxix, 88, to the information to be derived from progressive retrofixation of the tongue with cancer of the esophagus. He has never encountered this sign in other affections in the region but has found it constant even with incipient cancer of the upper third of the esophagus. The patient cannot put out his tongue except with difficulty and pain, and it is almost impossible to draw out the tongue.

SURGERY OF INTRAMEDULLARY AFFECTIONS OF THE SPINAL CORD: ANATOMIC BASIS AND TECHNIC

WITH REPORTS OF CASES *

CHARLES A. ELSBERG, M.D.
Surgeon to the Neurological Institute
NEW YORK

In the course of more than sixty spinal operations I have had occasion to observe a number of lesions within the substance of the cord which seemed amenable to surgical treatment. This led me to investigate the subject in order to determine the frequency of localized intramedullary disease, and the part of the cord into which an incision can be made with a minimum amount of injury to the delicate cord tissue. In addition, I have attempted to develop a special technic for intramedullary spinal surgery, and have made use of this technic in a number of spinal operations in which the cord itself was invaded during the operative manipulations.

The results of my investigations have convinced me that under the proper conditions and with the proper technic it is perfectly feasible and safe to incise the cord substance in order to allow of the extrusion of localized intramedullary growths, to drain cysts in the substance of the cord, etc. I am at present investigating experimentally on animals the subject of intramedullary operations, and hope in the near future to report my experiences and the results of the histologic studies of spinal cords in which incisions at various levels had been made.

Intramedullary tumors are not by any means so rare as ordinarily they are believed to be. Thus Allen Starr,¹ quoting from Schlesinger, states that among 302 tumors of the cord, 125 were within the cord substance. These included sarcoma, tuberculous tumors, gumma, glioma, lipoma, cysticercus, neuroma, cholesteatoma, myxoma, teratoma, adenoma (Benda), endothelioma, etc. Many of these intramedullary growths infiltrate the cord substance and increase in size by extending upward and downward, but some enlarge in their transverse diameter, are encapsulated and of small size. Gowers² says that "these tumors in some cases blend with the substance of the cord, but in other instances they are bounded by an area of softening which often isolates even invading growths. Some tumors are sharply limited." According to Flatau,³ the comparative frequency of extramedullary and intramedullary tumors is as 2.6 to 1 (fifty-seven intramedullary tumors in 213 cases). Although one cannot estimate from the reports the frequency of localized and encapsulated intramedullary tumors, the fact that one frequently finds illustrations and descriptions of such growths in the literature shows that they are not so very rare. Localized tumors have been found at operation by Krause,⁴ Ropke,⁵ von Eiselsberg,⁶ Elsberg and Beer,⁷ and many others. Localized cysts have been found by Krause⁴ and by myself. That localized collections of fluid do occur in syringomyelia and hematomyelia is well known. Foreign bodies (bullets) have been found lodged in the cord substance.

* Read in the Section on Nervous and Mental Diseases of the American Medical Association, at the Sixty-Third Annual Session, held at Atlantic City, June, 1912.

1. Starr, Allen: Text-Book of Nervous Diseases, 1909, p. 442.

2. Gowers: Diseases of the Nervous System, 1899, p. 609.

3. Flatau: Handbuch der Neurologie, II, 640.

4. Krause: Chirurgie des Gehirns und Rückenmarks, II.

5. Ropke: Arch. f. klin. Chir. (Langenbeck's), 1911, xevi, No. 4, p. 903.

6. Von Eiselsberg: Mentioned by Ropke (Footnote 5).

7. Elsberg and Beer: Am. Jour. Med. Sc., November, 1911

These localized intramedullary conditions have rarely been attacked by the surgeon, because the necessary operative manipulations are almost certain to result in extensive and irreparable injury to the cord tissue. For this reason it has been the common practice to consider disease within the substance of the cord entirely hopeless. In the literature, however, are to be found isolated cases in which intramedullary tumors were removed with a satisfactory improvement in the patients' symptoms (Ropke, von Eiselsberg, Ellsberg and Beer); intramedullary cysts and foci of softening have been drained (Krause, Ellsberg); a small well-encapsulated tuberculous focus has been removed (Veraguth and Brun), and the attempt has been made (Abbe, Krause, Ellsberg) to drain a syringomyelitic collection of fluid into the subdural space. The cord has been incised in order to remove a bullet from its substance (W. Braun), and for the purpose of decompression in extensive irremovable intramedullary tumors (Krause, Cushing, Ellsberg). These efforts to attempt the surgical relief of affections within the substance of the cord are isolated efforts, and were not based on regular well-worked-out methods of procedure.

For the proper development of intramedullary surgery, the neurologic surgeon must understand the structure of the cord in its finest detail. He must master the delicate technic of the making of an incision and must have at his command a method or methods by means of which the intramedullary manipulations shall be accomplished with a minimum amount of injury to the delicate and important structures of the spinal cord. In this connection I shall consider the fine anatomy of some of the conducting tracts of the spinal cord, the course of fibers in the posterior columns and the regions where an incision into the cord will cause a minimum amount of injury to fibers of the posterior roots.

ANATOMY OF THE CORD

Not only from their anatomic position and their physiologic character, but also from the ease with which they may be exposed, the posterior columns are the most favorable for an incision. The fibers in the posterior columns convey principally deep muscle and tactile sensations to higher levels, although the fibers for all varieties of sensation enter the cord in the posterior spinal roots. Our knowledge of the conducting paths for the various sensations is still incomplete; the following is a summary of all that is known:

The fibers for the sensation of pain enter the cord in the posterior roots, and soon pass through the posterior horn and gray matter to the anterior part of the lateral column on the opposite side. The fibers for thermesthesia take a similar course, but they do not cross to the other side so quickly as the pain fibers, but require from two to five segments for the complete crossing. The fibers for touch pass partly along the same course as the pain fibers and partly up the posterior columns on the same side to the posterior column nuclei at the extreme upper end of the cord. In these columns also lie the paths for deep muscle sense (postural recognition, spacial discrimination, etc.). When one part of the sensory pathway in the cord is interrupted, other tracts may take up the transmission of sensations. Although this is probably true for all kinds of sensation, the tactile sensations especially seem to run in a bilateral path and are not apt to be markedly affected by a purely unilateral lesion.⁸

8. Rothmann believes that sensory fibers for touch exist also in the anterior columns of the cord.

The posterior columns, in short, contain mainly fibers (endogenous and exogenous; primary and secondary paths) which contribute to the transmission of tactile and deep muscle (kinesthetic) sensations, and we must next determine the course of these tracts in the posterior columns.

As is well known, the fibers of the posterior roots from below upward enter the cord and lie at first just mesial to the posterior gray horn. A part of these fibers remain in the posterior column, where they divide into ascending and descending branches. The ascending branches give off numerous collaterals to the gray horns until the level of the next root above is reached. Fibers from this second root then take their position on the mesial side of the posterior horn, crowding the fibers from the preceding (lower) root more toward the median line. It will be seen, therefore, that the fibers finally form a succession of lamellar tracts which in each case lie at first next to the posterior horn and gradually become shifted medianward by those which enter the cord with the higher nerve-roots (Schaefer). This arrangement of tracts in the dorsal columns has been studied in the lower animals by Kahler and many others, while degenerations in the tracts of the cord in man

Fig. 1.—The course of fibers for tactile and deep muscle sense in the posterior columns of the cord (diagrammatic). The fibers form a series of lamellar tracts, the fibers from the lowest posterior roots lying nearest the posterior median septum of the spinal cord.

have been described in detail by Schaefer, Ziehen, Collier and Buzzard, Wichmann, Schultze, Petren and others.

As a result of this arrangement of conducting-paths in the posterior columns, the fibers from the sacral posterior roots soon come to lie nearest the posterior median fissure; outside of these run the lumbar roots, outside of these the dorsal, and so on (Fig. 1).

In the lumbosacral region the columns of Goll and Burdach are not distinct, and the fibers from the posterior roots occupy a great part of the dorsal column; while in the cervical and dorsal regions the arrangement is such that the posterior median column (Goll) contains only fibers from the sacral, lumbar and lowest dorsal posterior nerve-roots, while the postero-external column of Burdach contains the fibers from the upper dorsal and cervical posterior roots (Fig. 1). Therefore in the lumbosacral region an incision may be made anywhere in the posterior column. It is best made a few millimeters from the median line so that injury may not be done to the descending tracts (triangle of Gombault and Philippe, from the third sacral nerve to the conus) in the sacral region; the oval bundle of

Flechsigs (from the third and fourth lumbar nerves to the third sacral nerve), and the septomarginal bundle of Bruce and Muir (from the first to the third lumbar nerves) in the lumbar region. The incision should not be too near the posterior root zone, lest it damage the marginal fibers. The deeper the incision, the greater the probability of injury to fibers from the higher lumbar roots.

In the dorsal and cervical regions the incision should always be made in the posteromedian column, and the higher the level, the nearer should the incision be to the median line. In the upper and middorsal regions the incision is best made from 2 to 4 mm. from the median line, while from the level of the midcervical region upward it should be made very near the median line, preferably in the posterior median septum. The accompanying diagram (Fig. 2) will show the relations perfectly, and shows (in black) the region at different levels, where an incision can be made in the posterior column so as to injure only a few fibers from the sacral or lumbar posterior roots. It is important also to remember that in the sacral region there is very little white matter, the bulk of the spinal cord being formed

arachnoid should always be incised first and carefully grasped and raised with fine forceps. Then the proper part of the posterior column is selected and an incision less than 0.5 cm. long is made. The incision must be carefully deepened and enlarged, care being taken that it shall be in the axis of the cord. The enlarging and deepening of the incision is best done by means of a blunt instead of a cutting instrument. For this purpose an instrument like a small blunt strabismus hook is useful and by its means fewer fibers are divided and more are separated from each other.

In the case of an intramedullary tumor, the incision can usually be made into the most bulging part of the cord. When the tumor is exposed, no effort should be made to enucleate it, unless it is superficial and of small size. The growth should be left to extrude, to be removed at a later operation, according to the principles laid down by Dr. Beer and myself⁷ in a previous publication. As described in that paper, the method of extrusion is a procedure by means of which the amount of injury done to the cord in the removal of a tumor is reduced to a minimum. Almost the entire process is left to Nature rather than to the manipulation of the surgeon. If at the second operation the tumor is found to be well extruded but still intimately connected with the interior of the cord, it is best not to attempt its removal, for fear of grave injury to the cord itself. In the case of an infiltrating growth, the incision into the cord may be made of considerable length so as to obtain a maximum decompressive effect. In these infiltrating growths, which often increase in size very slowly, the tumor mass itself may sometimes be incised with advantage.

The incision should always be made slowly and should be stopped as soon as distinct bleeding occurs. Sponging should be done with extreme care so as to make the smallest amount of pressure on the cord itself. When a cystic collection of fluid or a small area of softening is opened, no effort should be made to remove the fluid in the cavity by sponging or by pressure. It will be sufficient to lay the cavity open and to remove by means of small cotton sponges the fluid which escapes by itself from the cavity.

Needless to say, the cord should never be grasped with forceps; it can be raised from its bed by means of traction on the dural sac or the pia-arachnoid.

After the removal by the extrusion method of an intramedullary tumor, the attempt may be made to unite the delicate edges of the cut pia-arachnoid by a few extremely fine (single strands of split silk) sutures. No suture should ever pass through the cord tissue itself.

If the anterior surface of the cord has to be exposed, this can usually be satisfactorily accomplished if one posterior root of one side is divided. By means of the cut root the cord can be well lifted up and partly rotated on its own axis so that the anterior column is brought plainly into view. In several spinal operations in which the anterior surface of the cord had to be exposed, I accomplished this satisfactorily by means of division of one posterior root.

EXPOSURE AND RECOGNITION OF INTRAMEDULLARY LESIONS

A complete laminectomy is always necessary when a thorough exploration and examination of the cord is to be made. This means usually that at least three spinous processes and laminae have to be removed, and that the laminae shall be taken away well out to their articulating surfaces. While the operation of hemilaminectomy has

Fig. 2 (after Schultze).—The areas in the posterior column of the human spinal cord in which ascending degeneration occurs after injury to the sacral and lowermost lumbar posterior roots of both sides. Within these areas (shaded in black) an incision, made in the posterior columns, will cause a minimum of injury to nerve fibers and only very few if any symptoms.

of gray matter. In the thoracic region there is a relatively small amount of gray matter, while in the lumbar and cervical enlargements the gray matter, as well as the white columns, are of large size.

In rare instances it might be necessary to incise the cord on its anterior aspect. It is well known that the spinal centers for the various muscles of the body are not situated in single segments of the cord. The cells in the anterior gray horns which supply each single muscle lie in two or more segments of the cord, so that a small incision through the anterior median fissure and into the anterior gray horn should not cause a great amount of motor or sensory disturbance.

TECHNIC OF ASPIRATION AND INCISION OF THE CORD

Aspiration of the cord can be done with entire safety, provided that only the finest aspirating needle is used and care is taken not to injure any of the fine blood-vessels which enter the cord through the posterior median septum from the pia-arachnoid. A very fine scalpel, such as the von Graefe knife used by the ophthalmologist, is the best instrument to use for the incision. The pia-

an undoubted field of usefulness, a wider exposure of the cord is necessary whenever a tumor has to be removed or the cord tissue is to be invaded.

After the dura has been incised, the cord is exposed, and covered by the pia-arachnoid, which may be raised from the cord by cerebrospinal fluid. The pia-arachnoid should not be injured when the dural sac is opened, and should be incised separately.

Sometimes it is difficult to differentiate between a subpial growth closely adherent to the cord and a true intramedullary tumor. While some intramedullary growths break through the posterior surface of the cord and bulge out the pia, the majority cause a fusiform enlargement of the cord, and it is necessary to divide the pia-arachnoid and a thin layer of cord tissue before the tumor is exposed. After the pia has been incised and retracted, the surgeon may think that he is incising cord tissue when in reality he is incising the capsule of the tumor. With increasing experience, one learns to recognize the soft creamy-white character of the cord tissue. If, in addition, one can demonstrate that posterior nerve-roots emerge directly from the tissue through which the incision has been made, mistakes should not occur. In several instances of intramedullary tumor, I was at first in doubt as to whether I was really incising cord tissue, but in most of the cases of intramedullary disease in which I have operated, there was never any doubt that the cord substance was being invaded.

Careful palpation of the cord will often inform the operator that a solid tumor exists in the cord or that the enlargement is due to a collection of fluid. I have gained the impression, also, that retention of fluid both above and below the enlargement of the cord is much more frequent in the cases in which an intramedullary lesion exists.

SYNOPSIS OF CASES

CASE 1.—*Intramedullary gliosarcoma of cervical cord; laminectomy; incision of cord, extrusion of tumor; removal, recovery.* Result: very marked improvement with return of power in all extremities; patient returned to her work.⁹

CASE 2.—*Intramedullary glioma of cervical cord; laminectomy; incision; extrusion; removal.* Result: death in four hours from respiratory paralysis.⁹

CASE 3.—*Intramedullary sarcoma of cervical cord; laminectomy (Dr. Beer); extrusion, removal, recovery.* Result: marked improvement; later: recurrence, operation, removal of tumor mass, no improvement.⁹

CASE 4.—*Infiltrating tumor of upper cervical cord and medulla oblongata; laminectomy, incision of cord, partial extrusion of tumor; death after two days from respiratory paralysis.* Post-mortem examination showed that the tumor extended into the medulla and had grown through the posterior surface into the posterior cranial fossa.¹⁰

CASE 5.—*Hydromyelia; laminectomy, incision of cord draining cord cavity into subdural space.* Result: Improvement. J. H., aged 29, service of Dr. Collins at the New York Neurological Institute. Pain in back and across shoulders since May, 1910, followed by numbness in right arm and hand and increasing weakness in right upper extremity. Increasing weakness and stiffness in right lower extremity.

January, 1912: Power in upper extremities fair—left better than right. Biceps, triceps and wrist-jerks exaggerated on both sides; diminution in all three sensations on right side over distribution of cervical fourth to cervical seventh. Slight sensory disturbances on left side. Abdominal reflexes absent; knee- and ankle-jerks exaggerated, double ankle clonus, right Babinski. Right lower extremity is weaker than left, no sensory loss. X-ray and Wassermann negative. Lumbar puncture: clear yellow fluid with excess of globulin. After

lumbar puncture, complete palsy of left lower and marked weakness of right lower extremity with absent knee- and ankle-jerks.

January 26: Laminectomy (Dr. Elsberg); removal of spinous processes and laminae of third, fourth, fifth and sixth cervical vertebrae; dura does not pulsate; dural sac much enlarged; dura pia and cord bound together by fine adhesions. Cord covered by network of congested vessels. Cord much enlarged and soft; aspiration in median line withdraws clear, yellow fluid. Suture of muscles and skin, dry dressing.

February 12: Wound reopened; 4 cm. incision in posterior median septum; much yellow fluid evacuated; probe passed carefully downward in cord cavity for 6 inches. Edges of incision in cord gape widely. Suture of dura, muscles and skin in usual manner. Wound healed by primary union; at first exaggeration of all symptoms, then gradual return of power in lower extremities and in upper extremities, diminution in sensory disturbances.

May 7: The patient had been slowly improving; power in the lower extremities was good; knee- and ankle-jerks were lively and there was no ankle-clonus; power in the upper limbs was distinctly better; the patient could walk with a little assistance, and had some control of the bladder.

Result: Slow but marked improvement.

CASE 6.—*Intramedullary tumor of cervical cord, laminectomy; incision of cord to allow of extrusion of tumor; improvement.* W. P. Y., aged 30, service of Dr. Collins at the Neurological Institute. Two years' history of pain in back of neck followed by weakness of right and then of left upper extremity; increasing weakness of lower extremities.

April 28: Upper extremities very weak, right more than left; power in hands almost nil; tactile sensation much diminished over area of right cervical third to cervical seventh, slightly over cervical eighth to dorsal second; marked hypalgesia over same areas; complete thermanesthesia over same areas. Indefinite sensory disturbance over left upper extremity. Abdominal reflexes absent; both lower extremities very weak—right more than left. Knee-jerks and ankle-jerks exaggerated, right more than left; double ankle-clonus, double Babinski. No sensory disturbances, but patient says that right lower limb feels numb. No loss of deep muscle sense. X-ray and Wassermann negative. Rapid advance of symptoms under observation.

April 29: Laminectomy (Dr. Elsberg); removal of spinous processes and laminae of fourth, fifth, sixth and seventh cervical vertebrae; dura does not pulsate. Incision of dura; no escape of fluid; cord much enlarged between cervical fourth and cervical seventh; at level of cervical sixth a transverse groove or depression extending all around cord; cord feels very soft; aspiration of cord negative. Exposed surface of cord of a reddish color; origin of left posterior roots surrounded by network of vessels; probe passed upward and downward within dural sac without meeting an obstruction. One centimeter incision of cord just to right of origin of posterior roots; incision deepened with blunt hook; at depth of several millimeters, yellow tumor; through intramedullary pressure incision in cord slowly spreads and lengthens with beginning extrusion of intramedullary tumor; marked bulging of tumor. Sutures of muscles and skin; removal of growth delayed to a second stage.

May 7: Wound healed by primary union; general condition excellent. Up to present, condition in lower extremities about the same as before operation; upper extremities somewhat weaker, but there is a decided improvement in touch and pain sense in right upper extremity.

CASE 7.—*Syringomyelia; gliosis cervicalis; laminectomy, incision of cord for decompressive purposes; recovery; marked improvement in power of upper extremities.* Louis P., aged 28, service of Dr. Bailey at Neurological Institute. Preoperative diagnosis: intramedullary tumor or syringomyelia. Marked weakness in upper extremities, almost complete loss of power in lower limbs. No loss of bladder control. Very marked loss of sensations of pain and temperature up to level of dorsal first area of distribution on both sides, most marked on right side. Very slight hypesthesia over same area.

9. Reported in *Am. Jour. Med. Sc.*, November, 1911.

10. Reported in *Ann. Surg.*, February, 1912.

Jan. 5, 1912: Laminectomy (Dr. Elsberg); removal of spines and laminae of seventh cervical, first and second dorsal vertebrae, and incision of dura. Escape of moderate amount of cerebrospinal fluid; exposed part of cord considerably enlarged and of abnormally firm consistency. Incision 1 cm. long just to left of posterior median septum; cord substance bulged markedly through incision and was of a yellowish color, but no distinct tumor tissue to be seen. Condition evidently one of gliosis. Suture of dura, muscles, fascia, skin.

Uneventful recovery from operation. Flexion at knees somewhat improved; sensation in lower limbs much better.

May, 1912: Power in upper extremities greatly improved.

Result: Some improvement.

CASE 8.—*Diffuse meningomyelitis with intramedullary cyst; laminectomy; incision of cord, drainage of intramedullary cyst; no improvement. Death three months later from exhaustion; autopsy showed extensive lesions throughout dorsal and lumbar cord.* A. R., aged 37, service of Dr. Abrahamson at the Montefiore Home for Chronic Invalids. Five years' history of numbness of both hands, weakness in both legs, severe pains in upper extremities; symptoms steadily progressive. Old syphilitic infection. Wassermann positive; some improvement after injection of salvarsan and mixed treatment. Before operation, paralysis of both lower extremities, knee- and ankle-clonus, Babinski, Oppenheim. Tactile sensation diminished from level of sixth cervical; pain and temperature diminished from level of first dorsal.

Jan. 8, 1912: Laminectomy (Dr. Elsberg); removal of sixth and seventh cervical, first and second dorsal spines and laminae; incision of dura, escape of small amount of fluid encapsulated between adhesions. Cord much enlarged over cervical seventh to dorsal first; cord feels fluctuating; incision of cord 2 cm. long opening into cyst cavity containing about 10 c.c. of clear fluid; walls of cavity are smooth and of a canary-yellow color. Numerous adhesions between dura and pia-arachnoid and cord. Diagnosis: meningomyelitis (specific), with cyst formation. Closure of wound in usual manner. Uneventful recovery except for slight wound infection.

Result: No improvement; tubercle bacilli in sputum; gradual emaciation with formation of bedsores; death April 10, three months after operation. Autopsy showed that the entire cord was the seat of extensive disease, numerous cavities in cord, diffuse thickenings of pia-arachnoid.

701 Madison Avenue.

ABSTRACT OF DISCUSSION

DR. PEARCE BAILEY, New York: Intramedullary surgery has been done previously as long ago as 1906, when Horsley in an article in a British journal advocated laminectomy and incision in the cord, such as was experimentally advocated by Allen of Philadelphia. But Dr. Elsberg, as far as I know, is the first to take the matter up systematically and consider its rather discouraging relations with the intramedullary growths and with the question of syringomyelia and hydromyelia. I think one thing that all neurologists ought to do more and more is to insist on special surgeons for these special and delicate operations. The majority of general surgeons are perfectly willing at any time to undertake laminectomy; but the more one sees of the laminectomies done by surgeons not skilled in this particular field and the lack of knowledge which they have of the parts, the more earnest and emphatic neurologists should be in insisting that experienced neurologic surgeons should do all the operations.

DR. CHARLES A. ELSBERG, New York: I think the amount of work the surgeon does within the cord should be reduced to the minimum; if it be a cyst to be opened or a tumor to be exposed, make the superficial incision with a sharp instrument, such as a small von Graefe knife, and deepen the incision by a blunt instrument. The surgeon cannot be as careful as is necessary, therefore he ought to do as little as possible under the circumstances and allow Nature to do her share.

The posterior route incision is very interesting to me, and very valuable, because it was the first region in which I attempted, in my anatomic studies, to make the incision. I found that that region very often is way around at the side,

where one has to manipulate the cord too much. It means a great deal more manipulation of the cord than would otherwise be necessary, and I think what one would gain in anatomic correctness one would lose in the manipulations and necessary injury to the cord. Every time you touch the cord it means that you may be doing some harm; and if you work on the theory that every time you touch the cord, no matter how gently, you are doing harm, you will be traveling the only safe road in this special surgery.

THE IMMUNIZATION AGAINST TYPHOID OF EIGHT HUNDRED AND NINETY-EIGHT PATIENTS IN AN INSTITUTION

WITH DESCRIPTION OF THE TECHNIC EMPLOYED *

PAUL G. WESTON, M.D.

WARREN, PA.

That typhoid fever is endemic in institutions is generally accepted as a fact. That it is occasionally epidemic is a fact. It is also a fact that the source of infection is usually hard to find and frequently is not found.

The presence of a case of typhoid in this institution caused a general search for the origin of the infection, but it was not found. The case occurred in a building occupied for the most part by aged and demented patients. The routine biweekly examination of water and milk gave negative results, as before.

Inasmuch as the best way of dealing with typhoid epidemics is to prevent their occurrence, it was suggested by the superintendent (Dr. H. W. Mitchell) that all patients not over 50 years of age should be immunized.

The bacterin was made from a culture sent me through the kindness of Major F. F. Russell, U. S. Army. Large surface growths were made on agar, washed off with sterile normal saline solution, killed and standardized so that 1 c.c. contained either one billion or two billion bacilli. One-half c.c. was found to be the most convenient quantity to inject. The suspension was preserved with 0.2 per cent. trikresol.

Before the first inoculation and again ten days after the last one, a drop of blood, approximately 20 cm., was obtained from each patient, on a piece of Lautenslager filter-paper.

In order to inoculate so large a number of insane and more or less resistive patients, it was necessary to devise some rapid and efficient method.

TECHNIC OF INOCULATION

All inoculations were made at night after the patients had retired. Two assistants were required, one of whom went ahead rolling up the sleeves of the patients; the other remained with the physician and carried two wide-mouthed bottles of 30 c.c. capacity, one of which contained the bacterin and the other a piece of cotton saturated with tincture of iodine. The syringes used were Sub Q and Luer of 2 c.c. capacity. The same platino-iridium needle was used for all inoculations. The needle was drawn through the iodine cotton, and the iodine wiped off with cotton saturated with alcohol. The arm was cleansed with alcohol at the insertion of the deltoid muscle.

Thus patients sleeping in dormitories were inoculated at the rate of twenty-seven seconds per man. In the wards, in which the patients were in separate rooms, it required thirty-nine seconds per man. Many of the

* From the Pathologic Laboratory of the State Hospital for the Insane, Warren, Pa.