sion, the dirt, especially on rainy and muddy days, were increasing and the desire for separate quarters for this daily throng was constantly growing more insistent.

Up to the end of 1908 while the house patients totaled 10,936 there had been 180,555 patients cared for in the out-patient clinics. This is a large number, but it covers many years. For the last year, 1915, the number cared for in this clinic was only 150 less than 26,000, largely over 2,000 patients every month! For the seven years from 1909 to 1915 the total number was 156,385. This year, 1916, will bring up the number for the past eight years to more than had been treated in the 42 years after the little hospital was started on Ninth Street in 1867.

When Dr. Mitchell passed away early in 1914 the opportunity came for relieving the hospital itself from this burden and at the same time for founding a worthy and spontaneous memorial in the hospital to which he had given of his best for so many years of his busy life. A large committee, numbering fifty to sixty, consisting of the members of the board, the members of the medical and surgical staff and assistants and many women was formed with Dr. Charles W. Burr as chairman, Mr. Charles Sinkler as secretary, and Mr. John W. Brock as treasurer. Through their abounding efforts even in the depressing financial conditions preceding the Great War the money to erect the memorial was obtained.

Right opposite to the hospital, across Seventeenth Street, stood the parish house of the chapel of the Epiphany Episcopal Church, unused and for sale. The lot measures 80 feet, 9 inches on Seventeenth Street and is 107 feet deep. It was purchased for $40,000. The alterations, furnishings and equipment have cost about $20,000 additional, a total, therefore, of $60,000. It is away from and not physically a part of the hospital, yet is within a few steps; convenient of access yet keeping all noise, dirt and possibility of contagion away from the house patients, whose quiet comfort and speedy recovery are thereby greatly promoted.

Had Dr. Mitchell himself been consulted, no memorial more pleasing to him could have been devised. No stately mausoleum, useless alike to the living and the dead, would have appealed to him. A busy clinic where thousands upon thousands will be helped back to joyous life because it is a useful life—this I am sure he would have thought the most grateful homage from his many friends.

W. W. KEEN

A NOTE ON THE SERUM TREATMENT OF POLIOMYELITIS (INFANTILE PARALYSIS)[1]

THE epidemic of poliomyelitis that is prevailing at the present time so extensively in New York and in some degree widely throughout the United States has led to many inquiries being made regarding the serum treatment of the disease, and particularly of the stage to which the treatment has advanced. This brief paper is intended not only to answer such inquiries, but also to provide a basis for the wider employment of the treatment where the difficult conditions surrounding the obtaining of the immune human serum can be surmounted.

It was demonstrated by Flexner and Lewis,[2] and afterwards confirmed by several investigators, that monkeys which had recovered from an attack of poliomyelitis induced experimentally were not subject to successful reinoculation with the virus of the disease. This was followed by the detection by Römer and Joseph[3] and later by others in the blood of

[1] From The Rockefeller Institute for Medical Research, New York.

[2] Flexner, S., and Lewis, P. A., "Epidemic Poliomyelitis in Monkeys," fourth note, *J. A. M. A.*, 1910, LIV., 45.

[3] Römer, P. H., and Joseph, K., *Münch. med. Woch.*, 1910, LVII., 568. Levaditi and Landsteiner, *Comp. rend. Soc. de biol.*, 1910, LXVIII., 311. Flexner, S., and Lewis, P. A., "Experimental

such resistant or protected monkeys, and then by Levaditi and Netter,[4] and by Flexner and Lewis in the blood of human beings who had recovered from acute poliomyelitis, of immunity substances which possessed the power of neutralizing the virus of poliomyelitis when the serum and the virus were brought together in the test tube. Flexner and Lewis ascertained, also, that the serum of monkeys actively immunized[5] with the virus under conditions in which all symptoms of the disease were avoided, contained similar immunity bodies.

EXPERIMENTAL SERUM THERAPY

The next step taken was the determination by Flexner and Lewis that both the immune monkey[6] and the immune human serum[7] which exhibited the neutralizing power for the virus possessed also therapeutic properties for monkeys inoculated with the potent virus of poliomyelitis in contradistinction to the normal serum from the same animal sources which was devoid of those properties.

The experimental demonstration of the therapeutic activity of the immune sera was made in the following manner. Rhesus monkeys were inoculated (*a*) intracerebrally and (*b*) intranasally with a virus which had become adapted to the monkey and was highly potent. The effective intracerebral dose of a Berkefeld filtrate of a 5 per cent. emulsion of the spinal cord of an infected monkey was less than 0.01 c.c. Hence the quantity of the filtrate injected into the brain of the etherized monkeys varied from 0.01 to 0.1 c.c. The inoculations were made in the afternoon and the therapeutic treatment was begun the next day, or from eighteen to twenty-four hours later. When the virus was introduced by the nasal route the filtrate was not employed, but an emulsion of the spinal cord was rubbed upon the upper nasal mucosa.

The immune sera were applied by intraspinal or subdural injection. The usual method was to inject from 2 c.c. to 3 c.c. of the immune sera through the lumbar puncture needle daily for several days or daily for three injections followed by an interval of three days when the three injections were repeated. The conclusions reached from these experiments were in substance that if the quantity of virus is not in excess of a given dose, the infection can be either wholly prevented or the onset of the paralysis much delayed. In other words when dealing with the virus adapted to the monkey which induces poliomyelitis almost without exception and in which the symptoms are far more severe and the mortality far greater than occur in the disease in human beings, the immune monkey and human sera are capable of preventing in all but a few instances the development of the virus even when inoculated intracerebrally, and in the exceptional instances in which the development is not wholly prevented, the onset of the disease is much delayed. The power, therefore, to neutralize the virus possessed by the immune sera is exercised *in vivo* under severe experimental conditions almost as constantly as *in vitro* under relatively favorable ones.

In order that maximal effect of the immune sera may be secured it is necessary that the injections be made into the subdural space which can be readily and safely accomplished by means of lumbar puncture. The reason for this mode of application of the serum depends upon the facts that it is the most direct route to the central nervous tissues and, however the virus is introduced into the body, it establishes itself in the cerebrospinal meninges.[8]

Poliomyelitis in Monkeys,'' seventh note, *J. A. M. A.*, 1910, LIV., 1780.

[4] Levaditi and Netter, A., *Presse med.*, 1910, XVIII., 268. Flexner, S., and Lewis, P. A., seventh note, *loc. cit.*

[5] Flexner, S., and Lewis, P. A., ''Experimental Poliomyelitis in Monkeys,'' eighth note, *J. A. M. A.*, 1910, LV., 662.

[6] Flexner, S., and Lewis, P. A., seventh note, *loc. cit.*

[7] Flexner, S., and Lewis, P. A., eighth note, *loc. cit.*

[8] Flexner, S., and Lewis, P. A., seventh note, *loc. cit.* Flexner, S., ''The Contribution of Experimental to Human Poliomyelitis,'' *J. A. M. A.*, 1910, LV., 1105. Flexner, S., and Amos, H. L., ''Penetration of the Virus of Poliomyelitis from the Blood into the Cerebrospinal Fluid,'' *Jour. Exper. Med.*, 1914, XIX., 411.

It is logical, therefore, to endeavor to bring the immune serum in as high a concentration as possible into immediate relation with the seat of disease.

The power of the immune serum, when injected subdurally, to prevent the development of experimentally induced poliomyelitis in the monkey, is further indicated by experiments[9] in which, on the one hand, the virus has been injected into the blood under conditions insuring its escape into the meninges and, on the other, when an emulsion of the virus has been introduced directly into the meninges and followed later by the serum injection.

SERUM THERAPY IN MAN

This aspect of the subject has been imperfectly developed up to the present time. Netter[10] was the first to apply the data obtained by experiments on monkeys to the treatment of cases of epidemic poliomyelitis in man. He has published the results obtained in a series of thirty-five cases which he regarded as highly favorable to the method. He employed the serum from cases of poliomyelitis in which complete recovery from the acute condition has taken place some time and even as long as thirty years previously. The serum injections were given subdurally as early after the appearance and recognition of the symptoms of poliomyelitis as possible. The dose of the serum, which must, of course, be sterile but need not be inactivated, should be determined by the age of the patient and will, in part, be determined by the quantity of serum available. Probably doses ranging from five to twenty cubic centimeters will be found suitable, the injection to be repeated once or more times at twenty-four hour intervals according to clinical conditions and indications. The effects of the immune serum should be sought in the checking of the progress of the disease, namely the prevention or minimization of the paralysis when employed in the preparalytic stages, and the arrest of its extension when used in progressing paralytic conditions. Since the immunity substances have been determined by neutralization tests to persist in the blood for many years, it is probable as Netter has indicated that persons who have passed through an attack of poliomyelitis several years earlier may be utilized as sources of the serum; while reasoning from analogy it would probably be advantageous to prefer persons whose attack was less remote so as to insure as high concentration of the immunity bodies as possible. The conditions surrounding the injection of the serum are identical with those observed in the analogous case of epidemic meningitis. Before each dose of serum is injected a suitable quantity of cerebro-spinal fluid is to be withdrawn, and the injection should be made slowly. In choosing the person who is to serve as the source of the blood from which the immune serum is to be derived precaution should of course be taken to secure a healthy donor; it would be advisable to fortify the usual clinical examination by a Wassermann test.

SIMON FLEXNER

[9] Flexner, S., and Amos, H. L., "Localization of the Virus and Pathogenesis of Epidemic Poliomyelitis," *Jour. Exper. Med.*, 1914, XX., 249.

[10] Netter, A., "Serotherapie de la poliomyelite nos resultants chez trentedeux malades," Indications technique—incidents possibles, *Bull. de l'Acad. de Med.*, Oct. 12, 1915. Netter, A., and Salanier, M., "Deux nouveaux cas de poliomyelite a debut meninge gueris par les injections intrarachidiennes de serum d' anciens malades," *Bull. Mem. Soc. Med. des Hop. de Paris*, Mar. 10, 1916.

THE CULTURE VALUE OF SCIENCE[1]

WISHING not to squander any of the few minutes allowed me in this program, I have written down what I have to say, and hope you will pardon me if by reading I seem unduly formal for the occasion.

The Scripps Institution for Biological Research believes it has a mission over and above what is indicated by its name. As "nominated in the bond," its function is to produce new knowledge in the realms of nature with

[1] Remarks to the teachers of science in the secondary schools of southern California on the occasion of their visit to La Jolla and the Scripps Institution for Biological Research of the University of California during the teachers' institute week in November, 1915.