POLIOMYELITIS
(Infantile Paralysis)

THE essential nature of infantile paralysis has been determined within the twenty-year period during which the disease, escaping from its endemic home in Norway and Sweden, has made its epidemic progress over the world. Only the tropics, and even they not wholly, have been spared its ravages.

It is probably just because infantile paralysis had never before prevailed in a world-wide epidemic that we are witnessing the periodical outbreaks which are so tragic in their consequences. On the whole, the outbreaks have been larger and more severe in North America than elsewhere and for reasons, as will appear, which are bound up with the nature of the disease.

Infantile paralysis is a disease long known to physicians, although its infectious and communicable nature was established only about forty years ago during an epidemic in Stockholm. Hence it is known to be a disease of microbic origin. The microbe or microorganism which induces infantile paralysis is so minute that it is not certain that it has ever been seen under the microscope. Because of its minuteness, it can pass through filters of earthenware which hold back, and prevent from passing, ordinary microorganisms, such as the bacteria.

The microbe of infantile paralysis differs in another way from the usual bacteria. While bacteria are easily made to grow outside the body, the microbe can be made to multiply in this way only under special conditions. These conditions are provided by growing and multiplying tissue cells taken from warm-blooded animals and propagated in tissue cultures. When the invisible microbe of infantile paralysis is cultivated with tissue cells, both increase together, the microbe probably within the cells.

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There are many other kinds of invisible microbes which produce diseases of plants and the lower and higher animals. The microbe of infantile paralysis belongs to this class of ultraminute living bodies. All these ultramicroscopic disease-producing microbes share the peculiarity that in order to be made to multiply outside the animal or plant which they attack as parasites, and in which they cause disease, they must be cultivated with living and growing tissue cells.

Certain pathologists have expressed skepticism about the microbe of infantile paralysis because of its invisibility and the difficulty of making it increase outside the body. This would be equivalent, let us say, to denying the existence of atoms because they also are beyond visibility and can not be made to increase at all by any means known to us at present. Now, physicists and chemists are not doubtful about the atom because of certain known properties concerning it. These properties enable physicists and chemists to experiment with the atom and to learn a vast number of things concerning its nature through the experiments. They are in no essential way hindered from acquiring this knowledge because of the minute size of the atom. In a very similar way pathologists have dealt and are dealing successfully with the invisible microbes of disease and prominently among them the microbe of infantile paralysis. A vast amount of new knowledge of infantile paralysis has been obtained by experiment since the microbe was discovered in 1910 simultaneously at the Rockefeller Institute in New York and the Pasteur Institute in Paris.

The control of any communicable disease is greatly promoted by the discovery of the mode of infection or the way in which the microbe enters and leaves the affected body. The epidemic in Stockholm and its environs in 1905 led to the recognition that infantile paralysis was passed from person to person. But just how this passage took

place could be conjectured but not definitely determined at the time.

With the discovery by Dr. Landsteiner in 1909 of the communicability of infantile paralysis to monkeys the way was suddenly opened to the detection of this essential fact and many other important facts regarding the disease which have since been brought to light. The first step forward consisted in the discovery at the Rockefeller Institute that the microbe of infantile paralysis escapes from the body in the secretions of the nose and throat. It is not as widely appreciated as it should be that a way for the disease-producing microbe to escape alive and undamaged from the body is just as essential for the spread of the disease as a way of effectively entering a healthy individual in whom disease is to be produced. Hence the detection of the manner and place of exit of the microbe may afford the clue as to its means of entrance. And this is actually what happened in the instance of poliomyelitis. Finding that the microbe escapes by way of the nose and throat led almost immediately to the discovery that it was able also to enter the healthy monkey and induce paralysis through these organs. This knowledge led in its turn to the detection of the microbe in the secretions of the nose and mouth of children suffering from infantile paralysis and also in these secretions of persons—parents especially—who have been in intimate contact with the sick children.

At the present time it is the firm belief of most pathologists that the microbe of infantile paralysis is carried from person to person, from the infected to the uninfected, through the secretions of the nose and throat. The public health measures designed to reduce the spread of the disease are based on this belief. All this does not mean that there may not be still other ways of communicating the disease yet to be discovered. It is known, for instance, that the microbe of infantile paralysis can be spread by milk. Two small, isolated outbreaks of the milk-borne disease have been detected in New York State within a few years. These epidemics differ from the usual ones in their restricted extent and almost explosive character. The cases tend all to arise in rapid succession, after which there is complete or nearly complete cessation. A few days or a week or two witness the entire progress of these outbreaks.

One attack of infantile paralysis, no matter how slight, usually affords protection for life. Associated with this state of immunity, and responsible in part, if not wholly, for it, is the presence in the blood of a substance which, when inoculated into monkeys, is capable of preventing the microbe from producing the disease. The serum of the blood, or its fluid portion separated from the corpuscles, is equally effective, and it is capable, not only of rendering the microbe inactive when the two are mixed in advance, but, also, as was discovered at the Rockefeller Institute in 1910, of preventing the onset of paralysis in monkeys when the microbe is first introduced and the serum from recovered human beings or monkeys is injected 24 to 48 hours later.

This observation is the experimental foundation for the convalescent serum treatment of infantile paralysis which, first applied in man by Professor Netter of Paris in 1911, has now come to be widely employed. The extent to which the serum treatment is effective has still to be determined with accuracy. It is now known not to be of value when paralysis has already occurred. On the other hand, it is believed that the earlier the serum is administered after symptoms appear the better the results obtained.

Not only are the protective and curative properties present in the blood of persons who have recovered from obvious attacks of infantile paralysis; they are present also, in some amount, in the blood of many adult persons who have never suffered from the disease. This is not peculiar only to in-

fantile paralysis. Many affections of microbic origin exist in two forms: one in which disease is frankly present; the other in which individuals exposed to the microbe harbor it for a time during which no symptoms of disease occur, but immunity to the microbe is secured. This is true of such common microbic diseases as diphtheria and scarlet fever, which may be cited as examples of a larger class. That the blood serum of normal adults renders the microbe of infantile paralysis inactive was noted by Anderson and Frost, of the U. S. Public Health Service, in 1911. Subsequent studies on a larger scale, carried out by the Harvard Poliomyelitis Commission under Dr. Aycock, have shown that this sort of unperceived immunization is taking place widely today in the United States. It is to this protective process, perhaps, that we have to look finally for the eradication of poliomyelitis from this country. It is probable that the reason northern America has suffered disproportionately from the disease in the past 20 years is that the general population, not having been exposed over a term of years as have many of the European populations, lacks the immunity conferred by the unperceived carriage just described of the microbe of infantile paralysis.

We gain a strengthened impression of this kind of protective mechanism at work in the dark by studying the age frequency of the disease and comparing the frequency with the ages at which the blood protection is demonstrable. In childhood, up to the tenth year, there is little protection discernible; this is the period of greatest frequency of the disease. From ten years on the protection rises and the frequency of the disease diminishes. In adults the protection reaches maximum and the cases minimum figures. The proportion of protected adults increases with the opportunity for exposure to the microbe; hence it is higher in urban than in rural communities. The ages of the children who are now suffering most in the New York epidemic conform to this rule. Indeed, with minor exceptions, the victims of the present epidemic have been born since 1916; far more children under rather than over ten years of age have been stricken.

The employment of convalescent serum for the treatment of early cases of infantile paralysis was begun in 1911. In 1916 Zingher, of the Department of Health of New York City, employed the serum of normal adults for treatment. The logic of this procedure is apparent from what has been stated concerning the antimicrobic powers of the blood of many adults. Probably the concentration of the curative substances is greater in convalescent serum, but this need not always be the case. In the absence of supplies of convalescent serum, normal adult serum may be employed for treatment. It is advisable to combine the serum of a number of individuals, rather than to rely on that of a single person, in order to increase the probability of administering an effective dose.

The convalescent serum has been shown experimentally not only to exert curative (therapeutic) properties but to possess preventive powers as well. Definite observations on this point, having as object a possible application to protective serum injection, were made at the Rockefeller Institute in 1928. At this time attention was directed to the employment of convalescent serum for prevention in an emergency. Fortunately, the case frequency of infantile paralysis is not high, so that resort to this measure will not often become necessary. Moreover, so far as convalescent serum is concerned, in an emergency the available supplies will be required for the treatment of declared cases. On the other hand, abundant supplies of normal adult blood are always procurable. In view of the high proportion of adult city dwellers who are immune, the blood serum of parents or other suitable persons can readily be administered to younger children who are exposed to infection. No assurance of abso-

lute protection can, of course, be given, but, by analogy with measles, benefit may be hoped for or even expected. Time and experience alone will make it possible to ascertain the value of this procedure.

The obvious effect of an attack of infantile paralysis is paralysis of the muscles. The microbe does not act on the muscles directly but indirectly through nerve cells presiding over the muscular movements and located in the spinal cord chiefly. These cells are acted on directly by the microbe and injured; sometimes the injury is so severe that the cells are destroyed outright; sometimes the injury is severe enough to interrupt function for a time only. In the one case the muscular paralysis is permanent; in the other restoration of function occurs. The microbe acts also on the cells and tissues about the nerve cells; the disturbance thus produced affects indirectly the function of the nerve cells. When these indirect effects disappear, with recovery from the disease, renewal of function of the nerve cells and muscles takes place. Time is often required for the complete reversal of the general cell, and tissue disturbances during which restoration of muscular power slowly returns. There is a great diversity in the extent and location of the injurious effects of the microbe, and there is very great variation in the intensity of the action exerted so that muscular paralysis, when present, may be slight or extensive, fleeting or permanent. The extent of the paralysis at the beginning of the attack is no accurate measure of its endurance. Recovery from paralysis on a wide scale is not only possible but often takes place.

Recapitulation

The microbe of infantile paralysis is known to belong to the class of invisible, filter-passing microorganisms to which the name of viruses is applied.

This virus has been found in the secretions of the nose and throat of persons ill of infantile paralysis and of well persons in intimate contact with the sick.

When the virus is applied to the nose and throat of monkeys it passes along the connecting nerve fibers to the brain and spinal cord and induces paralysis similar to that occurring in the human disease.

That communication of the disease from person to person is brought about by personal contact and the transfer of the secretions of the nose and throat of the sick to the well has been established by observation of human epidemics and by experiments on monkeys. Whether or not any other common manner of communication of the disease to man exists is not known. Present public health measures of control of infantile paralysis are based on this mode of personal infection.

An attack of infantile paralysis is protective for life, irrespective of the intensity of the attack.

Persons who have had infantile paralysis possess in their blood certain protective or healing substances which can be used effectively to treat persons sick of the disease, and perhaps to prevent the disease in other and exposed children. It is the fluid portion of the blood that is employed in this way under the name of convalescent serum.

Since many normal adults develop immunity to infantile paralysis as a result of exposure to the virus under circumstances not leading to obvious disease, their blood serum also carries, at times, the protective and healing substances. The serum of these adult persons, which is abundantly available, may sometimes be substituted for the serum of convalescents, which is necessarily limited in quantity.

There are strong reasons for believing that a gradual immunization of the population of the United States is taking place as a result of the epidemics of infantile paralysis which have prevailed in different parts of the country since the large Swedish-Norwegian outbreak of 1905.

The virus of infantile paralysis acts upon the nervous system and especially upon the nerve cells of the spinal cord which control

muscular movements. The muscles themselves are not directly affected. Since the virus injures the nerve cells and adjacent tissues with varying degrees of intensity, the effects on the muscles range from very slight to severe paralysis. Even when the paralysis is severe, restoration of motion takes place in part or even wholly as the injurious consequences of the disease subside.

Although the name—infantile paralysis—carries the implication of actual loss of motion by muscles, yet many cases of the disease never show paralysis at all. Indeed, there are reasons for believing that the cases of the non-paralytic disease exceed greatly in number those in which actual paralysis occurs.

Infantile paralysis is mainly but not wholly a disease of childhood. Adults are affected but infrequently. Now that we have learned that young children have rarely and older children and adults have often become immunized through unperceived or subclinical effects of exposure, we can better understand the peculiarities of age and place susceptibilities.

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RADIO AND EDUCATION

FROM the Biennial Survey of Education in the United States (1928-1930) published by the U. S. Office of Education, it appears that the number of broadcasting stations owned and operated by schools, colleges, and universities, states, municipalities, or their agencies, has decreased during the past five years. In 1926 there were 105 such stations; in 1927, 104; in 1928, 98; in 1929, 78; and in 1930, 65. The remaining stations of this kind are the only ones whose programs are not subject to commercial censorship.

Printed programs from these stations on file in the Office of Education show that they are broadcasting material of educational value and of interest to radio listeners who seek education rather than amusement.

These are the stations which the National Committee on Education by Radio is attempting to protect against commercial efforts to secure these channels. It is obvious that unless the states and institutions owning and operating these stations succeed in maintaining and developing their work the radio channels allocated to them will pass into the hands of the commercial broadcasters.

The educational stations shown in the list of the Federal Radio Commission issued February 2, 1931, follow. It will be noted that Emory and Henry College operates the only educational station in Virginia. The list:

WAPI—Birmingham, Ala.—Alabama Polytechnic Institute, University of Alabama, and Alabama College.
WBAA—West Lafayette, Ind.—Purdue University.
WBAK—Harrisburg, Pa.—Pennsylvania State Police, Commonwealth of Pennsylvania.
WCAC—Storrs, Conn.—Connecticut Agricultural College.
WCAD—Canton, N. Y.—St. Lawrence University.
WCAJ—Lincoln, Neb.—Nebraska Wesleyan University.
WCAL—Northfield, Minn.—St. Olaf College.
WCAM—Camden, N. J.—City of Camden.
WCAT—Rapid City, S. D.—South Dakota State School of Mines.
WCAX—Burlington, Vt.—University of Vermont.
WCOA—Pensacola, Fla.—City of Pensacola, Fla.
WEAI—Ithaca, N. Y.—Cornell University.
WEAO—Columbus, Ohio—Ohio State University.
WEHC—Emory, Va.—Emory and Henry College.
WEW—St. Louis, Mo.—St. Louis University.
WGST—Atlanta, Ga.—Georgia School of Technology.
WHA—Madison, Wis.—University of Wisconsin.