

sisted until his discharge on December 18, 1959. Since that time he has been retarded in his mental development, being classified in the imbecile-idiot range. He is unable to stand or walk or talk, is incapable of toilet training, and in order for him to be able to sit he must first be propped up. There is a spasticity in posturing of the right upper limb and the right lower limb, indicating a spastic weakness of these extremities. He still suffers occasional seizures and has a mental age in the range of five months.

Is it possible to determine, with reasonable medical certainty or reasonable medical probability, that something peculiar to Quadrigen was the proximate cause of the injuries suffered by the infant plaintiff? The question must be answered affirmatively. Dr. Charash, one of plaintiffs' experts, concluded that the child suffered a pertussis-vaccine encephalopathy,⁴ basing his conclusion on the temporal relationship between the immunization and the onset of illness; the unusual and spectacular sudden rise and subsequent rapid reduction in temperature; the appearance of unilateral seizures and weakness; the essentially extraordinary discrepancy between the very high protein and the absence of white cells in the spinal fluid; and the flatness of the fontanel. For the same reasons, he discounted the possibility of a viral encephalitis,⁵ one of the possible alternatives raised by defendant. Likewise, the suggestion that the infant may have developed a brain abscess from otitis media is not supported by the evidence. *What was it, then, that was peculiar to Quadrigen that it can be stated, with reasonable medical certainty or probability, that it caused the injuries already described?* In order to answer this question it is necessary to discuss in some detail pertussis and pertussis vaccine as incorporated in Quadrigen.

Pertussis, or whooping cough, is a communicable respiratory disease caused by a bacterial organism. The disease may attack the brain to the extent that convulsions, high fever, and occasionally hemorrhages in the brain are produced. Sometimes this is accompanied by hemiplegia or paralysis of half the body, and not infrequently there is a resultant mental retardation. The disease is particularly dangerous for children during their first year of life, since little or no maternal immunity is passively transferred to the newborn. Immunity, however, may be obtained through the injection of a vaccine.

A vaccine, by introducing an antigenic factor into the body of the recipient, is intended to stimulate the production of antibodies, which antibodies confer protection against the disease. In the process, lymphocytes, a form of cell contained in the lymph glands, absorb the antigenic factor and produce an antitoxin against the particular disease. With some infectious diseases, such as diphtheria and tetanus, it has been possible in developing a vaccine to isolate the soluble toxin or poison exerted by the bodies of these bacteria, and to inactivate this toxin with formaldehyde, thus converting the toxin into what is called a toxoid. This toxoid preserves the ability to immunize against the disease by stimulating the production of antibodies in the recipient, but it has lost its poisonous qualities.

The pertussis organism, however, is a unique, very complex one containing many different factors. There is an exotoxin, an endotoxin, a protective antigen, a factor that gives the Schwartzman phenomenon,⁶ a factor sensitizing to histamine, yeast, protein extracts, vaccines and endotoxin, to infection by gram negative bacteria and by influenza, to X-rays, pressure, the stress of cold, and to a marked degree sensitizing to ceretonium, one of the important neuro-hormones of the brain. The exotoxin in the pertussis organism is thermo labile, i.e., it is destroyed by heat, and all vaccines with which we are concerned are heated during preparation and the thermal labile exotoxin destroyed. However, the endotoxins inside the cell are not destroyed by heat. It is this endotoxin, also called a lipopolysaccharide, to which febrile reaction following administration of pertussis vaccine is usually attributed. In addition to the protective antigen already mentioned, there are some fourteen or fifteen different antigens, and nobody knows which, of all these antigens, is the one which stimulates production of the antibodies conferring protection against pertussis (whooping cough).

By reason of the complexity and mystery of the pertussis organism it was impossible to isolate the toxin conferring protective activity and make a toxoid out of it, as in the case of diphtheria and tetanus. Therefore, it was necessary to administer the entire bacteria organism, treating it in some way by heat or otherwise to kill the organism but preserve the antigenicity. As a result, whereas there were practically no reactions to diphtheria or tetanus toxoids, there were

⁴ Encephalopathy is any degenerative disease of the brain.

⁵ Encephalitis is an inflammation of the brain.

⁶ The Schwartzman phenomenon is the production of ulcers on injection under the skin of a rabbit.