quarters, with its imposing array of phrenological casts, as well as the splendid dissections of Holmes, Hodges, Jackson and other masters.

We saw him bring order out of chaos, introduce what were then modern methods, and, with his exceptional skill with the microscope, added to his executive ability, assist in building up and encouraging the splendid system of pathological and bacteriological teaching of which we are so proud.

Those were the days when scientific instruments and appliances were few, and money to buy them not to be had from the school, when alcohol and other chemicals were hard to get for lack of funds. There were no microtomes worthy of the name, and all the discoveries and advances in microscopical pathology had been made through the study of hand-made razor sections, and a large, thin section was unknown, even to Bilroth. Is it not probable that training in this school of scanty equipment was what helped to give Dr. Whitney his wonderful skill in quick diagnosis, and knack in the examination of fresh specimens?

Then came the construction of and moving into the new building on Boylston Street, the building that seemed, at the time, to be ample for the needs of the school for many years. Moving the precious contents of the old museum to their new quarters that he had so carefully planned was an anxious time, for it meant not only moving without breakage, or other damage, but the elimination of the useless and unfit. This being safely accomplished, it only remained for him to move into the new Sears laboratory in order to gain fresh impetus for his work and for him to grow in knowledge and skill, a growth that ended only with his life.

And that life was a happy one; happy in his family and home, happy in his friendships,—for he never had an enemy,—happy in his work.

To that work he devoted himself too closely, his friends thought. Every day at the school, every day at the hospital, and his constantly increasing consultation and medico-legal work left little time for recreation and relaxation. Even during the short summer vacation that he allowed himself, he was always on duty call, though no one loved the call of the sea more than he did, and no one who knew him well ever summoned him from his boat or his rest without regretting the necessity for so doing.

There is no branch of the medical profession which does not owe much to Dr. Whitney, but to the surgeons associated with him he became a necessity, a part of their professional lives. The hesitating surgeon, knife in hand, uncertain whether to do a trifling operation or one terribly mutilating and severe, could always depend on the decision of his master mind and vast experience, and a great number of men and

women today owe their intact bodies, or their lives, to his quietly spoken opinion.

In the hospital or in the home, with the rich or the poor, his presence meant the difference between haphazard surgery and intelligent surgery, between life and death. In the domain of rapid, exact surgical diagnosis, he was the unquestioned leader.

Another field in which he excelled, was in medico-legal work. His opinions and conclusions were always convincing, his decisions were accepted by the counsel for both sides, and he was universally commended for his fairness to both plaintiff and defendant. He never made a statement that he was not perfectly sure of, and could substantiate in every way.

As a medical man, he was able, exact, careful, progressive and just.

As a man, husband, father and friend, he was lovable and loving, kindly, gentle, courteous and too modest; a power for good in the hospital, school and community. In his death mankind has lost a willing helper, and we, a dear and devoted friend.

A PARTIAL LIST OF ARTICLES PUBLISHED BY DR. WHITNEY.

- The Identification of Seminal Stains. (1897.)
- The Possibilities and Limitations of Microscopic Diagnosis.
- The Alleged Increase of Cancer in Massachusetts. (1901.)
- Classification of Cancer upon an Embryological Basis. (1901.)
- A Comparative Study of the Death Rates for the State of Massachusetts for the Years 1850, 1875, and 1900. (1904.)
- A Study of Birth Rates, General Death Rates and Death Rates from Cancer for the New England States for the Year 1900. (1905.)
- A Study of the Statistics of Cancer in Massachusetts for the Year 1905. (1910.)
- A Quick and Simple Method for Fixing the Blood Corpuscles for Differential Staining. (1901.)
- Notes on the Production of the Test Serum in Rabbits. (1902.)
- Pyronin-Methyl Green; a Brilliant Double Stain for Cells and Bacteria. (1903.)
- A Brain Hardening by Jaiserling Method Showing the Track of a Bullet. (1903.)
- The Aloin and Guaiac Test for Blood Depends Solely upon the Iron Contained in the Hemoglobin. (1907.)
- Varicose Veins of the Papilla of the Kidney. A Cause for Persistent Hematuria. (1908.)
- The Gailloux Murder. A Case Solely of Circumstantial Evidence with Conviction of the Murderer. (1909.)
- A Delicate Method of Obtaining Hemin Crystals from Minute Blood Stains. (1912.)
- Cyanic Poison and the Tests for Its Detection. (1915.)
- Observations on Obtaining Hemin Crystals from Dried Blood. (1920.)
- A Sudden Death Following Intravenous Injection of Neosalvarsan. (1921.)

THE RESPONSIBILITY FOR DIPHTHERIA

BY JOSEPH GARLAND, M.D., BOSTON.

DIPHTHERIA, always a menace and public health problem, has become a public disgrace. While diphtheria was still a disease of unknown etiology, difficult of diagnosis and unsatisfactory to treat, it was feared because of the enormous toll it exacted and because the medical profession was without power in its efforts at control. These times have changed. Diphtheria can now be successfully treated and entirely controlled, and, if the proper measures were always adopted and uniformly carried

out, would eventually disappear from our list of dangerous diseases. The responsibility for the fact that it has not done so must fall upon the medical profession, which has the weapons to subdue this foe, and has not yet made full use of them.

Various terms were interchangeably used for diphtheria previous to 1821, when the present name was given to the disease by Bretonneau. Subsequently croup, even of the membranous type, was separately reported until recent years. For many years it was confused with various other diseases, including scarlet fever, until the organism was discovered by Klebs in 1883. Seven years later, Behring discovered antitoxin; in 1894 it was first used in this country, and since that time diphtheria has been a curable disease in practically all cases, if treatment is instituted early enough and in sufficient degree.

Previous to the general adoption of antitoxin, the death rate from diphtheria was about 150 persons out of every 100,000 in our population, with an average fatality percentage of about 28. Of these deaths, some 65 per cent. occurred in children under five years of age. Diphtheria antitoxin could potentially reduce this mortality to almost zero. Practically it has reduced it to about 18 deaths per 100,000 of population, with an actual fatality rate of 7-10 per cent., where it has remained stationary for years. Delay in calling the physician, mistakes in making the diagnosis, and delay in administering antitoxin in sufficient amount, are the chief factors in maintaining this level. Even with this reduction in mortality, the following figures prevail:

Calculated yearly mortality from diphtheria in the United States, 20-22,000, of which number over 60 per cent. are under five years of age.

NEW YORK CITY, 1913-1917

	MORBIDITY	MORTALITY
Total	73,068	6,291
Yearly average	14,613	1,258
1919-1920, totalover	28,000	2,280

MASSACHUSETTS, 1916-1921

	MORBIDITY	MORTALITY
1916	7,283	629
1917	10,322	838
1918	6,922	604
1919	7,929	591
1920	7,513	595
1921	9,061	476*

* First ten months only.

Recently the Massachusetts State Department of Public Health investigated one thousand deaths which occurred from diphtheria in this state, attempting "to ascertain what factor might be present and common to all of these deaths, to fix a theoretical responsibility, and to plan, as far as possible, for their prevention in the future."

Dr. Carey reported, "These statistics furnished much food for thought and some of our

findings were truly startling. Some of the more unsuspected findings were that 31.5 per cent. of these deaths occurred in individuals who had been sick one week or more without medical attention; 11.8 per cent. occurred in individuals who were moribund at the time of the doctor's first visit; 7.6 per cent. occurred in individuals in whom the condition was unrecognized until it was too late for the antitoxin to be efficacious, and 65 per cent. of these deaths occurred in children who were five years or under."

"The source of infection was given as unknown in nearly 90 per cent. of these deaths and the forms of the disease, in order of frequency, was laryngeal, pharyngeal, and nasal."

"From these investigated deaths, it appears that more attention must be paid to this group of individuals who fall within a pre-school age group, and intensive effort made to bring both to the profession and to the laity a more complete knowledge of the prevention and control of diphtheria."¹

In 1903, W. H. Park published a series of successful toxin-antitoxin immunizations on animals. Theobald Smith at that time suggested the possibility of immunizing children, but this was not attempted until 1913, when Behring reported results on human beings with toxin-antitoxin. In this year, also, the Schick test was introduced, and with the introduction of a practical method of determining susceptibility and natural and acquired immunity to the disease, came the possibility of putting toxin-antitoxin immunization on a practical basis. At this time Park and Zingher started their series of tests on scarlet fever patients at the Willard Parker Hospital, a series that has demonstrated the value of the test and subsequent toxin-antitoxin immunization of susceptibles.

The theory and technique of these procedures have been described so many times that it would be at the risk of needless repetition to devote much space to them at this time. Briefly, it was found by complicated tests that individuals with less than 1/30 unit of diphtheria antitoxin per cubic centimeter of blood may contract diphtheria. Those possessing this, or a larger amount of circulating antitoxin rarely, if ever, contract clinical diphtheria. The Schick test, consisting of the intradermal injection of 1/50 of the minimum lethal dose for a 250 gram guinea pig, of active diphtheria toxin, determines whether an individual possesses the protective amount of natural antitoxin. If 1/30 unit per cubic centimeter of blood is present, the injected toxin is neutralized, and no true reaction occurs. If less than this amount is present a local reaction takes place, consisting of a reddish area of infiltration, starting in 24-36 hours, reaching the height of its intensity after about four days, and then gradually disappearing. Pseudo reactions are due to an individual sensitiveness to the protein of the diphtheria bacillus, present in the test toxin.

The technique used with the products of different laboratories may differ slightly. In Massachusetts the contents of one capillary tube when discharged into 10 c.c. of sterile salt solution, as contained in the bottles provided with the outfit, furnishes a dilution of which 0.1 c.c. contains the amount of toxin required for the test. The control of heated toxin is prepared in the same way. In passing, it may be well to mention that the Massachusetts State Antitoxin Laboratory, founded by Theobald Smith, is not only licensed and inspected by the Federal Government, but conforms to rules of its own devising, exceeding in strictness those required by the Government. The reliability of products of this laboratory is above question.

Active immunization with toxin-antitoxin consists of the subcutaneous injection, in susceptible individuals, of active diphtheria toxin, sufficiently neutralized with antitoxin to render it harmless to the individual. This immunity is slow to develop, and after the course of three injections five or six months should elapse before re-Schicking, to test for the desired immunity.

There occurs, probably, not over 2 per cent. of error in the Schick test. In annual re-tests, carried out in institutions by Dr. Zingher, Dr. Schroeder, and others, 1.5 per cent. of the negatives of one year develop a positive reaction on the next annual test. Dr. Park believes this change is to be accounted for by error in technique and difference in toxin preparations. Slight fluctuation in the amount of natural antitoxin possessed by the individual may cause borderline cases to give, at times, positive and, at times, negative, reactions.²

The increase in the use of the Schick test and toxin-antitoxin has been phenomenal in the past four or five years, with New York as the pioneer city. Work in the public schools of New York was started in 1916, when the Department of Education gave permission to carry out the Schick test and active immunization in about two hundred and fifty schools.

During the past year, funds having been obtained from the Manhattan Chapter of the American Red Cross, the Schick test was applied in forty-four of the larger schools of Manhattan and the Bronx, over 52,000 children having been tested between the last of February and the end of the school year. This was all done, of course, with the parents' consent after circular letters had been distributed.

Children showing positive reactions were immunized with toxin-antitoxin. As a rule, children with straight positive reactions showed little local disturbance. Children with positive combined reactions showed considerable local redness, swelling, and tenderness of the arm at the site of injection, and varying degrees of constitutional disturbance. None showed any after-effects, and practically no local reaction oc-

curred among younger children. In over 50,000 immunizations there was never a single harmful result or a single infection.

In a school where those showing a positive test had received all three injections and had been re-tested after five months, 87.5 per cent. had become immune. Those still positive gave much fainter reactions and they received a fourth injection. Of schools where two injections had been given and re-tests made after two or two and one-half months, the per cent. of immunization varied from 64.5-76.1 per cent.

Other interesting data regarding susceptibility and immunity have been brought out by Zingher in this large series. Children from homes of the well-to-do show a higher percentage of positives; as high as 67 per cent. in some schools. In schools on the East Side of New York the percentage was as low as 16-20 per cent. The Lawrenceville School for boys at Trenton, N. J. (ages 12-21), showed 79 per cent. positive. At George School, Georgetown, Pa., the percentage was 75. In a rural school at Shilo, Cumberland County, N. J., the percentage of positiveness was 85.

Racial factors were also brought out. The colored race gives a high percentage of positives. Italians from crowded sections give the lowest. Bohemians and Irish are about one-third positive. Children of the same family have a tendency to show similar reactions. Contact immunization seems to play an important part in the production of natural immunity, and the same contact produces development of hypersensitiveness of individuals to the protein of the diphtheria bacillus, resulting in pseudo reactions.

Zingher has also, for purposes of practicability, made a division into age groups which it might be well to present here.

A. Infants Under Six Months.

(a) Under three months. Mostly have natural immunity. Do not develop active immunity after toxin-antitoxin.

(b) Three to six months. Generally immune. Toxin-antitoxin not as effective as later.

B. Pre-school Age.

(a) Six months to two years. Omit Schick test. Give toxin-antitoxin to all.

(b) Two to five years. Schick test may be used, but positive reactions very high. Simpler to inject all.

C. Public School Age.

(a) Five to six years. Advisable to inject all.

(b) Six to fifteen years. Use Schick test first.

D. High School Age.

Fifteen years and over. Schick test first.³

Some of these subdivisions would seem to be unnecessary. For practical purposes, four main divisions, according to age groups, with a separate procedure for each group, would be simpler.

A. Under Six Months.

This group is generally immune, but since the occasional case of diphtheria is liable to be fatal, the Schick test should be performed. If negative, re-Schick after six months, when the passive maternal immunity is lost, or, as the child would then fall into the next group, proceed with immunization. If the test is positive, proceed with immunization as with any other positive case.

B. Six Months to Six Years.

The Schick test being generally positive, immunize without testing.

C. Six to Eighteen Years.

Use the Schick test and immunize the susceptibles.

D. Over Eighteen Years. Adult Group.

Use the Schick test and advise as to the desirability of immunization, especially if the individual is liable to exposure to diphtheria.

The example set by New York is now being followed by many communities over the country. In Chicago, a commission appointed by Health Commissioner Robertson, has advised that city to make use of the Schick test and toxin-antitoxin, and over 12,000 persons have been immunized. This is but one example of many.

In Massachusetts, the work is under way, but much remains to be done. Certain school districts have taken up the work in Boston, notably the William Lloyd Garrison District; and other cities, such as Northampton, Holyoke, Chicopee, Springfield, Hingham, Brockton, Winchendon, Lawrence, and Waltham, are following the lead set by Lynn and Newton, two pioneer cities that have ably taken control of the situation. Work in the schools is soon to be undertaken by Framingham and Winchester.

Demonstrations of the test were conducted by the writer in various cities of the State during the spring, in the interests of the Committee on Public Health of the Massachusetts Medical Society,⁴ and further meetings of the same nature are, at present writing, being planned for the winter.

All school children in the Commonwealth should have the opportunity, through the schools, of being tested and immunized. All health boards should be equipped and ready to perform the test and subsequent immunization. Every family physician should be prepared to

use the test among his practice, or if too busy or otherwise unable to carry it out personally, should see that it is done by a capable individual, whether by the school physician, at a Board of Health clinic, or elsewhere.

Diphtheria is a preventable disease, and the agents for its prevention have been placed in the hands of the medical fraternity. The responsibility for their use and the responsibility for the combined existence of this disease is ours alone. Education of the laity, the awakening of the public to the benefits that can be derived from any form of medical advancement, are in our hands, and our duty is clearly before us.

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Book Reviews.

Therapeutic Immunization. By W. FORD ROBERTSON, M.D. New York: William Wood & Co.

In this volume of less than 300 pages, the author discusses the general subject of immunology and the entire field of bacteriological methods and, in addition, the treatment of diseases by means of bacterial vaccines. His chief ally in this work seems to be R. W. Allen, to whom he refers constantly as his *vade mecum*.

The first chapter is devoted to a discussion of the terminology and theories of therapeutic immunization. He then, at great length, discusses the bacteriological methods and the differential diagnosis of species, the methods of clinical investigation of infections, and the standardization of bacterial emulsions. So far, although the subject matter is somewhat sketchy considering the profundity of the subject he discusses, his information is adequate. In looking over the rest of this volume, one, at first, meets with certain statements which are surprising, to say the least. For instance, referring to the pneumococcus of pernicious anemia, he states that he has known for years "that the commonest form of pernicious anemia is due to an intestinal infection by a special type of pneumococcus." He bases this on thirteen cases.

In taking up the treatment of bacterial infections, one finds statements of a similar caliber. Concerning influenza, for instance, one reads that "therapeutic immunization has been found to cut short the malady," and "It has been satisfactorily established that preventive