

throat symptoms, but that where these are severe it almost invariably follows, whatever the treatment employed. The indications, however, are to keep the rhino-pharynx as clean as possible by syringing the mouth and nose. The indications for paracentesis of the drum membrane are the same as in other severe forms of otitis (page 884). The treatment of scarlatinal nephritis has been considered in the chapter devoted to Diseases of the Kidney (page 618). Diffuse cellulitis of the neck calls for free incisions early as the only means of preventing extensive sloughing.

During convalescence, tonics, particularly iron and digitalis, are called for. The urine should be frequently examined for a long time; antiseptic gargles and a nasal spray or syringe should be used as long as a purulent discharge from the nose or pharynx continues.

CHAPTER II.

MEASLES.

Synonyms: Rubeola, Morbilli.

MEASLES is an epidemic contagious disease, more widely prevalent than any other eruptive fever; very few persons reach adult life without contracting it. One attack usually confers immunity. It is highly contagious even from the beginning of the invasion, and spreads with great rapidity from the patient to all susceptible persons exposed. The poison, however, does not cling so long to clothing or apartments as does that of scarlet fever. Measles has a period of incubation of from eleven to fourteen days; a gradual invasion of three or four days with symptoms of an acute coryza; a maculo-papular eruption which appears first upon the face and spreads slowly over the body, and which lasts from four to six days. This is followed by a fine bran-like desquamation, which is completed in about a week. The mortality is low, except among infants and delicate children, where it may reach 30 or even 40 per cent. In institutions for infants and young children no disease is more to be dreaded than measles, not only on account of its severity, but the frequency with which, in such subjects, it is complicated by broncho-pneumonia.

Etiology.—The essential cause of measles is as yet unknown. It is generally believed to be due to a micro-organism, but, as in the case of scarlatina, all attempts to isolate it have thus far been unsuccessful. The poison is one which possesses remarkable powers of diffusion, but whose viability is much less than that of most of the pathogenic germs which are known. Only a short exposure is required to communicate the disease, and even close proximity to a patient does not seem necessary. One instance has come under my own observation where measles was appar-

ently conveyed by an exposure of half an hour across a hospital ward, a distance of at least fifteen feet.

Predisposition.—With the exception of young infants, children of all ages are extremely susceptible to measles. The disease broke out in a cottage of the New York Infant Asylum which was occupied by twenty-three children, nearly all of them being under two years old; only four escaped, all these being under five months old. In an epidemic reported by Smith and Dabney, 110 unprotected children, between the ages of eight and eighteen years, were exposed and only two escaped. In the Nursery and Child's Hospital, during the epidemic of 1892, there were 62 children over two years of age; five were protected by a previous attack and escaped; of the remaining 57 children, 55 took the disease. There were also in the institution 113 children under two years old; of this number 78 per cent took the disease; but although many were exposed, not one child under six months old contracted measles. The age of the persons affected depends much upon the length of time since the last outbreak of the disease. In an epidemic occurring in the Island of Guernsey, where the disease had not prevailed for many years, all ages were affected, the youngest being twelve days old, and the oldest, a man and wife, each aged eighty years. Somer has reported an instance of an eruption of measles appearing in a child twelve hours after birth; the mother was suffering from the disease at the time. Gautier has collected six additional cases, where measles either existed at the time of birth or developed within a few hours after it.

Except, then, in early infancy, the probabilities are very strong that every child exposed to measles will contract the disease. Occasionally, however, one is seen who seems insusceptible to the poison, no matter how close the exposure.

Epidemics of measles are more frequent and more severe during the spring months. They are least frequent and mildest during the autumn months.

Incubation.—In 144 cases,* where the period of incubation could be definitely traced, it was as follows:

Incubation of less than nine days.....	3 cases.
“ “ nine or ten days.....	22 “
“ “ eleven to fourteen days.....	95 “
“ “ fifteen to seventeen days.....	19 “
“ “ eighteen to twenty-two days.....	5 “

Thus in 66 per cent of the cases the incubation was between eleven and fourteen days, and in only one case was it less than a week. The constancy

* About twenty-five of these are taken from my own records; the remainder are mainly isolated cases, scattered through medical literature. The incubation is reckoned from the time of exposure to the beginning of the catarrh.

of the incubation period is strikingly shown in some epidemics. Thus in the one reported by Smith and Dabney in an institution in Virginia, exactly eleven days after the rash appeared in the first case, the disease developed in twenty children—no cases having occurred in the interval.

Duration of the infective period.—This is much shorter than in scarlet fever, and the average duration may be placed at four weeks. Haig-Brown discharged fifty-eight cases on or before the twenty-ninth day of the disease, and in no instance was measles spread by these children. Ransom, however, records one instance in which it was communicated thirty-one days after the appearance of the rash.

Measles is highly contagious from the beginning of the catarrhal symptoms. A case occurred in the Babies' Hospital under my own observation, in which a child conveyed the disease four days before the rash appeared. Ransom reports another precisely similar. An instance has been related to me by Dr. S. W. Lambert, where, of thirteen little girls who were at a children's party, only one escaped measles, the source of infection being a child who showed no rash until the following day; the child who escaped had previously had measles. The period of greatest contagion is still a matter of dispute, the general belief being that it is coincident with the highest temperature, the full eruption, and the most severe catarrhal symptoms.

With the fading of the eruption and the subsidence of the catarrh, the communicability of measles diminishes rapidly. It is relatively feeble during desquamation, and soon after this period it usually ceases altogether. It is generally proportionate to the severity of the catarrhal symptoms, and where these are protracted it is probable that the disease may be communicated for a much longer period than that mentioned.

Mode of infection.—Measles is usually spread by direct contagion, very infrequently through the medium of clothing, furniture, or a third person. Townsend (Boston) records an instance in which one family moved into a tenement house on the same day on which it was vacated by another family in which two children had suffered from measles, one of them fourteen and the other eighteen days previously. The apartments were not fumigated nor disinfected, and, although there were two susceptible children in the incoming family, they did not contract the disease. Measles rarely if ever clings to apartments for weeks or months, as does scarlet fever. Many instances are on record in which the disease has been carried by a third party; but, after all, this rarely happens, unless the contact both with the sick and the well child is very close and the interval short. It is very seldom that measles is carried by a physician who takes even the ordinary precautions. In a case reported by Girom, the clothing of a patient is stated to have conveyed the disease nineteen days after an attack, but this must be regarded as very exceptional.

Lesions.—The only constant lesions of measles are those of the skin and the mucous membranes, chiefly of the respiratory tract. According to Neumann, the process in the skin is of an inflammatory character, but is more superficial than in scarlet fever. There is congestion, accompanied by an exudation of round cells about the small blood-vessels, and also about the sweat and sebaceous glands, and the papillæ. To this exudation and the œdema, the swelling of the skin is due. It occurs everywhere, but is especially noticeable upon the face.

The changes in the mucous membranes are quite as much a part of the disease as are those of the skin. There is a catarrhal inflammation affecting the conjunctivæ, nose, pharynx, larynx, trachea, and large bronchi, which varies in intensity with the severity of the attack. In the most severe forms in infants and in young children, this inflammation extends with great uniformity to the small bronchi, and usually to the air vesicles, causing broncho-pneumonia. In severe cases, the lesion in the pharynx and larynx also, instead of being catarrhal, may be membranous; the larynx being much more frequently involved, and the ears much less so, than in scarlet fever. The lesions of the lungs and of other organs will be more fully considered under Complications.

The bacteria which are associated with the lesions of the respiratory tract are, in the milder cases, usually the staphylococcus, and in the more severe ones the streptococcus, although this is sometimes reversed. They may be found separately or together, and either form may be associated with the pneumococcus (see Bacteriology of Broncho-Pneumonia, page 482). The poison of measles produces conditions in the mucous membranes of the respiratory tract which are especially favourable for the development of these bacteria, which at such times are always present in the mouth in large numbers. Many of the other complications besides pneumonia are due to infection with these germs. Associated with the lesions of the mucous membranes, are found changes in the lymphatic glands with which they are connected; they may be of a hyperplastic or of a suppurative character.

Symptoms.—*Invasion.*—As a rule, the invasion of measles is gradual, both the fever and catarrhal symptoms increasing steadily up to the appearance of the eruption. The characteristic symptoms of the invasion are those of a severe coryza,—suffusion of the eyes, increased lachrymation, photophobia, sneezing, and a discharge from the nose. The hoarse, hard cough indicates that the catarrhal process has involved the larynx and trachea, as well as the visible mucous membranes. Frequently the patient complains of some soreness of the throat, and on inspection there is seen moderate congestion of the tonsils, fauces, and pharynx. On the hard palate are frequently seen on the second or third day small red spots, from the size of a pin's head to that of a pea. This is sometimes spoken of as the eruption upon the mucous membrane. The constitutional symptoms

are indefinite, and may be met with in almost any disease. There are dulness, headache, pains in the back, and the usual symptoms of *malaise*; there is rarely vomiting or diarrhœa. Drowsiness is a frequent symptom, and is regarded by the laity as characteristic.

The exceptional cases in which the invasion is abrupt are puzzling. There may be a sudden accession of fever with vomiting, and even convulsions, as in a case lately under my observation. Not infrequently, when the disease prevails epidemically, the invasion is sudden, with high fever and pulmonary symptoms which are so severe as to mask everything else until the rash makes its appearance, the case up to that time being often regarded as one of primary pneumonia or of influenza. The duration of the stage of invasion—i. e., from the beginning of the catarrh until the eruption—in 270 cases of which I have notes, was as follows:

1 day or less.....	35 cases.	6 days.....	20 cases.
2 days.....	47 "	7 ".....	6 "
3 ".....	64 "	8 ".....	2 "
4 ".....	64 "	9 ".....	2 "
5 ".....	29 "	10 ".....	1 case.

From this table it will be seen that the length of the period of invasion varies considerably,—more, I think, in infants and very young children (most of these were under three years old) than in those who are older. In the greater number of cases it lasts from two to four days.

Eruption.—The rash usually appears on the third, fourth, or fifth day of the disease—in the largest number upon the fourth day. As a rule, it is first seen behind the ears, on the neck, or at the roots of the hair over the forehead. It appears as small, dark-red spots, which are at first few, scattered, and not elevated, resembling flea-bites. In twenty-four hours the macules are much more numerous, and many of them have become papules. They frequently group themselves in crescentic forms. They are usually separated by areas of normal skin, but where the rash is intense they are frequently coalescent. From the time of its first appearance to the full development of the rash on the face, is usually about thirty-six hours, but may be from one to three days. With a full eruption there is considerable swelling of the face, especially about the eyes, and the features are sometimes scarcely recognisable. On the second day of the rash it begins to appear upon the neck beneath the chin, the upper part of the chest and back; on the third day the trunk is covered, and scattered spots are seen upon the extremities. The rash appears last upon the lower extremities, and by the time it is fully out upon them it has usually begun to fade from the face. In mild cases it remains discrete, but in severe ones it is frequently confluent upon the face and upon the extensor surface of the extremities. As a rule, it covers the entire body, even the palms and soles.

The eruption fades slowly in the order of its appearance, and there is

left behind, in typical cases, a slight brownish staining of the skin, which often remains for nearly a week. The duration of the rash is from one to six days, the average being four days.

There are many cases in which the rash does not follow the typical course described: (1) Instead of spreading gradually, the entire body may be covered in a few hours. (2) The rash may be hæmorrhagic. This condition was present in about five per cent of my cases. The whole eruption may be hæmorrhagic, or it may be so only upon certain parts—usually the abdomen or extremities. Under such circumstances small petechial spots take the place of the macules. This is the “black measles” of the older writers. It is in most cases a bad, but by no means a fatal symptom. I have seen it in several cases that were not especially severe. (3) The rash may be very faint, and of short duration, being scarcely elevated at all. (4) It may consist of very minute papules, closely resembling the rash of scarlet fever. It is to be remembered, however, that the irregular eruptions of scarlet fever much more frequently resemble measles than *vice versa*. (5) It may be very scanty, and late in its appearance; particularly in cases of great severity and hyperpyrexia—the so-called malignant cases. (6) Temporary recession of the eruption may occur at any time during the height of the disease, and is usually due to heart failure. A recurrence of the eruption after it has run its usual course is something which I have never seen; although such cases have been reported, I believe them to be very exceptional.

During the first two days of the eruption, the local and constitutional symptoms increase in severity, both usually reaching their maximum at the time of the full development of the rash upon the face. The skin is swollen, and the seat of intense itching and burning. The eyes are very red and sensitive to light, and there is swelling of the conjunctivæ with an abundant production of mucus or muco-pus, causing the lids to adhere. There is pain on swallowing, also swelling of the glands at the angle of the jaw or in the post-cervical region. The cough is frequent and very annoying. There is complete anorexia, and often diarrhœa. The tongue is coated, and may show at its margin enlarged papillæ, resembling the “strawberry” appearance of scarlet fever. As the rash fades the temperature declines rapidly, often reaching the normal in two or three days. The catarrhal symptoms now subside, and soon the patient is convalescent. Within a day or two after the fever has ceased, the rash disappears.

Desquamation.—This begins almost as soon as the rash has subsided, and is first noticed on the face and neck, where the eruption first appeared. The nature of the desquamation is invariably fine, branny scales, never in large patches, as in scarlet fever. It is often quite indistinct and may be overlooked. Its usual duration is from five to ten days. It may, however, be prolonged for two weeks. The amount of desquamation varies

considerably in the different cases. It is most marked in those in which there has been an intense eruption. There is frequently noticed at this time an odour about the patient which is quite characteristic of measles. During this stage the cough often persists and the eyes remain weak and very sensitive to light, but in other respects the patient usually feels perfectly well.

1. *The mild cases.*—The mildest cases are distinguished by low temperature, which at the height of the eruption usually reaches 102° F., but rarely lasts more than four days. The eruption is often scanty, and is never confluent. The swelling, itching, and other cutaneous symptoms are wanting, as is also the intense red colour of the skin. The rash is frequently obscure, and, without the other symptoms, hardly sufficient for diagnosis. The catarrhal symptoms are more uniform than the rash, but these are very mild as compared with the usual form. The duration of the rash is shorter, desquamation is scarcely perceptible, and there are no complications.

2. *The cases of moderate severity.*—The course of measles is much more regular in children over three years old than in infancy. In the former, the symptoms of invasion come on gradually, and the temperature rises steadily until the appearance of the eruption, which is in most cases

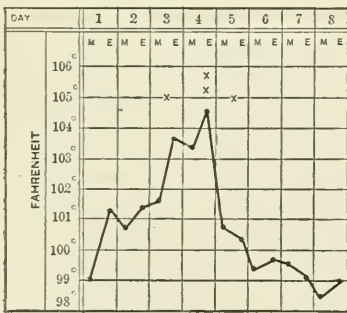


FIG. 158.

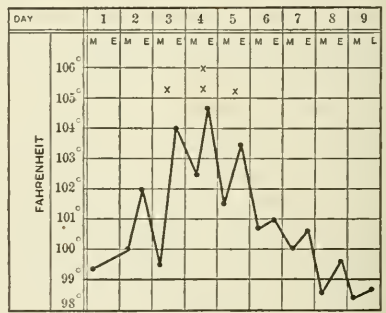


FIG. 159.

FIG. 158.—Temperature curve in uncomplicated measles, showing the gradual rise and critical fall; patient ten years old; x = first eruption; x = full eruption on the face.

FIG. 159.—Typical curve in uncomplicated measles, with gradual rise and gradual fall; patient three years old.

on the third or fourth day of the disease. Figs. 158 and 159 represent the typical temperature curve in average uncomplicated cases. Such a curve was seen in 44 per cent of 173 cases in which careful observations were made. Sometimes the decline in the fever is very rapid, almost a crisis, as in Fig. 158, but more often it falls gradually, as in Fig. 159. In such cases the duration of the fever is from five to nine days, the average being about a week. The other symptoms follow very closely the course of the fever. The maximum temperature is nearly always coincident with

the full rash upon the face, at this time usually being in uncomplicated cases from 103° to 104° F. in older children, and 104° to 105° in infants and young children.

A not very uncommon temperature curve is that of Fig. 160, where the onset of the disease is marked by a sudden rise to 102° or even 104° F., with a fall nearly or quite to normal on the second day, after which the fever rises gradually, as in the first group. This curve was seen in 5 per cent of my cases.

3. *The severe cases.*—In Fig. 161 is shown a type of the disease which is more frequent in infants than in older children, the important features being the late eruption and the continuance of the high fever for several days after the rash has begun to fade.

Such a prolonged course and so high a temperature are almost invariably due to some complication, usually bronchopneumonia. Where the pneumonia goes on to the production of areas

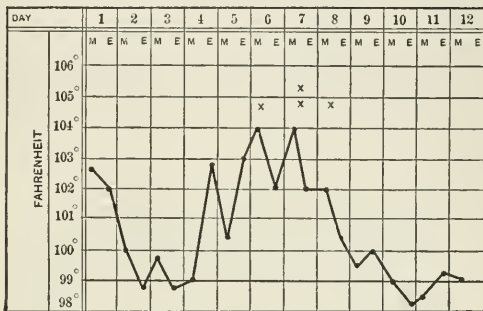


FIG. 160.—A not infrequent temperature curve in measles, showing abrupt invasion, but subsequent course typical; uncomplicated case; patient nine months old.

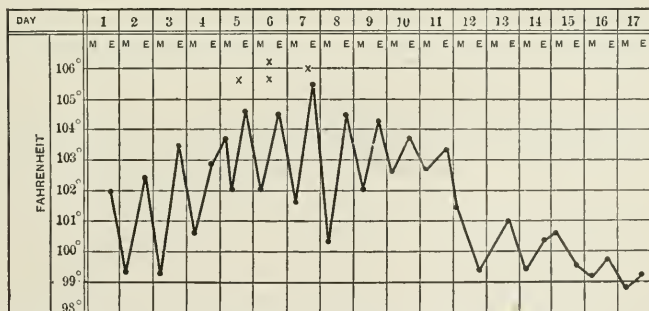


FIG. 161.—Measles with prolonged invasion; continuance of high temperature after full eruption due to severe bronchitis and diarrhoea; child two years old.

of consolidation, the fever usually continues for three and sometimes for four weeks, even though terminating in recovery.

Figs. 162 and 163 illustrate two types of the disease which are often seen when measles is complicated by pneumonia. In cases like that shown in Fig. 162 the onset is abrupt with high temperature, prostration, and pulmonary symptoms not unlike those of primary pneumonia. A temperature curve resembling this was seen in 28 of 173 cases. The rash is often late in appearance; it is faint and altogether irregular; it may

recede after the first day and reappear after an interval of one or two days. The catarrhal symptoms are not marked, but the whole force of the disease seems to be expended upon the lungs. The diagnosis of these cases presents great difficulties, and very often it would not be made but for the fact that there are other cases of measles in the family or the institution. This form is usually seen in infants, and it is very fatal.

In other cases marked by a sudden severe onset, the system seems to be overpowered by the poison of the disease itself. There are profound de-

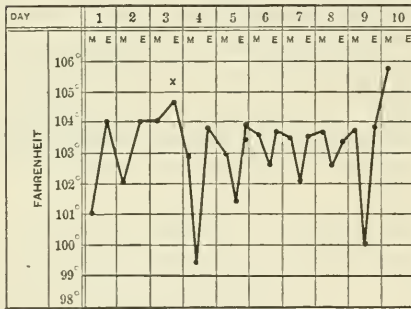


FIG. 162.

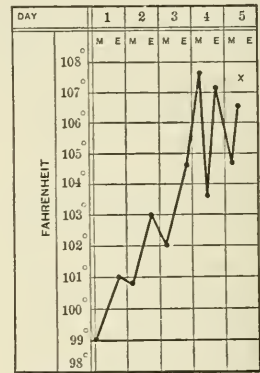


FIG. 163.

FIG. 162.—Fatal attack of measles, complicated by broncho-pneumonia; very severe symptoms from the onset; patient eighteen months old; death on tenth day.

FIG. 163.—Fatal attack of measles, complicated by broncho-pneumonia; early invasion mild, but rapid development of severe symptoms on fourth day; rash on last day; patient eight months old.

pression, and hyperpyrexia, and the patient may die from toxæmia with cerebral symptoms before the appearance of the rash or just as it is beginning to show itself. Sometimes the pulmonary symptoms are entirely wanting; at others the rash, if it appears, is hæmorrhagic.

In still another group of cases the onset is not violent, and for the first two days the attack may appear to be of only average severity; but there may then develop, often quite suddenly, pulmonary symptoms of such intensity as to cause death within twenty-four hours. The eruption, if seen at all, is faint and not characteristic (Fig. 163).

A secondary rise in the temperature after it has once fallen to normal was seen in 8 of 173 cases, being due to the development of otitis, ileocolitis, or late pneumonia.

Complications and Sequelæ.—The most frequent and most important complication of measles is broncho-pneumonia, and next to this are ileocolitis, otitis, and membranous laryngitis. Most of the others are infrequent; all complications are relatively rare in children over four years old.

Lungs.—The greatest danger in measles arises from pulmonary complications, and the frequency is greatest in children under two years of age. In two epidemics in the Nursery and Child's Hospital, embracing about 300 cases, nearly all in children under three years old, broncho-pneumonia occurred in about 40 per cent of the cases. Of those who had pneumonia, 70 per cent died. Fortunately, such a record as this is never seen outside of asylums or hospitals for young children. Of 2,477 cases, embracing several epidemics of measles among children of all ages, pneumonia occurred in 10 per cent. My own experience in the post-mortem room fully bears out the statement of Hensch, that a certain amount of pneumonia is found in almost every fatal case. Pneumonia is more frequent and its mortality is higher in spring and winter epidemics than in those occurring at other seasons. It may develop at any time from the beginning of invasion until convalescence, but it most frequently begins about the time of full eruption.

Lobar pneumonia, although rare, occasionally occurs as a complication in children over three years old. In some epidemics many of the cases of pneumonia are complicated by severe pleurisy, which adds much to the danger of the disease. This form is frequently followed by empyema. Pneumonia is always to be suspected when the temperature continues high after the full appearance of the rash.

Bronchitis of the large tubes, always accompanied by tracheitis, is seen in every case of measles, possibly excepting a few of the very mildest. This is so constant a feature as hardly to be ranked as a complication. In nearly all of the severe cases the bronchitis extends to the medium-sized and smaller tubes.

Larynx.—A mild catarrhal laryngitis accompanies almost every case of measles. Severe catarrhal laryngitis is present in about ten per cent of the cases; it may give symptoms which closely resemble those of membranous laryngitis, and the two are no doubt often confused. (For the points of differential diagnosis see page 443.)

Membranous laryngitis is more often seen as a complication of measles than of scarlet fever. It was present in 35 of 2,837 cases taken from miscellaneous sources; but in epidemics in institutions it is much more common than this. As a cause of death in older children it ranks next to pneumonia. When it develops at the height of the disease, as it usually does, it is due in nearly all cases to the streptococcus; but when it develops at a later period, it is usually due to the diphtheria bacillus. The streptococcus inflammation is in most cases associated with similar changes in the pharynx or tonsils, but not always. True diphtheria, occurring as a complication of measles, not infrequently begins in the larynx. The streptococcus inflammation may be as serious in this connection as is true diphtheria, from the probability, which amounts almost to a certainty, of the development of broncho-pneumonia. No complication is more to be

dreaded than this. The diagnosis between the true and pseudo-diphtheria may sometimes be made by the time of development, but only with certainty by cultures. I once saw in measles, where no false membrane was present in the rest of the larynx, a necrotic inflammation with almost entire destruction of the vocal cords—a condition which may be compared to that seen in the tonsils or epiglottis in scarlatina.

Throat.—A catarrhal angina is part of the disease, and is as characteristic of measles as is the eruption upon the skin. There is acute congestion and swelling of the tonsils, uvula, palate, and pharynx. In a certain proportion of cases, very much less frequently than in scarlatina, the development of membranous patches is seen upon the tonsils and adjacent mucous membranes. These occur in two or three per cent of the cases. They are to be regarded in the same light as similar conditions complicating scarlet fever (page 899), with these differences, that in measles there is much greater likelihood of the extension of the disease to the larynx, while extension to the nose and ears is much less probable. True diphtheria, however, may complicate measles, and cases of membranous inflammation of the tonsils or pharynx developing late in measles are usually due to the Loeffler bacillus.

Although in most cases the inflammations of the pharynx and tonsils which accompany measles are not serious when they are due to the streptococcus, they are sometimes quite as severe as any that accompany scarlet fever. They may cause death from general sepsis apart from any affection of the larynx.

Digestive system.—Gastric disorders are not more common than in other febrile diseases; but diarrhœa is very frequent, and in summer it may be even more serious than the pulmonary complications. All forms of diarrhœa are seen, from that which results from simple indigestion to the severe types of ileo-colitis. This complication is most often seen in children under two years old. The most severe intestinal symptoms are not usually seen at the height of the primary fever; but, beginning at this time, they often increase in severity, and are most marked in the second and third weeks of the disease.

Catarrhal stomatitis is present in almost every case of measles; less frequently the herpetic form is seen. Ulcerative stomatitis is not uncommon, particularly in institutions. One of the worst complications of measles, but fortunately a rare one, is gangrenous stomatitis, or noma. This usually occurs in inmates of institutions, or in children with bad surroundings who were previously in wretched condition. It is nearly always fatal.

Gangrenous inflammations of other parts of the body are sometimes seen after measles, especially of the vulva or the prepuce.

Nervous system.—I have seen convulsions at the onset of measles in but a single case. During the progress of the disease they are not so rare,

and may occur in connection with otitis, meningitis, or severe bronchopneumonia—chiefly in infants.

Meningitis is rare, but either the simple or the tuberculous form may occur, more often, however, as a sequel than as a complication. Insanity, usually of a temporary character, occasionally follows measles. In the epidemic of 108 cases reported by Smith and Dabney, insanity was noted three times, all the cases terminating in recovery. Epilepsy and chorea are rare sequelæ.

Ears.—Otitis is not so frequent as in scarlet fever, and in many epidemics it rarely occurs; in others it is often seen. In one hospital epidemic it was noted in 14 per cent of the cases. This epidemic occurred in early spring and affected very small children, both of which circumstances are favourable for the development of otitis. Usually both ears are affected, and the inflammation terminates in suppuration; but the otitis of measles is, as a rule, much less serious than that of scarlet fever, and much less frequently leads to permanent impairment of hearing.

Eyes.—Simple catarrhal conjunctivitis accompanies nearly every case of measles. In the severe form there is a muco-purulent catarrh, which may attain any degree of severity. In neglected cases, and among children who are poorly nourished, especially in asylums, the disease is apt to extend to the cornea. In a very large number of cases chronic conjunctivitis persists after measles, particularly in the class of children just mentioned.

Lymph nodes.—Swelling of the lymphatic glands of the neck is frequent, but not generally severe, and rarely terminates in suppuration. In a considerable proportion of cases chronic enlargement persists for months, and sometimes the glands may become tuberculous. Similar changes and similar consequences may occur in the glands of the tracheo-bronchial group.

Kidneys.—The infrequency of renal complications in measles is in striking contrast to scarlet fever. Transient febrile albuminuria is not uncommon, but a serious degree of nephritis, either clinically or at autopsy, I have never seen, and literature furnishes but few cases. Demme and Browning have each reported cases of nephritis following measles, in which death occurred from uræmia.

Heart.—Both endocarditis and pericarditis have occurred in the course of measles, but they belong to the rare complications. The same may be said of changes in the muscular walls of the heart.

Skin.—As complications, erysipelas, furunculosis, impetigo, and pemphigus have been noted; but all are rare.

Hæmorrhages.—Associated with the hæmorrhagic type of the eruption, severe and even fatal hæmorrhages may occur from the mucous membranes, and the latter are sometimes seen without the hæmorrhagic eruption.

Other infectious diseases.—Measles may be complicated by almost any of the other infectious diseases—scarlet fever, varicella, diphtheria, etc. It is rare that the two diseases are exactly simultaneous, but one usually develops as the other is subsiding. Epidemics of measles and whooping-cough more frequently occur together, or follow each other, than do any of the others. The relation of measles to tuberculosis seems to be particularly close. In some of the cases, tuberculosis follows directly in the wake of measles, an irregular temperature continuing from three to eight weeks, when death occurs from general tuberculosis with the principal lesions in the lungs. Acute miliary tuberculosis may follow even more closely. As a late manifestation, the most common one is tuberculosis of the bones, occurring as hip-joint disease, caries of the spine, etc. The relation of measles to tuberculosis seems to be that it furnishes conditions, especially in the lungs, which are favourable for the development of tuberculosis in patients who have been previously infected, but in whom the disease has been latent in some part of the body, especially in the lymph nodes. In other cases measles seems greatly to increase the susceptibility of the patient, so that tuberculosis is subsequently contracted after the slightest exposure. The frequent association of these diseases should never be forgotten, and on this account an attack of measles in a child with tuberculous antecedents should always be looked upon with apprehension.

Diagnosis.—The most important symptoms for diagnosis are the coryza, at first slight, but steadily increasing in severity, the gradual rise in temperature, and the maculo-papular eruption, appearing first upon the neck and face, and slowly extending over the body. Before the rash a diagnosis is impossible. When it is faint and of doubtful character, a hot mustard bath will often bring it out so distinctly as to make a diagnosis easy. In cases where the rash is irregular in its character or time of appearance, great importance is to be attached to the catarrhal symptoms, especially the condition of the eyes. The appearance of the throat and the fine red spots upon the hard palate are also important. The cases which present the greatest difficulties are the very severe ones and those in infants. Mild attacks are more characteristic than are the mild forms of scarlet fever.

From skin diseases, measles is distinguished by its temperature, which is rarely less than 102.5° F. at the height of the eruption; from other general diseases by the rash itself.

Prognosis.—This depends upon the age and previous condition of the patient, the character of the epidemic, and the season of the year at which it occurs. Except in children under three years of age, the deaths from measles are few; but in institutions containing little children, no epidemic disease is so fatal. The following statistics illustrate the general mortality of the disease as it has been observed:

Krauss and Hirschberg, Dresden Hospital, 49 years	1,461 cases; mortality, 4·2 per cent.
Sagoiski, St. Petersburg Hospital, 11 years.....	7,050 " " 9·2 "
Embden, one epidemic.....	461 " " 6·7 "
Demme, Berne Hospital, in one epidemic.....	224 " " 5·8 "
Alteberg, one epidemic.....	725 " " 1·2 "
Fleischmann.....	736 " " 22·0 "
Benz, Copenhagen.....	30,581 " " 3·0 "

The average mortality of the disease is thus from four to six per cent; but in epidemics observed in institutions containing only young children it is much higher. Henoch records an epidemic of 294 cases among children, nearly one half of whom were under two years of age, with a mortality of 30 per cent. In the epidemic of 1892, in the Nursery and Child's Hospital, New York, there were 143 cases, with a mortality of 35 per cent. The figures of the epidemic of 1895 were almost identical. All these children were inmates of the institution at the time they were taken ill, and, although many were delicate, few were suffering from other diseases when they were attacked with measles. The following table gives the exact figures of the epidemic of 1892:

From six to twelve months.....	42 cases; mortality, 33 per cent.
" one to two years.....	51 " " 50 "
" two to three years.....	27 " " 30 "
" three to four years.....	20 " " 14 "
" four to five years.....	3 " " 0 "

The average mortality among children under two years is probably not far from 20 per cent, but it is much higher in institutions. The death-rate diminishes rapidly after the second year.

In any single case the important symptoms for prognosis are the temperature and the character of the eruption. An initial temperature above 103° F., or one which remains high until the eruption appears, is a bad symptom. So also is one which rises after a full eruption, or which does not fall as the rash fades. The following table shows the highest temperature and mortality in 161 hospital cases:

Highest temperature not over 102°.....	6 cases; mortality, 0 per cent.
" " 102° to 103·5°.....	14 " " 7 "
" " 104° " 104·5°.....	49 " " 16 "
" " 105° " 105·5°.....	65 " " 40 "
" " 106° or over.....	27 " " 80 "

A favourable eruption is one of a bright colour, covering the body, remaining discrete, and spreading gradually. It is unfavourable for the eruption to appear late, to be very faint, scanty, or hæmorrhagic, or to recede suddenly, as this is usually due to a weak heart.

Of 51 fatal cases, the cause of death was broncho-pneumonia in 45, ileo-colitis in 4, and membranous laryngitis in 2. More than half the deaths occurred during the second week, the earliest being upon the fifth day of the disease.

The ultimate result of an attack of measles may not be evident for some time. Cases in which the temperature persists for two or three weeks without assignable cause after the disease is apparently over, should be watched with the greatest solicitude. The explanation of this is most frequently to be found in the lungs, although the physical signs are often obscure. The condition may be either subacute pneumonia or pulmonary tuberculosis. Even though the attack of measles may not have been in itself severe, seeds are often sown the full fruits of which are not seen until long afterward. Chronic glandular enlargements which may or may not be tuberculous, chronic bronchitis, chronic laryngitis, subacute or chronic nasal catarrh, hypertrophy of the tonsils, and adenoid growths of the pharynx,—all are frequent sequelæ.

Prophylaxis.—Measles is often regarded by the laity as so mild a disease that its prevention is thought of little importance, and no effort is made to limit its extension. The great probability that every person at some time in his life will have the disease, is no justification of unnecessary exposure. Although in older children measles is usually mild, this is not so in infants, who should be carefully protected from exposure. Special care should also be taken to avoid the exposure of delicate children or those with a strong tendency to pulmonary disease or to tuberculosis. In institutions it is of the utmost importance to secure prompt and complete isolation of the first case which appears.

The disease being usually spread by the patient and rarely from apartments, it follows that while early isolation is more important, there is not required the same thorough cleansing and disinfection which should follow every case of scarlet fever. In an institution, the ward or cottage from which a case has been removed should be quarantined for at least sixteen days after the appearance of the last case, and absolute security can not be said to exist until the end of three weeks. The same rule should be applied in private families where children who have been exposed should be quarantined apart from the patient, but not sent away. Under ordinary circumstances the quarantine of a case of measles should last four weeks from the beginning of invasion. It should be continued longer if there is pneumonia, otitis, or a nasal discharge.

Thorough cleansing and disinfection of the sick-room should be done before it is again occupied by children, and it should remain vacant at least two weeks. Children should be kept from all schools while the disease is in their homes, chiefly because they are otherwise liable to spread the disease while suffering from the early symptoms of invasion.

Treatment.—Measles is a self-limited disease, and there are no known measures by which it can be aborted, its course shortened, or its severity lessened. The indications are therefore to treat serious symptoms as they arise, and, as far as possible, to prevent complications, which are the principal cause of death.

The sick-room should be darkened, as the eyes are very sensitive to light. Every child with measles should be put to bed and kept there with light covering during the entire febrile period. There can be no possible advantage in causing a child to swelter by thick blankets, under the delusion that the disease may be modified thereby. The food should be light, fluid, and given at regular intervals. If the conjunctivitis is severe, iced cloths should be applied to the eyes, which should be kept clean by the frequent use of a saturated solution of boric acid, the lids being prevented from adhering by the application of vaseline or simple ointment. The intense itching and burning of the skin may be relieved by inunctions of plain or carbolized vaseline. The cough, when distressing, may be allayed by small doses of opium, either in the form of the brown mixture or by equal parts of paregoric and glycerin, of which from five to thirty drops may be given, according to the age of the child, every two hours. The restlessness, headache, and the general discomfort which accompany the height of the fever may be relieved by an occasional dose of phenacetine or antipyrine. As soon as the rash has subsided, a daily warm bath should be given, followed by inunctions to facilitate desquamation and prevent the dissemination of the fine scales.

The important indications to be met in the severe cases are very high temperature, cardiac depression, and nervous symptoms—dulness, stupor, sometimes coma, or convulsions. In some of the cases there are in addition dyspnoea and cyanosis, showing severe acute pulmonary congestion. For the nervous symptoms and high temperature, nothing is so reliable as the cold baths or packs (pages 47 and 48) and the nearly continuous use of ice to the head. I do not think there is any evidence that the use of cold increases the liability to pneumonia; but cold extremities, feeble pulse, and cyanosis, when associated with high temperature, call for the hot mustard bath, although ice should still be applied to the head. The indications for stimulants and the methods of using them are the same as in bronchopneumonia (page 510), which is usually present in cases requiring them.

To diminish the chances of pneumonia, it is necessary that every patient should be kept in bed during the attack, and care exercised to avoid exposure; that the chest should be protected with flannel and rubbed daily with oil. But still more important is it in hospitals and institutions where most of the cases of pneumonia occur, to allow the patients plenty of air space, never crowding them together in small wards. If possible, cases complicated by pneumonia should be separated from simple cases. From the fact that the pneumococcus and the streptococcus are found in the mouth so constantly and in such numbers in cases complicated by pneumonia, Méry and Bouloque have suggested systematic disinfection of the mouth several times a day, with the purpose of preventing this complication. There is reason in this suggestion, although its efficacy has not yet been put to a practical test.

The bronchitis and broncho-pneumonia of measles should be managed as in cases where they occur as primary diseases, as the coexistence of measles furnishes no new indications. The same is true of the diarrhœa, conjunctivitis, and otitis. Membranous laryngitis, pharyngitis, or tonsillitis should be treated like other cases of pseudo-diphtheria. Should cultures show the presence of the diphtheria bacillus, the case should be treated like one of ordinary diphtheria in the same situation.

During convalescence the eyes should be used very carefully for at least several weeks. Should the cough and slight fever persist, with or without physical signs in the chest, the patient should, if possible, be sent away to a warm, dry, elevated district, as the development of tuberculosis is always to be feared. Cod-liver oil should be given continuously throughout the succeeding cool season, and iron, wine, and other tonics according to indications. The cough itself should be treated as when it follows an ordinary bronchitis (page 470), creosote being more generally useful than any other drug.

CHAPTER III.

RUBELLA.

Synonyms: German measles; r otheln.

RUBELLA is a contagious eruptive fever which is rarely seen except when prevailing epidemically. It is characterized by a short invasion, with mild, indefinite symptoms, usually lasting but a few hours, and by an eruption which is generally well marked but of variable appearance. The constitutional symptoms are very mild, and the disease rarely proves fatal, not often being even serious. For a long time rubella was confounded with measles and scarlet fever, as the eruption sometimes resembles one and sometimes the other disease. Its identity is now fully established, and, as Str umpell well says, its existence is doubted only by those who have never seen it. The following peculiarities have been stated by Griffith (Philadelphia), who has written more fully on rubella than any other American writer, and to whom I am indebted for many facts in this article:

(1) Rubella is a contagious, eruptive fever, and not a simple affection of the skin; (2) it prevails independently either of measles or of scarlet fever; (3) its incubation, eruption, invasion, and symptoms, differ materially from those of both these diseases; (4) it attacks indiscriminately and with equal severity those who have had measles and scarlet fever and those who have not, nor does it protect in any degree against either of them; (5) it never produces anything but rubella in those exposed to its contagion; (6) it occurs but once in the individual.

Etiology.—Rubella is beyond question contagious, but is decidedly less so than either measles or scarlet fever; so that some observers have doubted its contagion altogether. It can be communicated at any time during its course, but is especially contagious during the early stage. Epidemics usually prevail in the winter or spring. As in the other eruptive fevers, a striking immunity is seen in infants under six months old; but, with this exception, all ages are liable to the disease.

The incubation of rubella varies considerably; the usual period is from eight to sixteen days, although the limits are from five to twenty-two days.

Symptoms.—*Invasion.*—This is rarely more than half a day, and in many cases no prodromata whatever are noticed, the rash being the first thing to attract attention. In a few cases there are mild catarrhal symptoms, with general *malaise* and slight fever. At other times there may be vomiting, convulsions, delirium, epistaxis, rigors, headache, or dizziness; but all are to be regarded as very exceptional.

Eruption.—Frequently a child wakes in the morning covered with the rash, no symptoms having been previously noticed. It generally appears first upon the face, and spreads rapidly to the whole body, the lower extremities being last covered. Less than a day is usually required for its full development. Exceptionally the eruption comes first upon the chest and back, and sometimes nearly the whole body is covered almost at once. The rash has occasionally been observed in the roof of the mouth before it was visible on the face. In a considerable number of cases the entire body is not covered; but the rash is more constantly seen upon the face than upon any other part.

Its character is subject to considerable variation. The eruption is most frequently composed of very small maculo-papules; they are of a pale-red colour, and vary in size from a pin's head to a pea. The spots are usually discrete, but may cover the greater part of the body where it is seen. On the face it is frequently confluent, and often appears here as large, irregular blotches of a red colour. From this description the rash will be seen to resemble that of measles more than that of any other disease. Very often, however, there is a tolerably uniform red blush which bears a close resemblance to the rash of scarlet fever; but even in such cases there will nearly always be found upon some part of the body, usually the wrists, fingers, or forehead, some typical maculo-papules. Between these two extremes all variations are seen. The colour of the eruption is sometimes dark red, and rarely it has been noted to be hæmorrhagic. The degree of elevation above the surface is also variable; sometimes this is so marked as to give to the skin a "shotty" feel, while in others the elevation is scarcely perceptible. The duration of the eruption is usually three days. Occasionally it lasts only two days, and it may last but one; it is rare for it to remain as long as four days. It fades in the order of its appearance,

and more rapidly than the eruption of measles. A slight brown pigmentation of the skin sometimes remains for a few days after the rash.

The highest temperature is coincident with the full eruption; this does not usually exceed 102° , and often it is only 100° F. As a rule, the temperature continues but two days, falling as the eruption fades. Very often the fall to normal is abrupt. Rarely severe cases are seen in which the fever lasts for four or five days, being 101° or 102° F. during the invasion, and rising to 104° or 105° F. during the full eruption. The other symptoms are in most cases even less marked than the fever. Occasionally catarrhal symptoms resembling a mild attack of measles are present, or a sore throat suggesting mild scarlet fever; but more frequently all these are absent. The eruption is usually out of all proportion to the other signs of disease.

Swelling of the post-cervical glands is one of the most constant features of rubella. In most epidemics it is seen in nearly all cases; but as a symptom for differential diagnosis it is not of great importance, as it is not uncommon in measles. The glandular swelling is most marked at the height of the disease; it is never very great, and subsides slowly without suppuration. Both vomiting and diarrhœa are rare in rubella. Swelling and itching of the skin are occasionally present, but to a much less extent than in scarlet fever or measles.

Desquamation.—This is always slight, and occurs in very fine scales lasting from one to five days. In many cases it can be discovered only by the most careful examination, and occasionally it is entirely wanting. Writers who have observed some fairly typical epidemics have stated that desquamation did not occur.

Complications and Sequelæ.—A characteristic feature of rubella is the absence both of complications and sequelæ. In the great majority of cases none are seen. Isolated instances have been reported in which have occurred, severe bronchitis or pneumonia, severe catarrhal pharyngitis, albuminuria, diarrhœa, phlyctenular conjunctivitis, multiple abscesses, otitis, erysipelas, and urticaria; but all are to be regarded as very exceptional.

Prognosis.—There are few diseases so free from danger as rubella. A fatal termination is extremely rare, and is usually due to pulmonary complications. Squire makes the significant statement that if the mortality reaches three per cent the disease is not rubella, but measles.

Diagnosis.—The principal interest attaching to rubella is in its diagnosis. This is a matter of extreme difficulty, and often it is an impossibility. The most characteristic thing about the disease is a well-marked eruption with very few other symptoms. Cases so closely resemble mild scarlet fever or mild measles that the differentiation by symptoms is impossible; it must be made from the surroundings and the fact that the disease is prevailing epidemically. Scarlet fever with a low temperature and abundant rash should always be regarded with suspicion, as should mea-

sles with a doubtful or absent catarrh. These difficulties in diagnosis can be appreciated only by one who has seen epidemics of measles and scarlet fever in institutions, and has watched the mild course of undoubted cases of these diseases which have there occurred.

It is never safe to make the diagnosis of rubella unless the disease is prevailing epidemically. Sporadic cases in which the diagnosis is made are, I believe, almost invariably instances of mild measles or scarlet fever. The first cases of rubella in an epidemic thus become difficult of recognition and are often overlooked. The continued absence in succeeding cases of the characteristic symptoms and complications of measles or scarlet fever should suggest to the physician that he is probably dealing with rubella.

Treatment.—None whatever is required for the disease excepting isolation, and even this is not imperative. The individual symptoms and complications are to be met with as they arise.

CHAPTER IV.

VARICELLA.

Synonym: Chicken-pox.

VARICELLA is an acute, contagious disease, characterized by a cutaneous eruption of papules and vesicles and by mild constitutional symptoms, serious complications and sequelæ being very rare. Although long confounded with varioloid, its existence as a distinct disease has been generally admitted for many years.

Etiology.—It is well established that the contagium of the disease is contained in the vesicles, as it may be communicated by inoculation with their contents. The specific poison, however, has not yet been isolated. Varicella is contracted by exposure to another case or through the medium of a third person. It affects children of all ages, one attack being as a rule protective. It is very contagious, resembling measles in this respect. The duration of incubation is quite uniformly from fourteen to sixteen days.

Symptoms.—Slight fever and general indisposition may be noticed for twenty-four hours before the appearance of the eruption, but in most cases the eruption is the first symptom. It usually appears first upon the face, scalp, or shoulders, as small, red, widely-scattered papules, and spreads slowly over the trunk and extremities. The papules in most cases come in crops, new ones continuing to appear for three or four days, even upon the same part of the body. The earlier ones have generally begun to dry up by the time the later ones appear, so that all stages of the eruption may be present at one time in the same region, this being one of its most

diagnostic features. The papules are at first very small, but gradually increase in size, and are surrounded by an areola from one fourth to half an inch in width. Many of them go no further than this stage, but the majority become vesicular. The vesicles are usually flat, and vary a good deal in size—the largest, being about one fourth of an inch in diameter. The process of drying up generally begins at the centre, which causes a slight depression, giving the vesicle a somewhat umbilicated appearance. The areola is most distinct at the time of the fully-formed vesicle, and fades as the latter dries. Crusts now form, which fall off in from five to twenty days, depending upon the depth to which the skin has been involved. In the majority of cases no mark is left, but after the most severe attacks, where the true skin has been involved, scars remain, and occasionally there is quite deep pitting. Such marks are few in number, and are most likely to occur upon the face.

Sometimes, especially upon hands and feet, the vesicle appears without having been preceded by a papule; often there is no areola, and the vesicle resembles a drop of water upon healthy skin. In most cases pustules are not seen, but they may develop in consequence of irritation or infection, the result of scratching, or in children who are poorly nourished. Under these circumstances deeper ulceration may occur, lasting for weeks. In rare cases there may be a necrotic inflammation about the site of the pock, a condition to which is sometimes given the name *varicella gangrenosa*. It is not peculiar to varicella, and is described elsewhere under the head of Gangrenous Dermatitis (page 872).

The pocks are usually most abundant over the back and shoulders, and their number is in proportion to the severity of the disease. In mild cases only twenty or thirty may be found upon the entire body, but in severe cases the skin may in certain regions be nearly covered. The eruption is never confluent. The pocks are almost invariably seen on the hairy scalp, and frequently three or four may be found on the mucous membrane of the mouth or pharynx,—a point of some diagnostic value. In the latter situation the appearance is first a tiny vesicle, and later a superficial ulcer resembling that of herpetic stomatitis.

The temperature is highest when the eruption is most rapidly appearing, this usually being the second or third day. In an average case it reaches only 101° or 102° F., and lasts but two days; in severe cases it may rise to 104° or 105° F., and last for four or five days. It falls gradually to normal as the rash fades. The other symptoms are mild and not characteristic. There is no coryza, cough, vomiting, or diarrhoea, but instead only the general indisposition which accompanies any febrile disorder.

Complications.—The most serious complication is erysipelas, which develops about the pocks, particularly when they are deep and attended with some ulceration. I have known of three fatal cases from this cause.

Adenitis, either simple or suppurative, and abscesses in the cellular tissue, are occasionally seen. Nephritis is very infrequent, but a number of cases are recorded. It may occur at the height of the disease, but more often at a later period, like the nephritis of scarlet fever. Varicella is quite frequently complicated by other infectious diseases. In the New York Infant Asylum epidemics of varicella and scarlet fever at one time occurred together, and in at least a dozen children both diseases were seen at the same time.

Diagnosis.—The diagnosis of varicella is usually easy, provided the following points are kept in mind: First, that the eruption comes out slowly and in crops, so that papules, vesicles, and crusts may be seen upon the skin in close proximity; secondly, that the umbilication is due only to the mode of drying up of the vesicle, which begins at the center; thirdly, the appearance of the pocks upon the mucous membranes, and the history of exposure. It is distinguished from urticaria and other forms of skin disease by the presence of fever.

Treatment.—Although it is usually a trivial disease, isolation of cases of varicella should be enforced in schools and in institutions containing many infants. In the home, unless the other children are delicate or in poor condition, quarantine is unnecessary. The disease may probably be conveyed as long as the crusts are present, hence isolation should be maintained until they have fallen off. In most cases constitutional symptoms of the disease are so mild as to require no treatment.

Locally, the itching, when annoying, may be allayed by sponging with a weak solution of carbolic acid or the use of carbolized vaseline. When the crusts have formed, this ointment or vaseline containing two per cent ichthyol should be applied. Care is necessary to keep the skin clean, and, in the case of infants, to prevent scratching. In severe cases the urine should invariably be examined.

CHAPTER V.

VACCINIA—VACCINATION.

VACCINIA (cowpox) is a febrile disease induced in man by inoculation with the virus obtained either directly from the cow (bovine virus) or from a person who has been inoculated (humanized virus). The disease is not contagious in the ordinary sense of the term, but is communicated by inoculation either accidental or intentional.

The nature of the protection against smallpox which vaccination affords is even now but imperfectly understood. The fact, however, remains one of the best attested in medical history. It is the imperative duty of the physician to see to it that every young infant is vaccinated,

and no foolish sentiment or prejudice on the part of the parents should be allowed to stand in the way.

Re-vaccination.—Regarding the duration of the protective power of a single vaccination, positive statements are impossible. Nearly all writers are agreed that vaccination should be done in infancy, again at puberty, and a third time at about the age of twenty or twenty-five. Many also insist upon re-vaccination at about the seventh year. It is a safe rule when smallpox is prevalent to vaccinate every person who has not been successfully vaccinated within five years.

Choice of Virus.—Modern experience is quite unanimous in the substitution of bovine for humanized virus, the advantages being that the lymph is much more likely to be obtained pure, uncontaminated by the germs of erysipelas or suppuration, and that the risk of transmitting syphilis is thereby avoided. There is now no difficulty in obtaining the ivory or quill points used for the preservation of bovine virus. There are many vaccine farms which can be depended upon for the purity and freshness of the virus which they supply.*

Time for Vaccinating.—In selecting a time for vaccination, the child's age and general health must be taken into consideration. It is pretty well established that the constitutional disturbance is much less in infancy than in later childhood, and less in very young infants (under one month) than in those of five or six months. Wolff states that of forty-two infants successfully vaccinated during the first week of life, not one showed any constitutional disturbance; after the fifth month, however, febrile symptoms were invariably present, and occasionally severe. A good rule for general practice is to vaccinate every healthy infant as soon as it begins to gain regularly in weight, this being in most cases during the first two months of life. In delicate infants or in those whose nutrition is a matter of great difficulty, those who are syphilitic, those suffering from eczema or any other form of active skin disease, vaccination should be deferred until the child is in good condition, unless it is likely to be exposed to smallpox. As a rule, vaccination should be avoided during dentition.

Methods of Vaccinating.—In my experience it is better to vaccinate in one place rather than to make two or three inoculations. Either the leg or the arm may be chosen; in young infants it is usually easier to protect the vaccine sore upon the leg than upon the arm. The point selected for inoculation should be either the outer aspect of the left calf, about the junction of the middle with the upper third of the leg, or the insertion of the left deltoid. The skin should be washed with soap and water, dried, and then washed with alcohol. With an ordinary large-sized cambric needle, which

* My own experience with that of the New England Vaccine Company of Massachusetts has been extremely satisfactory.

should be a new one, three or four scratches should be made a quarter of an inch long, and these crossed by as many more, just deeply enough to draw blood. The moistened vaccine point is now thoroughly rubbed for a full minute over the wound. After this has dried thoroughly the part may be covered with isinglass plaster moistened in boiled water, although if thorough drying has taken place the plaster is not necessary. The needle should not be used for a second child. The vaccinated limb should not be washed for twenty-four hours.

The Normal Course of Vaccinia.—The course of a proper vaccination-pock is quite uniform, and one which does not follow this course should not be considered protective. The original wound heals like any other scratch, nothing of importance being seen until the fourth or fifth day, when a slight areola is visible about the site of inoculation, which enlarges until it is an inch or two in diameter. Then there rises a vesicle, sometimes two, which afterward coalesce. The vesicle is from one fourth to one half an inch in diameter, and has a depressed centre (Fig. 164). By the ninth or tenth day the fully-formed vesicle is seen. The areola is now two or three inches wide, and there is more or less swelling. The lymph nodes in the axilla, or in the groin if the leg has been inoculated, are slightly swollen, tender, and sometimes painful. The vaccine pock changes but slightly for a day or two, after which, usually upon the eleventh day, the areola fades, the vesicle ruptures and discharges, or dries to a crust, this process occupying about two days. The crust remains for from one to three weeks, when it falls off leaving a smooth bluish scar which afterward fades to a white, and becomes somewhat honeycombed.

In some cases the symptoms are more severe. There may be swelling of the whole limb and marked pain. The original vesicle may be two or three times as large as usual, and secondary vesicles may form in the neighbourhood (Fig. 165). The inflammation may extend deeply into the subcutaneous tissue, and it may be followed by suppuration or even sloughing. There is then left an ugly ulcer, sometimes an inch wide and one fourth of an inch deep, to be filled slowly by granulation. In such cases the whole course of the disease may be from five to eight weeks.

If in a young infant the first inoculation is unsuccessful, at least three trials should be made with good virus, and in the event of further failure, after a year vaccination should be repeated. A failure to inoculate does not mean insusceptibility to smallpox, as is often popularly believed, but most frequently arises from the fact that the virus is inert. I have known one case in which the seventh, and another in which the thirteenth, inoculation was successful after previous failures; occasionally there are seen children who can not be inoculated at all.

Constitutional symptoms, as previously stated, are often absent in the case of very young infants; but in others there is quite constantly present a fever which runs a fairly regular course. It usually begins on the fourth



FIG. 164.

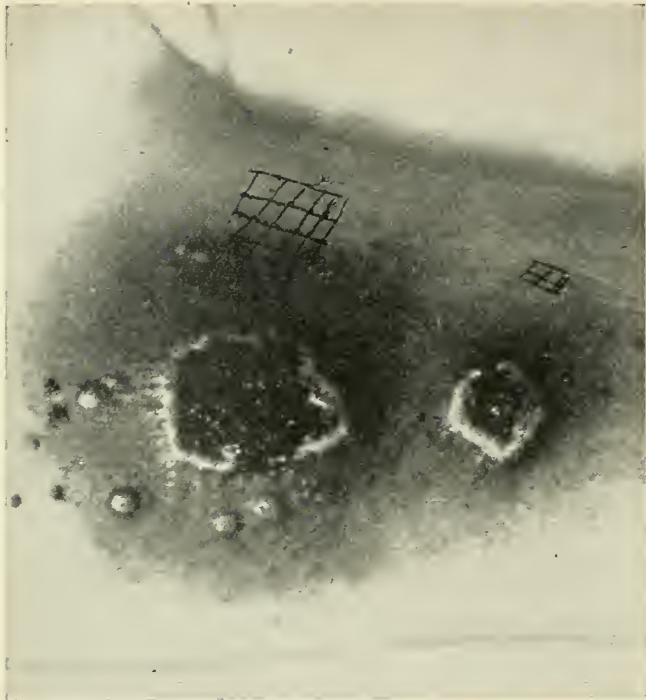


FIG. 165.

VACCINE VESICLES.

FIG. 164 shows typical vaccine vesicles upon the tenth day, giving also the exact size of the scarification, and an areola of average appearance. FIG. 165 shows vesicles also upon the tenth day, with the exact size of the scarification, and illustrates the relation between the two. There are several small vesicles near the large one, and an unnecessarily large sore has resulted. Both vesicles were produced with the same lymph. (After photographs by William C. Cutler, M. D.)

or fifth day, is remittent in type, and rises gradually, reaching its highest point with the full development of the vesicle. At this time it varies from 101° to 104° F., falling gradually to normal. The duration of the fever in cases running the usual course is four or five days. Accompanying it there may be anorexia, restlessness, loss of sleep, slight indigestion, and other symptoms of a general indisposition.

Variations in the Course of Vaccinia.—Occasionally the period of incubation is prolonged, and no evidence that the inoculation has been successful is seen for from ten to fourteen days, or even longer, and yet the subsequent course may be normal. In some cases multiple pocks are present, which may be produced by auto-inoculation, usually by scratching. They may be only in the neighbourhood of the original one, or upon any other part of the body. In cases of eczema of the face, inoculation has not infrequently been carried thither. A generalized eruption of pocks is sometimes seen, although this is very rare. In secondary vaccination both the local and general symptoms may be quite as intense as in the primary cases, and in many instances they are even more severe.

Complications and Sequelæ.—Post-vaccine eruptions occur in great variety, and from three quite distinct causes. Even with pure virus there may be urticaria, erythema, or a general roseola which often resembles the eruption of measles, and occasionally purpura has been seen. As the result of mixed infection at the time of the original inoculation, there may be produced impetigo contagiosa, syphilis, or even tuberculosis. From subsequent infection of the vaccination wound, there may be furunculosis, cellulitis, or erysipelas. The complications are in the main the result of the causes just enumerated. In addition to the diseases mentioned, there may be pyæmia, gangrenous dermatitis, suppurative adenitis, and in rare cases pneumonia or nephritis. Sequelæ are very rare; but where latent constitutional tendencies have existed they may be aroused to activity, as in the case of tuberculosis. A child who has once had eczema is liable to a recurrence at such a time; and in very delicate children a condition of malnutrition is frequently intensified if the vaccinia has been particularly severe.

The mortality of vaccination is stated by Voigt, from careful statistics drawn from German sources, to have been 35 in 2,275,000 cases, including both primary and secondary vaccinations. Of the deaths, 19 were due to erysipelas, 8 to gangrene, 2 to cellulitis, 3 to "blood poisoning," and 3 to other causes. It will be observed that these were all, or nearly all, from preventable causes.

Treatment.—The purpose of this is simply cleanliness and protection, to prevent the irritation of clothing, and also to prevent the child from scratching, for by these means the vesicle usually becomes infected. No treatment is required until the vesicle has formed. The limb should then be protected by clean linen, or, better, by a vaccine shield, of which one

made of a wire network and fastened to the limb by a tape, is probably the best form. As soon as the vesicle ruptures and begins to discharge serum, it should be frequently dusted with boric acid. If there is suppuration, the pock should be treated antiseptically, like any other granulating wound. If a vaccinated limb is kept perfectly clean, and the pock dry by the free use of the powder mentioned, very little trouble need be apprehended. If the local symptoms are at all severe, the limb should be kept at rest. For this reason, a child old enough to walk should not be vaccinated upon the leg.

The complications are to be treated as when these conditions arise under other circumstances.

CHAPTER VI.

PERTUSSIS.

Synonym: Whooping-cough.

PERTUSSIS is a contagious disease which prevails epidemically and in most large cities endemically. Although it may affect persons of any age, it is generally seen in young children, and as a rule it occurs but once in the same individual. While in later childhood pertussis may be ranked as one of the milder infectious diseases, in infancy it is one of the most fatal. Its principal complications are broncho-pneumonia and convulsions. Pertussis is characterized by catarrhal and nervous symptoms. The catarrh affects the mucous membranes of the respiratory tract, and is probably due to a specific form of infection. It is accompanied by a hyperæsthetic condition of these mucous membranes. The most prominent nervous manifestation is a peculiar spasmodic cough which occurs in paroxysms, and from which the disease takes its name. The cough is no doubt of reflex origin, from an irritation which by different writers has been located in various parts of the respiratory tract. In addition to these conditions, there is present in pertussis a very marked irritability of the nervous system generally, which in infancy frequently shows itself by convulsions.

Etiology.—Pertussis is probably due to a micro-organism, but its nature is as yet unknown. Proximity to a patient is all that is required to communicate the disease, and as in the case of measles even close proximity is not necessary. There seems to be no doubt, from clinical experience, that the disease may be contracted in the open air.

Predisposition.—Fully one half the cases of pertussis occur during the first two years of life. This statement, which is in accord with general experience, is borne out by the following statistics of Szabo (Buda-Pesth),

showing the ages at which the disease was met with in 4,591 cases, comprising the records of one clinic for thirty-four years :

Under one year.....	1,028 cases.	Three to four years.....	904 cases.
One to two years.....	1,008 “	Four to seven years.....	803 “
Two to three years.....	659 “	Over seven years.....	189 “

Pertussis thus shows a stronger tendency to affect very young infants than does any other contagious disease. It not infrequently occurs during the first six months of life, a number of cases are on record in which it has occurred during the first month, and one has recently come to my notice where a child twelve days old was attacked, whose mother was suffering from the disease at the time the child was born. Statistics taken from a large number of epidemics show that the disease is nearly twice as frequent in the winter and spring as in the summer and autumn. Epidemics of pertussis often occur at the same time with or follow those of measles.

The susceptibility to pertussis is very great, and is equalled only by that to measles. Biedert reports that of 401 children exposed during an epidemic in a certain village, 366, or ninety-one per cent, took the disease.

Infective period.—Pertussis may be communicated from the very beginning of the catarrhal stage; exactly how long a given case may be contagious it is impossible to say positively. It is pretty certain that it is so during the entire spasmodic stage, and probably longer. In most cases quarantine is required for two months from the beginning of the attack, and in many cases for a much longer time. The usual source of the contagion is the patient, rarely the room or the clothing. While it is possible that pertussis may be carried by a third party, this is very unlikely unless a person has been in very close contact with a patient, and goes at once without change of clothing to another child.

Incubation.—The very gradual onset of pertussis renders it impossible in the majority of cases to fix the exact date, and hence to establish the definite duration of the period of incubation. In cases where it could best be determined it has usually been found to be from seven to fourteen days, or about the same as measles. If, after an exposure, sixteen days pass without the development of a cough, the probabilities are very strong that the disease has not been contracted.

Lesions.—The only constant lesions of pertussis consist in a catarrhal inflammation of varying intensity, which affects the mucous membrane of the larynx, trachea, and bronchi, and sometimes that of the nose and pharynx. If the child dies during a paroxysm, either with or without convulsions, the brain is found intensely congested and may be the seat of punctate hæmorrhages, or even larger extravasations. The lungs always show emphysema if the attack has been severe or protracted. The other pulmonary lesions are due to complications, the most frequent of which is broncho-pneumonia. Catarrhal enteritis and colitis are not infrequent.

Symptoms.—The symptoms of pertussis are usually divided into three stages—the catarrhal, the spasmodic, and the stage of decline.

The catarrhal stage continues on the average for about ten days, although cases show considerable variation on this point. Some children whoop almost from the very beginning of the disease, while others may cough for several weeks before a typical whoop is noticed. The symptoms in the beginning are indistinguishable from those of an ordinary attack of subacute tracheo-bronchitis, and unless there has been an exposure to pertussis no suspicion is excited. After five or six days, however, the cough, instead of abating as in an ordinary cold, gradually increases in severity and occurs in paroxysms. At first these are mild, and there are only two or three a day, but they gradually increase in frequency and severity until the typical whoop is heard which marks the beginning of the spasmodic stage. During the first stage there may be symptoms of a mild grade of catarrhal inflammation of the nose, pharynx, and larynx, and often there is a slight elevation of temperature.

The spasmodic stage.—In a typical paroxysm of average severity the child, who can usually foretell it, will often run for support to the lap of the mother or the nurse, or seize a chair with both hands. There now occurs a series of explosive coughs, from ten to twenty in number, coming in such rapid succession that the child can not get its breath between them; the face becomes of a deep red or purple colour, sometimes almost black; the veins of the face and scalp stand out prominently; the eyes are suffused, and seem almost to start from their sockets; there follows a long-drawn inspiration through the narrowed glottis, producing the crowing sound known as the whoop; and then another succession of rapid coughs follows and another whoop. In a single severe paroxysm, which lasts two or three minutes, the child may whoop half a dozen times; with the final paroxysm a mass of tenacious mucus is usually brought up. The most common attendant symptoms of the paroxysm are vomiting and epistaxis. In a young child vomiting is almost certain to follow, if food has been recently taken. Epistaxis sometimes occurs with nearly every severe paroxysm, but in most cases the bleeding is slight. After such an attack as that described, a child is at times so exhausted as to be hardly able to stand; there is profuse perspiration; his mind is confused, and he may be completely dazed. In infants the attack may result in a degree of asphyxia so deep as to necessitate artificial respiration.

The number of severe paroxysms or “kinks” in twenty-four hours varies, according to the severity of the case, between half a dozen and forty or fifty. There are always many more of a milder form. Paroxysms are often excited by eating or drinking anything which is cold, by a draught of air, or by imitation; they are usually more frequent during the night than the day, and in a close room than in the open air.

In less severe cases no paroxysms of the grade above described may

occur, and no typical whoop may be heard throughout the attack; but the paroxysmal nature of the cough which continues until the plug of mucus is raised, the watery eyes, and the vomiting which follows a paroxysm, stamp the disease as pertussis. In young infants the whoop is frequently not marked. The child sometimes coughs until it is asphyxiated, and yet no whoop occurs. The paroxysms are also modified by intercurrent disease, especially by attacks of pneumonia or severe bronchitis. At such times they usually become less frequent and less typical, and may be absent for several days, returning as the complication subsides.

The seat of irritation which produces the cough has been located by different observers in different mucous membranes: some have thought it to be in the nose, others in the trachea, the bronchi, or the larynx. It is very probable that it may not always be in the same mucous membrane; and that the infectious catarrh, which is really the most important element in the disease, may vary in its intensity and location in different cases. The weight of evidence seems to be that in the great majority of cases the source of irritation is in the larynx or trachea. From laryngoscopic examinations made during the disease, Von Herff found the mucous membrane of the larynx to be swollen and congested, and occasionally the seat of small hæmorrhages or superficial ulcers. He states that the frequency and severity of the paroxysms corresponded with the degree of laryngitis, and he found that a paroxysm could always be excited by irritating the mucous membrane between the arytenoid cartilages. During a paroxysm he observed that there was a collection of mucus on the posterior laryngeal wall, the removal of which had the effect of shortening the paroxysm.

Rossbach made laryngoscopic examinations, with negative results so far as the larynx was concerned, but he states that a plug of mucus could always be seen in the lower trachea for one or two minutes before the paroxysm occurred. There is little doubt that this collection of mucus is the exciting cause of the paroxysm, as it is a familiar clinical fact that the paroxysm always continues until this is dislodged.

The average duration of the spasmodic stage is about one month. It increases in intensity for the first two weeks, remains stationary for about a week, and then gradually diminishes in severity. The course and duration are, however, subject to wide variations. In mild cases this stage may last only a week; in severe cases, especially in the winter season, it may continue for three months, at times greatly subsiding, but lighting up again with all its previous severity with every fresh attack of cold. After it has entirely ceased the whoop may return with an attack of bronchitis, and continue for a month or more. This is not to be regarded as a true relapse of pertussis. The habit of the paroxysmal cough once established, it tends to recur with every slight bronchitis, often for months afterward.

The stage of decline.—Gradually the severity of the paroxysm abates, the whoop ceases, and the cough resembles more and more that of ordinary bronchitis. This stage usually continues about three weeks, but may be prolonged indefinitely in the winter months.

Complications.—*Hæmorrhages.*—The hæmorrhages of pertussis are mechanical, and depend upon the intense venous congestion which accompanies the paroxysm. Epistaxis is the most frequent variety, and occurs in a considerable proportion of the severe cases, in a few with almost every severe paroxysm, but it is rarely severe enough to require local treatment. Hæmorrhages from the mouth may have their origin either in the pharynx or the bronchi, the blood being brought up by the cough; such hæmorrhages are usually small. Conjunctival hæmorrhages are less frequent, and are usually slight, although I have seen the entire conjunctiva of one eye covered. In a case under my observation there was bleeding from both ears with every severe paroxysm, for more than a week. This child had previously suffered from scarlatinal otitis, with perforation of the drum membrane. Small extravasations into the cellular tissue beneath the eyes are occasionally seen, giving an appearance somewhat like an ordinary “black eye.” Intracranial hæmorrhages are not frequent, but many examples have been recorded, and they may be severe enough to produce death. They are usually meningeal, very rarely cerebral; according to their extent and location they may produce hemiplegia, monoplegia, aphasia, facial paralysis, or disturbances of the special senses of sight, hearing, sensation; in addition, there may be convulsions or rigidity, but rarely complete coma. The extravasations are usually small, and the symptoms which they produce disappear at the end of a few weeks. Fatal cases with autopsies have been reported by Cazin, Marshall, and others. In almost every instance these hæmorrhages have occurred as a direct result of severe paroxysms of the cough. Purpura hæmorrhagica as a sequel of pertussis was twice seen at the New York Infant Asylum.

Respiratory system.—The most serious complications of pertussis are connected with the lungs. By far the largest proportion of deaths is due to pulmonary complications, usually broncho-pneumonia. This is more frequent in winter and spring than in the summer months, and is especially to be dreaded during infancy. In later childhood lobar pneumonia is occasionally seen. Pneumonia rarely begins before the second week of the disease, and most frequently develops at the height or toward the close of the spasmodic stage. The physical signs present no peculiarities; the cough changes somewhat in character during the pneumonia, and the whoop may not be heard. The prognosis of the pneumonia is bad, because of the debilitated condition of the children at the time of its occurrence. A great danger is from the supervention of convulsions, this being a frequent mode of termination. As there is always considerable

emphysema the rapidity of breathing is frequently out of proportion to the temperature, which often is only moderately elevated. If the child escapes the dangers of the acute stage, death may still occur from exhaustion, owing to the protracted course which the disease frequently runs.*

Bronchitis of the large tubes is present in almost all the severe cases, and is not of itself serious. Bronchitis of the small tubes has the same dangers and the same complications as broncho-pneumonia.

Vesicular emphysema has been present, I think, in every case which I have seen upon the post-mortem table; a certain amount of it, no doubt, occurs in every severe case. It is produced by the forcible cough of the paroxysm. In very severe cases interstitial emphysema is also found. Northrup has reported a remarkable instance of this complication. Rupture of the air-blebs which form on the surface of the lung, may lead to emphysema of the cellular tissue of the mediastinum, and the air may find its way along the great vessels into the neck, and finally into the subcutaneous cellular tissue of the entire body. Cases of general subcutaneous emphysema have been reported by Croker and Hodge, both of which ended fatally, one in three and one in eight days from the beginning of the emphysema. In the great majority of the cases vesicular emphysema is not permanent.

Digestive system.—During the summer, infants with pertussis are almost certain to suffer from diarrhœa; it may be only an occasional symptom, or the attack may be severe and prolonged, resulting in the development of ileo-colitis. The intestinal complications may be almost as serious in summer as are those of the respiratory tract in winter. Vomiting is even more frequent than diarrhœa, and, while it may be distressing at any age, it is especially so in infancy. So frequently does the taking of food excite vomiting, that the nutrition of these patients often becomes a matter of the greatest difficulty, and in fact the most serious problem in the management of a case. Malnutrition and even marasmus may follow, or the general resistance of the child may become so reduced by lack of food that it falls a ready prey to pneumonia.

Nervous system.—There may be convulsions, coma, paralysis, aphasia, disturbances of sight or hearing, and in rare cases even of the mental condition. The most serious of these complications are convulsions. They are much more frequent in infancy than later, and are particularly so in those who are rachitic, where they are often fatal. Convulsions are of course more common in severe attacks, but they may occur suddenly where there has previously been no cause for anxiety. They are especially to be dreaded if pneumonia is present. The attack of convulsions may be the culmination of the extreme degree of nervous irritability which accompanies the paroxysm, it may be due to asphyxia, or to an intracranial

* For further particulars regarding the pneumonia of whooping-cough, see page 503.

lesion; if the latter, there is usually meningeal hæmorrhage. This is to be suspected if there are continued convulsions for several hours, with general rigidity or hemiplegia.

Disturbances of the sight are not infrequent in severe cases; usually these are transient, but there may be blindness lasting two or three days or even weeks. The transient symptoms most likely depend upon circulatory changes in the brain during the paroxysm, while those which last for two or three weeks are probably due to meningeal hæmorrhage. Disturbances of hearing are rare. The different forms of paralysis occurring with pertussis may likewise be transient or permanent. They are to be explained in the same way as the disturbances of the special senses. The most common form is hemiplegia.

Albuminuria is not infrequent, being found in 66 of 86 examinations by Knight. The quantity of albumin is rarely large, and it may be accompanied by a few hyaline casts. Both are probably the result of circulatory disturbances in the kidney. Other complications of pertussis are hernia, prolapsus ani, and ulcer of the frenum linguæ.

Diagnosis.—In the early part of the catarrhal stage it is impossible to make a diagnosis; there is no way by which the disease can be distinguished at that period from an ordinary cough; but after a week the gradual increase in severity in spite of treatment, and the fact that the cough becomes more and more paroxysmal, and that it is accompanied by vomiting and suffusion of the eyes, should make one strongly suspect pertussis. If the disease is prevalent, the diagnosis may be regarded as certain when these symptoms are reached, even without the typical whoop. Cases which present the greatest difficulty in diagnosis are those of a mild type, where, perhaps, without ever having a typical paroxysm, a child who has been exposed to pertussis coughs for a number of weeks. Under these circumstances it may be impossible to say, even at the close of the attack, whether it was or was not pertussis; but if a child has no fever and no physical signs of bronchitis, and has been exposed to the disease, the probabilities are strong that a severe cough which continues six or eight weeks, and upon which ordinary treatment has little or no effect, is pertussis.

The diagnosis is difficult also in early infancy, for at this period every cough is likely to show more or less of a spasmodic character, and there may be occasionally heard a fairly typical whoop in the course of an ordinary attack of bronchitis. This is to be compared to the laryngeal spasm which occurs with a mild attack of catarrhal laryngitis. Abortive cases also present difficulty in diagnosis. I have seen in a single family three children with pertussis of typical duration and severity, and a fourth child suffering from a cough, which lasted but two weeks, and in whom the whoop was heard only for one day. If such cases occurred by themselves, it would be impossible to make a positive diagnosis.

Irritation of the pneumogastric or recurrent laryngeal nerve from enlarged tracheal or bronchial lymph nodes, whether of a simple or tuberculous character, may give rise to a spasmodic cough, which in certain cases may be indistinguishable from whooping-cough. The prolonged duration of these cases is sometimes the only diagnostic point; but the paroxysms are usually not so severe as in true pertussis, and the course is generally less typical.

Prognosis.—The most important factor in the prognosis of the disease is the age of the patient. After the fourth year it is indeed rare that either a fatal result or serious complications are seen; but during infancy, and particularly during the first year, there are few diseases more to be dreaded. This is especially true on account of the connection of whooping-cough with the three most fatal conditions of infantile life—broncho-pneumonia, diarrhœal diseases, and convulsions. Fully two thirds of the deaths from whooping-cough occur during the first year of life. The prognosis is very much worse in infants of the first three months than in those who are older and consequently have more resistance. It is better in the summer than in the winter, because broncho-pneumonia is then less frequent. It is particularly bad in delicate infants, in those who are rachitic, in those who are prone to attacks of bronchitis, in those who have suffered previously from pneumonia, and in those with a strong tendency to tuberculosis.

The exact mortality of whooping-cough it is difficult to state in figures. During the first year of life it is probably not far from twenty-five per cent, although it diminishes rapidly after this time. In foundling asylums and hospitals for infants it is to be ranked among the most fatal diseases, and in some epidemics the mortality in such institutions is as high as fifty per cent.

Fully two thirds of the deaths during whooping-cough are from broncho-pneumonia; the next most frequent cause is diarrhœal diseases. Convulsions may be the mode of death in either of the above conditions, or may occur apart from them. During the first year, death often results from marasmus, the child having been reduced by the prolonged disease. Occasionally death is due to asphyxia following a severe paroxysm, to intracranial hæmorrhage, or to general emphysema.

As a predisposing cause of tuberculosis, pertussis is second only to measles. In both diseases tuberculosis develops in much the same way and from much the same causes (p 922).

Prophylaxis.—Pertussis is a contagious disease, and a child suffering from it should be isolated from other children wherever this is possible. Children with pertussis should never be allowed to attend school, and needless exposure should always be avoided.

Young infants, delicate children, and those with a predisposition to tuberculosis, should be most carefully protected against exposure, since it

is in them chiefly that the disease is likely to be serious. As it is from the patient that the disease is nearly always contracted, there does not exist the same necessity for the fumigation and disinfection of apartments as after other contagious diseases. In institutions, however, this should always be practised, and in private houses if the room is subsequently to be occupied by an infant.

It is as undesirable as it is impossible to confine a child with pertussis to a single room during the attack; all those persons for whom exposure would be dangerous should therefore be sent away from the house. Quarantine should continue on the average for six weeks, or until the spasmodic stage is over.

Treatment.—*General measures.*—It is extremely important that children should have plenty of fresh air throughout the attack. It is a matter of common observation that they have fewer paroxysms while out of doors than in the house, and that the paroxysms are very much more frequent when children are confined in close rooms. They should be kept in the open air as much as possible during the day, in pleasant weather, and even on unpleasant days the windows should be freely opened. If a child's temperature is above 100° F., he should not be sent out, but may have fresh air in the room. In all cases it is important to have the windows freely opened at night, unless bronchitis or broncho-pneumonia is present.

A change of air is desirable for cases in which the cough is unduly prolonged. A warm place at the seashore is one which is most likely to be beneficial. The improvement during a sea voyage is sometimes very marked, and it surpasses even a residence at the seashore.

The rooms occupied by children suffering from pertussis should be frequently changed, thoroughly aired, and, when possible, occasionally fumigated. This change of rooms, clothing, bedding, etc., sometimes exerts a marked influence on the course of very prolonged attacks, the inference being that continued re-infection takes place. Such a change should be made twice a week, and it is of special importance in hospitals, where many children quarantined in a ward seem to cough interminably.

Vomiting and indigestion are both so frequent that feeding becomes at times very difficult. In most cases it is necessary to repeat the meal in a short time, if the first one has been vomited in consequence of a severe paroxysm. Children over two years old should in all such cases be kept upon a fluid diet, chiefly of milk. For infants, milk should be diluted, and in many instances it must also be partially peptonized. Any medication which causes disturbance of the stomach must be omitted. In severe cases, on account of the inability to retain a proper amount of food, the child's strength should be kept up by the use of alcoholic stimulants.

Local treatment.—This may be in the form of insufflations of powder

into the nose, local applications to the larynx by a spray or swab, and inhalations.

The first two methods have been advocated, in the belief that the cough is due to an infectious catarrh having its seat in the nose or larynx. For insufflation, quinine or benzoic acid is preferred, mixed with some finely divided, inert powder, such as bicarbonate of sodium, talcum, or coffee; these are used with the powder insufflator once or twice daily. Local applications to the larynx may be made by means of the spray or swab. Resorcin and carbolic acid, each in a one-per-cent solution, are most used. These applications are made once or twice daily. I have not seen from any of the above methods the beneficial results claimed, and I believe them to have been exaggerated. The application of cocaine to the larynx, although highly recommended, should never be employed in young children on account of the danger of poisoning.

Inhalations are of much more value. They are useful to modify the catarrh by allaying irritation, facilitating the expulsion of the mucus, and possibly as antiseptics. Those most employed are carbolic acid, creosote, and cresoline. In my experience creosote is by far the best. These substances may be used dropped upon cotton in a respirator, or vapourized over an alcohol lamp (page 58), or cloths may be dipped in solutions and hung in the patient's room. In using carbolic acid the possibility of absorption should not be forgotten, and the urine should be watched. In paroxysms of great severity, inhalation of chloroform may be required as the only means of warding off convulsions or preventing dangerous asphyxia.

Internal medication.—Of the innumerable drugs which have been recommended for this disease, three possess undoubted advantages over all others—viz., quinine, belladonna, and antipyrine. Quinine is best given to young children as an aqueous solution of the bisulphate; it should be given in full doses, from eight to ten grains daily to an infant under two years, and from fifteen to twenty grains to children from two to four years old. The only objection to quinine is its tendency to upset the stomach; if it causes vomiting the dose must be reduced or the drug discontinued. It will usually be found more successful in children over, than in those under, four years. I rarely attempt to use it in infants.

Belladonna may be used in the form of the fluid extract or atropine. It is important to begin with a small dose and gradually increase both its frequency and size until the physiological effects of the drug are produced. To an infant two years old, half a minim of the fluid extract may be given every four hours as an initial dose, gradually increasing to every two hours; if atropine is used, gr. $\frac{1}{400}$ may be given in the same way. Although belladonna usually has a decided influence in reducing both the

frequency and the severity of the paroxysms, it causes so many unpleasant symptoms that it is difficult to continue its use for a long period.

Antipyrine has been in my hands more satisfactory than either quinine or belladonna. It may be used with safety even in young infants in considerably larger doses than are ordinarily employed. For a child six months old the initial dose should be one grain every three hours; later, this may be given every two hours, and sometimes even more frequently. For a child two years old the initial dose should be two grains every four to six hours, gradually increased if necessary up to two grains every two hours. The frequency of the dose will depend upon the severity of the case. In the event of the development of pneumonia the antipyrine should be discontinued.

With bromoform and other newer remedies I have had much less success than with those referred to. Nearly all drugs which allay nervous irritability have a certain amount of effect in controlling the paroxysms of pertussis; chloral and trional are often useful where the night attacks are so severe as to prevent sleep. Better results are sometimes obtained from a combination of the bromide of sodium with antipyrine than from the latter given alone. I do not believe that any form of internal medication or local treatment shortens pertussis; but, inasmuch as the disease is self-limited, great benefit to the patient results from the reduction of the number and the diminution of the severity of the paroxysms.

In establishing the value of any method of treatment, it should be remembered that the number of cases in which the disease is considerably shorter than the average is large, and also that almost any method of treatment if employed after the attack has reached its height will be thought beneficial, as the natural tendency is then to improve. The value of any particular line of treatment is to be judged in a given case only by its effect in reducing the number and severity of the paroxysms. This ought to be evident in the case of drugs within two or three days, and can only be determined by keeping a careful record of the number of severe paroxysms day and night. No drug succeeds equally well in all cases.

In a mild case, where the number of severe paroxysms does not exceed eight or ten during the day, where there is no vomiting and the general health is not affected, it is not usually advisable to continue the administration of any drugs throughout the disease. A single dose of antipyrine or phenacetine at night may be all that is necessary. All cases in infants must be watched with great care and the parents warned of the possible dangers which may supervene suddenly, even in the course of mild attacks. For severe cases antipyrine should be given to diminish the frequency and the severity of the paroxysms and inhalations of creosote used if much catarrh is present. All the fresh air possible should be allowed. For older children the same plan of treatment may be followed, or quinine or belladonna may be substituted for the antipyrine.

As these drugs are given solely for the purpose of diminishing the frequency and severity of the paroxysms, their continuous use should be deferred until the symptoms are sufficiently severe to greatly disturb the child, the benefit at this period being more striking than if they are begun early and used continuously.

CHAPTER VII.

MUMPS.

Synonym : Epidemic parotitis.

MUMPS is a contagious disease characterized by swelling of the parotid, and sometimes of the other salivary glands, with constitutional symptoms which are usually mild. Both severe complications and a fatal termination are extremely infrequent. The disease is not a very common one, and general epidemics are rare.

Pathology and Lesions.—The contagious character, definite incubation, and typical course, stamp the disease as a general one due to a specific poison, probably a micro-organism, whose nature is as yet unknown. It is probable that infection takes place through the salivary ducts.

The precise nature of the changes in the gland is still a matter of dispute, as opportunities for pathological examination are very rare. From existing evidence it would appear that the gland substance is first involved, and afterward the surrounding connective tissue. The gland is the seat of an intense hyperæmia and œdema; the walls of the salivary ducts are swollen, and the ducts are obstructed. While the primary disease does not tend to excite suppuration, pyogenic germs may occasionally gain entrance and an abscess form; but this is to be regarded as a rare, accidental infection.

In the great proportion of cases the parotids alone are affected, although the same changes are occasionally found in the other salivary glands. There are no other essential lesions of the disease, those which are found depending upon complications.

Etiology.—Mumps is spread by contagion, close contact being usually required to communicate the disease, although it is known to have been carried by a third party and even by clothing. The susceptibility of children to the poison of mumps is much less than is the case with the other contagious diseases, so that only a small number of those who are exposed take the disease. The greatest predisposition is between the fourth and fourteenth years. Infants are rarely affected, although a case in a child three weeks old is vouched for by so good an observer as Demme.

Mumps is contagious from the beginning of the symptoms. Two cases have come under my notice in which the disease was communicated

before any swelling was seen. It is impossible to fix with certainty the duration of the infective period. The disease is undoubtedly communicable for several days after the swelling has subsided; and for safety a case should be isolated for three weeks from the beginning of symptoms, or at least ten days after the swelling has disappeared.

Incubation.—In forty-eight collected cases in which the incubation was definitely determined, it varied between three and twenty-five days. It was less than fourteen days in only four cases, and in twenty-six of the forty-eight cases it was between seventeen and twenty days. In three cases of my own in which it could be definitely fixed, the incubation was nineteen days in one and twenty days in two cases. The average period of incubation, then, may be stated to be from seventeen to twenty days.

Symptoms.—In the milder cases the local symptoms are the first to attract attention; in those which are more severe there are frequently prodromal symptoms of from twelve to forty-eight hours' duration,—anorexia, headache, vomiting, pains in the back and limbs, and fever. Soltmann has reported a case ushered in by convulsions. The initial temperature in a mild attack is 100° to 101° F.; in a severe one, from 102° to 104° F.

Of the local symptoms, the pain usually precedes the swelling; it is increased by movement of the jaws, by pressure, and sometimes by the presence of acid substances in the mouth. It is usually referred to the posterior part of the jaw just below the ear. The swelling may begin simultaneously in both parotids, but more frequently one side is involved a day or two in advance of the other. It usually reaches its maximum on the third day, often on the second, remains stationary for two or three days, and then subsides gradually. The degree of swelling varies with the severity of the attack. When it is marked, the patient presents a ridiculous appearance and is scarcely recognisable; it fills the lateral region of the neck between the jaw and the sterno-mastoid muscle and extends forward upon the face to the zygomatic arch, so that the centre of the tumour is usually the lobe of the ear. The other salivary glands may swell simultaneously with the parotids, or several days later, even after the parotid tumour has disappeared. Occasionally swelling of the submaxillary or the sublingual glands occurs before that of the parotid, and in rare instances these may be the only glands affected.

As a rule, the parotid of both sides is involved. Of 282 cases both sides were affected in 215. When one side alone is involved, it is the left a little more frequently than the right. The interval between the swelling of the two sides may be a week, or even five or six weeks, but usually it is only two or three days.

The salivary secretion is usually very much diminished, and the dry mouth causes great discomfort. An exceptional instance has been reported by Simon, in which a distressing salivation occurred, the secretion amounting to six or eight ounces daily.

Although as a rule the patient is not seriously ill, mumps may in rare cases produce most alarming and even dangerous symptoms. The temperature may for several days reach 104° F. or more, deglutition may be extremely difficult, pressure on the jugular veins may lead to venous hyperæmia of the brain, causing headache and sometimes delirium; there is sometimes great prostration and the symptoms of the typhoid condition. These severe attacks are nearly always in children over twelve years old.

The constitutional symptoms of mumps usually last from three to five days; the swelling continues on an average a little less than a week. If the case has been a severe one, slight swelling may continue for two weeks or even longer. Relapses, in which the opposite side from the one first affected is involved, are quite frequent, occurring in about ten per cent of the cases.

Complications and Sequelæ.—In childhood the complications are few and usually unimportant; but in adolescence they are occasionally serious. Orchitis is exceedingly rare in childhood; of 230 cases observed by Rilliet and Barthez, this was seen in but 10, and only 3 of these cases were under fifteen years, and no case under twelve years old. When orchitis occurs it is generally toward the end of the second or the beginning of the third week; it is usually marked by an accession of fever, sometimes by a chill; if severe, nervous symptoms may be present. The local symptoms do not differ from those of an ordinary attack of orchitis. The body of the testicle and not the epididymis is generally affected. The acute symptoms continue for three or four days, and the entire duration is about a week; although the testicle is often enlarged for some time afterward, and atrophy of the organ may follow.

In females, congestion and swelling of the breasts, ovaries, or labia majora may occur; and, although they are all very rare, most of them have been observed even in young children.

Nephritis has in a few instances followed mumps, sometimes coming on as late as four or five weeks after the attack. Single cases have been reported by Croner, Isham, Henoch, and others. Nervous sequelæ are more frequent, but even these are rare. Jaffrey has reported a case of multiple neuritis with typical symptoms, occurring three weeks after an attack. Facial paralysis three weeks after mumps has been reported by Hellier, apparently due to an extension of inflammation from the gland to the seventh nerve.

Pearce* has collected an interesting series of forty cases of deafness following mumps, in which there was no sign of otitis, the symptoms coming on suddenly with vertigo, a staggering gait, and often with vomiting. In most of the cases the deafness was unilateral and the loss of hearing was permanent. The cause assigned was disease of the auditory

* Manchester Chronicle, 1885.

nerve, the seat of the trouble being in the labyrinth. Toynbee has reported an instance of hæmorrhage into the labyrinth. Otitis media is rarely seen.

Suppuration of the parotid glands occurs in about one per cent of the cases, and is probably due to accidental infection. Gangrene and sloughing of the parotid were observed twice by Demme in 117 cases, both of which proved fatal. Pneumonia, meningitis, endocarditis, and pericarditis have all been observed as complications of mumps, although all are extremely rare.

Prognosis.—In the great proportion of cases mumps is a mild disease, and terminates in complete recovery in a few days. In young children complications are infrequent, and those which occur are rarely severe.

Diagnosis.—Mumps is most likely to be confounded with acute swelling of the cervical lymph nodes. In a parotid swelling, the lobe of the ear is near the centre of the tumour, which extends backward to the sterno-mastoid muscle and forward upon the face as far as the zygomatic arch, embracing the angle and ramus of the jaw.

A swollen lymph node is usually entirely below the ear and behind the jaw, never extending upon the face. The tumour is generally smaller and more circumscribed if only a single node is involved, and it comes on much more slowly than does mumps. When only the submaxillary or sublingual glands are affected, the diagnosis from swollen lymph nodes is sometimes impossible except by the course of the disease. Mumps is characterized by the rapidity with which the swelling occurs, and by its relatively short duration.

Treatment.—The disease is self-limited and the individual symptoms rarely distressing, so that in most cases very little treatment is required. If constitutional symptoms are present the patient should be kept in bed, and if there are none he should be confined to the house. The gland should be protected by cotton or spongio-piline, and if the pain is severe heat should be applied or the gland painted with belladonna. The diet should be liquid, on account of the pain produced by mastication. The mouth should be kept clean by the use of some antiseptic mouth-wash. The general symptoms and complications are to be treated according to the indications in the individual cases. Cases of mumps occurring in schools or institutions should be quarantined for three weeks, and in private practice where there are susceptible persons. Fumigation and disinfection after an attack are unnecessary.

CHAPTER VIII.

DIPHTHERIA.

UNTIL within the last few years it has been customary to class as diphtheria all diseases characterized by the production of a false membrane upon the mucous membranes of the throat or air passages. Bacteriological study of these cases has yielded results so uniform that we are now able to separate them into two groups: In one, there has been demonstrated the constant presence of the Klebs-Loeffler bacillus—the *Bacillus diphtheriæ*; this group includes cases formerly classed as primary diphtheria, and also certain others such as primary membranous laryngitis and rhinitis, the pathology of which has been the subject of much dispute. In the other group the Klebs-Loeffler bacillus is absent; this group includes most of the membranous inflammations of the throat which occur as complications of measles and scarlet fever, and many primary cases of such inflammations affecting only the tonsils or the tonsils and pharynx, and formerly regarded by some as croupous tonsillitis, by others as mild or doubtful diphtheria. The form of bacteria which has usually been found in these inflammations which simulate diphtheria, is the streptococcus pyogenes, occasionally the staphylococcus. In the following pages the term *diphtheria* will be limited to those cases in which the Klebs-Loeffler bacillus is present, the others being grouped under the head of false or *pseudo-diphtheria*.

Diphtheria may then be defined as an acute, specific, communicable disease due to the bacillus of Klebs and Loeffler. It is usually characterized by the formation of a false membrane upon certain mucous membranes, especially those of the tonsils, pharynx, nose, or larynx. Like other pathogenic organisms, however, this germ acts with varying intensity, and may cause inflammation of all degrees of severity, from a mild catarrhal angina to the most serious membranous inflammation; but to all alike the term diphtheria should be applied. In its mild form it may be almost without constitutional symptoms; but in its severe form it is attended by great general prostration, cardiac depression, and anæmia, it is frequently complicated by pneumonia and nephritis, and it may be followed by localized or general paralysis; it then constitutes one of the diseases most to be dreaded in childhood. While, therefore, there are now included under the term diphtheria many cases formerly not recognised as such, there are excluded many others which somewhat resemble it clinically, but in which the bacillus of diphtheria is absent.

Etiology.—*The Bacillus Diphtheriæ.*—This was first described by Klebs in 1883, and during the following year it was isolated by Loeffler

and shown to be pathogenic. Little was added to this discovery until 1888, but from that time until 1891 very extensive observations were made in France, Germany, and America,* all confirming the early conclusions of Loeffler. By 1891 all the conditions, says Welch, had been fulfilled to demonstrate that this bacillus was the cause of diphtheria,—viz., (1) its constant presence; (2) its isolation in pure culture; (3) the reproduction of the disease in animals by inoculation with pure cultures; (4) the finding of a similar distribution of the bacilli in the original and in the experimental disease.

The bacillus of diphtheria varies considerably in size and shape even in the same culture. Its length is from 1.5 to 6.5 micro-millimetres; its diameter, from 0.3 to 0.8 micro-millimetres. In a specimen it occurs singly or in pairs, sometimes in chains of three or four; the bacilli may lie parallel, but frequently two form an acute or an obtuse angle (Plate XVIII, 3, 4, and 5). They are straight or slightly curved, and are somewhat swollen or club-shaped at their ends. The bacilli have no spores, but contain highly refractile bodies, which cause them to stain peculiarly. With alkaline methyl blue (Loeffler's stain) they stain in a very characteristic way; not uniformly, but the oval bodies in the central parts or in the extremities of the bacillus, stain more deeply than the rest of the protoplasm. This difference is not seen in the old cultures which stain with difficulty (Park).

The best culture medium is Loeffler's blood-serum.† After ten or twelve hours, at a temperature of about 100° F., the colonies (Plate XVIII, 1 and 2) appear slightly elevated, of a white or grayish colour, with rounded but generally irregular borders. They may increase to one fourth of an inch in size; and although the early colonies are about the same size as those of the streptococcus, the later ones are larger. They do not liquefy the blood-serum.

Distribution and mode of communication.—Diphtheria prevails epidemically, endemically, and sporadically. In most large cities it is endemic, occasional cases occurring throughout the year, with periods in which outbreaks of considerable severity are observed. In the country it prevails chiefly as an epidemic. The disease is often introduced into remote districts in some inexplicable manner, and before its nature is recognised a large number of persons have been exposed, and an epidemic results.‡

* For a summary of the literature upon this subject see Welch and Abbott. Johns Hopkins Hospital Bulletin, February and March, 1891; Prudden, New York Medical Record, April, 1891; Park, New York Medical Record, July and August, 1892.

† Blood-serum two thirds, nutrient bouillon one third, glucose one per cent.

‡ The following is an example of the way in which diphtheria may be introduced: In the country branch of the New York Infant Asylum, consisting of a somewhat isolated community of about five hundred persons, chiefly children, there had been no

Diphtheria does not arise *de novo*. Every case has its origin in a previous case either directly or remotely. The bacilli may enter the body through the inspired air; they may be taken into their mouth with toys or other articles upon which they have lodged, or by kissing, and sometimes accidental inoculation occurs. As a rule, the bacilli first gain a foothold upon the mucous membrane of the tonsils, nose, or larynx.

Direct infection is the cause in the great majority of the cases. There is no proof that the bacilli are contained in the breath of a person suffering from the disease. They are discharged in great numbers in the saliva and mucus from the mouth and nose, and in pieces of membrane which are coughed up; they are not present in the urine or feces. The most contagious cases are those of pharyngeal diphtheria of severe type and long duration, chiefly on account of the amount of discharge which accompanies them. The cases that are least contagious, and for precisely opposite reasons, are those in which the membrane is limited to the larynx and lower air passages.

Direct infection may occur from persons convalescent from diphtheria, whose throats still contain virulent bacilli, or from persons suffering from a mild form of the disease, which is not recognised as diphtheria. In the latter way it is often spread in schools. It has been shown that a person may harbour virulent bacilli in his nose or throat, and may even communicate the disease to others, without himself suffering from diphtheria at any time.

The length of time during which a patient with diphtheria may convey the disease to others is somewhat uncertain. Transmission is possible so long as virulent bacilli remain in the throat; these are frequently found two weeks after the membrane has disappeared and the patient is regarded as entirely well, and in a few cases they are found five or six weeks or longer after recovery.

Indirect infection is not uncommon, and may occur from the bed or clothing of the patient, from the carpet, furniture, wall-paper or hangings of the room, from toys or picture-books, from dishes, feeding-bottles, or drinking-cups, from swabs and brushes used for local applications to the throat, from spoons and tongue-depressors, and from surgical instruments with which tracheotomy or intubation has been done. Diphtheria may be carried by a third person, but rarely except by one who has been in close

case of diphtheria for several years until 1887. The first case was one of membranous laryngitis, proving rapidly fatal in two days. At autopsy, membrane was found only in the larynx. The case was regarded at that time as evidence of the existence of a primary non-diphtheritic membranous croup. In the course of the next few weeks there developed a number of cases of typical diphtheria. On investigation, it was discovered that the nurse who had charge of the child first affected, had been a few weeks before in attendance upon a case of diphtheria. During the five years following, cases of diphtheria occurred in the institution every year.

contact with the patient—either the physician or nurse. The frequency of diphtheria in physicians' families bears witness to the great danger of infection in this manner.

Bacilli may retain their virulence for an indefinite period. Both Park and Loeffler found cultures in blood-serum to be virulent after seven months; Roux and Yersin, bacilli in dried membrane to be virulent after twenty weeks; and Abel, upon a child's toy after five months.

Domestic animals may in rare instances be carriers of infection, and in the case of pigeons, at least, they may themselves suffer from the disease. Diphtheria has been repeatedly spread by milk, but very rarely through the contamination of a water supply. Bad drainage, defective sewerage, and decomposing organic matter are occasionally associated with outbreaks of diphtheria, these furnishing conditions favourable to the development of the bacilli; but apart from the presence of the bacilli they are incapable of producing the disease.

Predisposing causes.—Local conditions in the throat influence very largely the occurrence of diphtheria. An important predisposing cause is the existence of a chronic catarrhal inflammation of the mucous membranes of the nose and throat, so frequently found in children suffering from adenoid growths of the pharynx or enlarged tonsils. These adenoid growths, the tonsillar crypts, and the cavities of carious teeth, may harbour the bacilli for a considerable time both before and after an attack. The condition of these membranes in other acute infectious diseases furnishes a marked predisposition to diphtheria. This is most striking in the case of measles and scarlet fever; it is seen less frequently in typhoid fever and influenza. Children with very sensitive mucous membranes, such as those reared in institutions or in tenement houses, are peculiarly susceptible. Infection through a healthy mucous membrane, if not impossible, is certainly very unlikely.

The two sexes are about equally liable to the disease. Children under ten are much more often affected than those who are older, the greatest susceptibility as regards age being between the second and fifth years. Of 14,688 deaths occurring in New York from diphtheria during ten years, the ages were as follows (Billington):

Under one year.....	1,214
One to five years.....	9,622
Five to ten years.....	3,212
Ten to fifteen years.....	311
Over fifteen years.....	329
	<hr/>
	14,688

While diphtheria is seen throughout the year, it is rather more frequent during the cold than the warm months. Of 18,688 deaths occurring in New York from diphtheria during thirteen years, there were

10,769 from October to March, inclusive, and 7,919 from April to September, inclusive (Bosworth).

The incubation of diphtheria is short. In most of the cases in which it could be definitely traced it has been between two and five days. It is shorter when the disease is epidemic, when the patient is very susceptible, when the local conditions in the mucous membranes are favourable, and when the type is virulent. The virulence varies much in different cases and in different seasons, and while it is frequently true that persons infected from a mild case have a mild type of the disease, and those infected from a malignant one a severe type, there is no certainty that such will be the sequence. Dr. W. H. Park informs me that, out of many hundreds tested in the laboratory of the New York Health Department, by far the most virulent type of the bacillus was obtained from the throat of a boy who had what was clinically regarded as a very mild form of tonsillar diphtheria.

Second attacks of diphtheria, while more frequent than those of measles or scarlet fever, are relatively rare. It seems to be established by recent observations that the immunity conferred by one attack of diphtheria is of comparatively short duration, amounting probably to a few months only. In my own experience, however, I can recall but very few instances of second attacks. R. W. Parker (London) believes the protection afforded by one attack to be quite as complete as that of measles or scarlet fever.

Lesions.—The essential lesions of diphtheria consist not in the production of a membrane, but, as long ago pointed out by Oertel, and more recently by Babes, Sidney Martin, and others, in certain acute degenerative changes in the cells of the body caused by the diphtheria toxines. These changes are seen particularly in the epithelial cells of the affected mucous membranes, the heart muscle, the kidney, the liver, the peripheral nervous system, the spleen, and the lymph glands; the most characteristic being those of the nerves and the liver. There are other lesions which are the result of the action of other organisms, especially the streptococcus pyogenes and the pneumococcus, either alone, together, or in conjunction with the diphtheria bacillus. The most important lesions due to these organisms are broncho-pneumonia and nephritis; but there may be found in the blood, and in many of the organs of the body, the evidences of the invasion of these bacteria—i. e., a streptococcus septicæmia, less frequently a general pneumococcus infection.

Distribution of the diphtheria bacillus in the body.—Unlike many other pathogenic organisms, the diphtheria bacillus is not widely distributed throughout the body. It is found in great numbers on the surface of the affected mucous membranes and in the false membrane itself, particularly in its superficial portion, but it does not invade deeply the subjacent structures. It is only exceptionally found in the blood and

in distant organs, and then in such small numbers that its presence is rarely discovered except by cultures.

The diphtheria toxins.—The wide-spread effects seen in diphtheria are due to the action of certain substances called *toxines* which the diphtheria bacillus produces during its growth on mucous membranes. The toxins have been studied especially by Roux and Yersin, Brieger and Fraenkel, and have been called tox-albumins. They are very diffusible, readily entering the lymphatic circulation and the blood, and through these channels may affect the entire body. It has been shown by Welch and Flexner and others that in susceptible animals there may be produced by the injection of the toxins all the characteristic lesions of diphtheria except the membrane, as well as the essential symptoms of the disease, even including paralysis. For the production of the membrane living bacilli are required.

“Catarrhal” diphtheria.—It has been already stated that a membrane is not always present in inflammations excited by the diphtheria bacillus. The routine practice of making cultures from diseased throats has established the fact that in a large number of cases catarrhal inflammation may be the only result of diphtheritic infection. To the naked eye there may be only the ordinary changes of a catarrhal inflammation of a mucous membrane; but even in such cases Oertel found the characteristic degenerative changes in the epithelial cells. These, of course, vary in degree with the severity of the process.

The diphtheritic membrane.—The membrane is most frequently seen upon the mucous membrane of the tonsils, soft palate, uvula, pharynx, nose, larynx, trachea, and bronchi; less frequently upon the mouth, lips, œsophagus, conjunctivæ, middle ear, stomach, and genital organs. It may also affect fresh wounds, notably a tracheotomy wound, or any abraded cutaneous surface. The gross appearance of the membrane varies greatly (Plate XVII). It is most frequently of a gray or mouse-colour, but it may be pearly white, yellow, green, and sometimes almost black. It is composed of fibrin, cells, granular matter, and bacteria. Its consistency varies with the relative proportions of the different elements. When made up chiefly of fibrin it is firm and retains its form, often being discharged as a complete cast of the nose, larynx, or trachea. When the amount of fibrin is small the membrane is soft, friable, and sometimes granular. It is more closely adherent upon the mucous membranes covered with squamous epithelium, as in the pharynx and upper air passages, than upon those covered with columnar and ciliated epithelium, as in the lower air passages.

The microscopical examination shows the fibrin to be sometimes granular, but usually in the form of a network, inclosing in its meshes small round cells and epithelial cells in various stages of degeneration. On the surface and in the superficial layer there is usually found quite a variety

of bacteria including diphtheria bacilli. Beneath this is a cellular layer containing little or no fibrin, in which also the diphtheria bacilli are usually found. In the deepest parts of the false membrane and in the mucous membrane itself they are few in number or absent.

Characteristic changes which are similar in all the affected mucous membranes are found in the epithelial cells. The cells undergo marked proliferation and infiltration with leucocytes; they show also degenerative changes in their protoplasm and fragmentation of their nuclei, which result in the formation of granular masses of necrotic substance. The infiltration with small round cells is variable in degree in the different mucous membranes; in some it extends deeply into the submucous and even the muscular layers, while in others it is very superficial. Marked evidences of cell death are seen also in the cells infiltrating the deeper layers. In places the epithelium is detached, in others the line between the false membrane and the granular mucous membrane is scarcely distinguishable.

The seat and the distribution of the membrane.—This varies somewhat with the age of the patient, the season, and the peculiarity of the epidemic. In the following table are given some figures from the records of the New York Infant Asylum. These cases were taken consecutively, and did not belong to a single epidemic:

Above the larynx (63 cases).	{	Tonsils only.....	27 cases.
		Pharynx or pharynx and tonsils.....	18 "
		Pharynx and nose or rhino-pharynx.....	18 "
Not above the larynx (10 cases).	{	Larynx only.....	6 "
		Larynx and trachea.....	1 case.
		Larynx, trachea, and large bronchi.....	1 "
Both above and below the larynx (36 cases).	{	Larynx, trachea, large and to smallest bronchi.....	2 cases.
		Pharynx and larynx.....	12 "
		Pharynx, larynx, and trachea.....	6 "
		Pharynx, larynx, trachea, and large bronchi.....	4 "
		Pharynx, larynx, trachea, large and to smallest bronchi.	10 "
		Nose, pharynx, larynx, and trachea.....	1 case.
		Nose, larynx, and trachea.....	1 "
		Pharynx and trachea (none in larynx).....	1 "
Pharynx, trachea, and bronchi (none in larynx).....	1 "		
			109 cases.

All these cases were in young children, 80 per cent of them being under two years old. In the first group the mortality was 30 per cent; in the second group, 90 per cent; in the third group, 92 per cent. The larynx was involved in 42.2 per cent of the cases. The location of the membrane was determined by autopsies in all the sixty-one fatal cases. The strong tendency of the disease in young children to invade the lower air passages, and to extend far into the bronchi when once the larynx is involved, is also shown in a report upon eighty-seven autopsies in laryngeal cases made by

Northrup. In only three was the larynx alone the seat of membrane; in 57 per cent the membrane descended into the bronchi, and in 37 per cent, to the finest bronchi. All these records are of the pre-antitoxine days.

An interesting comparison with the figures above given may be made with those of Lennox Brown of 1,000 cases, including persons of all ages, but mainly, doubtless, children:

Above the larynx (841, or 84·1 per cent).	{	Fauces (including tonsils) alone.....	672 cases.
		Nose alone.....	2 "
		Fauces and nose.....	165 "
		Mouth or lips alone.....	1 case.
		Hard palate alone.....	1 "
Involving the larynx * (159, or 15·9 per cent).	{	Larynx alone.....	4 cases.
		Larynx and fauces.....	109 "
		Larynx, fauces, and nose.....	46 "

The tonsils are the most frequent and usually the earliest seat of the diphtheritic membrane; it may form here a tough, leathery patch, partially or completely covering and very adherent to them; or the disease may affect only the tonsillar crypts, so that the gross lesion may resemble that of ordinary follicular tonsillitis. There is in most cases only moderate swelling, but it may be so great that the tonsils are in contact. The surrounding cellular tissue is infiltrated with inflammatory products.

The membrane covering the pharynx and uvula is also usually very adherent and intimately blended with the mucous membrane. The uvula is swollen and œdematous. Membrane may be seen only upon the fauces and uvula, or the posterior and lateral pharyngeal walls may be covered down to the level of the cricoid cartilage, but generally not below this point. If the posterior pharyngeal wall is covered, the membrane is apt to extend into the rhino-pharynx, and may fill the entire pharyngeal vault, covering the posterior portion of the velum and extending into the posterior nares. The adenoid tissue of the vault is a favourite seat, and is frequently the part most affected. The amount of infiltration of the submucous tissue varies much in the different cases.

The nose may be involved secondarily to the rhino-pharynx, or infection may be through the anterior nares; if the latter, it is not infrequently the only part involved. Many cases classed as nasal are really rhino-pharyngeal. The membrane in the pure nasal cases is usually thick and tough and often separates *en masse*. Both sides are generally involved, but it may be unilateral. Catarrhal diphtheria of the nose and rhino-pharynx is probably more frequent than in any other location.

The epiglottis is swollen to three or four times its normal thickness, and the aryteno-epiglottic folds are œdematous. The anterior surface of

* These being clinical and not pathological records, the number in which the disease extended below the larynx is not given.

the epiglottis is rarely covered by membrane; but its lateral borders and posterior surface, and the aryteno-epiglottic folds are involved in most of the severe pharyngeal cases (Plate XVII, C). This lesion is associated with pharyngeal rather than with laryngeal diphtheria.

The lesions which extend most deeply are thus seen in the tonsils, uvula, pharynx, and epiglottis. But even here there is very rarely deep or extensive sloughing.

The lesions of the larynx, trachea, and bronchi are similar to the above, although much more superficial. The interior of the larynx may be completely covered, the membrane coating the true and false vocal cords and lining the ventricles of the larynx; or it may extend from the epiglottis down to the anterior surface of the larynx, while the posterior surface is free. The membrane in the larynx is not usually very adherent, and it frequently separates and is coughed up in large pieces or even as a cast. The membrane covering the epiglottis and the aryteno-epiglottic folds is very adherent, like that of the pharynx. Catarrhal laryngitis is not an uncommon complication of pharyngeal diphtheria.

In a considerable number of cases the membrane stops abruptly at the lower border of the larynx. In the trachea it is generally loosely attached, and often it is found at autopsy entirely separated from the mucous membrane. It is almost invariably associated with membrane in the larynx. Usually the membrane in the bronchi is continuous with that in the trachea. Occasionally I have seen the trachea and larger bronchi passed over and found membrane only in the larynx and smaller bronchi. As a rule, the bronchi of both sides are affected, and to the same degree. I once saw a case of laryngeal diphtheria in which membrane was found only in the bronchi of one lung. The above exceptions are to be explained as accidents in the mechanical transportation of bacilli.

The extent of the membrane varies greatly in different cases. It may stop at the bifurcation of the trachea or at the bifurcation of the primary bronchi; but if it goes beyond this point it is likely to extend to the minutest subdivisions. In the large bronchi, as in the trachea, the membrane is loosely attached. In the smallest bronchi it is more adherent, and sometimes only to be made out by the microscope. Exceptionally a very tough fibrinous membrane forms in the trachea and bronchi, of sufficient thickness and consistency to be expelled as a cast, reproducing almost the entire bronchial tree.

The inflammation of the mucous membrane of the larynx, trachea, and bronchi is very much less severe and more superficial in character than that of the pharynx, tonsils, and upper air passages.

The buccal cavity is seldom covered by the membrane, and then only in the worst cases of pharyngeal disease; it may line the cheeks, cover the lips, gums, and more or less of the hard palate, but rarely the tongue. It

usually occurs in patches rather than as a continuous membrane. In a recent case I saw the membrane on the lower lip, extending on to the face, though the buccal cavity was free. Only once have I seen the membrane in diphtheria extend from the pharynx into the œsophagus; it is surprisingly infrequent. The membrane is very rarely found in the stomach, and in no case, so far as I am aware, has the diagnosis of true diphtheria been confirmed by cultures. I have in several instances seen membrane in the stomach; cultures, however, showed streptococci, but no diphtheria bacilli.

The middle ear is not very often involved. Otitis usually results from direct extension of the membrane from the rhino-pharynx through the Eustachian tube. It may lead to very extensive destruction of the mucous membrane of the tympanum, and often to permanent injury. Infection of the conjunctivæ is also rare, and is probably due to accidental inoculation rather than to extension from the nose through the lachrymal duct.

Diphtheria may attack an abraded cutaneous surface usually by direct inoculation, or it may involve a fresh wound. This is most frequently seen in the wound in the neck from tracheotomy. Most of the recorded cases in which diphtheria is stated to have involved the folds of the anus, the female genitals, the prepuce, or recent wounds, were observed before we had the means of separating by cultures, true from pseudo-diphtheria. A very considerable proportion of these cases doubtless belong to the latter group.

Visceral lesions.—The visceral lesions of diphtheria are due partly to the action of the diphtheria toxins and partly to the invasion of the body with other organisms, especially the streptococcus. It is to experimental diphtheria that we owe our most accurate knowledge of the former changes, for in human diphtheria the large proportion of all the fatal cases show evidences of so-called "mixed infection." Thus, of forty-two autopsies upon cases in which the diphtheria bacillus was demonstrated during life, Reiche * reports that both the streptococcus and the staphylococcus were found by culture in the kidney or spleen in 64·3 per cent, and in 45·2 per cent the streptococcus alone. He found the streptococcus in the kidney in some cases dying very early,—in one on the second day of the disease.

The visceral lesions of diphtheria consist in wide-spread areas of cell death similar to those which have already been described as occurring in the epithelial cells of affected mucous membranes, together with hæmorrhages due to changes in the blood-vessels and possibly in the blood itself. The lesions are found in the lymph nodes, spleen, heart muscle, epithelium of the kidney, liver cells, peripheral nerves, and in the lungs.

The lymph nodes of the cervical region are the most constantly and

* Centralblatt für innere Medicin, 1895, No. 3. Quoted by Welch, Transactions of the Association of American Physicians, 1895.

the most seriously affected. Similar but less marked changes are seen in the tracheo-bronchial and the mesenteric groups, and in the lymph nodules of the mucous membrane of the stomach and intestine. There are degenerative changes in the cells of the nodes most affected, with marked infiltration with leucocytes and frequently small hæmorrhages. The cellular tissue in the neighbourhood of the cervical nodes is often extensively infiltrated with cells. The process in the lymph nodes usually terminates in resolution, rarely in suppuration.

The changes in the spleen are quite constant. The organ is swollen, sometimes very much so, and deeply congested. Hæmorrhages are often seen beneath the capsule; the spleen pulp is soft, the follicles are large, and cell degeneration is quite constantly observed similar to that which takes place in the lymph nodes.

There are frequently small hæmorrhages beneath the capsule of the liver, and sometimes these are seen throughout the organ. There are found scattered through the liver, areas of necrotic hepatic cells which are peculiar to this disease; some of these areas are infiltrated with leucocytes.

The kidneys are involved in almost all fatal cases except where death occurs early from laryngeal stenosis, also in nearly every severe case which terminates in recovery. There is in the milder cases only acute degeneration of the epithelium of the tubes and the tufts, which is the result of the action of the diphtheria toxins; or in the more severe forms there may be acute exudative or even acute diffuse nephritis, the latter usually coming on at a later period of the disease. In the production of these two forms of inflammation, infection with streptococci probably plays the principal part. Welch states that hyaline changes in the glomerular capillaries and small arteries are characteristic features of the nephritis of diphtheria.

In cases dying suddenly in the early stage of the disease, cardiac thrombi are occasionally found. These may be formed rapidly only a short time before death, or slowly during several days when the circulation is very feeble. Portions of these thrombi may be carried into the pulmonary or systemic circulation, causing embolism in any of the arteries of the extremities, the lungs, or other viscera. Even in the early fatal cases the heart muscle may be seriously affected; in the later ones this is almost constant. The changes consist in a toxic myocarditis, the left ventricle being most involved.

Degeneration of the arteries, especially of the endothelial layer, is occasionally seen, and there may be infiltration of the adventitia. The arteries of any of the viscera may be the seat of hyaline degeneration.

The lesions of the brain are very slight and inconstant. In the spinal cord there have been found multiple hæmorrhages into the membranes, and certain degenerative changes in the ganglion cells in the anterior horns, to which great significance was formerly attached, as they were

thought to be the explanation of post-diphtheritic paralysis. These changes are, however, slight in comparison with those which have been found in the spinal nerves, with which they are generally associated. That diphtheritic paralysis is due not to the central lesion but to peripheral neuritis was first shown by Westphal in 1876, and more fully by Déjénie during the following year. Degenerative changes have been demonstrated not only in the spinal nerves but also in the hypoglossal, spinal accessory, motor-oculi, pneumogastric, and even in the nerves of the heart. According to Sidney Martin* these nerve degenerations constitute the most characteristic lesion of diphtheria. (See chapter on Multiple Neuritis, page 785.)

In infants and young children broncho-pneumonia is found at autopsy, it is safe to say, in at least three fourths of the cases, and in a large proportion of these it is the cause of death. It is well-nigh constant in cases of diphtheritic bronchitis of the finer tubes, and is usually present where the membrane has extended to the bifurcation of the trachea. The most important factor in the production of pneumonia is the aspiration of bacteria, chiefly streptococci, from the upper air passages. These germs are always present in the throat, and find in diphtheria conditions most favourable to their development. The pneumonia of diphtheria seems therefore to be due to auto-infection rather than to outside causes. Prudden and Northrup found streptococci almost constantly present in the pneumonia of diphtheria, often in pure culture. In cases studied by others the streptococcus has been found alone or associated with the pneumococcus or with the diphtheria bacillus, or with both of them.

Where there has been laryngeal stenosis, some emphysema is invariably present, and usually it is of the vesicular variety. In extreme or protracted cases of stenosis there may be interstitial emphysema. Rupture of some of these blebs may lead to the escape of air into the cellular tissue of the mediastinum or of the neck, which may result in the production of a general emphysema of the subcutaneous cellular tissue.

Blood.—According to the recent studies of Ewing, Morse, Billings, Jr., and others, there is found in all severe cases of diphtheria a reduction in the number of red cells to the extent of 500,000 to 2,000,000 (5,000,000 being assumed to be normal). There is a nearly proportionate reduction in the hæmoglobin, this amounting to from twelve to twenty-eight per cent. While the hæmoglobin falls coincidentally with the number of red cells, it is regained much more slowly. Leucocytosis was found in twenty-six of thirty cases studied by Morse, and in forty-nine of fifty-three by Ewing. It is said to be generally proportionate to the severity of the attack, but is occasionally wanting in the most severe as well as in some of the very mildest cases. The increase in the leucocytes is in the polynuclear forms.

* British Medical Journal, August 24, 1895.

Symptoms.—The clinical picture of diphtheria is one which presents wide variations, depending upon the principal location of the disease, its severity, and its complications. For practical purposes the following seems the simplest grouping that can be made:

1. The mild cases, in which there is either no membrane, or the amount of membrane is small and limited to the tonsils or to the nose, with few or none of the constitutional symptoms which follow absorption of the diphtheria poison. These cases partake essentially of the character of a local disease.

2. The severe cases, which are of two kinds: first, those in which there are marked evidences of constitutional poisoning from diphtheria toxins; and, secondly, those with laryngeal stenosis. The first form is usually accompanied by an extensive formation of membrane in the pharynx and sometimes in the nose. The larynx may be involved secondarily to disease in the pharynx or nose, or it may be primarily affected.

3. The cases of mixed infection or the septic cases. In very many of the cases of the two preceding groups streptococci are found in the throat, but they are not in sufficient numbers or of sufficient virulence to modify the course of the disease. In the cases to which the term mixed infection is applied, in addition to the constitutional symptoms of diphtheritic toxæmia and the local conditions which usually attend it, there are marked evidences of a general septicæmia, usually due to the streptococcus. In these cases the symptoms of inflammation are especially prominent, not only in the pharynx but sometimes in the lymph glands and cellular tissue of the neck, which may be followed by suppuration or sloughing. This form is frequently complicated by broncho-pneumonia even without laryngeal disease, and sometimes by severe nephritis.

Cases without membrane.—During an epidemic of diphtheria in a family or an institution, cases are frequently seen which present the clinical evidences of only a catarrhal inflammation of the nose or pharynx, and yet cultures show the presence of the diphtheria bacillus. These bacilli have been found by Koplik, Park, and others to be virulent in very many of the cases tested, but not in all. Such cases are susceptible of two explanations: first, that they are examples of simple catarrhal inflammation due to other causes, such as cocci, the diphtheria bacillus although present not being the active cause of the inflammation,—in other words, they are cases of simple catarrhal inflammation with the accidental presence of the diphtheria bacillus; the second is, that they are cases of “catarrhal diphtheria,” or an inflammation caused by infection with the diphtheria bacillus, but not of sufficient intensity to lead to the production of a membrane. The latter is the view of pathologists, and the one to which clinicians must, it seems, inevitably come. However, a membrane has so long been regarded as a *sine qua non* of this disease that the

existence of diphtheria without it, is something which the clinician finds it hard to grasp.

Cases of the kind mentioned may be either pharyngeal or nasal. In the pharyngeal cases there are present the usual appearances belonging to a catarrhal inflammation of moderate severity, often accompanied by swelling and tenderness of the cervical lymph glands. In the cases classed as nasal the usual seat of the pathological process in children is the rhinopharynx. There is a persistent and usually abundant nasal discharge, which is thin, irritating, and occasionally streaked with blood, and which may continue for weeks. In most of these cases constitutional symptoms are absent; in a few there may be a very slight rise of temperature. The clinical evidence that these are cases of diphtheria is, first, that they may infect others; and, secondly, that they may be followed by the sudden development of the symptoms of laryngeal diphtheria. However, nothing but a bacteriological examination is conclusive. The mildness of these cases may be due to the fact that the bacilli are only slightly virulent, that their number is small, or that the resistance of the patient is great. Catarrhal diphtheria is not in itself serious, but it may be followed, particularly in young children, by laryngeal diphtheria and stenosis, or, after it has existed for a time, pharyngeal diphtheria may develop in its usual form. Cases like those just described are to be distinguished from others in which bacilli, either of the virulent or the non-virulent variety, are found without any evidence of inflammation.

Cases with a small amount of membrane.—Tonsillar diphtheria.—The exudation is usually limited to the tonsils (Plate XVII A), and may partake of the character of either follicular or croupous tonsillitis; sometimes there is a slight extension to the faucial pillars or to the pharynx. These cases are quite common, and in some epidemics most of those seen are of this variety. They are more frequent in older children and adults than in infants and young children.

The onset is accompanied by a little soreness of the throat; the initial temperature is from 100° to 103° F.; but the symptoms are often not severe enough to keep the patient in bed. If seen early, the throat shows slight redness, followed by a gray film, and later by a gray or white deposit upon the tonsils. It may start as a small patch which enlarges, or as small, isolated spots which coalesce or remain separate. Until it disappears the membrane generally remains of its original colour. It is generally quite adherent, and can not easily be removed with a swab; usually it is sharply defined, but with a somewhat irregular outline. In many cases the patch is not larger than the finger nail. The inflammatory changes in the pharynx are slight; a faint red areola is frequently present at the border of the patch. The lymph glands behind the jaw are slightly swollen or may be normal. There is no nasal discharge and very little increase in the saliva or mucus from the pharynx. The constitutional

symptoms are slight, sometimes almost absent. The temperature commonly continues above the normal while the membrane lasts, its usual range being from 100° to 102° F. The membrane remains from three to ten days,—a shorter time if antitoxine is used. It is very often a matter of surprise that so small an exudate is so persistent. The urine is generally normal. The parents are loath to believe that strict quarantine is necessary in so mild an illness; and where the membrane is only upon the tonsils, even after the disease has run its course, the physician may be led to doubt the diagnosis of diphtheria.

The points which characterize this form of the disease are: the prevalence of diphtheria in the house or in the neighbourhood, a lower temperature than is usual in simple tonsillitis, the absence of marked inflammatory signs in the throat, the adherence of the membrane, its duration, and its white, fibrinous appearance. In most cases one with experience can usually make an accurate diagnosis from the clinical symptoms; but there are others in which the diagnosis from ordinary tonsillitis is impossible, even by the most practised observers, except by bacteriological examination. When diphtheria bacilli are found in these mild cases the question often arises whether they may not be the non-virulent form. Park tested forty such cases, and found the bacilli to be virulent in thirty-five and non-virulent in five. In twenty of the forty cases the clinical diagnosis was follicular tonsillitis.*

These experiments of Park, corroborated by many other observers, show how great is the error of regarding lightly the possibility of infection from mild cases.

Unless the larynx is involved—a not very infrequent occurrence in young children—cases in which the amount of membrane is small almost invariably recover. Occasionally even such mild diphtheria is followed by post-diphtheritic paralysis, but usually affecting the throat only.

Severe cases.—The onset may be gradual, even insidious. There is then a slight indisposition for a day or two, and perhaps some soreness of the throat; the temperature, however, is but little elevated, often less than 100° F. The symptoms may steadily increase in intensity for four or five days, until the maximum is reached. At other times the disease begins abruptly with vomiting, headache, chilly sensations, and a temperature of 103° or 104° F. Occasionally, the first thing to attract attention is the swelling of the cervical lymph glands, which may be so great that mumps is suspected. The abrupt onset is more often seen in young children than in those who are older.

* From one of these mild cases was obtained a bacillus whose virulence so greatly exceeded that obtained from any other case of diphtheria, that its cultures were used for the preparation of toxins for injecting horses. It was by means of these powerful toxins that the strongest antitoxine was produced. The toxins from this bacillus are now used in half a dozen of the principal laboratories of this country where antitoxine is prepared.

The membrane upon the tonsils resembles that of the mild form previously described, but, instead of remaining limited to them, it gradually spreads to the fauces, the lateral wall of the pharynx, the uvula, the rhino-pharynx, and into the posterior nares. The rapidity with which the membrane extends is in direct proportion to the severity of the attack. In some it may cover all the parts mentioned in twenty-four hours from its first appearance; in others this may require four or five days. When the nose is first affected there is an abundant discharge of serum and mucus, occasionally tinged with blood, which may continue several days before any membrane is visible. Such cases sometimes develop much more slowly, and no membrane may be seen in the anterior nares for a week.

When a severe case is fully developed there is a very abundant discharge of mucus from the mouth and nose. The tonsils, the entire faucial ring, and the pharynx are covered with membrane (Plate XVII, B) which is at first gray and gradually becomes darker often being of a dirty olive-green colour. Membrane is sometimes seen upon the lips, or in patches in the mouth. There is obstruction to nasal respiration from the swelling of the palate, tonsils, and the tissues of the rhino-pharynx; the mouth is half open, the breathing noisy, the tongue dry, and the lips are fissured and bleed readily. Occasionally large nasal hæmorrhages occur which may necessitate plugging the nares. Both nostrils are generally blocked by the swelling and the false membrane; the discharge excoriates the upper lip, and frequently has a fetid odour. During the second week there is often regurgitation of fluids through the nose, owing to paralysis of the palate. The lymph glands at the angle of the jaw swell rapidly; in severe cases they are very prominent, and there may also be extensive infiltration of the cellular tissue about them, although this is more characteristic of the cases of mixed infection. The local symptoms are the cause of much discomfort, especially the copious discharge of mucus and the nasal obstruction.

The constitutional symptoms usually increase steadily with the extension of the membrane. In the most severe cases the system is overwhelmed with the poison, and all the evidences of intense toxæmia are present by the second or third day of the disease. This is shown by great muscular weakness and prostration, by a feeble, rapid pulse, and a mental state of complete apathy or stupor, sometimes alternating with great restlessness. It is more frequent for the constitutional symptoms to develop gradually, and not to reach their height before the fifth or sixth day. The pulse becomes rapid, weak, and compressible, sometimes irregular; and there is a great and steadily increasing anæmia. The course of the temperature is irregular, and bears no constant relation to the severity of the other symptoms. Its usual range is from 101° to 103°, but in some of the worst cases it may never go above 101° F. It fluctuates irregularly with the development of complications, and sometimes without apparent cause.



A



C



THE DIPHThERITIC MEMBRANE.

A. Typical tonsillar diphtheria.

B. Severe pharyngeal diphtheria (fatal case).

C. Pseudo-diphtheria. The specimen is seen from behind, the larynx and trachea having been laid open, and shows an extensive membrane involving the epiglottis and the entire lower pharynx, but extending into the larynx only a short distance. It is also seen upon the posterior surface of the uvula and soft palate, the tonsils being only partially covered. The colour of the membrane is not characteristic of pseudo-diphtheria, as the same appearance is often seen in true diphtheria, particularly of the septic type.

By the second or third day the urine regularly shows the presence of albumin, and by the end of the first week the quantity is often large. Granular and hyaline casts, and occasionally blood in small quantities, are also found. The amount of urine secreted is not noticeably diminished, and dropsy is rare. There is complete anorexia, and often vomiting and diarrhoea are present; in some of the cases they are prominent. Nervous symptoms are seen in all the very severe cases. There may be dulness and complete indifference to surroundings, but more frequently, owing to the discomfort arising from local symptoms, there is extreme restlessness and excitement, sometimes followed by delirium.

At any time during the first week, but not often after that time, symptoms may arise indicating that the disease has extended to the larynx. The first signs of laryngeal invasion usually appear from the second to the fifth day of the disease. There are at first hoarseness, a croupy cough, and slight dyspnoea. In the severe cases these symptoms steadily increase until all the signs of laryngeal stenosis are present. The symptoms of diphtheria of the larynx, whether it begins there or follows disease of the pharynx, have already been described in the chapter on Diseases of the Larynx (page 446). The severe symptoms are due to membrane in the larynx; the milder ones may arise from catarrhal laryngitis.

The local process in the pharynx seems to be a self-limited one. By the fifth or sixth day it has usually reached its height, and after that the appearances do not change essentially for two or three days. From the seventh to the tenth day, in favourable cases, the diphtheritic membrane begins to loosen and separate from its attachment. It hangs loosely from the palate or uvula, and can often be pulled away in large masses. The detachment is frequently rapid, and in two or three days from the time when the first improvement is seen, the tonsils and pharynx may be almost free from membrane. The mucous surface left behind is of a bright-red colour and bleeds easily. The separation of the membrane in the nose and rhino-pharynx takes place more slowly. From the former it may disintegrate gradually or come away *en masse*. With the disappearance of the membrane the local symptoms abate rapidly,—the discharge ceases, the swelling of the lymph glands subsides, deglutition becomes easy and natural, and nasal breathing is re-established. Simultaneously with these changes in the throat the constitutional symptoms improve, but much more slowly. Convalescence is often protracted. The anæmia and muscular weakness, and, most of all, the feeble heart action, may persist for weeks. The more severe the local disease has been, the slower is recovery.

Instead of the usual course just described, the diphtheritic membrane may persist for two or even three weeks. In rare cases relapses occur, the membrane forming again after it has entirely or partially disappeared.

The early course of the disease in the fatal cases often does not differ

from that of the severe cases which end in recovery except in the malignant form, which kills in twenty-four or forty-eight hours, and which, after all, is rare. Death most frequently occurs at the height of the local process in the throat, usually from the fifth to the tenth day. It may be due to progressive asthenia the result of diphtheritic toxæmia, such cases being characterized by steadily increasing prostration, great anæmia, feeble, irregular pulse, vomiting, refusal to take food or stimulants, and mental apathy or stupor. Death is frequently due to heart failure, which may be quite sudden and occur early or late. In other cases death is due to complications, particularly broncho-pneumonia, rarely to nephritis or hæmorrhages, and in still others to invasion of the larynx.

Even after the throat has cleared off completely the disease may end fatally from the occurrence of late pneumonia or nephritis or from sudden heart paralysis. Cases of the variety last mentioned are particularly distressing ones, and not infrequent. It often happens that the patient is regarded as convalescent, and the great vigilance of the previous days or weeks has been relaxed. The physician has ceased his frequent visits and looks in only once a day to satisfy himself that the patient is doing well, and all congratulate themselves that the danger is over. If the pulse is carefully watched, it is one day discovered that it is weaker than formerly, and occasionally there is slight irregularity. It is usually slower, but may be more rapid than normal. On inquiry, it is found that the patient does not take his food so well, that he has refused stimulants, and perhaps has vomited once or twice. Slight dyspnœa is noticed, and the face is paler than usual. Sometimes, within twenty-four hours from the beginning of such symptoms, the patient is dead. The changes for the worse occur very rapidly. The pulse becomes weaker, more irregular, often abnormally slow, but very rapid on slight exertion, and there may be a sense of præcordial weakness or distress. There are dyspnœa without cyanosis, anxiety, and great restlessness, but the mind is clear. There is vomiting if food or stimulants are taken. The extremities are cold. Auscultation shows feeble and indistinct heart sounds, but no murmur. The pallor is extreme. Death results from sudden syncope, sometimes during an attempt to administer food, sometimes from such slight exertion as turning in the crib.

Instead of such a rapid course, the same symptoms may develop more gradually during three or four days, the significance of the earlier symptoms not being appreciated. Sometimes no premonitory symptoms are present, and the child falls dead after walking across the room, or suddenly sitting up in bed, or after some other muscular effort, or possibly as a consequence of passion or excitement.

Although such symptoms are more often seen after severe cases, they may occur after those of only moderate intensity, and even when the patient has been considered well enough to be up and about or out of

doors. One little girl was considered well enough to go coasting, and died suddenly after the exertion.

The explanation of sudden heart failure during or after diphtheria is not always the same. When it occurs at the height of the disease it is sometimes due to cardiac thrombosis, probably always associated with changes in the muscular walls. When it occurs late and follows some sudden muscular effort or excitement without premonitory symptoms of any sort, it is probably the result of changes in the muscular walls—a toxic myocarditis. When prodromal symptoms are present, and particularly when it is accompanied by vomiting, abdominal pain, and disturbed respiration, it is probably the result of a toxic neuritis affecting either the pneumogastric or the cardiac nerves, and is to be regarded as a form of post-diphtheritic paralysis. In many cases, no doubt, changes are present both in the nerves and in the myocardium. The other forms of diphtheritic paralysis which may result fatally, are discussed in the chapter on Diseases of the Peripheral Nerves.

Cases of mixed infection or septic diphtheria.—The symptoms are usually severe from the outset. The exudation in these cases is generally of a yellow or dirty-gray or olive colour, sometimes being almost black from the presence of blood. The membrane is usually extensive, covering the entire pharynx, often extending to the nose and the middle ear, and occasionally spreading to the buccal cavity. There is great swelling of the tonsils and uvula, and it is often impossible to obtain a view of the pharynx; all the evidences of inflammation are usually more marked than in the severe uncomplicated cases. Sometimes the inflammation is of a necrotic character, and there may be extensive sloughing of the tonsils, the uvula, or the soft palate. The nasal discharge is generally abundant, and often very offensive. There is marked swelling of the cervical lymph glands, and frequently extensive infiltration of the cellular tissue of the neck, so that the head is thrown back to relieve the pressure upon the larynx and trachea. The swelling sometimes forms a distinct collar, reaching from ear to ear and filling out the whole space beneath the jaw. The pressure upon the jugular veins leads to congestion and swelling of the face and congestion of the brain.

The general symptoms are those of a severe septicæmia. The temperature is usually higher than in simple diphtheria; it follows no regular course, but is generally high and widely fluctuating, ranging from 101° to 106° F. Dr. Biggs informs me that in the Willard Parker Hospital, in the cases characterized by such high temperatures, where bacteriological examinations have been made *post mortem*, there have been uniformly found either a general streptococcus or pneumococcus infection, usually the former. The pulse is weak, rapid, and compressible. The peripheral circulation is poor, the extremities are often cold, there is extreme muscular prostration, and both vomiting and diarrhœa are frequent. There

may be excitement, restlessness, and active delirium, or dulness, apathy, and stupor. Nephritis is very frequent and is often severe; the urine contains a large amount of albumin and casts of all varieties, but rarely blood. Dropsy is not usually present, and suppression of urine is seldom seen. In a large proportion of the children under three years old broncho-pneumonia develops. This is indicated by the accelerated breathing, higher temperature, and cough, and often occurs even when the larynx is not involved. The spleen is usually enlarged, and frequently the liver also. Such severe symptoms continue for from two days to a week; the patient may die from the sudden invasion of the larynx, or there may be suppression of urine and uræmic convulsions; but more frequently the cause of death is asthenia or broncho-pneumonia. Death usually occurs while the local disease is at its height. Occasionally it comes later from heart failure, where the signs of local improvement may have begun.

Recovery from this type of the disease is rare, and those who manage to escape the dangers of the acute period have still others to encounter. Among the latter may be mentioned: extensive sloughing in the throat or of the cellular tissue of the neck, which may be followed by severe or even fatal hæmorrhage, diffuse suppuration of the same region, nephritis, which may develop as late as the end of the second or even the third week and may prove rapidly fatal, late pneumonia or pleurisy, and finally paralysis of the heart or respiration, as in the severe uncomplicated cases.

Complications and Sequelæ.—Most of the complications of diphtheria have already been mentioned either under the head of Lesions or Symptoms. It only remains to consider their clinical association.

Otitis is not very frequent. It occurs particularly in the rhinopharyngeal cases, and is sometimes due to the diphtheria bacillus alone, but more often to mixed infection. The type of inflammation is usually a severe one, and it may be accompanied by necrotic changes in the drum membrane which resemble those of scarlet fever.

Broncho-pneumonia is the most frequent complication in young children. It occurs especially in laryngeal cases, and in those of a septic type whether the larynx is involved or not. Pneumonia usually develops at the height of the disease, although it is occasionally seen late and even during convalescence. Other pulmonary complications are infrequent. Pleurisy with a serous effusion may occur in connection with severe nephritis, and empyema in septic cases. Emphysema is a complication of laryngeal diphtheria; it is nearly always vesicular, sometimes interstitial, and may become general, extending into the cellular tissue of the neck and afterward that of the entire body. Pericarditis, endocarditis, and meningitis are all very rare and are seen chiefly in septic cases of the most severe type. Myocarditis is much more frequent, and is present to a greater or less degree in nearly all severe cases, although in but a small proportion of these does it give rise to distinct symptoms. It is closely

connected pathologically with degeneration of the cardiac nerves, and it may be a cause of sudden death at any time during the acute period of the disease or during convalescence.

Thrombosis and embolism are among the less frequent complications. If cerebral, they may cause hemiplegia, aphasia, and sometimes convulsions; if peripheral, they usually affect one of the lower extremities, where they may cause sudden pain, numbness, and coldness of the limb, followed by partial paralysis, œdema, and sometimes even by gangrene. Thrombosis of the pulmonary artery or of the heart may be a cause of sudden death, the symptoms being dyspnoea and præcordial distress, with pallor or cyanosis. Both thrombosis and embolism are associated with a very feeble action of the heart, and generally they are preceded by degenerative changes in its muscular walls.

Hæmorrhages are usually nasal, and while in most cases they are not serious, they may necessitate plugging of the posterior nares. Bleeding from any other mucous membrane may occur, but it is rare except from the mouth. Subcutaneous hæmorrhages are not very infrequent, and are evidence of a very high degree of diphtheritic toxæmia. They usually occur as small petechial spots, but are sometimes extensive. They may be seen upon almost any part of the body, most frequently upon the abdomen and lower extremities; but the most extensive extravasation I have ever seen was in the neck, reaching from the clavicle almost to the ear and covering nearly one lateral half of the neck.

Albumin is present in the urine of almost every case of moderate severity, usually depending upon acute degeneration of the kidney. Severe nephritis is most frequently seen in septic cases. It usually develops at the height of the local disease, but may come during convalescence. The most common form is acute exudative nephritis, in which there are albumin and casts in the urine, but rarely dropsy or signs of uræmia. It is seen in most of the fatal septic cases except those due to laryngeal obstruction, but it is seldom a cause of death. Less frequently acute diffuse nephritis occurs, with dropsy, scanty urine or even suppression, vomiting, and all the usual symptoms of acute uræmia. It may be a cause of death.

Functional disturbances of the stomach are very frequent, and are in fact present in most of the severe cases, but lesions of the mucous membrane are rare. While diarrhœa is often seen without intestinal lesions, the latter are of frequent occurrence. The most characteristic form of inflammation is a follicular ileo-colitis, which seldom goes on to ulceration. It is extremely rare that the membranous form is seen, and then it is generally associated with the presence of streptococci, not diphtheria bacilli. The intestinal symptoms usually begin while the process in the throat is at its height, but often continue for some time after the throat has cleared. Although severe intestinal inflammation is rare, it is a most serious complication when it occurs, which is generally in infants and very young children.

Diphtheria is usually followed by a severe and often persistent anæmia which may continue for weeks. Pneumonia, nephritis, and cardiac disease may first show themselves during convalescence, and so be ranked as sequelæ. The most important sequel of diphtheria, however, is multiple neuritis or post-diphtheritic paralysis (page 790).

Diagnosis.—The diagnosis of diphtheria rests upon two kinds of evidence—clinical and bacteriological. While the bacteriological diagnosis is, on the whole, more exact, it should not be depended upon to the exclusion of the clinical diagnosis. The prevailing tendency to disregard the clinical evidences of the disease and rely wholly upon bacteriology, is greatly to be deprecated. These means of diagnosis are not mutually exclusive, but complementary. Bacteriology applied to the diagnosis of diphtheria has rendered incalculable service, but it has its limitations. As has well been said by Welch, the mere presence of the diphtheria bacilli in the throat of a patient no more proves that he has diphtheria, than the presence of the pneumococcus in his saliva establishes the fact that he has pneumonia. Again, the case may be one of undoubted diphtheria and yet the bacilli may not be found at the first examination, although they are found at subsequent examinations—a thing which has repeatedly happened in my own experience. The delay thus occasioned in the application of early treatment is a matter of the greatest importance, especially in connection with serum therapy. Finally, because of the occasional presence in the throat of a non-virulent diphtheria bacillus and of the so-called pseudo-diphtheria bacillus, even a positive report by the bacteriologist may be misleading; but after all this will seldom be the case in actual practice. While in no way detracting from the immense advantage of having bacteriological assistance in making the diagnosis, I insist that the clinical manifestations of diphtheria must be observed by the physician with the same care as heretofore, particularly since the great body of the profession are as yet compelled by circumstances to rely solely upon a clinical diagnosis. Every one who has seen much of the two methods of diagnosis studied side by side will, I think, admit that in fully four fifths of the cases an accurate clinical diagnosis can be made after twenty-four hours' observation, and in a considerable proportion of these in a shorter time; the remaining one fifth require either a longer period of observation or continue doubtful to the end. The great majority of the cases of this group are of the mildest variety and terminate in recovery. In them an accurate diagnosis is of importance more for the sake of others than for the patient himself.

1. **The Clinical Diagnosis.**—In arriving at this, there must be considered, first, the patient and his surroundings; secondly, the constitutional or general symptoms; thirdly, the local evidences of disease. The chances of diphtheria are greatly increased if the patient is a child under ten years of age, if his home is in a tenement house or an institution, if he attends

a public school where he mingles with children coming from all sorts of homes, and if there are other cases in the family or in the neighbourhood. On the contrary, the chances are much lessened if the patient is over ten years old, if he lives in a private house, if there is no diphtheria in the neighbourhood, and if he does not mingle with children who come from doubtful or infected localities. In tonsillitis a history of repeated attacks is often obtained, and is of some value. If the throat symptoms occur with measles or scarlet fever, the time of their development is of much importance; when they precede the eruption or appear while the fever is at its height, the disease is rarely true diphtheria; while, if they develop at a later period or after defervescence, diphtheria is highly probable.

The mode of onset and the constitutional symptoms are of some importance in diagnosis, but diphtheria develops in such a variety of ways that, taken by themselves, the constitutional symptoms prove little. The onset of diphtheria is more frequently gradual, and the initial temperature is more often low, than is the case with other throat inflammations; but the exceptions are many. Diarrhœa, vomiting, coated tongue, and anorexia, count for little on either side. The presence of a nasal discharge, especially if abundant, ichorous and tinged with blood, the early development of the symptoms of croup, the rapid enlargement of the cervical lymph glands, and the early appearance of albumin in the urine,—all point strongly to diphtheria. Later symptoms which are especially diagnostic are marked anæmia, progressive asthenia, intense toxæmia often with a low temperature, very feeble pulse which is sometimes slow, sometimes rapid, sudden attacks of syncope, nasal hæmorrhages, nasal regurgitation from paralysis of the soft palate, contagion, and, finally, the development of post-diphtheritic paralysis of the muscles of the throat, eye, or extremities, with paralysis of the heart or respiration.

For early diagnosis much more reliance is to be placed upon the local appearances than upon the general symptoms. The characteristic membrane of diphtheria appears, in the great majority of cases, first upon the tonsils usually as a gray film, which gradually becomes more dense and white, and often has the look of being plastered on. The colour of older membrane is gray, greenish-yellow, brown, sometimes black. Beginning as a small patch, it soon spreads so as to cover the tonsils. It frequently affects one tonsil twenty-four or thirty-six hours before the other, and occasionally it is confined to one side. In exceptional cases it begins in the crypts of the tonsil and appears as isolated dots, which may coalesce to form a continuous patch like that already described, or it may remain isolated like the exudate of an ordinary follicular tonsillitis. When the membrane is removed it usually requires some force, and the entire patch may come away, leaving bleeding points, but it reforms in most cases within twenty-four hours. More important still for diagnosis is the fact that the membrane spreads from the original seat, and also the manner of

its spreading. If it extends from the tonsils to the faucial pillars and the uvula, it is almost surely diphtheria; so also in most cases when it extends to the lateral walls of the pharynx. Doubtful patches on the tonsils or fauces followed by symptoms of croup, may be considered as diphtheria with almost absolute certainty. The rapidity of the spreading varies much in the different cases, depending upon the intensity of the infection; but the gradual extension beyond the tonsils, as shown by observations made at intervals of eight or twelve hours, usually settles the diagnosis in the primary cases. However, if the throat symptoms complicate measles or scarlet fever the above rules do not apply. Such cases are to be judged by the time at which the membrane appears, as already stated.

In pure diphtheria there is a notable absence of œdema of the faucial pillars and uvula, so common in throat inflammations due to cocci. In fact, whenever there are seen in the throat evidences of a very high degree of inflammation, it points either to mixed infection or to false diphtheria. The same is true of a very friable membrane, yellow in colour from the presence of pus cells, and also of deep sloughing of the tonsils or the pillars of the fauces.

Primary membranous inflammation of the larynx may always be safely regarded as diphtheria; but if there is no visible membrane, the diagnosis is rendered positive only by a bacteriological examination. This may be true of many nasal cases where the only symptoms are a discharge of the character previously described. Such cases may continue for weeks with no symptoms other than the discharge. Some of them are examples of catarrhal diphtheria; in others, membrane is present in the post-nasal space or in the nose itself.

The most characteristic clinical differences between diphtheria and other inflammations accompanied by an exudation upon the throat or in the nose—i. e., pseudo-diphtheria—are shown in the following table:

DIPHTHERIA.	PSEUDO-DIPHTHERIA.
1. Often a history of exposure to a previous case.	1. Usually none.
2. Prevails epidemically.	2. It is questionable if it ever does.
3. Onset often gradual, with low temperature and slight constitutional symptoms.	3. Onset usually abrupt, with high temperature and quite marked constitutional symptoms.
4. Previous attacks rare.	4. Often a history of repeated attacks.
5. Often begins in the larynx.	5. Seldom if ever does so when primary.
6. If pharyngeal, often shows a strong tendency to extend to the larynx.	6. This tendency is much less marked.
7. Primary cases frequently severe.	7. Rarely severe unless secondary, particularly to measles or scarlet fever.
8. When it complicates measles or scarlet fever it often develops late, after primary fever has subsided.	8. Usually occurs at the height of the primary disease, sometimes even preceding the eruption.

DIPHTHERIA.

9. The middle ear not so often involved.
10. Occasionally limited to the nose (croupous rhinitis).
11. Adenitis constant; not much surrounding inflammation, except in cases of mixed infection; suppuration is rare.
12. Albuminuria the rule, except in the mildest cases.
13. Nasal regurgitation from paralysis of the palate in the second week or later.
14. Toxic symptoms common: asthenia; great anaemia after the fourth or fifth day; later, sudden heart paralysis, respiratory paralysis, or post-diphtheritic paralysis of throat, eyes, or extremities.
15. The membrane usually thicker and more adherent; can often be removed in large masses.
16. Greater tendency to spread from its original seat.
17. Longer duration noticeable, especially in mild cases, where it may last five to ten days.
18. Usually less evidence of inflammation of mucous membrane and in surrounding parts.
19. After removal of membrane a red surface left; ulceration slight and superficial; rarely a tendency to sloughing.
20. A very extensive membrane of a white or pearl-gray colour, covering tonsils, uvula, fauces, pharynx, and nose, is almost invariably true diphtheria, if primary.
21. A thick gray membrane, not removable without force, with little or no inflammation, and although confined to the tonsils lasting five or six days, is almost invariably true diphtheria.
22. A membrane on the tonsils, similar to that described, with isolated adherent patches on the uvula or anywhere in the pharynx, is usually diphtheria; doubtful patches upon the tonsils followed by croup, almost invariably diphtheria.

PSEUDO-DIPHTHERIA.

9. Much more frequently; in scarlet fever almost invariably.
10. Doubtful if it ever is so.
11. Adenitis often slight or absent in primary cases: in scarlet fever, marked inflammation which extends to tissues around the glands; frequently suppurates.
12. Rarely seen in primary cases, and sometimes not in secondary form, even though the symptoms are severe.
13. Never seen.
14. Septic symptoms frequent, but the peculiar toxic symptoms are never seen.
15. Thinner, more friable, and less adherent; rarely removed in large masses.
16. Tendency much less; in most primary cases membrane limited to tonsils.
17. Shorter duration; three to five days.
18. Evidence often of intense inflammation.
19. In bad cases, often marked ulceration with deep sloughing and suppuration.
20. An exudation of isolated yellow dots which never coalesce, confined to the tonsils, with considerable swelling and evidence of inflammation and usually with a high temperature, is seldom true diphtheria.
21. An exudation of soft, yellow patches, changing to a dirty green, which can be partly or entirely wiped off without hæmorrhage, whether confined to the tonsils or extending to the pillars of fauces and lasting only three or four days, is seldom true diphtheria.
22. Cases with much general inflammation of the tonsils and pharynx, with small patches of a yellow exudate, are seldom true diphtheria.

The difficulties of diagnosis are greatest in the mild cases and in the early stage. There are very few cases, except those of the mildest type, in which a diagnosis is not possible by the course of the disease; but there are very many in which an early diagnosis is impossible without cultures.

It is not often difficult to distinguish diphtheria from any other disease; but the exudation upon the pharynx or tonsils may be confounded with thrush or herpes. This mistake can scarcely be made by one who examines a case with any degree of care. The appearance of the tonsils on the second or third day after tonsillotomy has been performed, may be easily mistaken for diphtheria by one who is unfamiliar with the appearance of the wound.

Diphtheria of the mouth may be mistaken for herpetic or ulcerative stomatitis. It is, however, much more common for these latter affections to be called diphtheria than for the opposite mistake to be made. Diphtheria of the mouth alone is so rare that it may almost be dropped from consideration. As a rule, this is seen only in the worst cases of pharyngeal diphtheria.

It is sometimes difficult to distinguish cases of scarlet fever in which the throat symptoms are severe and appear early, from cases of primary diphtheria. In many of these cases the eruption appears late, and is not characteristic. Much importance is to be attached, as pointing toward scarlet fever, to a prevailing epidemic, a history of exposure, a sudden onset with severe symptoms, vomiting, prostration, very high temperature, and to a very active inflammation in the pharynx. In all cases with a sudden onset, in which from the throat symptoms one is inclined to make a diagnosis of diphtheria, the possibility of scarlet fever should not be forgotten; and one should never omit to examine the patient thoroughly for an eruption. The diagnosis of primary diphtheria of the larynx has already been considered (page 447).

2. **The Bacteriological Diagnosis.***—*The technique.*—In many cases an immediate diagnosis may be reached by smearing a cover-glass with a swab which has been drawn over the diphtheritic membrane; the cover-glass is then dried and stained. Although in the hands of an expert this method is fairly exact, it is not adapted to general use, as bacilli directly from the throat are much less typical than those from cultures, and the chances of contamination are much increased. Furthermore, the mouth often contains bacilli which somewhat resemble the Loeffler bacillus; so that on the whole the result is more likely to be doubtful than if cultures are made.

* I am greatly indebted for many facts in these pages to the Scientific Bulletin No. 1, of the New York Health Department, in whose bacteriological laboratory, under the supervision of Drs. H. M. Biggs and W. H. Park, some of the best work in the world in the bacteriological diagnosis of diphtheria has been done.

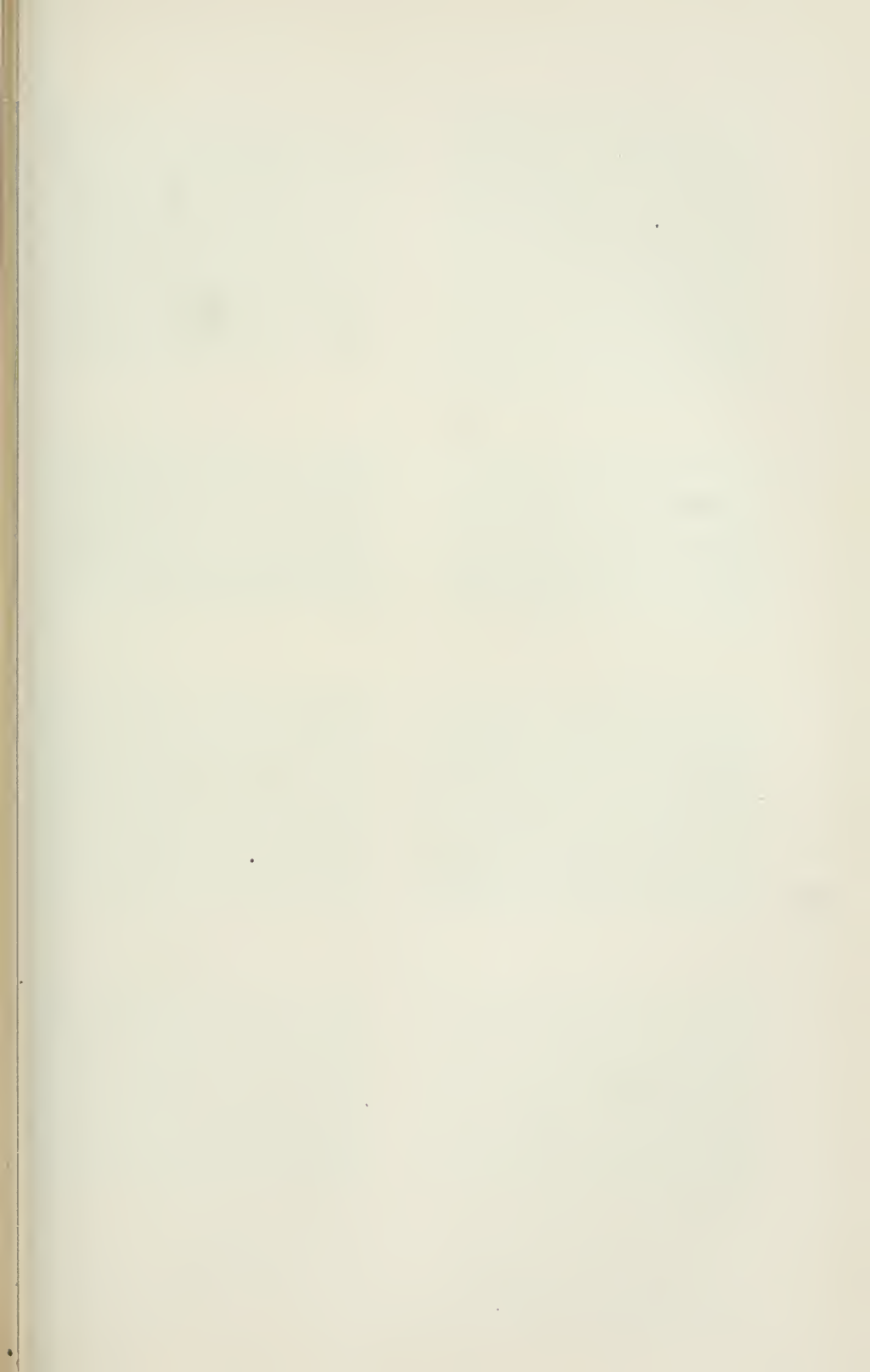
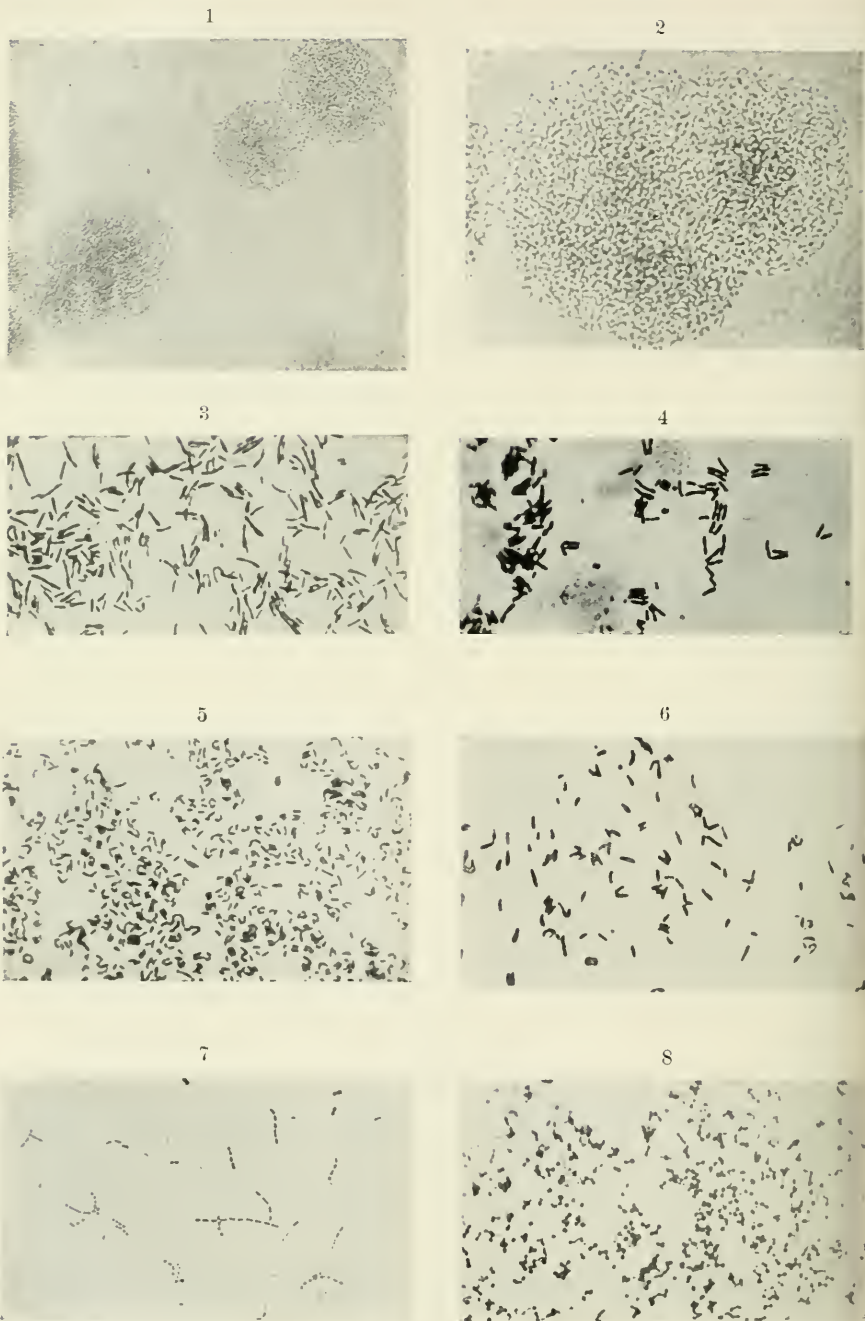


PLATE XVIII.



DIPHThERIA BACILLI AND THEIR ASSOCIATES.

1 and 2, colonies of diphtheria bacilli under a low and a high power: 3, 4, 5, characteristic diphtheria bacilli $\times 1,000$; 5, showing the short even-stained diphtheria bacilli: 6, pseudo-diphtheria bacilli; 7, streptococci from a serum culture: 8, streptococci from a smear directly from the throat.
(After Park.)

In making cultures there is required a sterilized swab and a tube or plate of Loeffler's blood-serum (page 952). The swab is made from a piece of wire roughened at one end where it is wound with absorbent cotton. In taking a culture from the throat, the tongue should be depressed and the tonsils, pharynx, or other seat of visible membrane rubbed firmly with a swab, which is then rubbed over the surface of the culture-medium in the tube or on the plate. In laryngeal cases the culture should be taken from the posterior wall of the pharynx, and in nasal cases from the nostril. The tube or plate is then placed in an incubator for twelve or fourteen hours and kept at a temperature of about 100° F. (37° C.), at the end of which time the colonies (Plate XVIII, 1 and 2) may be examined. A sterilized platinum needle is dipped into a colony and washed off in a drop of sterilized water upon the cover-glass, dried in the air, and then heated by passing several times over an alcohol flame and stained for ten minutes with Loeffler's solution of alkaline methyl blue, without heating; after which it is rinsed, dried, and mounted in balsam. Examination with an oil-immersion lens, in the great majority of cases, shows either a great number of diphtheria bacilli (Plate XVIII, 3, 4, and 5) and a few cocci, or only cocci in pairs or short chains (7 and 8); exceptionally, the cocci and bacilli may be present in nearly equal numbers.

Although the first slide may seem conclusive, a positive opinion should not be given without examining at least three colonies from different parts of the specimen. The diagnosis is completed by testing the virulence of the bacilli found. This is usually done by injecting a guinea-pig with a pure broth-culture. When death occurs within seventy-two hours, the bacilli are said to be fully virulent.

The reliance to be placed upon bacteriological diagnosis.—Many misleading statements have been published in regard to the relative frequency of cases of membranous inflammation due to the diphtheria bacillus and to other bacteria. My own experience coincides fully with the statements made by Welch and Baginsky, that in the great proportion, fully ninety-five per cent, of the cases in which one would unhesitatingly make the diagnosis of diphtheria by clinical symptoms, the Loeffler bacillus is found, provided proper precautions are observed. It will almost invariably be found: (1) if there is visible membrane in the pharynx; (2) if the culture is made during the period in which the membrane is forming; (3) if no antiseptics have been applied shortly before using the swab; (4) if the culture has been made with sufficient care to avoid contamination.

The diphtheria bacillus sometimes disappears early; hence cultures made while the membrane is loosening may be negative. If the membrane has disappeared, or if none has been present, it may be necessary, as has been shown by Koplik, to go into the tonsillar crypts with probe or

spoon to discover bacilli.* It is therefore important in all cases to consider the duration of the disease before drawing a conclusion from a negative culture. If the case is one of laryngeal disease without pharyngeal exudation, a negative culture from the pharynx in the early stage is not uncommon, although a little later bacilli may be coughed up and found in the pharynx in abundance. Hence negative results are most frequent late in pharyngeal and early in laryngeal cases. A single negative culture is never to be taken as conclusive, although in most conditions other than those mentioned it may be so regarded.

The next question for consideration is how far one is justified, from the microscopical appearances of bacilli and from their mode of growth, in deciding that they are virulent, without resorting to the test of animal inoculations. The consensus of opinion among bacteriologists at the present time is that, for diagnostic purposes, all bacilli present in suspicious throats, having the morphological and cultural characteristics of diphtheria bacilli are to be regarded as virulent unless the contrary is proved, the latter being very infrequent. This is equally true of bacilli from both mild and severe cases, for it is well known that the most virulent bacilli are often found in cases clinically of a mild type.

Non-virulent bacilli resembling the Loeffler bacillus.—There may be found in throats two forms of bacilli which resemble the diphtheria bacillus and which may occasionally be a source of error. The first is the non-virulent diphtheria bacillus, a form which corresponds in every other characteristic with the Loeffler bacillus, but which lacks virulence as shown by animal tests. The exact status of this form is not yet fully determined. The view most widely accepted is that of Roux and Yersin—viz., that they are simply diphtheria bacilli which have lost their virulence. The other form, though in many particulars resembling the Loeffler bacillus, differs from it in being shorter, plumper, and more uniform in size, and in producing an alkali in broth cultures; to this the term *pseudo-diphtheria bacillus* † (Plate XVIII, 6) has been given. It is more frequently seen than the form just described and like it is non-virulent. Both these forms of bacteria are rare in throats where a suspicion of diphtheria exists.

The presence of virulent bacilli in the throats of healthy persons.—That virulent bacilli may be harboured for an indefinite period in the throat

* Dr. Martha Wollstein, pathologist to the Babies' Hospital, has reported to me the following case illustrating this point: The first swab from a doubtful exudate upon the tonsil revealed the Loeffler bacillus. The case was reported to the Board of Health, who a day or two later took a culture from the throat, the exudate having at that time disappeared, and reported the case as negative. On the following day Dr. Wollstein made a second culture from the tonsillar crypts, finding as before the Loeffler bacilli in great numbers. Such cases indicate how great caution must be observed in drawing conclusions from negative cultures, especially if made late.

† An unfortunate term, as this bacillus has nothing to do with the form of angina classed as pseudo-diphtheria, which is generally due to the streptococcus.

or nose of a healthy person is proved by many observations. In Escherich's well-known case, the throat of an apparently healthy nurse, under whose care a number of cases of diphtheria had developed, was found to contain numerous virulent bacilli which remained for weeks. In a case observed by Park, virulent bacilli were found for months in the nose of an apparently healthy infant, and this child communicated diphtheria, it was believed, to two other members of the family, without itself ever suffering from the disease. Similar instances have been reported by Feer, Loeffler, and others; but they are to be regarded as very exceptional. However, the presence of bacilli in the nose or throat of a child who has recently been exposed to diphtheria is of very common occurrence. The New York Health Department made observations upon forty-eight children in fourteen families in which one or more cases of diphtheria had occurred, and where no attempt at isolation had been made. In one half these cases bacilli were found, and animal tests showed them to be virulent in every one of six cases tested, although four of the children did not develop diphtheria. Of the entire number, forty per cent subsequently developed diphtheria. My own experience in two institutions where diphtheria has been endemic, fully confirms the observation that bacilli of all degrees of virulence are very frequently found in the noses or throats of such exposed children, although a large proportion of them never develop the disease. Outside of institutions and infected tenement houses, however, such a condition is extremely rare. In a series of three hundred and thirty cases studied by Park, in which no exposure to diphtheria was known, virulent bacilli were found in but eight persons, two of whom subsequently developed the disease. In twenty-four of this series, non-virulent diphtheria bacilli were found, and in twenty-seven the pseudo-diphtheria bacillus. Any person, but especially a child who has been in contact with a case of diphtheria, may receive bacteria into the throat, where they may be present for days or weeks before the disease develops, and such persons may convey the disease to others, although they themselves may never have it.

Summary.—1. For ordinary diagnostic purposes the discovery in the throat of a case of suspected diphtheria, of bacilli having the appearance of the Loeffler bacillus, may be regarded as conclusive evidence of diphtheria.

2. Cultures may yield negative results late in pharyngeal cases when the membrane is separating or after it has disappeared, or early in laryngeal cases; but in no instance is a single negative culture to be regarded as conclusive.

3. Both the local appearance of the throat and the stage of the disease are always to be considered in connection with the bacteriological report.

4. Virulent bacilli are frequently found in the noses or throats of children exposed to diphtheria, apart from all throat lesions. Such a finding is not in itself evidence that these persons have diphtheria, although,

inasmuch as they may infect others and as a considerable proportion of them subsequently develop diphtheria themselves, they should be regarded with suspicion and if possible kept under observation.

5. Non-virulent bacilli are occasionally, and virulent bacilli are rarely, found in the throats of healthy persons where there is no history of exposure to diphtheria.

6. The existence of a membranous inflammation in the nose or pharynx, associated with the presence of diphtheria bacilli, is conclusive evidence of the existence of diphtheria.

7. The presence of such bacilli, associated with marked evidences of catarrhal inflammation of the mucous membrane, is likewise evidence of diphtheritic infection.

Prognosis.—There is no disease in which it is more difficult to foretell the outcome than in diphtheria, and none in the course of which unexpected dangers more often arise. So many possibilities exist that even the mildest case must be regarded as serious and carefully watched, since we can never know when unfavourable symptoms may develop. Jacobi puts it well when he says, "The physician will often be deceived, and more frequently in mild cases than in severe ones." In perhaps the majority of cases it is impossible to tell how severe the attack will prove before the third or fourth day of the disease.

The factors to be considered in the prognosis of any given case are: the age and previous condition of the patient; the time when treatment is begun; the extent of the membrane and the rapidity with which it is spreading; the degree of diphtheritic toxæmia as shown by the condition of the pulse and the nervous symptoms; whether or not the membrane has invaded the larynx; and the presence or absence of complications, especially nephritis and broncho-pneumonia. Pure diphtheria has usually a better prognosis than cases of mixed infection.

So many circumstances modify the death-rate of diphtheria that figures are of no value for comparison unless their source is considered. There must always be taken into account, the age of the patients treated and whether the statistics are drawn from private or hospital practice; if the latter, what sort of cases are received at the hospital and the treatment employed. Diphtheria is very fatal during the first two years of life, from two causes: first, from its strong tendency to invade the larynx and lower air passages; and secondly, from the frequency with which broncho-pneumonia occurs as a complication, both with and without membrane in the larynx and trachea. Of eighty-five consecutive cases under twenty-six months of age observed in the New York Infant Asylum, in a period extending over two years, the mortality was 68 per cent; in over two thirds of the fatal cases the disease involved the larynx. In diphtheria hospitals, where most of the mild cases included in the above statistics would probably not have been admitted, the mortality in children under

two years has varied from 60 to 80 per cent; in private practice it has ranged for this age from 30 to 60 per cent—i. e., without antitoxine.

After the second year there is a steady fall in the mortality up to puberty. From a comparison of many statistical tables it may be stated that, under the same conditions, the mortality from two to five years is two thirds the mortality of the first two years; while that from five to ten years is one half, and that from ten to fifteen years about one fifth the mortality of the first two years. Series of cases from different sources and treated by different methods show very nearly this relative mortality.

In some seasons a mild type of the disease prevails, the number of laryngeal cases is small, and the mortality therefore is less than half that which is usually seen. In other seasons, with the opposite conditions, the mortality may be trebled. The influence of the method of treatment upon the mortality will be considered in the pages devoted to treatment.

There has been considerable discussion as to what influence the general introduction of bacteriological diagnosis has had upon diphtheria statistics. While many cases of pseudo-diphtheria, most of which recover, have been excluded, there have been included many cases formerly regarded as examples of simple tonsillitis. According to the data collected by the New York Health Department, there are excluded by bacteriology more cases than are included. In April, 1896, there were reported to the Department as diphtheria (without a bacteriological examination) 107 cases which were proven by cultures to be pseudo-diphtheria; while during the same month there were 80 cases returned as doubtful or as pseudo-diphtheria, which by bacteriological examination were proven to be true diphtheria. The results obtained in several other months were very similar.

It can not be too often emphasized that the danger from diphtheria is not over when the throat has cleared off. The most frequent cause of death after this time is heart paralysis, which may come very suddenly. This danger exists after every severe case and it occasionally occurs after those in which the early symptoms were only of moderate severity. Less frequently death late in the disease is due to paralysis of respiration, to nephritis, or to broncho-pneumonia.

Prophylaxis.—In no infectious disease can so much be accomplished in the way of prevention as in diphtheria.

Public funerals of children dying from diphtheria should at all times be prohibited. Schools should be closed whenever the disease is epidemic. Children from families where diphtheria exists should not be allowed to attend school, not only ordinary day schools, but Sunday schools, dancing schools, and the like; first, for the reason that they may, while healthy, be the carriers of the disease, but, what is even more important, that they may mingle with other children while themselves suffering from diphtheria in an early stage or in a mild form. Such children should be kept

from school for at least two weeks after the recovery of the last case in the family.

In every large city, hospitals for diphtheria patients should be established, not only for the poor, but with private rooms for cases developing in hotels, boarding houses, or in any place where isolation is impossible. The removal of diphtheria patients from tenement houses to a hospital should be insisted upon whenever there are other children in the family. Every city should be provided with a steam disinfecting plant, where carpets, blankets, bedding, etc., can be sent from the sick-room for disinfection. It is also desirable that the board of health in every city have a bacteriological laboratory,* where the diagnosis in all doubtful cases may be settled by means of cultures, in order that proper and necessary means of prophylaxis may be taken in every case of true diphtheria, even though it is mild, and also that unnecessary expense and trouble be not imposed in cases of pseudo-diphtheria.

Quarantine.—Not only every undoubted case of diphtheria, but every suspected case, should be immediately isolated. Quarantine for the latter should continue until the diagnosis is settled either by a bacteriological examination or by the course of the disease. Positive and suspected cases should not be isolated together. The quarantine in every instance must be complete; no person should be allowed in the room except the attendants and the physician. The meals and everything else required by the patient should be left outside the door.

Bacteriology has furnished some very definite data from which the necessary duration of the period of quarantine may be determined. In this the physician is to be guided by the time that the bacilli remain in the throat, for the patient is to be considered as dangerous while they persist. This point was investigated by the New York Health Department in 605 cases: In 304 of these the bacilli had disappeared by the third day after the membrane was gone; and in 301 they persisted for a longer time,—in 176, for seven days; in 64, for twelve days; in 36, for fifteen days; in 12, for twenty-one days; in 4, for twenty-eight days; in 4, for thirty-five days; and in 2, for sixty-three days. While it is unquestionably true that in a certain number of cases these persistent bacilli have been found non-virulent, the opposite has been frequently shown. Of 15 cases in which the virulence was tested, virulent bacilli were found in 9 at periods varying from eight to twenty-five days after the membrane was gone. Tobiesen found that of 46 patients leaving the hospital under ordinary rules, virulent bacilli were present in 24 at the time of their discharge. The general rule should be to continue quarantine until a cul-

* The example of the New York Health Department in establishing a municipal laboratory for the bacteriological diagnosis of diphtheria has now been followed by nearly every large city in this country.

ture shows the throat to be free from bacilli; in the absence of the culture test, quarantine should be continued in mild cases for ten days, and in severe cases for three weeks, after the membrane has disappeared. The danger after this period in either instance is very slight; for even where virulent bacilli are found long after the membrane has disappeared, their number is usually small. The rules above given should be followed with reference to children returning to school or mingling with other children, and adults who are thrown into close contact with children.

Treatment of suspected cases.—During an epidemic of diphtheria every sore throat should be looked upon with suspicion, and every such case isolated as soon as any exudation appears upon the tonsils, or a watery nasal discharge begins. In institutions it is desirable that cultures be made from suspicious cases of pharyngitis, even though no membrane is present. All such patients should be separated from the other inmates of the home or the institution, and while waiting for the results of the bacteriological examination or for positive symptoms, antiseptic gargles should be used. If there are patches on the tonsils, the case should be treated as true diphtheria, in order that no time may be lost. If the bacteriological examination shows the disease not to be true diphtheria, the patient may be released from quarantine in two or three days, provided the throat symptoms disappear. It is, of course, important that the conditions laid down with reference to bacteriological diagnosis shall have been fulfilled. Should symptoms continue, however, a second culture should be taken, since the bacilli at the first examination may have been so few as to have escaped the swab.

Treatment of children exposed.—When a case of diphtheria occurs in a family or an institution every child that has been exposed should receive an immunizing dose of antitoxine. Although many points regarding immunization are still unsettled, there can be no doubt that for a limited time, probably about a month, the serum confers almost complete protection.

Some of the most striking evidences of the value of the serum for immunization have been obtained in New York institutions, especially in the Nursery and Child's Hospital and the New York Infant Asylum, both of which have been under my own observation. The results in these institutions, together with those obtained elsewhere, are shown in the accompanying table, which was prepared by Biggs.*

In the two institutions first named in the table, many infants under three months old were injected, and several under a week old, without anything more than transient disturbances. In one of these institutions 21 pregnant women and 8 women in the puerperal state were injected; there

* The Medical News, November 30, 1895.

was no reaction in any of them, and, though the urine was examined daily for a week, in none did albumin appear.

Table Showing the Results of Antitoxine Injections for Immunization.

PLACE OF OBSERVATION.	Children immunized.	Cases of diphtheria developing among those immunized between 1 and 30 days.	Cases developing within 24 hrs.	Cases developing after 30 days.	Number of cases of diphtheria that occurred in the institutions previous to immunization.
New York Infant Asylum (1st immunization.)	224	1 mild on the 19th day.	0	6	107 cases in 108 days.
New York Infant Asylum (2d immunization).	245	1 mild on the 12th day.	0	4	6 cases in 12 days.
Nursery and Child's Hospital.	} 136	0	0	0	{ 46 cases in 90 days. 15 cases in 18 days.
New York Juvenile Asylum.		81	0	0		{ 12 cases; 3 cases in 2 days.
New York Catholic Protectory.	114	0	1	0	5 cases in 3 days.
Bellevue Hospital	11	0	0	0	2 cases in 10 days.
Health Department inspectors.	} 232	1 mild on the 19th day.	3	3 { 1, 30th. 1, 31st. 1, 55th.	One or more cases in more than 90 families.
Total		1,043	3			4	13

In the Bulletin of the New York Health Department are brought together twenty-nine reports, covering 15,986 injections of antitoxine in exposed persons for the purpose of immunization. The number attacked with diphtheria during the thirty days following injection was but 79, or 0.5 per cent. Nearly all of these had a mild form of the disease, only one case being fatal. Many of these injections were made in the early days of antitoxine, and doses now regarded as insufficient were given.

The dose for immunization is from 50 to 350 units, the former being that required for an infant under three months, and the latter for a child of twelve or fourteen years; for one from five to ten years the usual dose is 200 to 300 units. With the strongest serum, the larger dose can now be administered in a volume of ten minims.

If possible, cultures should be made from the throats of all exposed children, and those having no bacilli should be sent away from the house. Children whose throats contain bacilli should be separated from others, but not necessarily confined in-doors. Those who are old enough should use a gargle of bichloride, 1 to 5,000. For very young children it is wise to spray, or better, to syringe the nose with either Seiler's or a simple saline solution, two or three times a day. The throats of all such children should be carefully inspected twice a day. In a hospital the same general rules should be adopted.

Nurses.—Those in charge of diphtheria cases should receive an immunizing dose of antitoxine of 300 or 400 units. As diphtheria is con-

tracted, not from the breath of the patient or the air of the room, but by receiving the bacilli into the mouth or air passages, all possible means should be taken to destroy the bacilli discharged, and to secure absolute cleanliness in everything about the sick-room. Nurses should never be allowed to eat or sleep in the sick-room, and an antiseptic gargle should be used four or five times a day. The hands should be kept clean, and only such dresses worn as can be readily washed and disinfected. It is the nurse who is most likely to contract the disease, on account of the continued exposure. Hence, these measures should be rigorously insisted upon. She should be allowed a few hours in the open air every day.

Physicians.—The physician should take the same precautions as in scarlet fever (page 907). A pocket tongue-depressor should not be used for the examination of the throat, but a spoon which is kept in a solution of carbolic acid, 1 to 40. In order to prevent the coughing up of mucus or membrane in the face of the physician, a pane of ordinary window glass may be held in front of the patient's face during inspection of the throat.

The sick-room.—The carpets, hangings, upholstered furniture, everything in fact not necessary for the patient's welfare, should be removed, especially books, toys, cushions, etc. The room should be a large one, if possible with an open fireplace, well ventilated, and fresh air should be allowed in abundance. The floor should be washed once a day with a solution of bichloride, 1 to 2,000, and dusted often with cloths moistened in the same solution. All handkerchiefs, bed linen, and clothing removed from the patient should be treated as in a case of scarlet fever. Pieces of membrane and other matters discharged from the patient should be put into a solution of carbolic acid, 1 to 20, or of bichloride, 1 to 1,000. Pieces of old muslin or absorbent cotton should be used to cleanse the nose and mouth of the patient and burned immediately. All vessels for the reception of expectoration or other discharges should contain bichloride, 1 to 2,000. The bed-linen should be very frequently changed, and everything kept scrupulously clean. In the room should be a large bowl of carbolic acid, 1 to 40, or some similar solution for the cleansing of hands, and a tray of the carbolic solution for spoons, syringes, or other things used in the treatment of the patient. All spoons, cups, or other dishes used by the patient should be carefully sterilized by boiling for twenty minutes. No milk or other food should be allowed to stand about the room. There is no objection to the hanging of sheets moistened in carbolic, bichloride, or other disinfectant solutions before the door, but neither this nor hanging them about in the sick-room is to be regarded as having any value in disinfecting the air of the room. They create a false sense of security, and often lead to the neglect of thorough cleanliness, which, after all, is the essential thing.

Disinfection of apartments after an attack should be done as after scarlet fever (page 907).

Treatment.—*General measures.*—It is important in every case that there should be plenty of fresh air in the room throughout the attack. Where it is possible, it is desirable to have two rooms for the patient, so that he can be changed from one to the other every day, giving time for thorough cleanliness and airing. In hospital wards, patients should never be crowded together. Small wards, containing three or four beds, are much to be preferred to very large ones. Even in mild cases the patient should be kept in bed throughout the entire attack, and in severe cases this should be continued for some time during convalescence. It is especially important where there have been symptoms of cardiac depression during the acute stage.

Nursing infants may be fed on breast milk obtained by a breast pump, but should not be put to the mother's breast. The feeding of older children must be managed very much as in other cases of severe illness (page 191). Milk is the main reliance; it should usually be diluted, and for younger infants often partially peptonized. The greatest difficulty in feeding is seen in the latter part of the disease, when the patients are septic and have a strong aversion to food, when vomiting is easily excited and when swallowing is difficult on account of the swelling and pain. It is then that forced feeding by means of gavage is most valuable. This is much more successful with children under three years old than is rectal feeding. In children of five or six years, who struggle against the tube in the mouth, it may be passed through the nose with very little difficulty. The results are, as a rule, extremely satisfactory, and gavage may be used with advantage in many intubated cases.

Stimulants.—There is no question in regard to the value of alcohol in diphtheria. It is altogether the most powerful drug we possess to combat the effects of the disease upon the nervous centres and the heart. Stimulants should be begun as soon as the depressing effects of the poison of diphtheria are shown upon the pulse and general condition of the patient. In most cases, therefore, they are not needed until the third or fourth day; in a few they may be required from the outset, and in some they may not be required at all. The indications for alcoholic stimulants are marked prostration, a feeble pulse, and a weak first sound of the heart. In regard to the quantity, one ounce of whisky or brandy in twenty-four hours is enough to begin with, for a child four years old. This should be diluted with at least six parts of water. In very bad cases five or six times as much may be given; the only limit to the quantity is the tolerance of the stomach. The method of administration should be the same as in other severe acute diseases (page 49). Usually stimulants should not be combined with food. A child is more apt to rebel against the stimulants than the milk, and it is important that nothing be done to interfere with the taking of proper nourishment. Other heart stimulants than alcohol, though inferior to it, are of value

in some cases. The most useful one is strychnine, which should be given as in pneumonia (page 510). Camphor and carbonate of ammonia are valuable for rapid effect in syncopal attacks, and digitalis in other cases where the pulse is weak and arterial tension low, but it is not wise to give it in large doses. In cases of threatened heart paralysis occurring late in the disease or during convalescence, nothing is so valuable as morphine hypodermically. Full doses must be given and repeated every two to four hours, so that the child may be kept completely under its influence.

Except for stimulation or the control of special symptoms such as vomiting or diarrhoea, all internal medication would better be omitted; for there is yet wanting proof that drugs influence the course or the result of the disease.

Local treatment.—Since the introduction of antitoxine, medical opinion has undergone a decided change with reference to local treatment. While it is not desirable that it should be entirely abandoned, still it has assumed a position of secondary importance; and under conditions where it can be carried out only with great difficulty and the use of considerable force, as in the case of very young or intractable children, it is often wise not to attempt it systematically.

The purpose of local treatment, it is now generally agreed, should be cleanliness, and not the destruction of bacilli. Cleanliness of the nose, mouth, and pharynx is important, inasmuch as one of the chief dangers of the disease is the aspiration of bacteria contained in the abundant secretions of these parts, into the larynx and bronchi. Our aim should therefore be to keep the parts as clean as possible without too severely taxing the strength of the child. Harm often results from attempting to do too much.

For cleansing the nose and rhino-pharynx only syringing can be depended upon. Nasal syringing is indicated when there is much nasal discharge, whether membrane is visible in the anterior nares or not, unless there is so much resistance on the part of the child that it can not be done without a good deal of force. In such cases more harm than good may result. However, in septic cases with a profuse fetid discharge it may be necessary to syringe the nose, no matter how strongly the child resists. Whether it shall be done forcibly in such a case, will depend upon the condition of the patient's strength and his pulse. The purpose in syringing is not so much to clear the nose, from which absorption is slow and imperfect, although this is useful, as to flush the rhino-pharynx, from which absorption is always very active. Only bland solutions should be employed, such as a common-salt solution, strength of one per cent, or a boric-acid solution, one to four per cent strength.

For ordinary cases, the syringe and the method described on page 57 may be used. For some cases a fountain syringe possesses manifest ad-

vantages, and it is rather more convenient for hospital purposes. All solutions should be used lukewarm, and in sufficient quantity to irrigate the parts thoroughly, a few such irrigations being much better than a great many partial ones. By a skilful nurse syringing can in most cases be done with comparatively little disturbance to the child.

Slight nasal hæmorrhages may necessitate less frequent syringing, and a free hæmorrhage may oblige us to stop it altogether. Astringent solutions of alum, Monsel's solution, lemon juice, etc., are sometimes beneficial in such cases, but they must be largely diluted. In children who are old enough to use them, the mouth and pharynx should be kept clean by gargles. A solution of boric acid, listerine, or Dobell's or Seiler's solution much diluted, may be employed.

In cases with a moderate nasal discharge it is usually sufficient to syringe three or four times a day; but in those of the most severe or septic type, with very abundant discharge, syringing should be repeated as often as every two hours during the day and every four hours at night.

External applications to the throat have practically no effect upon the disease, but are often useful to relieve pain and tension in the swollen lymph glands. In very young children heat is to be preferred to cold, and may be applied either by means of poultices, or, better, spongopiline wrung from very hot water, covered with cotton and then with oiled silk; prolonged poulticing should not, however, be allowed. For older children an ice-bag may be used, and this frequently gives great relief.

The Serum Treatment.—This has been the outcome of a long series of experiments in which many men have had a share; but it is to Behring pre-eminently that the credit belongs for the development of the principles of serum-therapy. It will be sufficient here to indicate the more important steps which have led to this discovery. In December, 1890, Behring and Kitasato published experiments which demonstrated that it was possible for the blood of an immunized animal (one which had been injected with the toxins of a disease in gradually increasing doses, until a condition was reached when such injections produced no reaction) when injected into another animal to convey immunity, and also cure the disease if artificially produced. This was first shown to be true of tetanus. In August, 1892, Behring further showed that the blood of an immunized animal had the power both of protecting and curing susceptible animals which had been inoculated either with the toxins or with the bacilli of diphtheria. Early in the same year he produced from animals his so-called "normal" serum, which was used in his animal experiments, this being one sixtieth of the strength of his No. 1 serum now employed. The further steps consisted in gradually increasing the strength of the serum by the use of stronger toxins for injection. Up to this time small ani-

mals had been used, and the serum produced only in limited quantity. Later, Roux conceived the idea of using horses for injection, and from this time they were generally employed. In the latter part of 1893 the serum was first tried upon diphtheria patients in the Berlin hospitals, and, although it was still very weak, encouraging results were observed. At the International Congress held at Rome in March and April, 1894, Heubner reported his results in cases treated by the serum, followed the same month by a report from Ehrlich, Kossel, and Wassermann, with two hundred and twenty cases, which up to that time had been treated with antitoxine, showing a decided reduction in the death-rate. The results improved steadily with the strength of the serum employed. By August, 1894, the beneficial results of the serum were considered sufficiently established to warrant placing Behring's serum on sale. The new treatment attracted but little notice until the Congress at Buda-Pesth in the summer of 1894, where Roux presented a report of three hundred cases treated at Paris under his supervision, with results so striking that the interest of the entire medical profession was at once aroused. Since the beginning of 1895 the serum treatment has been tested on a large scale all over the world.

Regarding the nature of the antitoxine and its mode of action but little is as yet definitely known. Two theories have been advanced: one, that its action is a chemical one, directly neutralizing the toxine of diphtheria; the other, that its effect is rather a vital one, rendering the cells tolerant of the diphtheria toxine. Without being in any sense germicidal in its effect, the antitoxine produces a condition in the blood which arrests the growth of the diphtheria bacillus and the membranous inflammation which this excites.

Following the plan of Roux, the diphtheria antitoxine is produced at the present time from the blood-serum of the horse. This is drawn into sterilized vessels and preserved in small sterilized bottles, each of which is designed to contain a sufficient quantity for a single dose. It is preserved by the addition of carbolic acid (Behring), camphor (Roux, New York Health Department, and others), or some other antiseptic. Properly prepared, it will keep without deterioration for from three to six months; but after one year it loses somewhat of its antitoxic properties, this amounting, according to the experiments of Park, to perhaps one third of its original strength. It should be kept in a cool, dark place, and after a bottle has been opened it should be used within a few days. The effort to prepare and preserve the antitoxine in a dry form has not thus far been very successful.

The strength of the serum is measured in antitoxine units, the unit being an arbitrary one and representing the ability to neutralize a definite quantity of diphtheria toxine. The improvements in the production of the serum have thus far consisted in increasing its strength. Behring's

normal serum as first used contained in each cubic centimetre (15 minims) one antitoxine unit; that sold as Behring's No. 3 contains 150 units in each cubic centimetre. Several American manufacturers have now placed on sale a serum containing 500 units in each cubic centimetre, and have produced one containing 750 units in each cubic centimetre. There may now be obtained also an "extra-potent" Behring's serum which contains 500 units in each cubic centimetre. The stronger serum has been produced by the use of stronger toxins for animal injections, those at present employed being many times stronger than those formerly regarded as the strongest possible.

The concentration of the serum is of immense advantage, and has simplified many things in connection with its administration. Horse-serum being merely the vehicle of the antitoxine, and itself, it is believed, capable of producing unpleasant effects when large quantities are injected, it is desirable to administer the dose of antitoxine in the smallest amount of serum possible. There seems now to be good evidence that the local discomfort—œdema, pain, etc.—and also the various eruptions, which sometimes follow its use, have depended largely upon the amount of horse-serum injected. With the concentrated serum now available, it is never necessary to use more than 5 cubic centimetres (75 minims) for a single dose, and usually but half this quantity. This does away with the necessity for large and special syringes. The hypodermic syringe as made for veterinary use, holding 5 cubic centimetres, answers every purpose, and is, I think, to be preferred on account of the smaller size of the needle. For nearly a year I have used no other instrument. The syringe should be rinsed with alcohol immediately before using, and the needles should always be boiled. Care should be taken that all air is expelled from the syringe before the injection is made. The seat of injection is of comparatively little importance now that the dose of antitoxine can be given in so small a volume. The cellular tissue of the abdomen or the thigh is perhaps the best location. If a small needle is used, no application of adhesive plaster is necessary; but the needle puncture should be covered with the finger for a few moments.

Rules for accurate dosage in antitoxine are as yet impossible. It is desirable to give in every case enough to neutralize the amount of diphtheria toxine present in the blood, but we have no very exact means of determining how much this is. It depends upon the virulence of the bacilli—which may be judged by the severity of the attack and the extent of the membrane—the time when the injection is made, and somewhat upon the age of the patient. The general experience of the profession thus far is, that for children over two years old the initial dose should be from 1,500 to 2,000 units in all severe cases, including those of laryngeal stenosis, this dose to be repeated in from twelve to sixteen hours if no improvement is seen, and again in twenty-four hours if the course of the

disease is unfavourable. The third dose is rarely necessary. Exceptional cases of great severity, especially when seen late, should receive somewhat larger doses than those mentioned—i. e., 3,000 units. Mild cases should receive 1,000 units for the first injection, a second being rarely required. For children under two years old, the initial dose in a severe case or one of laryngeal stenosis should be 1,000 units, to be repeated as above indicated; in a mild case, 600 units. The most concentrated serum is to be preferred, and only that obtained from a reliable source should be used. It is unfortunate that legal restrictions do not make it impossible for any other to be sold. My own experience has been chiefly with the serum of Behring and that of the New York Health Department, both of which are absolutely reliable, as are also the serum of Mulford and that of Parke, Davis & Co.

Not only must a sufficient dose be given, but, to be efficient, the antitoxine must be administered early in the disease before the diphtheria toxins have done their work. The serum can not undo the serious damage already done to the cells of the body, and this at the time of injection may be so great that death will result. One who waits until his cases have grown alarmingly worse under other treatment and gives but half doses, will see little benefit from antitoxine. In very mild cases, with older children, one may wait for the result of a bacteriological examination where such examinations are possible, but never in a severe case and never in a young child. In the group of severe cases should be placed every one which at the first visit shows a pharyngeal exudate covering more than the tonsils, also all cases with symptoms of laryngeal invasion, and all with an exudate in the pharynx and a profuse nasal discharge. If in a doubtful case twelve hours' observation shows that the membrane has spread from its original seat, no further delay is admissible. Experiments have shown that after a fatal dose of diphtheria toxine, an animal can usually be rescued if the antitoxine is administered within forty-eight hours, but rarely after that time. In human diphtheria marked benefit usually follows injections made as late as the third day; but after three days have passed little benefit is to be expected, although it occasionally follows even later injections. On the other hand, in very severe or in malignant cases irreparable harm may be done by the disease during the first twenty-four hours.

The local effects of the injection are a slight redness, pain, and usually some transient œdema. General eruptions are seen in a considerable number of cases, from five to forty per cent according to various observers. They are most frequent from the eighth to the twelfth day after injection, usually appearing in the form of an urticaria. Although in most cases slight and transient, the body may be covered and the urticaria continue to be most annoying for several days. Various forms of erythema have been occasionally observed, and in a few cases swelling of the joints.

There appears to be a close connection between the amount of horse-serum administered and the occurrence of these symptoms. They are certainly much less frequent since the use of more concentrated antitoxine.

The effect upon the diphtheritic membrane is usually noticeable within twenty-four hours; it first stops spreading, and soon begins to soften and loosen. The swelling of the mucous membrane subsides and the local disease abates, very much after the manner seen when the disease runs its usual course. The striking thing after the use of antitoxine is the rapidity with which these changes take place, and the abrupt transition from an advancing to a retrograde process. The evidence of the subsidence of the inflammatory conditions in the larynx and trachea is quite as marked as in the pharynx. The symptoms of stenosis, even when severe, often diminish in a few hours and continue to improve, making operation unnecessary in a very large number of cases where previously it seemed inevitable. The membrane loosens rapidly in the larynx and trachea, sometimes necessitating the frequent removal of the intubation tube, where operation has been performed. It is the experience of McNaughton (Brooklyn), and of some other operators, that the tube is more frequently coughed up after the use of antitoxine than formerly, probably because of the rapid subsidence of the swelling. Improvement is also shown by the cessation of the nasal discharge, the re-establishment of nasal respiration, and the diminution in the swelling of the glands of the neck.

The effect upon the constitutional symptoms is not less striking. In favourable cases there is seen, often in twelve hours, a fall in temperature and improvement in the pulse and in the nervous condition of the patient. Sometimes the change in the general symptoms is seen earlier than in the local conditions.

The limitations of antitoxine.—It is important that these should always be kept in mind. The serum must be given early, for if given late it can not undo the mischief already done by the diphtheria toxine. Cases of great severity have often passed the period when recovery was possible, before the antitoxine is given. This period may in some cases be three days, in others it may be less than twelve hours. The tissues most susceptible to the diphtheria toxine are probably the nervous structures, the heart, and the kidneys; and the consequences of its action may be seen in the production of nephritis, in sudden heart failure at the height of the disease, or some form of post-diphtheritic paralysis, in spite of the fact that antitoxine was given at a period early enough to avert death from local disease in the larynx or bronchi. Again, antitoxine is of no value in cases of streptococcus septicæmia. The early arrest of the inflammation excited by the diphtheria bacillus is unfavourable to the spread of streptococcus infection, yet sometimes the latter has gained such headway or is

of such intensity as to involve almost the entire body. Against the phlegmonous inflammation of the throat or the cellular tissue of the neck, broncho-pneumonia, and nephritis, antitoxine is powerless; and just in proportion to the severity of these inflammations are negative results seen.

Real and alleged dangers from antitoxine injections.—In the cases where sudden death has followed antitoxine injections, the evidence that antitoxine was the cause of death is not conclusive. That only three or four alleged instances of this have occurred among the hundreds of thousands of antitoxine injections which have now been made, is sufficient to establish the fact that the serum itself is harmless. These rare accidents have been attributed to the carbolic acid used to preserve the antitoxine, to the injection of air,* to the shock from needle puncture, and to individual idiosyncrasy.

Regarding the unfavourable effects upon the heart, the kidneys, and the blood, attributed to antitoxine, they are to my mind not proved. In a disease like diphtheria, where the heart and kidneys are so often and so seriously affected, and where cardiac and renal symptoms in so many cases are so suddenly manifested, it is impossible to say, even when such symptoms follow the injection of serum, that they are not due to the original disease. They were seen with great frequency before antitoxine was heard of. It is, however, not impossible that in a very young or delicate child the sudden introduction into the circulation of such a large quantity of horse-serum as was first used (i. e., 20 or 30 cubic centimetres) might intensify existing cardiac or renal disturbance—a result not probable and I think not reported with the concentrated serum now in use. Observations regarding the effect of the serum upon the blood were made by Billings, Jr., upon twenty-nine cases of diphtheria. He found the reduction both in the hæmoglobin and the red cells to be much less than the average found in cases of diphtheria of similar severity not treated by the serum.

At the present time, after the serum has been in general use for nearly two years, no evidence has been adduced as to its danger or injurious effects which should deter any one from its use. Those which have been reported are to be looked upon in the light of accidents for which the antitoxine was probably not responsible.

The results with antitoxine in hospital practice.—Guerard, in Bulletin No. 3 of the New York Health Department, has collected reports of 9,893 cases treated with the serum, with an average mortality of 18·3 per cent. Of these cases, 7,277, in which the mortality was 20 per cent, were returned by 53 hospitals; the reports from the same hospitals give as their previous mortality an average of 44·3 per cent. The accompanying chart

* Seibert and Schwyzer, New York Medical Journal, May 30, 1896.

(Fig. 166) shows the results obtained in the Children's Hospital, Berlin, with and without the serum.

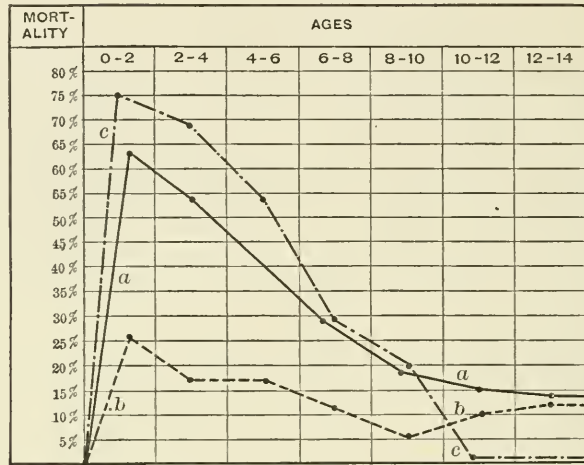


FIG. 166.—Chart showing the percentage mortality from diphtheria in the Children's Hospital, Berlin, for three periods: *a, a*, for four years before the introduction of the serum; *b, b*, for the first year of the serum treatment; *c, c*, for two months during that year when the supply of serum failed. (After Baginsky.)

The fact that during August and September of the first antitoxine year, when the supply of serum became exhausted, the death-rate rose at once to nearly three times what it had been, and fell again when the serum was again in use, is one of the most striking demonstrations yet published in favour of the serum. Identical experiences are reported by Korte, Heim, and Ganghofner, all showing that the results were not explained by a milder form of the disease, for when antitoxine was omitted the same mortality prevailed as had been formerly observed.

Results in private practice.—The largest number of cases from this source has been brought together in the Collective Investigation made by the American Pædiatric Society.* This embraces 5,794 returned by 615 physicians from 114 cities and towns in America, with an average mortality of 12.3 per cent. But in this report is included every case returned in which the serum was given, many of which were moribund at the time of injection, the serum being used only to gratify parents. If these cases and those dying within twenty-four hours after the first injection be excluded, there remain 5,576 cases, with a mortality of 8.8 per cent. Of 4,120 injected during the first three days the mortality was 7.3 per cent, or, excluding moribund cases and those dying twenty-four hours after the

* Archives of Pædiatrics, July, 1896.

first injection, but 4.8 per cent. The diagnosis of diphtheria was confirmed by a bacteriological examination in 83 per cent of these cases; in the remainder it rested upon the clinical symptoms.

Influence of the serum upon the diphtheria mortality in cities.—If Behring's antitoxine is the specific remedy for diphtheria that it is claimed to be, its general use should produce a decided fall in the actual mortality from diphtheria. We will take the figures from four large cities—New York, Berlin, Paris, and Chicago; from the first three we have full reports not only of the antitoxine period, but of several years preceding.

In the city of Paris, during the six years preceding the use of antitoxine (1889 to 1894 inclusive), the average number of deaths from diphtheria and croup was 1,518; the minimum number was 1,009, this being in 1894, during the last four months of which antitoxine was in general use. During the first year of antitoxine (1895) the number of deaths fell to 442, or considerably less than one half the mortality of any previous year during the period considered.

The following table gives the number of deaths per month for the first three months of the six years before, and the two years after the introduction of the serum: *

CITY.	Average monthly mortality, 1889-'94, without serum.	Minimum monthly mortality, same period.	1895. With serum.	1896. With serum.	
Paris.....	January.....	160	120 (1892)	48	47
	February.....	152	108 (1893)	47	56
	March.....	180	148 (1894)	45	48
Berlin.....	January.....	135	102 (1891)	79	58
	February.....	117	103 (1891)	64	54
	March.....	114	86 (1891)	88	47
New York (1894 only).	January.....	317	.....	207	181
	February.....	276	.....	171	172
	March.....	236	.....	168	165

The only month in which a lower mortality occurred without antitoxine than with it was in Berlin, in March, 1891; but it will be seen that the amount of diphtheria in the city that year was much less than the average, as is indicated by the figures for January and February.

The following chart (Fig. 167) shows even better than the table the influence of the introduction of antitoxine. Had the serum been employed to the same extent in all the cities, we should doubtless see a corresponding reduction in the number of deaths in all. But, as is well known, the serum was much more generally employed in Paris than in either of the other cities.

* These figures are taken from the advance sheets of Bulletin No. 3 of the New York Health Department, placed at my disposal by Dr. H. M. Biggs.

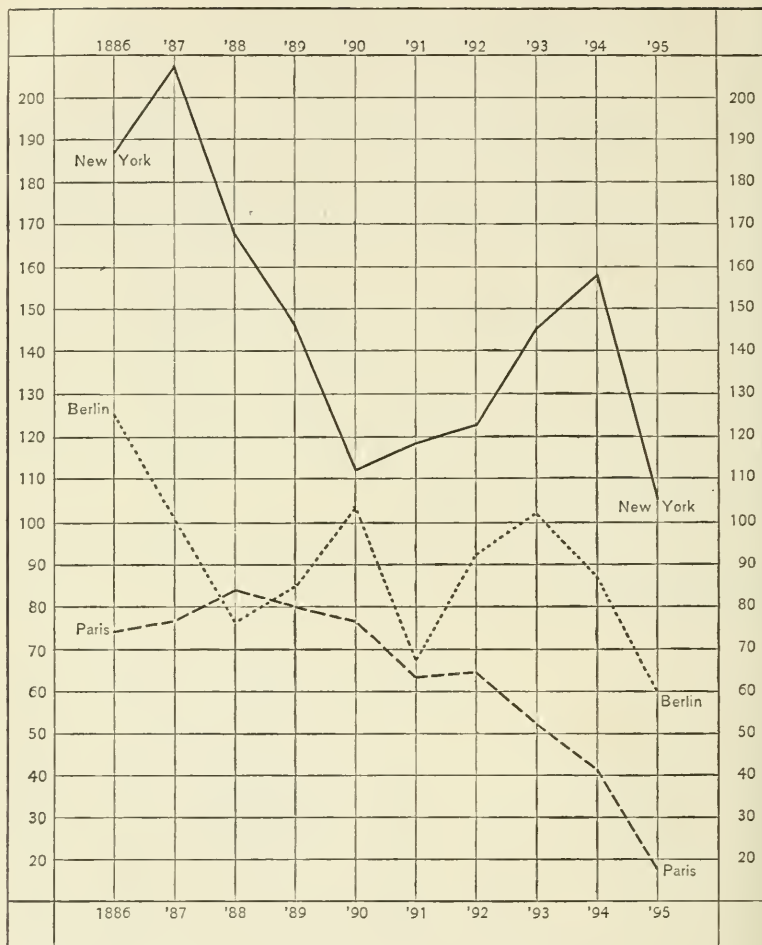


FIG. 167.—Chart showing deaths from diphtheria and croup per 100,000 of population in New York, Berlin, and Paris. During the last half of 1894 antitoxine was widely used in Berlin, and during the last four months of that year it was in general use in Paris. It will be noted that the only time during the period when the lines of the three cities correspond, is since the use of the antitoxine. (From Bulletin No. 3, New York Health Department.)

The results in the city of Chicago are quite as striking as those in Paris, and are shown by the accompanying chart (Fig. 168), which demonstrates how a rapidly rising death-rate was checked by the introduction of the serum in October, 1895.

The lines for both years show a relatively small number of deaths during the summer, but a rapid increase in the autumn months. It will be noted that during every month of the second year up to and including October, there was an increase in the fatal cases over the previous year,

and that in October the daily death-rate was 8.1 a day, as against 5.5 the previous year. The epidemic of diphtheria at this time had attained such proportions in the city that the question of closing all the public schools was considered. In the latter part of October the Health Department brought antitoxine into general use by establishing sixty stations throughout the city where it could be obtained, and organizing a special corps of physicians to visit the diphtheria cases. One of these was sent to every case in a tenement house, and the serum injected unless refused by the parents. The effect upon this daily death-rate is graphically shown in the chart. Of 1,468 cases treated by the inspectors, the mortality was but 6.4 per cent; and of 1,112 cases injected during the first three days, but 2.5 per cent.

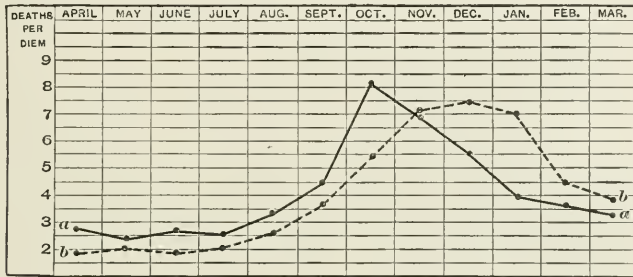


FIG. 168.—Showing the average daily mortality from diphtheria in Chicago for two years. The dotted line, *b, b*, indicates the mortality from April, 1894, to April, 1895; the line *a, a*, the mortality from April, 1895, to April, 1896. Antitoxine was introduced at the close of October. (From the Report of the Chicago Health Department.)

Results in other American cities have been no less striking. In the city of Newark, N. J., there were reported to the Board of Health, from June 20, 1895, to March 20, 1896, 939 cases of diphtheria; 606 of these were treated by the serum, with 85 deaths, a mortality of 14 per cent; 333 cases did not receive the serum, and among these there were 138 deaths, a mortality of 41.4.

In the city of Boston, Ernst reports 1,156 cases treated by the serum, with 165 deaths, a mortality of 14.2 per cent. The report by MacCullom from the diphtheria wards of the Boston City Hospital shows even better results. Of 844 cases treated by the serum, there were 96 deaths, a mortality of 11 per cent; the previous mortality in the same institution without serum was 40 per cent.

The results as modified by the time of injection and the age of the patients.—The statement has been already made that striking improvement from the use of the serum is seen only when it is used early. In the American Paediatric Society's report the mortality of 4,120 cases injected during the first three days was 7.3 per cent, including even those which were moribund at the time of injection; of 758 cases in-

jected on the fourth day the mortality was 20·7 per cent; and of 690 injected later than the fourth day it was 35·3 per cent. The figures are from private practice. The statistics from diphtheria hospitals show approximately the same variation, but the percentages are all slightly higher.

It has been the experience of nearly every one, that the greatest reduction in mortality is seen in the youngest patients. In the above report the mortality of 867 cases two years old and under, was 23·3 per cent; while, excluding moribund cases and those dying within twenty-four hours of the first injection, it was only 19·2 per cent. There are two factors in this great reduction from former figures. These infants are patients for whom often little or nothing could be done by local treatment, and in whom broncho-pneumonia was almost certain to follow the invasion of the larynx. The serum enables us largely to dispense with local treatment, and when used early in the great majority of cases it prevents the extension of membrane below the larynx.

The results in laryngeal cases.—The allegation that the favourable results obtained with the serum are to be explained by the mildness of the disease can not be applied to diphtheria of the larynx. These cases are not mild, nor do they tend to spontaneous recovery; furthermore, the results obtained both by intubation and tracheotomy without antitoxine are well known. Laryngeal diphtheria therefore furnishes the crucial test of the serum treatment. The benefits of the serum are seen, first, in the number of cases that recover without operation; secondly, in the percentage of recoveries in operative cases; thirdly, in the shortening of the time that the tube is necessary.

It is not yet possible to give exact figures regarding the proportion of laryngeal cases that recover without operation. Baginsky found that during the two months in which the serum treatment was interrupted in the Childrens' Hospital in Berlin, because the supply was exhausted, the proportion of cases requiring operation was 55·2 per cent, while with the serum, during the period immediately preceding and following this, it was only 18·1 per cent. This is to be explained partly by the fact that by the early use of the antitoxine the larynx less frequently became involved, and partly by the number of laryngeal cases recovering without operation.

In the Pædiatric Society's report there were 1,256 laryngeal cases, of which 554 recovered without operation. Welch's paper* contains figures from seven European observers with reference to this point, who together report in 401 laryngeal cases, 27·2 per cent of recoveries without operation. The improvement in the results of operated cases are even more striking:

* Transactions of the Association of American Physicians, 1895.

Results from Intubation with and without Antitoxine.

SOURCE.	Cases.	Mortality.	
Ranke, European hospitals	1,445	62·5	Without antitoxine.
Welch, European hospitals	342	29·8	With " "
McNaughton and Maddren, private practice in America	5,346	69·4	Without " "
American Pædiatric Society's Report, private practice in America	533	25·9	With " "
Dillon Brown, private practice, with calomel fumigations	279	49·4	Without " "
Reports of operators with experience of 10 cases or more, in American Pædiatric Society's Report	280	23·2	With " "

O'Dwyer says of his last 100 operations, that the first 70 without the serum gave a mortality of 73 per cent, the last 30 with the serum a mortality of 33·3 per cent. McNaughton says that in his last 72 operations without serum the mortality was 66·6 per cent; the first 72 with serum, 33·3 per cent.

It is useless to multiply evidence, for from all parts of the world the testimony is the same, that the mortality in cases of laryngeal diphtheria requiring operation has been reduced at least one half by the introduction of serum. This marked improvement is due to two causes: the serum shortens very materially the length of time it is necessary to wear the tube; and, what is far more important, it prevents the extension of the membrane downward into the trachea and bronchi, in this way removing in great measure the danger of broncho-pneumonia.

The results from tracheotomy have likewise been greatly improved by the serum, although not to the same degree as those from intubation. A collection of 23,941 tracheotomies for croup by Prescott and Goodthwait* gives a mortality of 71·3 per cent. Of 873 tracheotomies with serum † the mortality was 40·9 per cent. It is now generally conceded, not only in America but all over the continent of Europe, that as a primary operation intubation should always be performed, tracheotomy being reserved for the rare cases in which intubation has failed to relieve the stenosis.

Summary.—1. Behring's antitoxine is a specific remedy for experimental diphtheria in animals.

2. Experience is now sufficient to justify the statement that it is so in man, and just in the degree to which we can fulfil the conditions which are essential in experimental diphtheria.

3. These conditions are, that the serum must be administered early—usually within forty-eight and certainly within seventy-two hours—that the dose be adequate, and the case be one of pure diphtheria.

* Gillet, Séro-thérapie, Paris, 1895.

† Guerard's collection, in New York Health Board Bulletin.

4. Experience shows the serum to be much less efficacious in cases of so-called mixed infection or septic diphtheria, and that it is valueless in membranous inflammations which are due to streptococci—i. e., pseudo-diphtheria.

5. The serum itself is essentially harmless both when injected in healthy persons for immunization, or in those suffering from diphtheria. Serious symptoms following injections are so exceedingly rare that they must be attributed to other causes.

6. Unpleasant symptoms, rashes, etc., have a close relation to the volume of serum injected, and with the concentrated preparations now available they have become much less frequent.

7. In a young child the serum should be injected upon a clinical diagnosis of diphtheria without waiting for a bacteriological confirmation.

8. In older children one may wait for this in a mild case, but never in a severe one, particularly a laryngeal case.

9. For all cases, but especially for young children, the most concentrated preparation of antitoxine which can be obtained should be employed.

10. From the most trustworthy statistics which are now available, it appears that the actual mortality from diphtheria (including membranous croup) has been reduced at least one half by the general adoption of the serum treatment; and

11. That in cases injected during the first two days the mortality is less than five per cent.

12. The evidence is conclusive that in laryngeal diphtheria the serum in sufficient doses largely prevents the extension of membrane into the trachea and bronchi, and thus prevents broncho-pneumonia.

13. There are not yet sufficient data at hand to enable one to state to what degree the heart, the kidneys, and the nervous system are protected by the serum. It is, however, certain, that to insure protection of the nervous system, the injection must be made very early.

14. While much still remains to be learned regarding immunization, present knowledge justifies the statement that for a period—approximately a month—the protection conferred is practically complete. Immunizing doses should therefore be given to every child in an infected household or institution.

15. Gratifying as were the earlier results with the serum treatment, they have been constantly improving, and there is every reason to believe that, with larger experience both in its preparation and its use, still better results will yet be reached. Certainly there is no remedy for any disease that has more testimony in its favour than has now antitoxine for diphtheria.

Other treatment in connection with antitoxine.—In the mild cases nothing else is required except to keep the child in bed and to continue a fluid diet. In the severe cases, heart stimulants, especially alcohol and

strychnine, are to be used as formerly, according to the condition of the pulse. Nasal injections of bland fluids, either a warm salt solution or five-per-cent boric acid, should be used every three or four hours in severe nasal or naso-pharyngeal cases, unless the child is very young or intractable, but if he struggles much against them more harm than good is likely to result from their continuance. The mouth should be kept clean by the use of an antiseptic mouth-wash, such as Seiler's solution, or, in the case of older children, by a gargle of bichloride 1 to 10,000. A fluid diet, careful nursing, and absolute quiet are the only other measures that can be regarded as essential. The use of strong antiseptic or caustic applications, whether by the spray, swab, or syringe, for the purpose of controlling the local disease, should be entirely omitted. The heart and the kidneys should be watched in all cases, not only during the disease but for some time after it.

Convalescence.—After a severe attack of diphtheria convalescence is always slow on account of the anæmia and the depressing effects of the disease. Patients should invariably be kept in bed for at least a week after the throat has cleared, and longer if any tendency to cardiac weakness is seen. The pulse should be carefully watched, and irregularity, intermission, diastolic, or a weak first sound of the heart, should make one apprehensive. An abnormally slow pulse may be more serious than one which is rapid. Under such circumstances the patient should be kept recumbent and absolutely quiet, since sudden and even fatal syncope may be the result of the violation of these rules.

The extreme degree of anæmia requires that iron be given for a considerable time during convalescence, to be followed by cod-liver oil, wine, and other tonics.

Great difficulty is occasionally experienced in getting rid of the bacilli in the throat. Inasmuch as it is now generally made a condition of release from quarantine that the throat shall have been shown by cultures to be free from bacilli, this becomes a matter of much importance. The tonsillar crypts and the adenoid tissue of the rhino-pharynx are the places where bacilli are likely to remain. The most efficient means appears to be, to syringe the nose four or five times daily with a solution of bichloride, 1 to 5,000, to which one eighth glycerin has been added, and to use the same solution as a gargle. For children under four years old a simple salt solution, or a dilute Dobell's solution, should be substituted and the gargle omitted.

PSEUDO-DIPHTHERIA.

Synonyms: False diphtheria, streptococcus diphtheria, scarlatinal diphtheria, diphtheroid inflammation, croupous tonsillitis.

At the present time there are included under the term pseudo-diphtheria all inflammations of the throat and upper air passages characterized by the production of a false membrane, in which the Loeffler bacillus is not found. When these inflammations are primary they are rarely serious; but when they complicate scarlet fever or measles they may be very severe, and frequently prove fatal.

Frequency.—Numerical statements regarding the relative frequency of this disease and true diphtheria signify very little, because of the variable conditions under which observations have been made. From the investigations of Park, Baginsky, Martin, Morse, and others, it would appear that in from twenty-five to thirty-five per cent of the cases formerly sent to hospitals with a clinical diagnosis of diphtheria, the disease was pseudo-diphtheria. Most of these were mild, and were then regarded by many physicians as simply cases of tonsillitis, the exceptions being those which were secondary to scarlet fever or measles.

Of the membranous inflammations occurring in the diseases just mentioned, the great majority are examples of pseudo-diphtheria. Of seven cases of membranous angina in measles and three in scarlet fever, studied by Prudden, all were proven to be pseudo-diphtheria; of nineteen occurring with scarlatina, studied by Park, only two were found to be true diphtheria; and of sixteen occurring with scarlet fever and three with measles, studied by Booker, none were true diphtheria. The observations made along the same lines by Sorenson, Wurtz and Bourges and others have confirmed the results obtained upon this side of the Atlantic. It has been the general experience of all writers that when it complicates the diseases mentioned, pseudo-diphtheria occurs, as a rule, at the height of the primary disease, sometimes preceding the eruption, while true diphtheria more often occurs later, even during convalescence.

Etiology.—As was first shown by Prudden in 1888, and abundantly confirmed by others since that time, this inflammation is usually due to the streptococcus pyogenes; it may be found alone, or associated with the staphylococcus aureus or albus, and occasionally the staphylococcus may be found alone.

The streptococcus is very frequently found in the throats of healthy persons, particularly at certain seasons in cities, and in children who live in tenements or who are inmates of hospitals or other institutions. The local conditions in the mucous membranes during an attack of measles, scarlet fever, and other infectious diseases, are especially favourable for the devel-

opment of these germs, which at such times are very often present in great numbers even when no membrane is seen.

Bad drainage and sewer-gas poisoning are other conditions with which this form of sore throat often exists, and a predisposition is afforded by unhygienic surroundings of any description. From the fact that the streptococcus is so widely distributed, attacks of pseudo-diphtheria may occur in any place and at any time, irrespective of epidemic influences or even the occurrence of other cases.

To what degree these cases are to be regarded as communicable, and what precautions regarding isolation and disinfection are required, are questions of much importance. The most extensive investigations upon these points are those made by the New York Health Department.* As a result of observations upon 450 cases which were followed, the conclusion was reached that the disease was so slightly contagious (if at all), and usually so mild, that strict isolation and subsequent disinfection were unnecessary. Of 113 cases occurring in 100 families, in only 14 was there a history of exposure to a similar case; and in only 9 was there another case in the same family. In many of the latter, a common origin appeared more probable than that one case was derived from another.

At the present time the general opinion of the profession seems to be that these cases are to a slight degree communicable, to be compared in this respect to ordinary catarrhal colds or possibly to pneumonia. They are probably more contagious in the presence of the poison of scarlet fever or measles.

Lesions.—In the primary cases the membrane is generally confined to the tonsils or is chiefly there, there being only small deposits elsewhere. In the secondary cases, the entire pharynx may be covered and the disease may extend to the nose, the mouth, the middle ear, and occasionally to the larynx, trachea, and bronchi.

The structure of the membrane resembles that of true diphtheria, and it is impossible by a microscopical examination alone always to separate the two diseases. In many cases the membrane is softer, more friable, and contains a relatively larger number of cells than does that of true diphtheria, but the structure of the latter varies so much that it is not safe to draw any positive conclusions.

In the mild cases the inflammation of the mucous membrane is a superficial one and the false membrane is not very adherent. In the severe cases, chiefly the secondary ones, the process extends much deeper. There are usually seen only congestion, œdema, and cell infiltration, but deep suppuration, and even extensive necrosis may take place. This usually occurs in the tonsils, palate, uvula, or epiglottis; but it may extend to the tissues of the pharynx and into the cellular tissue of the neck. The

* Scientific Bulletin, No. 1.

lymph nodes are swollen in all the severe cases, and often the inflammation ends in suppuration.

The streptococci are found in the false membrane, in the underlying mucous membrane, in the lymph spaces and in the lymph nodes. In the most severe cases there are present the lesions of a general streptococcus infection. The blood swarms with these germs, and they may set up inflammations in any of the organs, but especially in the lungs and the kidneys, less frequently the serous membranes. Small foci of suppuration may be found in any of the viscera.

Symptoms.—1. *The primary cases.*—The onset is usually sudden, with well-marked symptoms: there are frequently chilly sensations, headache, vomiting, general pains, and in most cases the child complains of soreness of the throat and pain on swallowing. There are first seen a general redness and swelling of the tonsils, sometimes of the entire pharynx; shortly afterward membranous patches appear upon the tonsils. These vary greatly in appearance. In colour they are yellow or gray, often changing later to a dirty-olive tint. (Plate XVII, c.) The membrane seems loosely attached and can frequently be wiped off with a swab. It is soft and friable, very rarely thick, firm, or tenacious. It is often irregular in its outline, which is not sharply defined. The membrane usually remains but three or four days and disappears rapidly. As a rule, it is limited to the tonsils, and does not spread after it first forms. Occasionally, however, small patches are also seen upon the fauces or the pharynx. The œdema and other evidences of inflammation in the throat are usually more marked than in true diphtheria, and the swelling of the lymph nodes behind the jaw is slight. The constitutional symptoms are generally more severe during the first two days, and the temperature may be 103° or 104° F., but by the third day it falls, and most of the symptoms subside. It is rare for the disease to extend either to the nose or the larynx. Generally there are no complications and no sequelæ.

2. *The secondary cases.*—Some of these are mild, and do not differ from those just described, but most of the severe cases are included in this group. The clinical picture of the latter is that of *scarlatina anginosa*, as given by the older writers, and it does not differ in any essential particulars from the septic form of true diphtheria (page 969). The local symptoms are those of severe pharyngeal diphtheria, and the constitutional symptoms those of septicæmia.

When the disease complicates scarlet fever, the symptoms may precede the eruption, but they usually begin at the height of the primary fever—i. e., from the second to the fourth day—and gradually increase in severity, reaching their maximum from the fifth to the eighth day of the disease. In measles the throat symptoms are somewhat later; they begin at the height of the primary fever, and often increase while the eruption fades. In nearly all severe scarlatinal cases the disease involves the nose and the

middle ear. In measles both these complications are less frequent, but there is a much greater tendency to involve the larynx, and if the larynx in a young child the process is almost invariably complicated by broncho-pneumonia. In some cases the larynx is invaded when there is no membrane in the pharynx; but this is very infrequent, unless the disease is true diphtheria. Catarrhal laryngitis in a young child may produce symptoms which are practically identical with those of the membranous form, and there is little doubt that many cases complicating measles in which the latter diagnosis is made are really examples of catarrhal laryngitis, particularly if no membrane is visible in the throat.

Secondary cases as a class are characterized by high temperature (Fig. 169), rapid, feeble pulse, great prostration, and delirium, apathy or stupor, and often albuminuria. In fatal cases death usually occurs at the height of the disease, from asthenia, broncho-pneumonia, or nephritis, sometimes

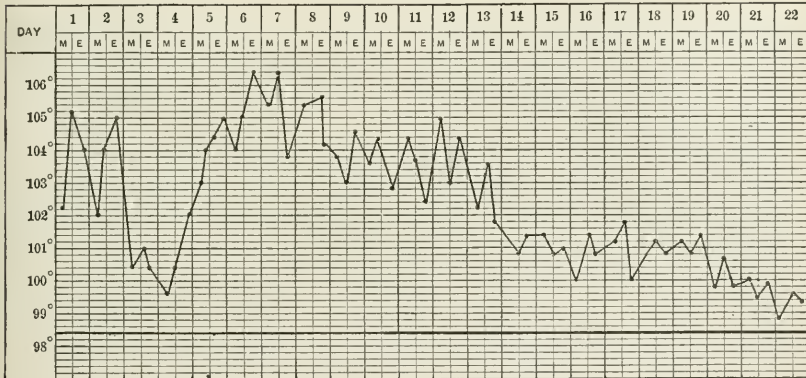


FIG. 169.—Pseudo-diphtheria following measles. The chart begins at the time of the full eruption in a severe case of measles. On third day temperature fell, with fading eruption, and child seemed convalescent. With secondary rise in temperature, the tonsils, which before had been only red, showed membranous patches, the exudation rapidly spreading until the entire pharynx was covered; throat symptoms very severe, with great swelling of cervical glands, but the membrane did not extend beyond the pharynx. From sixth to twelfth day a most profound septicæmia, so that life was despaired of. The patient was a vigorous child, and, escaping both nephritis and pneumonia, made a good recovery. Convalescence quite rapid; no sequelæ. Repeated cultures were made from the throat, but all showed only streptococci. Patient a girl four years old. Case observed in private practice.

from laryngitis. If none of these complications develop, patients may withstand the toxic symptoms even when they are very severe. If the attack terminates in recovery, the local disease follows very much the same course as in diphtheria. The subsequent anæmia is, however, less severe, and none of the dangers of convalescence connected with cardiac or respiratory paralysis are present.

There may be in connection with the local process in the throat, deep sloughing of the tonsils or adjacent structures, suppuration of the lym-

phatic glands or in the cellular tissue of the neck, occasionally followed by serious hæmorrhage. However, all these complications are rare, and if the patient survives the danger of the acute stage of the disease, he usually recovers.

Diagnosis.—The clinical features which distinguish pseudo-diphtheria from true diphtheria have already been considered (page 974). It is impossible in any case to be certain of the diagnosis except by cultures; for, although by clinical symptoms alone one may in the great majority of cases be certain that a given case is one of true diphtheria, to say that any membranous inflammation of the throat is not diphtheria, is impossible. The bacteriologists have taught us to be cautious in pronouncing too positively upon even the mild cases, as it has been clearly shown that some of them may be caused by the most virulent of diphtheria bacilli (page 965).

In the secondary cases the diagnosis by clinical symptoms is more accurate. A membrane which appears in the throat early in the course of measles or scarlet fever, or at the height of the primary disease, is due to the streptococcus in at least four cases out of five; while one which develops late or after the primary fever has subsided, is generally due to the diphtheria bacillus.

Prognosis.—There is no more striking contrast between true and pseudo-diphtheria than in their mortality when they are seen side by side. Of 117 primary cases of pseudo-diphtheria observed by Park in the Willard Parker Hospital, New York, the mortality was 3·5 per cent; of 127 cases of true diphtheria seen in the same institution at the same time, the mortality was 34·5 per cent. In a group of 154 hospital cases reported by Baginsky, there were 118 of true diphtheria, with a mortality of 38·2 per cent, and 34 cases of primary pseudo-diphtheria, with a mortality of 5·5 per cent. From the same hospital, Philip has published a report upon 376 cases: 332 of these were true diphtheria, with a mortality of 37 per cent; 31 were cases of primary pseudo-diphtheria, with no mortality. The Bulletin of the New York Health Department contains a report upon 324 cases of pseudo-diphtheria in children, with a mortality of 9, or 2·8 per cent; 4 of the fatal cases complicated scarlet fever; of the primary cases, the mortality was but 1·5 per cent. These were not hospital cases. The larynx is very seldom involved in primary cases, and unless this occurs, they nearly always recover. From the above data the deduction seems warranted that in a child previously healthy, primary pseudo-diphtheria is not a serious disease.

Turning now to the secondary cases, we find a very different state of things. Large statistics are not yet available, but from those already published it would appear that the usual mortality of pseudo-diphtheria, when it is secondary to scarlet fever and measles, is from 20 to 40 per cent. However, when these diseases prevail epidemically in institutions for

young children, the mortality not infrequently reaches 70 or 80 per cent. Under such conditions the cases complicating measles give, as a rule, a higher mortality than those complicating scarlet fever.

Prophylaxis.—In primary cases strict quarantine is unnecessary after the question of diagnosis has been settled. However, in private practice, healthy children should be excluded from the sick-room during acute symptoms. Cases of pseudo-diphtheria occurring in measles or scarlet fever should certainly be separated from uncomplicated cases. By way of prevention, something can be done in these diseases by keeping both nose and throat as clean as possible during every severe attack, by the use of an antiseptic mouth-wash or gargle, and by a nasal spray or even nasal syringing. For young children only weak solutions should be employed, such as a diluted Dobell's or Seiler's solution, 1 : 10,000 bichloride, or a one-per-cent solution of boric acid. For those who are older, stronger solutions may be used, especially as a gargle.

Treatment.—Every child with a membranous patch on its throat requires close watching. If the child is young—i. e., under ten years old—the diphtheria antitoxine should be administered, pending the result of a bacteriological examination. The primary cases require only the treatment of attack of tonsillitis; the child should be put to bed, the bowels freely opened, and the diet should be light and fluid. If old enough he should gargle five or six times a day with some one of the solutions mentioned above; but with younger children it is not worth while to persist in any attempts at local treatment, unless the case is manifestly progressing unfavourably, when the treatment should be the same as in the secondary cases.

The occurrence of a patch upon the tonsil of a child with scarlet fever or measles should be the signal for beginning active local treatment. If the child is old enough so that it can be done without force, the tonsils should be touched three times a day with a solution of bichloride, 1 : 500, with a swab, and a gargle should be used every hour during the day, of 1 : 5,000 bichloride, or a saturated solution of boric acid. If there is a nasal discharge, the nose should be syringed with a bland solution, as in true diphtheria (page 987). In a younger child forcible swabbing is a very doubtful expedient. It is usually better to content one's self with syringing both the nose and the mouth with bland solutions. The frequency with which these measures are used will depend upon the severity of the case. The treatment of these cases by the "streptococcus antitoxine" has not yet reached a point where it is to be recommended.

In the general management of these cases, feeding, stimulants, etc., the same plan is to be followed as in diphtheria.

CHAPTER IX.

TYPHOID FEVER.

TYPHOID FEVER is an acute infectious disease due to a specific germ—Eberth's bacillus—which is abundantly present in the intestinal discharges of affected persons. It is very rare in infancy, but is not infrequent in childhood. As compared with the same disease in adults, the typhoid of childhood is characterized by its shorter duration, milder course, the infrequency of serious complications, and its low mortality.

Etiology.—*Age.*—I have never seen typhoid fever in a child under two years old, and I believe it to be very rare, although undoubted cases have been reported even during the first year. Murchison records one only six months old, and Ogle another four and a half months old, the diagnosis being confirmed by autopsy in both instances. No case of typhoid was seen in the New York Infant Asylum during my eight years' service there, about ten thousand cases of illness having been treated during the period, and over seven hundred autopsies made. In seven years but one case was admitted to the Babies' Hospital, this being in a child over two years old. In over two thousand autopsies—chiefly upon children under two years old—made at the New York Foundling Asylum, Northrup did not meet with a single case of typhoid, nor was one known to have occurred in that institution for twenty years. The exceptional cases in infancy have almost invariably been observed in general epidemics. In an epidemic in Montclair, N. J., in 1894, 115 persons were attacked, 3 of these being under two years old. In a severe epidemic in Stamford, Conn., in 1895, 406 persons were attacked, 4 being children under two years old.

After the second year typhoid is by no means rare, but it is not until after the fifth year that it can be said to occur frequently. The following figures, embracing groups of cases reported by eight writers, represent perhaps as well as statistics can the relative frequency with which the disease is seen at the different ages: Of 970 cases, 8 per cent occurred under five years, 42 per cent between five and ten years, and 50 per cent between ten and fifteen years.

Typhoid is almost invariably contracted by drinking water or milk which contains the germs of the disease. It is not within the scope of this article to discuss the manifold ways in which this may occur. The epidemics of Montclair and Stamford, already referred to, were definitely traced to infected milk. The infrequency of typhoid in infants is explained, in part at least, by the fact that most of the water and a large part of the milk taken have previously been boiled, or at

least heated. In cases where the period of incubation could be determined with something approaching accuracy, this has varied between five days and three weeks.

Lesions.—Typhoid in young children is so seldom fatal that opportunities for a study of the lesions have been limited. In a general way the lesions resemble those of adults except in severity. There is acute swelling of Peyer's patches, especially in the lower ileum, and of the solitary follicles of the small intestine and the colon, which may be followed by ulceration. There are frequently present the evidences of a mild catarrhal enteritis. The mesenteric glands are swollen and the spleen is enlarged and soft.

The intestinal lesions are, as a rule, much less severe than in adults; in a considerable number of the cases this process does not go on to ulceration; and when ulcers form they are seldom large or deep, and perforation is very rare. Montmollin gives the following facts concerning 23 autopsies, most of them, however, being in children over eight years old: ulcers were present in 17 cases; they were situated in the lower ileum in 16, and in 10 they were only there; in the ascending colon in 9, and only there in one case; in one other case they were in the transverse colon, and in another they extended to the sigmoid flexure; perforation occurred in 3 cases, in every instance in the lower ileum. In 25 autopsies by Reimer, ulcers were noted in 20, and in 2 there was perforation. The autopsies made upon young children show even less severe intestinal lesions than those mentioned. In fact, some cases in which the clinical diagnosis was beyond question, have shown only moderate redness and swelling of Peyer's patches, the solitary follicles and the mesenteric lymph nodes,—lesions which are exceedingly frequent in cases of simple diarrhoea, as my own experience has abundantly demonstrated. It should be emphasized that in a doubtful case such post-mortem findings do not establish the diagnosis of typhoid. Indeed, they prove nothing unless cultures from the intestinal contents, the mesenteric glands, or other organs, show the typhoid bacillus. From a consideration of the clinical course of the disease, it seems very probable that in a large proportion of the cases which recover, ulceration does not take place. Enlargement of the spleen is practically constant. The degenerative changes in the heart, the kidneys, and the liver are much less frequent and generally less severe than in adults. The lesions of other organs will be considered under Complications.

Symptoms.—The peculiar features of typhoid in early life are seen only in children under ten years old; for after this time the disease does not differ essentially from the adult type. In brief, the typhoid of early childhood may be characterized as a fever more often with nervous symptoms, than with intestinal symptoms.

Onset.—A sudden onset with well-marked symptoms—fever, prostration, vomiting, etc.—is not uncommon; in fact, it is quite as frequently seen as

the insidious beginning with lassitude, headache, coated tongue, anorexia, and gradual rise in temperature. In cases developing abruptly it often appears as if an acute indigestion had been the means of precipitating the attack. The most frequent initial symptom is vomiting; a chill is rare. I have once known the disease to be ushered in by convulsions, but this is very exceptional. Epistaxis occurs as an early symptom rather less frequently than in adults.

Condition of the bowels.—There is no constant relation between the severity of the intestinal lesions and the condition of the bowels. Taking large groups of cases together, diarrhoea is present in about half the number. Morse's* observations, however, upon children under ten years old showed that constipation was present in two thirds, and diarrhoea in only one third of the cases. The diarrhoea is rarely profuse, from two to four discharges a day being the average. The appearance of the stools is seldom characteristic; they are usually thin and fluid, often containing mucus. Constipation may be present at the beginning only, or it may persist throughout the attack. Tympanites is generally moderate in degree, and is often entirely absent; it usually accompanies constipation. Marked iliac tenderness and gurgling are infrequent.

Spleen.—By the end of the first week this is almost invariably found to be enlarged to a sufficient degree to be recognised by palpation (page 832), unless a satisfactory examination can not be made owing to the presence of tympanites or the extreme irritability of the child. Usually the spleen extends but an inch or an inch and a half below the ribs, but at times it may be three inches or more. Swelling of the spleen is an important symptom not only for diagnosis, but also for prognosis; its persistence always indicates that the disease is not at an end even though the temperature has reached the normal, and a relapse should be expected.

Eruption.—It is the experience of nearly all who have seen much of typhoid in children that the eruption is less constant, less abundant, and less characteristic than in adults. Of 670 cases in Morse's collection, it was noted in but 60 per cent. The typical eruption consists of small, scattered, rose-coloured spots, which appear chiefly or solely upon the abdomen at the beginning of the second week. They come in successive crops, each one of which generally lasts three days, the whole duration of the eruption being about a week. The eruption reappears in most cases in which relapses occur.

Prostration, emaciation, etc.—As a rule the prostration is quite sufficient to keep a child in bed after the first few days. The general weakness after this time is in direct proportion to the height of the tempera-

* Typhoid Fever in Childhood, with an Analysis of 284 Cases; Boston Medical and Surgical Journal, February 27, 1896. In this article, to which I am indebted for many statistics, will be found quite a full bibliography of the subject.

ture. Loss of flesh is steady and usually marked; and in a prolonged attack there is marked emaciation.

Temperature.—In the cases with a gradual onset, the typical temperature curve is one which rises steadily for from two to seven days, fluctuates within the limits of one to three degrees during the second week, and steadily declines during the third week, reaching the normal on the average at the end of the third week. In cases with an abrupt onset, the temperature rises at once to from 102.5° to 105° F., but subsequently may run the same course as in the first group.

The following are the most important variations from the temperature curve of adults: The initial rise is much more frequently rapid; during the second week the remittent character is less marked, this probably depending upon the fact that ulceration is less frequent and less extensive; the average duration is shorter. In young children the proportion of cases in which the fever lasts only from eight to fourteen days is quite large (Fig. 170). In Wolberg's* 277 cases, the duration of the fever was fourteen days, or less in 70 per

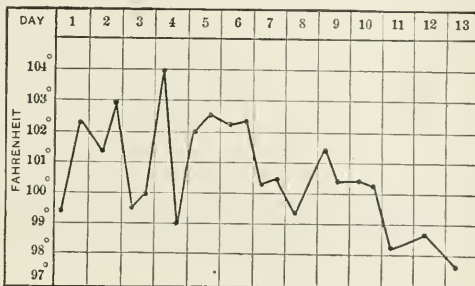


FIG. 170.—Typhoid fever of short duration in a child thirteen months old. Spleen enlarged; eruption typical; no diarrhoea and only moderate abdominal distention. There were two other cases in the family, all being due to the same cause—infected milk. (After Northrup.)

cent of the cases, and eight days or less in 2.8 per cent. Of this series, 60 per cent of the children were eight years old or under. In a series of 295 cases reported by Montmollin, most of which were in children over eight years old, the disease lasted over three weeks in 30 per cent. The same peculiarity is brought out by Morse's figures: not counting relapses, the average duration of 75 cases under ten years old was 19.3 days; of 202 cases from ten to fifteen years old, it was 22.6 days. After the age of ten years the type of the fever is much like that seen in adults. The maximum temperature in the mild cases is 103° or 104° F.; in the severe ones it often reaches 105° or 106° F., but rarely goes above this point. The range is usually higher than in adult cases of the same severity. Typhoid is about the only disease where the temperature runs higher in older than in younger children. At the beginning of convalescence a subnormal temperature is very frequent, and by many writers is considered to be the rule. A secondary rise is most frequently due to errors in diet, but may occur from the development of complica-

* Jahrbuch für Kinderheilkunde, Bd. xxvii, S. 28.

tions. A sudden fall indicates either perforation or intestinal hæmorrhage.

Relapses are not infrequent; they were present in 11 per cent of 284 cases reported by Morse, and in 8.4 per cent of 533 cases collected by him. They follow about the same course as in adults. The interval between the attacks varies from two days to two weeks. The relapse is usually shorter than the primary fever, but is characterized by a reappearance of the eruption and most of the previous symptoms (Fig. 171).

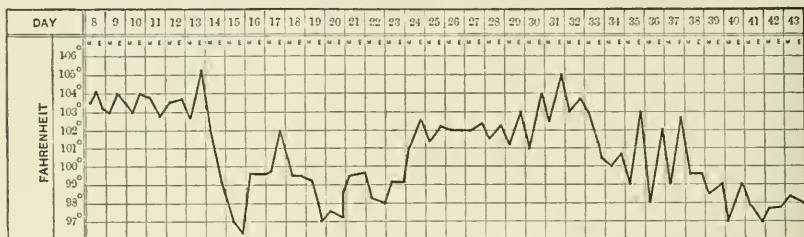


FIG. 171.—Typhoid fever with relapse. Child two and a half years old; early temperature high and symptoms typical; natural fall on fourteenth day; rise on seventeenth day apparently due to otitis; relapse on twenty-fourth day, with fresh eruption and return of splenic swelling which had disappeared. Temperature was subnormal at the end both of primary and secondary fever.

Nervous symptoms.—As a rule, these are more prominent in severe cases than the intestinal symptoms, and are directly proportionate to the height of the temperature. The extreme nervous symptoms belonging to the typhoid state in adults—subsultus tendinum, carphologia, and coma vigil, with the dry glazed tongue, etc.—are rare in childhood, and when present are generally in patients over ten years old. Headache and mild delirium at night are very frequent, the former being seen in the majority of cases. Young children are usually dull, apathetic, and often in a state of semi-stupor. Occasionally the disease may closely simulate meningitis. There may be general hyperæsthesia, delirium or stupor, opisthotonus, contracted or unequal pupils and strabismus; but very seldom convulsions. The nervous symptoms are usually most severe in the second, or early in the third week, and subside as the temperature declines.

Pulse.—This is increased in frequency, but not to the degree that is seen in most diseases of childhood with a similar elevation of temperature. The force and rhythm of the pulse are usually good, irregularity, very low tension, and dirotism being rare as compared with adults; they may occur either at the height of the disease or during convalescence. Functional heart murmurs are quite frequent.

Intestinal hæmorrhage.—Of 946 collected cases, mainly from hospital reports, intestinal hæmorrhage occurred in 30, or about three per cent; the majority of these were in children over ten years old. Thus Morse reports that in 77 cases under ten years old there was no case of hæmor-

rhage; while in 204 cases between ten and fifteen years it was seen in 9 cases. The most frequent time of its occurrence is toward the end of the second week. Montmollin reports 14 cases of hæmorrhage, with 4 deaths; in Morse's 9 cases there were 5 deaths.

Intestinal perforation.—This is even more rare than hæmorrhage. In 1,028 collected cases, this accident occurred but twelve times, or in 1.1 per cent. Eight of these proved fatal. Perforation is indicated by a sudden fall in the temperature, with collapse; usually there is vomiting and the rapid development of tympanites. The infrequency of both perforation and hæmorrhage is explained by the superficial character of the intestinal lesions and the absence of deep ulceration.

Complications and Sequelæ.—The complications of typhoid in early life are infrequent and usually mild. Bronchitis is present in most of the severe cases. Pneumonia was noted in 9 per cent of seven hundred cases, reported by various authors. Both serous and purulent effusions into the chest are occasionally seen, and less frequently abscess of the lung. Gangrene of the lung, and severe inflammation or ulceration of the larynx are extremely rare.

A small amount of albumin is found in the urine in most of the severe cases at the height of the disease, but a marked degree of nephritis is infrequent. It was seen but three times in 295 cases reported by Montmollin.

Complications referable to the nervous system are not very frequent, but are of much interest. Meningitis is extremely rare. Morse has collected twenty-one cases of aphasia, in two of which it was clearly due to embolism; in the remainder, however, it apparently was not dependent upon any organic lesion. In two thirds of the cases it came on during convalescence, and in nearly all complete recovery occurred after an average duration of three weeks. Aphasia usually followed a severe type of the disease, and in most of the cases was not accompanied by any other paralysis or by mental disturbance. Insanity is a rare sequel of typhoid in children, the usual type being acute mania. Adams (Washington) has recently reported two examples of this, both terminating in recovery. Chorea is not an infrequent sequel, and is seen rather oftener than after the other infectious diseases. In most of the series of reported cases no mention is made of multiple neuritis as a sequel of typhoid, but it is certainly not very rare.

Otitis is not an infrequent complication, occurring much oftener than in adults. It is principally seen in young children and during the cold season. Among the less frequent complications may be mentioned: parotitis, which is usually suppurative and is seen in septic cases; abscess of the liver, examples of which have been reported by Bokai, Asch, and others; gangrenous inflammation of the mouth or genitals; pericarditis, endocarditis, and peritonitis, suppurative inflammations of joints, mul-

multiple abscesses and furunculosis. Tuberculosis of the lungs or bones not infrequently follows typhoid.

Diagnosis.—The diagnostic symptoms of typhoid are the continuous fever, the eruption, tympanites, and enlargement of the spleen. Unless the first two are present the case must be regarded as doubtful. One should be very slow to make the diagnosis of typhoid in a child under three years old, unless the disease is epidemic. The great proportion of sporadic cases reported as occurring in infancy are probably not typhoid. After the fifth year the disease is more frequent, and its symptoms in general resemble those of adults, except in severity.

The differential diagnosis is to be made from malarial fever, ileo-colitis, meningitis, tuberculosis, and from other ill-defined continuous fevers of unknown origin. From malarial fever the diagnosis is to be made by the temperature curve, the plasmodium in the blood, and the effect of quinine. In most of the cases of malaria the temperature will be found to touch the normal at some time in the twenty-four hours. While the presence of the plasmodium in the blood is conclusive, its absence is not so. The administration of full doses of quinine is a diagnostic test of much practical importance; an irregular or remittent fever which yields promptly to quinine is most certainly not typhoid.

Ileo-colitis and typhoid fever are not often confounded. The former is almost limited to the first three years of life, a time when typhoid is extremely rare. The intestinal symptoms of ileo-colitis are marked even though the temperature is not high, and they are altogether more severe than is usual in typhoid; while enlargement of the spleen, tympanites, and the eruption are not present.

The cerebral symptoms of typhoid may be difficult to distinguish from meningitis, unless one has watched their development. Irregular respiration, a slow, irregular pulse, localized paralysis and complete coma are seldom, if ever, seen in typhoid, and a retracted abdomen very rarely, while the enlarged spleen and the peculiar eruption are not seen in meningitis. In typhoid with pronounced nervous symptoms the temperature is usually higher than in meningitis.

General tuberculosis very often resembles typhoid so closely that a differential diagnosis is almost impossible until local signs of tuberculosis have appeared, usually in the lungs. (See page 1036.)

Widal's serum-test.—This consists in the "clumping" and immobilizing of typhoid bacilli in broth cultures, caused by the blood serum of a person sick with typhoid fever. This blood test, although but recently introduced, has already been shown to possess great value in making the diagnosis of typhoid, the characteristic reaction being obtained after the first week in the great majority of cases of this disease. As it has been found, although very exceptionally, in other conditions, it can not be regarded as an infallible test. (See Biggs and Park, Amer. Jour. of the

Med. Sci., March, 1897; also, Brannan, N. Y. Med. Jour., March 27, 1897, for a full discussion of the subject, with references to the recent literature.)

Prognosis.—Of 2,623 cases collected from the reports of twelve different writers, the mortality was 5.4 per cent. These are, however, almost all taken from hospital reports, where as a rule the mildest cases are not brought for treatment. The mortality of the disease in children, including all cases, probably does not exceed 3 or 4 per cent. Death seldom occurs from the disease itself, but usually from some accident or complication; the most frequent causes of death are pneumonia and intestinal hæmorrhage or perforation. Occasionally death results from general sepsis with parotitis, bed sores, nephritis, meningitis, or heart paralysis. The most fatal period is the third week.

Treatment.—The low mortality of this disease shows how successful all methods of treatment are likely to be considered. In the great majority of cases very little active treatment is required. Every patient with typhoid should be put to bed and kept there during the febrile period, and a few days beyond it, no matter how mild the attack may be. A fluid diet also should be prescribed in every case, preferably milk which should be given regularly every three hours, and not pushed greatly beyond the desires of the patient. Milk may be diluted or partially peptonized, and kumyss or matzoon may be substituted for it if the stomach is irritable. Plenty of water should be allowed, unless it disturbs the stomach.

The discharges should be immediately and thoroughly disinfected by a solution of carbolic 1:20. If the movements are in a chamber or a bed-pan they should be covered with this solution for at least six hours before they are thrown into the water closet. If napkins or diapers are used, they should be soaked in some efficient antiseptic solution for twelve hours and then thoroughly boiled. Sheets stained by discharges should be treated in the same way, and all bed-linen should be boiled for two hours apart from the washing of the family. Aside from these general measures the treatment of the disease is the treatment of symptoms.

Diarrhœa calls for treatment only when the movements exceed four or five in twenty-four hours. If no more than this number are present, they should not be interfered with. Opium and bismuth are undoubtedly the best means for controlling excessive diarrhœa, but care should be taken that they are not pushed to the degree of inducing constipation.

Constipation may be relieved by small doses of the salines, or an occasional dose of castor oil, but all active purgation should be avoided. In many cases daily irrigation of the colon with tepid water is better than anything else. On the whole, constipation is more troublesome to control than diarrhœa.

Tympanites is rarely severe enough to require treatment; it may be relieved by turpentine stupes, by a glycerin suppository, or a small glycerin

injection (one teaspoonful of glycerin to two ounces water), or, better still, by the use of the rectal tube.

Whenever the temperature goes above 103° F., antipyretic measures are indicated. In mild cases, sponging with cold water or with alcohol and tepid water, equal parts, is generally sufficient. In cases which do not yield to such measures, baths should be employed. For young children the graduated bath (page 48) should be used; for those who are older the bath should be from 75° to 85° F., its duration depending upon the amount of reduction affected. The body should be actively rubbed during the bath to prevent shock and cardiac depression. The only contra-indications to the bath are extreme prostration with great cardiac weakness, or the existence of intestinal hæmorrhage. The case with which the cold bath can be employed in children makes it especially valuable. The cold pack (pages 47 and 48) may be substituted for the bath where circumstances make the latter impracticable. The bath or pack should be repeated in an average case in from two to four hours, or whenever the temperature has risen to 103° F. The method of applying cold which causes the least disturbance to the patient is the one which should always be selected.

The milder nervous symptoms—headache, restlessness, sleeplessness, etc.—may be relieved by an occasional dose of phenacetine, either alone or in combination with the bromides, or by cold or tepid sponging; the more severe ones usually occur with high temperature, and are best controlled by the cold bath.

Stimulants in most of the cases are not called for. They are to be given according to the indications afforded by the pulse, the first sound of the heart, and the child's general condition. They are seldom needed earlier than the middle of the second week; they should be well diluted. Brandy or whisky is to be preferred to wines, and, unlike the milk, they may be given at frequent intervals whenever the patient will take them best. Intestinal hæmorrhage calls for absolute quiet, morphine hypodermically, and turpentine or ergotine by the mouth. Intestinal perforation is to be treated by hypodermics of morphine.

CHAPTER X.

TUBERCULOSIS.

TUBERCULOSIS is an infectious communicable disease, now universally admitted to be due to the bacillus tuberculosis of Koch. It may be local or general, and may involve any organ and almost any structure in the body.

Etiology.—*Frequency.*—Müller, in 500 autopsies upon children in Munich, found tuberculosis in 40 per cent of the cases; in 30 per cent

death was due to tuberculosis, and in the remaining 10 per cent tuberculosis was found at autopsy in patients dying from other diseases. I do not think it is so frequent in this country, for, of 726 consecutive autopsies in the New York Infant Asylum, tuberculosis was found in only 58, or 8 per cent of the cases; 6 per cent of the deaths were due to tuberculosis, and in 2 per cent the children died from other diseases. Of 319 consecutive autopsies in the Babies' Hospital, tuberculosis was found in 44, or 14 per cent.

Predisposing causes.—The predisposition to tuberculosis is general or local. General predisposition may be inherited directly from parents who have themselves suffered from tuberculosis, or from those who, in consequence of syphilis, alcoholism, or any other constitutional vice, have transmitted a feeble constitution to their children. Inherited predisposition is exceedingly common, and really signifies a diminished resistance of the cells of the body to tuberculous infection. It should be distinguished from the very exceptional condition of congenital tuberculosis, where infection takes place before birth. General predisposition includes the child's surroundings, in so far as they affect the constitution and lower the general vitality. Children reared in the city, either in institutions or in crowded tenements, are more frequently affected than those who have had the advantage of the best surroundings, not only because of their increased chances of exposure, but also from their feebler resistance. Marasmus, intestinal diseases, and, in fact, any debilitating general or local disease, may predispose to tuberculosis.

A local predisposition is created by any pathological condition of the mucous membranes or organs most exposed to infection. The most important are repeated attacks of bronchitis, broncho-pneumonia, or pleurisy, and chronic catarrhal inflammation of the mucous membrane of the nose or pharynx, so frequently associated with enlarged tonsils or adenoid growths of the pharynx. Much less frequently the local predisposition is the result of some previous disease of the intestines.

The rôle played by other diseases in the development of tuberculosis is an important one, and until recently but little understood. In a very large number of cases tuberculosis develops as a sequel of one of the acute infectious diseases, particularly measles, pertussis, or epidemic influenza. In such cases there has probably existed previously a latent tuberculosis, usually in the bronchial lymph nodes. This process, sometimes long quiescent, under the stimulus of a new infection may be awakened to activity. It is to be noted that it is the infectious diseases that are intimately associated with pulmonary complications, which are liable to be followed by tuberculosis.

x *Age.*—No age is exempt from tuberculosis. It was formerly believed that the disease was rare in infancy, but recent observations have shown that, although its form is somewhat different, it is more frequent in infancy than at any period of later childhood. Statistics, taken chiefly from

two institutions where children up to four years of age are received, give the following results, the diagnosis being confirmed by autopsy in nearly every case under two years old:

Under three months.....	5 cases
From three to six months.....	21 "
" six to twelve months.....	31 "
" twelve to eighteen months.....	29 "
" eighteen to twenty-four months.....	10 "
" two years to five years.....	32 "
Over five years.....	15 "
Total.....	143 "

It will be seen that the first year furnished 57 cases, the second year 39, and the succeeding three years but 32 cases.

Mode of infection.—The possibility of intra-uterine infection, or the direct transmission of tuberculosis, has been demonstrated by cases recorded by Birch-Hirschfeld,* Lehmann, Bar and Rénon and others. In the case first referred to, the organs of a foetus, taken from a woman dying from general tuberculosis, were found to contain tubercle bacilli, although no tuberculous lesions were present; bacilli were found in the capillaries of the liver; inoculations from the spleen and kidney produced the disease in animals; and the placental tufts were filled with bacilli. In Lehmann's case there were tuberculous lesions in the placenta as well as in the child's organs.

Intra-uterine infection is highly probable in many of the cases of children born of tuberculous mothers, who develop the disease during the first few months of life, although they may show no evidence of it at birth. Among my own cases there were five which died of tuberculosis during the first three months. One of these children was but twenty days old. It was born prematurely of a mother who at the time was suffering from advanced tuberculosis, and died from that disease shortly after the child. Besides other lesions, the autopsy showed, in the case of the mother, tuberculosis of the endometrium. In this instance the infection of the child certainly took place before birth.

In another case, a child died of general tuberculosis, with wide-spread lesions, at the age of seven weeks. The mother of this infant died from tuberculosis eleven days after the birth of the child. Intra-uterine infection must, however, be considered rare in comparison with the frequency with which infection takes place after birth, instead of being, as was formerly supposed, very common.

Tuberculosis may be communicated by direct inoculation, as in the case of a bite from a person suffering from the disease, several instances of which are on record. The rite of circumcision performed by a rabbi

* Wiener medicinische Blätter, No. 17, 1891.

suffering from tuberculosis is also known to have caused the disease. One of the most striking instances of direct infection is that reported by Reich.* In a town of about 1,300 inhabitants, the obstetric practice was divided between two midwives. Within fourteen months no less than ten infants, who had been delivered by one of these women, died of tuberculous meningitis. In none of these families was there a history of tuberculosis. This midwife was found to be suffering from pulmonary tuberculosis, and died from that disease. It was her custom to remove the mucus from the mouth of the newly-born infants by direct mouth-to-mouth aspiration, and then to establish respiration by blowing into the nose. In the practice of the other midwife, who was healthy, no cases of tuberculosis occurred, although she treated the newly-born infants in the same fashion.

x The following instance of infection has recently come to my notice: Two little girls were much in the room and about the bed of a young woman who was suffering, it was afterward discovered, from pulmonary tuberculosis. Within three months of that time, and within six weeks of each other, both died of tuberculous meningitis.

Examples might be multiplied indefinitely of cases where children have contracted the disease from a close exposure to nurses or other persons in the household. More frequently, however, the mode of infection can not be traced, the exposure doubtless being in most of these cases long antecedent to the development of symptoms.

Aside from accidental inoculation already mentioned, the tubercle bacilli may gain an entrance to the body either through the respiratory or the alimentary tract or the skin—the last, however, being so very rare that it need only be mentioned. In infancy and early childhood, infection through the respiratory tract is the rule. This is conclusively shown by the situation of the primary lesions (pages 361 and 1022). The source of the bacilli in the inspired air is mainly the sputum of patients suffering from pulmonary tuberculosis, which dries and becomes part of the dust of the street, of the railroad car, the home, or the hospital. Bacilli may be taken into the alimentary tract with milk from tuberculous cows or tuberculous women. Infection in this way I believe to be very rare.† Unless

* Berliner klinische Wochenschrift, No. 37, 1878.

† In this connection the following incident is interesting as bearing upon the other side of the question: Near a large American city was a fancy stock farm of registered Jersey cows, which supplied milk for table use and infant feeding to a large number of families in the wealthiest part of the city, for a period of over ten years. At the end of that time the tuberculin test was used for the first time, and 45 per cent of these cows were found to be tuberculous, and were killed by order of the State Board of Health. The diagnosis was confirmed by autopsies upon the animals in every instance. An investigation was instituted among the children who had been fed upon this milk, but in only one case of many hundreds could it be learned that tuberculosis had developed, and in this instance it was by no means established that the

the udder is the seat of disease, the number of bacilli in cow's milk is so small that the chances of infecting a child after these bacilli have passed the stomach are exceedingly small. Its possibility even is questioned by many good authorities. The same may be said regarding the transmission of tuberculosis through the milk of a nurse. Infection from the meat of tuberculous animals is doubtless a possibility, but hardly more. Bollinger's experiments in feeding animals with the expressed juice of such meat gave negative results.

The Various Paths of Infection adopted by the Tubercle Bacillus.—

The tubercle bacilli which enter the body with the inspired air are arrested upon the mucous membrane of the upper or the lower respiratory tract; upon which one of these, is largely determined by local conditions in the various mucous membranes. Both clinical experience and animal experiments indicate that the bacilli may pass through a mucous membrane without inducing in it a tuberculous disease, but that penetration is much easier if the mucous membrane is the seat of a catarrhal inflammation, or if the epithelium has been injured. The bacilli are taken up by the lymphatics from the surface of the mucous membrane upon which they have lodged, and are carried to the nearest lymph nodes, where, for a considerable time at least, they are arrested. It has long been a familiar clinical fact that the great majority of children who suffer from tuberculosis of the cervical lymph nodes escape general tuberculous infection, so eminent an authority upon this subject as Treves considering this to be a very exceptional result.

It is not infrequent, in autopsies both upon children and adults dying from various non-tuberculous diseases, to find tuberculosis limited to the bronchial lymph nodes. In a series of 125 autopsies at the New York Foundling Asylum upon children with tuberculosis, Northrup* found 13 such cases, these being children who had died from acute non-tuberculous diseases. Many confirmatory reports have been published by Bollinger (Munich) and others. I have myself seen it in a number of instances.

H. P. Loomis † (New York) made inoculation experiments with the bronchial lymph nodes taken from the bodies of thirty persons dying by violence or from acute disease, in whom no evidence of tuberculosis in any other part of the body could be found at autopsy. From eight of the cases he produced tuberculosis in animals by inoculation. Arnold has shown

milk had been the source of infection. It should be stated that this was before the days of sterilizing milk for infant feeding. Besides the families who took the milk in the manner mentioned, the employees at the farm were accustomed to drink the skimmed milk in large quantities daily as a beverage in the place of water. Many of them continued to do this for years, and yet not one of them developed tuberculosis.

* New York Medical Journal, February 21, 1891.

† The Medical Record, December 20, 1890.

by experiments with dust inhalation in animals, that in a short time the bronchial lymph nodes were filled with dust, though the bronchi and alveoli were free; but, however prolonged the inhalation, dust was never found in the lymphatic vessels beyond the nodes.

Arriving at the lymph node, the bacilli light up a tuberculous inflammation of varying degrees of intensity, depending upon their number and upon local conditions. This inflammation may pass through the usual changes of tuberculous glands—congestion, swelling, cell proliferation and caseation; or the process may be arrested at any point, and the products of inflammation become encapsulated by a proliferation of fibrous tissue, in which condition they may remain latent in the body for an indefinite number of years—possibly for a lifetime. This is what occurs in older and more vigorous children, and it is consistent with every outward sign of health; but it is a smouldering ember which at any time may be fanned into flame under the stimulus of an inflammation excited by some other cause.

In infants and young children, the tendency is always for the bacilli to lodge first in the bronchial lymph nodes, probably on account of the favourable conditions for entrance existing in the bronchi and lungs. In those who are delicate and have but little resistance, the process in the lymph nodes is likely to go on to caseation and softening, and secondarily to this process in the glands, the lung may become infected. Of 91 cases observed by Northrup, in which the mode of infection could be pretty accurately traced, in 88 it was primarily in the bronchial lymph nodes. The manner of the extension of the disease to the lung is not always easy to trace; but in many instances it has been shown to be the result of the softening of one of these small tuberculous lymph nodes, which then ulcerates through the wall of one of the small bronchi or a blood-vessel, in this way distributing its bacilli through the lung.

Although this is the course usually taken by bacilli when they are inhaled, it is not always the case. Lesions in the lungs are occasionally found where the lymph nodes are not involved; and there are other cases in which advanced changes exist in the lung, while only the earlier ones are seen in the lymph nodes. In these cases, which perhaps are to be considered as exceptional, the tuberculous process probably begins in the walls of the small bronchi, the alveoli, or in the connective-tissue septa.

Tubercle bacilli entering the alimentary tract rarely cause lesions of the gastric mucous membrane, or through it reach the lymphatic circulation. In the intestines, however, more favourable conditions exist. It is possible for the bacilli to reach the mesenteric lymph nodes without causing disease of the intestinal mucous membrane, but I believe it to be exceedingly rare; for by careful search I have never yet failed to find intestinal ulceration where the lymph nodes were manifestly tuberculous.

Lesions.—In the following table are given the different lesions of tuberculosis as they were found in 119 autopsies, of which I have notes. These represent the lesions of infancy and early childhood, 66 per cent of these children being two years old or under. There are introduced for comparison, the statistics of 131 autopsies from the Pendlebury Hospital Reports (Manchester, England). Very few of the cases in this series were under three years, the hospital admitting only older children :

Frequency of the Different Visceral Lesions of Tuberculosis.

ORGANS.	Personal cases ; 119 autopsies (chiefly under three years).		Pendlebury Hospital Reports ; 131 autopsies (chiefly over three years).	
Lungs.....	117	99·0 per cent.	122	93·0 per cent.
Pleura.....	69	58·0 “	100	76·0 “
Bronchial lymph nodes.....	108	96·0 “	91	70·0 “
Brain.....	40	37·0 “	60	46·0 “
Liver.....	77	65·0 “	86	65·0 “
Spleen.....	88	75·0 “	76	58·0 “
Kidneys.....	46	39·0 “	54	41·0 “
Stomach.....	5	4·0 “	1	0·8 “
Intestines.....	40	37·0 “	65	50·0 “
Mesenteric lymph nodes.....	38	35·0 “	77	59·0 “
Peritonæum.....	10	9·0 “	37	28·0 “
Pericardium.....	7	6·0 “	4	3·0 “
Endocardium.....	1	0·8 “	..	.....
Thymus.....	3	2·5 “	..	.....
Suprarenal capsules.....	2	1·7 “	2	1·6 “
Pancreas.....	3	2·5 “	..	.....

The varieties of tuberculosis seen at different ages.—During the first two years of life, tuberculosis, with great uniformity, involves first the bronchial lymph nodes and the lungs. It is most frequently the pulmonary process which is the cause of death, and next to the lungs, death is due to tuberculosis of the brain. It is rare for any other local tuberculous process to be fatal at this time of life. Of 72 cases of tuberculosis in the first two years of life, in which the exact nature of the lesions was determined by autopsy, the lungs were extensively involved in all; but death was due to meningitis in 13, in only one to tuberculous peritonitis, and in one to hæmorrhage from a tuberculous ulcer of the intestine. During infancy, meningitis is rare except when associated with pulmonary tuberculosis; but after the second year, meningitis is relatively more frequent. Of the deaths from tuberculosis during the third year, meningitis was present in over one half the number. After this time it frequently exists with few and sometimes with no lesions in the lungs, it being often secondary to tuberculosis of the bones or lymph nodes.

Beginning with the third year, tuberculosis of the bones, cervical and mesenteric lymph nodes, peritonæum, and intestines, becomes more frequent, and in any of these organs it may occur as the principal lesion, although at autopsy the lungs, even at this age, are rarely found free from infection.

Pulmonary Lesions.—As compared with adults, the pulmonary tuberculosis of children is more widely diffused, and the predominance of cases in which the lesion is at the upper lobes, though less marked, still exists. The peculiarities are principally seen in children under two years. In those who have passed the sixth or seventh year, the pathological processes resemble those of adult life. In my own autopsies the oldest lesions were found 69 times in one of the upper lobes (left 35, right 34); 23 times in the right middle lobe, and 35 times in one or other of the lower lobes (left 24, right 11). Although localized tuberculous processes are frequently met with in patients dying from other diseases, those who die from tuberculosis usually show wide-spread lesions of the lungs, and the younger the child the more diffuse they are.

1. Miliary tuberculosis of the lungs.—In nearly every case of pulmonary tuberculosis, miliary tubercles are found in some part of the lung; usually they are seen upon the surface and in scattered areas in the vicinity of some older process. Occasionally in older children, but very rarely in infants, they are distributed through nearly the whole of both lungs.

In some places the lung, with the exception of these gray granulations, appears quite normal; in others it is congested, and shows between the tubercles the lesions of simple broncho-pneumonia in its various stages. There is also an acute bronchitis of the middle-sized and smaller bronchi. The microscope shows that the tubercles usually develop in the walls of the small bronchi or the blood-vessels, or very close to these structures. In their gross appearance, the lungs in these cases resemble those in ordinary acute broncho-pneumonia, with the exception that everywhere upon the surface and throughout the substance of the lung are seen the small gray granulations, and in most cases some small yellow tuberculous nodules. The pleura is usually normal except for the presence of the tubercles. This form of the disease represents the rapid dissemination of tubercle bacilli throughout the lungs, the miliary tubercles being the result of the inflammation excited by their presence.

2. Tuberculous broncho-pneumonia.—This is the most frequent and the most characteristic form of tuberculosis in infants and young children, and it is the one which at this age usually causes death. In this form of disease there are produced in the lung, caseous nodules, or larger caseous areas, some of which have usually undergone softening by the time the case comes to autopsy. The process generally runs a somewhat subacute course. With the lesions mentioned there are always associated those of simple broncho-pneumonia.

The pleura is involved in almost every case. There may be simply dense connective-tissue adhesions which bind the lung firmly to the chest wall, or the pleura may be greatly thickened and contain caseous deposits. Occasionally empyema is seen, but it is almost always sacculated and small.

Both lungs are usually involved, but one to a much greater degree than the other. There are found large areas of consolidation which sometimes involve an entire lobe, but more often areas are seen in several lobes. These portions of the lung appear much firmer and harder than in ordinary pneumonia. The upper lobes are more often affected than the lower, and especially that part of the lobe which is near the root of the lung, on account of its frequent association with tuberculosis of the bronchial glands; the disease very often extends forward from this point to the middle lobe of the right, or the corresponding part of the left lung. On section the affected part of the lung usually shows many caseous nodules varying in size from a pin's head to a walnut, which appear of a pale yellow colour, and resemble caseous lymph nodes. They contain giant cells and are usually filled with bacilli, those which have softened containing yellow pus. There is nearly always seen in some part of the lung a large caseous area; and not infrequently there may be diffuse caseation of almost an entire lobe (Fig. 172). Sometimes no spot of softening is seen even in these large areas, but in the great majority of them there are found cavities of variable size with ragged but not dense walls.

Softening and excavation represent the final stages of the process in tuberculous pneumonia. It has been shown by Prudden that these changes are chiefly or entirely due to other pathogenic organisms—usually the streptococcus or staphylococcus—and not to the tubercle bacillus. Softening usually begins in the centre of a caseous part, often at several points at the same time. Areas of excavation large enough to deserve the name of cavities were present in thirty-five of seventy two autopsies upon tuberculous patients, two years old and under. They are found in the great majority of the cases in which continuous pulmonary symptoms have been present till death. They vary in size from a cherry to a hen's egg, and sometimes a much larger one is seen (Fig. 173). They are usually rather deeply seated, and partially or entirely filled with caseous masses or pus, but very seldom perforate the pleura, causing pneumothorax or pyo-pneumothorax. It is rare in a young child to find cavities surrounded by dense fibrous walls such as are seen in older children or in adults; for in infancy the process of softening once begun usually advances steadily until the death of the patient.

It is very frequent to find at autopsy small cavities surrounded by larger areas of caseous pneumonia, and these in turn surrounded by a zone of simple pneumonia through which are scattered many miliary tubercles. Often the lesions mentioned will be present in one lobe, while the other lobe or the opposite lung will show only the changes of a simple pneumonia.

The bronchial lymph nodes are in these cases invariably found to be tuberculous, and not only those at the root of the lung, but if a dissection

is made, a chain of these tuberculous glands will be found to follow the larger bronchi for some distance into the lung (Fig. 176). Sometimes one may discover one of these which has softened and ulcerated through into a small bronchus, and in this way has spread the infection throughout that part of the lung.

Microscopical examination of these cheesy nodules shows that they most frequently begin as tuberculous deposits in the walls of the small



FIG. 172.



FIG. 173.

FIG. 172.—Tuberculous pneumonia. A vertical section through the middle of the right lung of a child thirteen months old. The greater part of the upper lobe is uniformly caseous—a diffuse tuberculous pneumonia; near the centre the commencement of a cavity is seen; below it has the appearance of a consolidation from simple pneumonia. The part of the lower lobe shown is normal.

FIG. 173.—Cavity from breaking down of tuberculous pneumonia; another view of the same lung, the section being made very near the posterior border of the lung. The cavity occupies at this point nearly the whole of the upper lobe. At autopsy this cavity contained numerous loose caseous masses, the largest being the size of a marble. The lower lobe is normal. (For history see Fig. 179.)

bronchi, either in the mucous membrane, the fibrous coat, or the lymphatics; sometimes, however, they begin in the walls of a small vein or artery. Cell proliferation takes place, separating the coats of the bronchus or blood-vessel, and partly or entirely obstructing its lumen. Softening may

take place and the contents be discharged into the bronchus or blood-vessel. About this focus other changes of an inflammatory character

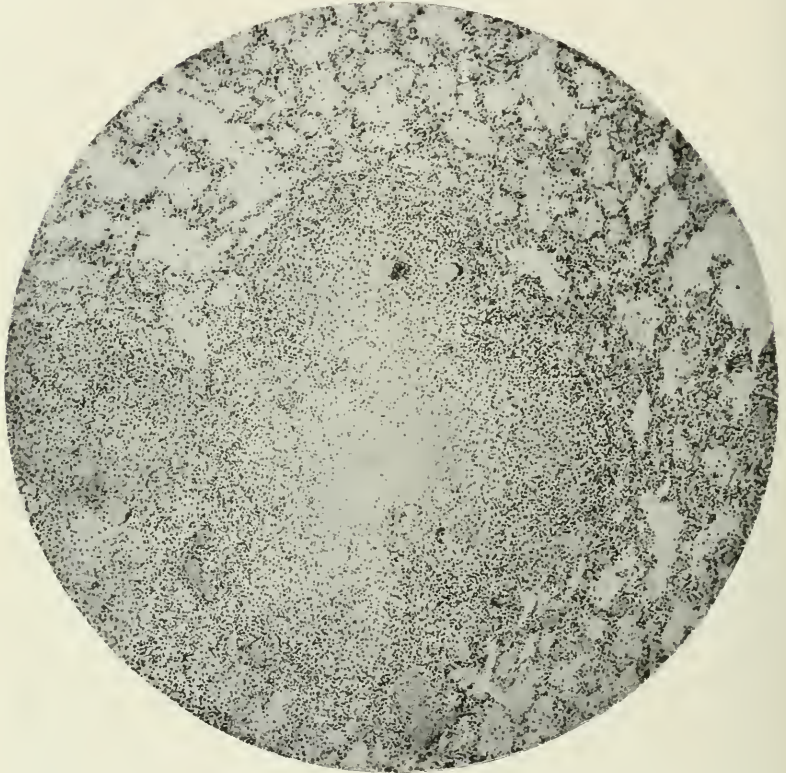


FIG. 174.—A small tuberculous nodule surrounded by lung tissue which shows only slight inflammatory changes. The centre of the nodule is necrotic; at its periphery is shown infiltration with round cells and several giant cells. (From Karg and Schmorl.)

occur, as a result of which each cheesy nodule is surrounded by a zone of simple broncho-pneumonia (Fig. 174) which tends, in a measure at least, to limit the tuberculous process. The larger caseous areas are formed by an extension of this process to the zone of pneumonia which surrounds it; but in its further growth it is still preceded by a simple pneumonia (Fig. 175). The rapidity with which the lesions advance differs much in the different cases, and is greatly modified by the patient's age; in infants the progress is apt to be continuous until the death of the patient; in older children it is usually slower, and is often interrupted by longer or shorter intervals of arrest and even of partial retrogression. Such periods are marked by the absorption of the simple inflammatory products in the zone of pneumonia surrounding the tuberculous nodule, accompanied by improvement in the symptoms and

often by a disappearance of some of the physical signs. During these times of quiescence there is an opportunity for the organization of the cells infiltrating the alveolar walls and septa into a more or less resistant fibrous wall which acts as a barrier against the advance of the pathological process.

Not infrequently one sees in the post-mortem room one or two caseous, or less frequently calcareous, nodules encapsulated by firm, organized connective tissue where a most careful search fails to show any other tubercu-



FIG. 175.—Pulmonary tuberculosis, showing areas of tuberculous pneumonia and conglomerate tubercles. In the greater part of the specimen the air vesicles are filled with the products of simple pneumonia. The larger dark areas, *A A A*, are spots of tuberculous pneumonia, while at *B B* only single air vesicles or groups of two or three are affected by the tuberculous process. The specimen shows a comparatively early stage of the process, of which the late stage is represented by Fig. 172. Patient, a child three months old; the symptoms, those of simple acute pneumonia. There were conglomerate tubercles scattered through both lungs, and large areas of cheesy pneumonia in the left lower lobe.

lous lesion in the lung. If, however, the nodules are widely scattered through the lung, such an arrest of the process is not to be expected.

3. Chronic pulmonary tuberculosis, chronic phthisis.—With the patho-

logical process as it is seen in adults, we have nothing to do in infants and very young children. In those who have reached the age of eight or ten years the disease is essentially the same as in adult life, and need not be described here.

In little children the nearest approach to this condition is seen in the cases of tuberculous broncho-pneumonia, which run a slow, irregular, and somewhat chronic course. The essential features of the process in these patients is a chronic interstitial broncho-pneumonia with tuberculous nodules which rarely undergo softening, but usually become encapsulated.

The gross lesions closely resemble those of simple chronic broncho-pneumonia (page 535). There are the same generalized pleuritic adhesions and the shrunken cicatricial condition of the part of the lung most affected, with bronchiectasis, compensatory emphysema, etc. The tuberculous nodules are old and for the most part converted into dense fibrous tissue in the centre of which, however, some softened, caseous areas are often seen. Lesions like those described, which may be regarded as a form of recovery, are usually found in patients who have died of other diseases; sometimes in those who have died of other forms of tuberculosis—of the brain, bones, or peritonæum; at other times they are associated with a recent process in some other part of the lung. The bronchial glands may be somewhat enlarged and contain encapsulated caseous masses, or they may be calcareous.

Bronchial lymph nodes (bronchial glands).—The prominence of the lesions of the lymph nodes is one of the most striking features of tuberculosis in infancy and early childhood. Those which are most frequently affected are connected with the bronchi. The lymph nodes, to which the term “bronchial glands” is generally applied, consist of three groups: the first of which surround the trachea; the second are situated at the bifurcation of the trachea and surround the primary bronchi; while the third follow the course of the bronchi into the lung, being found, according to anatomists, as far as the fourth division. The anatomical relation of the different groups should be borne in mind, since upon them the symptoms principally depend. The first group, or the peri-tracheal lymph nodes, are in relation with the superior vena cava, the pulmonary artery, the pneumogastric and recurrent laryngeal nerves; the second group, at the bifurcation of the trachea, with the œsophagus, pneumogastric nerve, and aorta; the third group, with the bronchi and the branches of the bronchial and pulmonary arteries and veins.

All the groups are usually involved at the same time, but in varying degrees, and in most cases those belonging to one lung to a greater extent than the other; in my own cases those of the right side have more often been involved than those of the left. There may be simply two or three tumours as large as a hazelnut, or there may be a mass two or three inches

PLATE XIX.



TUBERCULOSIS OF THE TRACHEO-BRONCHIAL LYMPH NODES.

From a fairly nourished child, four months old, who was under observation for three weeks, with slight fever and a most severe, teasing, dry cough, which was almost constant, and upon which no treatment seemed to have the slightest effect. At first there were no signs of disease in the lungs; later there were a few coarse scattered râles.

There were small tuberculous deposits throughout both lungs, with quite a large area of cheesy pneumonia in the right middle lobe, and scattered miliary tubercles in other organs.

in diameter, which is made up of ten to twenty of these nodes fused together by inflammatory products, completely surrounding the trachea and both the large bronchi. It is rare that the individual glands are more than an inch in diameter, and most of them are smaller than this.

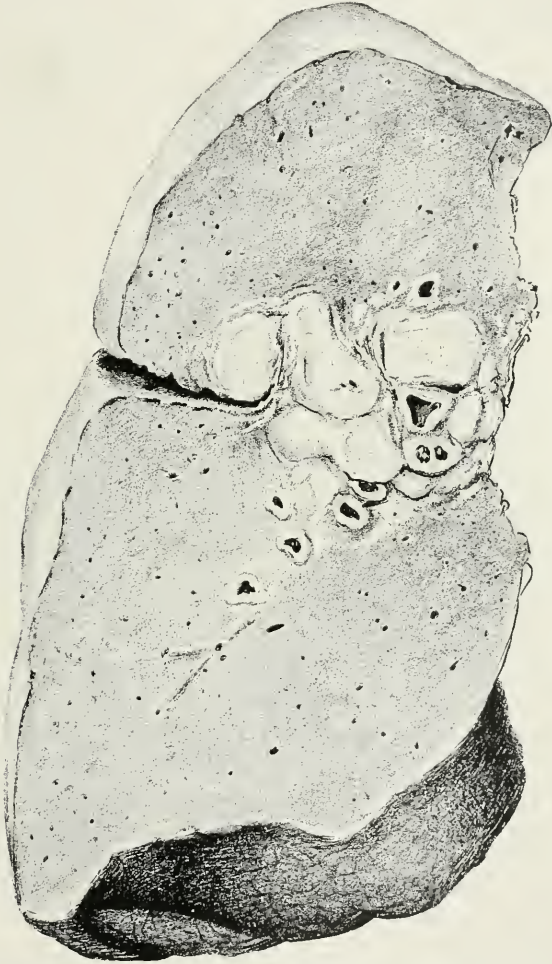


FIG. 176.—Tuberculous bronchial lymph nodes. Section of the lung of an infant through cheesy bronchial lymph nodes at the root of the lung, and adjacent cheesy masses, several of which have softened at the centre; the lung otherwise normal; life-size. (After Northrup.)

A well-marked but not unusual example of this condition is shown in Plate XIX. There is usually found a chain of these tuberculous glands following the course of the large bronchi for some distance into the lung; sometimes these are almost as large as the external group (Fig. 176); at other times they are not noticed unless a somewhat careful dissection is

made. The process is not infrequently more advanced in these deeply-seated glands than in those situated at the root of the lung; and lesions here are also more important, as it is very frequently through them that the lung becomes infected.

The pathological changes through which these glands pass as a result of tuberculous infection, are very similar to those already described with reference to the cervical glands (page 825). Suppuration is less frequent than in the region of the neck, while calcific degeneration is much more so. This applies especially to children over three years old. In infancy suppuration is not infrequent in the bronchial glands, while at this age calcification is extremely rare. Infection of these lymph glands is not always followed by general tuberculosis or even by infection of the lung. Although the process has gone on to caseation, these inflammatory products with bacilli may become encapsulated, and may remain innocuous for an indefinite period. The bacilli may die or may exist here, living, for years. At any time the old process may be lighted up, and a more or less rapid dissemination of tubercle bacilli take place through the lungs or through the whole body. Latent tuberculosis more frequently exists in the bronchial lymph nodes than in any other structure in the body.

Secondary lesions may be produced by these lymph nodes. The pneumogastric and recurrent nerves may be surrounded by one of these cheesy masses which causes pressure and irritation. The œsophagus, the trachea, or the bronchi, may be compressed or opened by ulceration. The superior vena cava usually suffers only compression, but this or any of the other large vessels may be opened. Ulceration may also take place into one of the large or small bronchi or the trachea. If the gland has softened and broken down, and if the bronchus is a small one, the only result of this may be a rapid spreading of tuberculous infection throughout the lung. If sudden rupture occurs, a large caseous mass may escape into the trachea, or a large bronchus, with a result similar to that produced by any other foreign body. If suppuration occurs, the abscess may rupture into the surrounding cellular tissue, causing mediastinal or retro-œsophageal abscess (page 276). This may open externally at the suprasternal notch, or in the first or second intercostal space, or may ulcerate into any of the large vessels, the œsophagus, or the pericardium, or may burrow downward into the peritoneal cavity.

Pleura.—This is rarely normal in any case of tuberculosis. In acute general tuberculosis the only lesion may be a deposit of miliary tubercles upon the visceral pleura. In most of the other cases there are found fibrous adhesions over the part of the lung involved, binding it to the pericardium, the diaphragm, or the chest wall. The amount of thickening of the pleura varies a good deal, but is rarely great. In about one fifth of my own autopsies tuberculous nodules were found in the pleura; with these lesions there is usually considerable thickening. Pleurisy with

a hæmorrhagic exudation is very rare in the tuberculosis of early childhood. Empyema is also rare, being seen in but five per cent of my cases, and then it was small and sacculated. Pneumothorax and pyopneumothorax are very rare in children under three years of age; they were not seen in any of my cases.

Heart.—It is exceptional for the pericardium to be affected even in the most generalized forms of miliary tuberculosis. In such cases the usual lesion is a deposit of a few gray tubercles upon the visceral surface. In chronic cases other lesions analogous to those of the pleura may be seen, but all are rare in childhood. In a single instance I have seen miliary tubercles upon the endocardium. They are extremely rare, and the development of cheesy nodules in the heart is almost unknown in early life.

Brain.—Tuberculosis of the brain is not uncommon during infancy, being then associated in nearly all cases with general tuberculosis, and especially with tuberculous pneumonia; but it is relatively twice as frequent after the second year. There may be found miliary tubercles alone, or these may be accompanied by inflammatory products—tuberculous meningitis—or there may be caseous nodules. Miliary tubercles are frequently found in small numbers in cases which have presented no symptoms. The lesions of tuberculous meningitis have already been described (page 715). Cheesy nodules are rare in infancy, being noted in but 2·5 per cent of my own autopsies, which were mainly on children under three years old; while in the Pendlebury Hospital cases, including those between four and twelve years old, they were noted in 24·4 per cent. These nodules vary in size from a pea to a child's fist; they are usually associated with tuberculous meningitis, but they may exist alone. When they are large they rank as cerebral tumours, being most frequently seen in the cerebellum. They rarely soften, but may be the seat of calcareous deposits.

Liver.—This is frequently involved in general tuberculosis, although it is doubtful if it is ever the seat of primary infection except in the congenital cases. Usually the only lesion is the presence of miliary tubercles on its surface and in its substance, and in most cases these are not numerous. They are found in about two thirds of the cases. In a smaller number there are tuberculous nodules of various sizes. In nearly every protracted case the liver is markedly fatty. In very late cases of tuberculosis of the bones, it is frequently the seat of amyloid degeneration.

Spleen.—This is more frequently affected than the liver, but in very much the same way. In most of the cases of general tuberculosis, miliary tubercles are present in the spleen, these being usually numerous, both upon the surface and throughout the organ. Not infrequently small tuberculous nodules are also seen, but there are rarely any which are larger than a pea. The size of the spleen is not altered if only miliary tubercles are present; but with the tuberculous nodules it may be much enlarged.

Amyloid degeneration is found under the same conditions as in the liver.

Stomach.—Tuberculosis of the stomach is one of the rare lesions; both its contents and its acid reaction seem to protect it against direct infection from the mouth. Tuberculous ulcers were seen in five of my autopsies, which is a larger proportion than is usually noted.

Intestines.—These are less seriously affected in infancy than in older children, which is rather surprising when we consider how susceptible are the intestines of infants to other forms of infection. The explanation of this difference seems to me to be this: Intestinal infection is nearly always secondary to disease of the lungs; primary lesions being extremely rare. Infants usually die from the more rapid tuberculous processes in the lungs or brain before there has been time or opportunity for intestinal infection to occur. The opportunities for such infection depend upon the number of bacilli which are coughed into the pharynx and swallowed. In infancy this number is small, because of the many who die of tuberculous pneumonia or meningitis before extensive softening in the lungs has taken place. In older children the slower course of the pulmonary disease gives ample time for intestinal infection, while the more extensive softening and excavation are accompanied by the discharge of a much larger number of bacilli. The intestinal lesions and those of the mesenteric lymph nodes with which they are almost invariably associated, are described on page 361.

Peritonæum.—In infancy the peritonæum is not often involved even in general tuberculosis, and at this age it is very rare for it to be the seat of the principal tuberculous process. This occurred but once in my own 119 autopsies. In older children it is more frequent; of the 131 Pendlebury Hospital cases, the peritonæum was involved in 37, or twenty-eight per cent. In most cases of general tuberculosis there are only deposits of miliary tubercles; less frequently there are tuberculous nodules with other inflammatory products. The lesions in these cases are described with Diseases of the Peritonæum (page 420).

Thymus gland.—In three of my cases tuberculous nodules were found in the thymus body, the size varying from a small pea to a hazelnut. Some of the largest nodules had undergone softening at the centre. All these were cases showing widely disseminated tuberculous lesions.

Pancreas.—In three of my cases this organ also was the seat of small tuberculous nodules, all of them being cases of general tuberculosis.

Uro-genital organs.—Serious tuberculosis of any part of the urinary tract is very rare in children. Miliary tubercles were found in the kidneys in about one third of my autopsies on tuberculous patients. They are generally few in number. Tuberculous nodules of the kidney I have seen but once in a young child. They are very rare before the fourteenth year (page 623). In two of my autopsies tuberculous nodules were found in the suprarenal capsules. Tuberculosis of the testicle has been observed

in rare instances among children, although not in one of my own series. Koplik (New York) has reported several cases.

Tuberculosis of the bones and of the external lymph nodes have already been described (pages 825 and 837)

THE CLINICAL FORMS OF TUBERCULOSIS.

I. GENERAL TUBERCULOSIS.—Cases of tuberculosis present a wide variety in their symptomatology. Almost every case possesses some peculiar features which depend upon the constitution of the patient, the source of infection, the rapidity with which the bacilli are disseminated through the body, or the numbers in which they enter. The general symptoms usually precede the local ones, but in probably the majority of cases they are masked and unrecognised. It is not often possible to recognise tuberculosis until the process is quite well advanced in some one organ. The early symptoms in most cases are very indefinite and susceptible of many explanations.

1. **Cases Resembling Infantile Marasmus.**—In early infancy, tuberculosis often gives at first and for a long time only the symptoms of marasmus. Infants are pale and thin, they do not gain in weight, and finally become emaciated. There is nothing characteristic about these symptoms, and it should be remembered that they depend much more frequently upon simple marasmus than upon tuberculosis. There may be no cough and no fever sufficient to attract attention, and the case may even go on to a fatal termination without any symptoms except those of infantile marasmus. This I have seen at least a dozen times in cases that came to autopsy.

More frequently, however, there are developed toward the end of the disease both the symptoms and signs of pulmonary disease and fever. These are generally found together, as the process in the lungs is the cause of the rise of temperature. The febrile symptoms are often not seen until the last two or three weeks of life. The course of the temperature is irregular. It is never of the hectic type and rarely high. The usual range is between 100° and 102° F. The pulmonary symptoms are generally few and not very well marked. There is usually some cough, but it is rarely severe. The breathing is more rapid than would be explained by the temperature alone. Severe dyspnoea and cyanosis are rare, and are seen only at the close of the disease. The physical signs are those of either localized bronchitis or of broncho-pneumonia.

The other symptoms usually relate to the digestive tract. There may be indigestion, with occasional vomiting and green undigested stools, or there may be diarrhoea. The intestinal symptoms depend on the general condition of the child and the constitutional disease, rarely upon a tuberculous process in the stomach or bowels.

If the case has gone on to the development of constant fever and rec-

ognisable physical signs which slowly spread, the infant's fate is sealed. The progress of the case from this time is steadily downward, and the child can live at most but a few weeks. Death generally occurs from progressive asthenia without the development of any new symptoms. Occasionally toward the close, cerebral symptoms rapidly develop, and the child is carried off in a few days by tuberculous meningitis; sometimes there is a rapid spreading of the disease in the lungs, and death occurs with symptoms of simple acute pneumonia.

Diagnosis.—The difficulty in diagnosis is chiefly during the first year of life. Every circumstance in the patient's surroundings and family history which bears upon the development of tuberculosis must be weighed to establish the fact of inheritance or of exposure to contagion. In simple wasting, the usual history is that the infant was plump and well nourished at birth. A sufficient cause for its condition can in most cases be found in improper or insufficient nourishment or the want of proper care. (See causes of marasmus, page 204.) Often the wasting follows some acute disease of infancy, most frequently some form of gastro-intestinal disease.

In tuberculosis, the infant may show all the signs of malnutrition at birth, but in most cases they are of later development. They either come without adequate cause, or are associated with pulmonary disease or they follow measles or pertussis. No explanation of the wasting can be discovered in the food, the surroundings, or in the condition of the digestive organs. Diarrhœa and vomiting more frequently follow than precede it. The above facts are sufficient to warrant a suspicion only that tuberculosis is present until some local manifestation occurs, usually in the lungs. The early wasting without adequate cause, followed by the gradual development of low fever, and finally the appearance of signs of subacute broncho-pneumonia, form the most characteristic features of general tuberculosis in early infancy. Yet all these symptoms are occasionally met with in cases in which the autopsy shows none of the lesions of tuberculosis, for simple broncho-pneumonia frequently occurs in patients suffering from marasmus; but in such cases fever is usually slight and it may be absent.

The wasting and cachexia of hereditary syphilis sometimes resemble tuberculosis, but the early history in syphilis is usually so characteristic, and other symptoms of the disease are so rarely wanting, that the mistake is not likely to be made if a patient is submitted to a careful examination. In the absence of definite syphilitic symptoms the chances are greatly in favour of tuberculosis.

2. Cases in Older Children with Symptoms Resembling a Continued Fever.—Before the development of fever in these cases, there is usually quite a protracted period of very indefinite symptoms, each one of which alone is unimportant, but all of which taken together should excite sus-

picion. Such children are usually delicate; they are persistently anæmic without sufficient reason; they often show a loss in weight; there is a marked cachexia, sometimes a capricious appetite, and a digestion easily disturbed. In some of them a change in disposition is observed, and they become peevish and fretful and are disinclined to muscular exertion. All these symptoms indicate a gradual decline in the general health.

This clinical picture may be due to many causes, but it should always arouse in the mind of the physician a suspicion of incipient tuberculosis, particularly in a child who by surroundings or inheritance is predisposed to that disease. After these indefinite symptoms have lasted a few weeks fever is added. Sometimes the prodromal symptoms are absent or unnoticed and fever is the first evident symptom. This fever is peculiar in that it comes without evident cause and without any local manifestations of disease. The temperature is not often high, but it is continuous. The tympanites and the rose-coloured spots are not present, but the general aspect of the patient is strikingly like that belonging to typhoid fever.

After the fever has lasted from one to three weeks there develop some signs of localized tuberculosis, generally in the lungs, or the fever may decline gradually, and although the patient improves he does not get well. He is still weak and does not gain in weight, and the thermometer shows the existence of a very slight amount of fever. Before long he may grow rapidly worse and the course of the temperature becomes irregular, with alternate exacerbations and remissions. Such an irregular and inexplicable fever sometimes puzzles the physician for three or four weeks before the characteristic features which stamp the process as tuberculous are present. One general symptom is almost invariably associated with the fever, viz., wasting. This may not be rapid, but is progressive. The tuberculous cachexia is frequently unmistakable; but in most of the cases one must wait for the process to advance far enough in some one of the organs to give local signs or symptoms before he can be sure of tuberculosis. In four cases out of five this is in the lungs. Less frequently it is in the peritonæum, the brain, or a general infection of the lymph glands throughout the body. If in the lungs, the process manifests itself as a broncho-pneumonia whose tuberculous character may be suspected from its localization—the apex or the middle of the lung in front—but chiefly from the fact that the general symptoms, fever and wasting, have for so long a time preceded the local signs of disease. From this time, the course of the disease may be that of a typical tuberculous broncho-pneumonia.

If the tuberculous process is localized in the brain, we have dulness, vomiting, headache, apathy, irregular pulse, irregular respiration, and finally convulsions and coma—in short, the symptoms of tuberculous meningitis; if in the peritonæum, we have abdominal distention from

gas or fluid, tenderness, pain, diarrhoea, or constipation; if in the lymph glands, there is a general enlargement of those situated in the neck, and sometimes those of the axillary and inguinal regions, with symptoms indicating similar changes in those at the root of the lung.

Diagnosis.—In distinguishing general tuberculosis from typhoid fever, very great stress is to be laid on the family and previous history of the patient and the surroundings, as favouring tuberculosis. On the other hand, the prevalence of typhoid fever in the family, the neighbourhood, or the institution in which the case occurs, is important. The extreme infrequency of typhoid in children under two years old should always lead the physician to scrutinize very carefully every case in which he is disposed to make such a diagnosis at that time of life. In typhoid, the course of the fever is more regular than in tuberculosis, but less so than in the typhoid of adults, and the spleen in nearly every case is sufficiently enlarged to be easily felt below the ribs. The rose spots are usually present. But the most conclusive evidence is that afforded by the blood reaction in Widal's serum-test; without this, by the gradual cessation of the fever in the third or fourth week and complete recovery of the patient.

In tuberculosis, on the contrary, the fever is less regular. It commonly shows wider fluctuations, the spleen is not usually enlarged, and there are no rose spots. Tympanites and abdominal tenderness are sometimes seen, but the fever shows no disposition to stop after the third week, and the wasting is continuous. The signs in the lungs, at first few, increase from day to day. In most cases one must wait for ten days at least, and in many three weeks, before a positive diagnosis can be made.

II. TUBERCULOUS BRONCHO-PNEUMONIA.—This occurs clinically under the following conditions: (1) It may begin in the lungs or extend to the lungs from the bronchial glands, the symptoms in either case being essentially pulmonary from the outset. (2) It may follow either form of general tuberculosis described—that resembling marasmus in infants, or that resembling a continued fever in older children. In both of these the pulmonary symptoms develop gradually in the course of the general symptoms of the disease. (3) It may occur in the course of any of the forms of local tuberculosis,—of the bones, peritonæum, intestines, external lymph glands, or skin. In such cases the invasion of the lungs frequently marks the last stage of the process. (4) It may follow any of the infectious diseases, especially measles or pertussis, even though they are not complicated by broncho-pneumonia, but more frequently when they are. (5) It may follow single or repeated attacks of simple bronchitis or pneumonia.

Clinically the cases may be divided into three groups: First, the most rapid ones, lasting from one to three weeks; secondly, those running a more protracted course, with a duration of from three weeks to three months; thirdly, those which are more or less chronic. In the first two

groups the progress is nearly always steadily downward, and a fatal termination the almost inevitable result; in the third form the course is more irregular, and marked by a series of exacerbations and remissions.

1. **The Most Rapid Cases.**—In this form of the disease there are found scattered through certain portions or nearly the whole of both lungs, miliary tubercles and minute tuberculous nodules, the intervening parts of the lung being involved more or less seriously in a simple inflammation. In most of the cases the clinical picture is that of simple acute broncho-pneumonia, for it is to the accompanying broncho-pneumonia, and not to the scattered tuberculous deposits themselves, that the symptoms and the physical signs are due. The development of the disease, although acute, is not usually abrupt. There are present, fever, cough, dyspnœa, accelerated respiration, prostration, and sometimes cyanosis. The temperature in these cases is never hectic, but its course is a somewhat irregular one the usual range being between 100° and 104° F. In most of the cases it differs in no respect from the temperature of simple broncho-pneumonia. Sometimes it is seen that the general symptoms are severe and the physical signs wide-spread, and yet the range of temperature is not high. To be sure, this is occasionally seen in a simple broncho-pneumonia, but it is more frequent in tuberculosis. The cough early in the disease is slight, but later becomes severe and often distressing. In infants and young children it may be of a paroxysmal character, resembling pertussis. Expectoration is wanting in infancy, and is not often seen in those under seven years, so that bacilli in the sputum is a symptom of only a small number of cases. Bloody expectoration, likewise, is rare in children.

The conditions in the lungs which give physical signs are bronchitis of the smaller tubes, with areas of complete or partial consolidation. In character, these signs are identical with those of simple broncho-pneumonia (page 499). They may be scattered throughout the whole of both lungs; but when localized they are more frequently in the upper than in the lower lobes, and rather more frequently in front than behind. Although both lungs are involved, they are usually not affected to the same degree. The patient may die before signs of complete consolidation are present; more often there are during the last few days small areas of partial consolidation, as shown by broncho-vesicular breathing, exaggerated voice, and slight dulness. These signs may be due to the simple broncho-pneumonia, and are often found in the lower lobes behind. Large areas of complete consolidation, with pure bronchial breathing, bronchial voice, and marked dulness are infrequent.

From the beginning of acute symptoms the progress of the disease is steadily downward, death resulting from the same causes as in simple broncho-pneumonia. The end is marked by cyanosis, great dyspnœa, weak pulse, and extreme prostration. In a few cases there develop shortly before death cerebral symptoms, indicating tuberculous disease of the

brain. Such symptoms may be the first to lead the physician to suspect the process to be a tuberculous one. In these cases death may occur in convulsions in two or three days from the first cerebral symptoms. In other cases the course is slower, with the typical symptoms of meningitis.

2. **The More Protracted Cases.**—In this form of the disease there are found in the lungs caseous nodules, with larger areas of caseous pneumonia, and usually some spots of softening. The process is not usually so generalized as in the cases just described, but as in them there is always

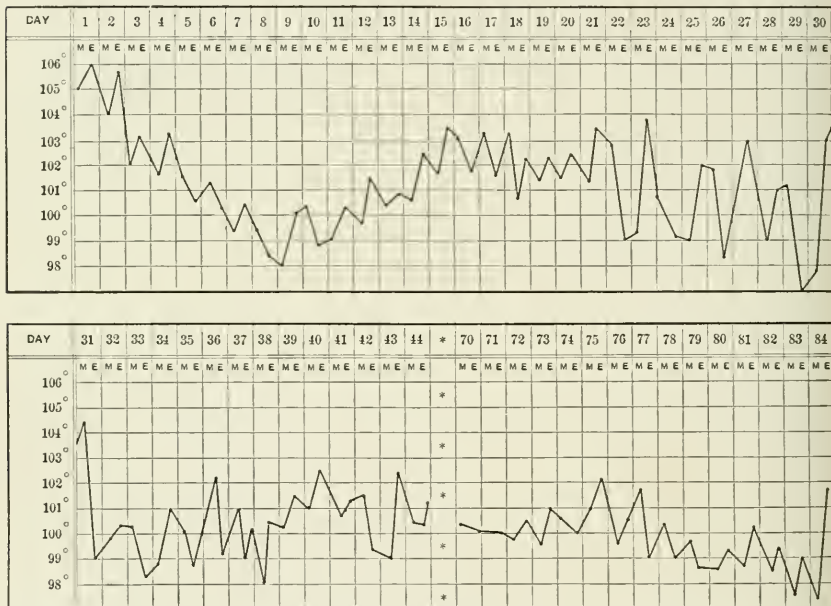


FIG. 177.—Tuberculosis following measles. Child sixteen months old, inmate of an institution. Chart begins on fifth day of a severe but uncomplicated attack of measles, and shows a natural decline to normal. Fever then returned and continued till death, twelve weeks later. Record for the period which is omitted was much like that which immediately precedes and follows. Early symptoms not acute, only slow wasting, slight cough and fever, with scattered râles throughout chest. Signs of consolidation not distinct till eighth week, then present in right upper lobe. Toward the end, rapid emaciation, marked pulmonary symptoms, and signs of cavity at right apex. Autopsy showed a large cavity, extensive tuberculous deposits throughout both lungs and in nearly all abdominal organs.

associated a certain amount of simple pneumonia. This is the most frequent and most characteristic form of pulmonary tuberculosis in infancy and early childhood. Its usual duration is from one to three months; its course is then steady and uninterrupted. In its slower or subacute form it lasts from three to six months, and its course is then more irregular.

The mode of onset will depend upon the conditions under which the disease develops. When the general symptoms of tuberculosis—fever and wasting,—have preceded those in the lungs, the evolution of the latter is gradual, with cough, rapid breathing, dyspnoea, increased prostration,

etc. When the pulmonary symptoms are present from the beginning, they are the same as in simple broncho-pneumonia, with the exception that they usually come on less acutely. The latter is true of cases which are secondary to some other form of tuberculosis in the bones, peritonæum, etc.

When pulmonary tuberculosis follows measles (Fig. 177) or whooping-cough which has been complicated by simple pneumonia, the early symptoms may present no unusual features. After two or three weeks the temperature gradually falls, and the physical signs improve, but neither quite disappears. The cough continues, though its severity somewhat abates. In the course of a few weeks the child, who has meanwhile improved somewhat in his general condition, becomes distinctly worse, often without any assignable cause. The temperature rises to 102° or 103° F.; the cough increases, and an extension of the disease in the lungs is evident by the physical signs. In other cases the progress of the disease after the pneumonia which complicated measles is without an intervening period of apparent improvement. It sometimes happens that the attack of measles or whooping-cough is not accompanied by any serious pulmonary symptoms, and the case goes on to apparent recovery, except that there remain anæmia, a slight cough, and fever. The temperature, although not high, persists; but it may be two or three weeks before there are present definite symptoms and signs of disease in the lungs.

Fever is a constant accompaniment of all active tuberculous processes in the lungs in the child as in the adult, it being absent only during the periods of remission which occur in the cases of slow and irregular prog-

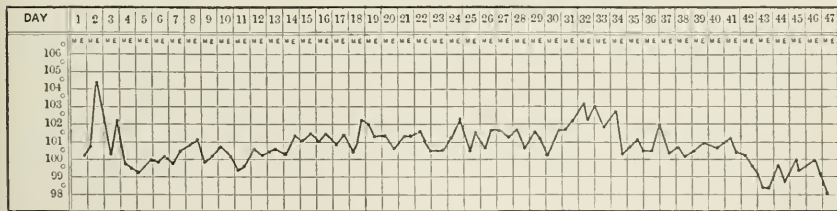


FIG. 178.—Tuberculous pneumonia, general tuberculosis. Patient eleven months old, and under observation at the time he was taken sick. Chart of entire illness is given. Disease began as an acute pneumonia in lower part of left axilla and spread to entire lower lobe. Early signs of consolidation; at end of two weeks, flatness so marked that a needle was inserted, fluid being suspected. Vomited frequently, and had loose discharges from bowels throughout the illness; abdomen much swollen for last two weeks. Autopsy showed cheesy pneumonia of part of the upper and the entire left lower lobe, where were two small cavities. Recent tubercles found throughout right lung, and extensive deposits in abdominal organs with peritonitis, intestinal ulcers, etc.

ress. It is a very important guide to the progress of the disease. The early fever depends chiefly upon the coexisting broncho-pneumonia, and its course resembles that of simple pneumonia of the protracted variety. There is no typical curve. The fever is not often steadily high, and in many cases it is never high (Fig. 178). It frequently runs for

several days between 99° and 102° F., and then, without evident cause, rises to 104° F. or over; again, it may be scarcely over 100° F. for days together. In infants the morning temperature is frequently subnormal, although the evening temperature may be 102° or 103° F. Even toward the close of the disease, when softening and breaking down are actively going on, the regular hectic temperature of adults is rarely seen in a young child (Fig. 179). While the presence of fever is of great signifi-

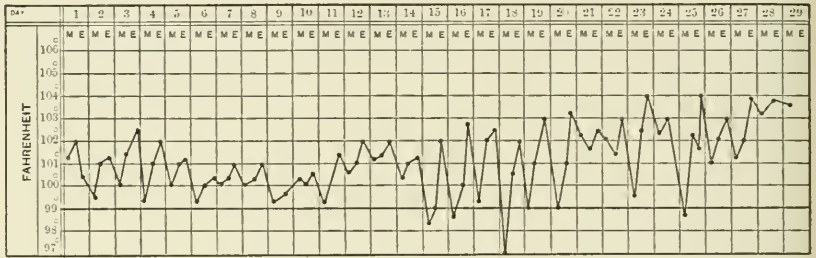


FIG. 179.—Tuberculous pneumonia, with extensive softening and excavation. A delicate child, thirteen months old; weight, ten pounds; came under observation four weeks before death, with consolidation at apex of right lung. Signs increased in intensity, and extended in area until there were heard, from clavicle to below the nipple—exaggerated bronchial voice and breathing and many moist rales; percussion note was flat; behind, the same signs at extreme apex. No distinct signs of a cavity; no hectic fever; no sweating. Autopsy showed large cavity (Fig. 173) at right apex partly filled with caseous masses; diffuse caseous pneumonia (Fig. 172) of the rest of right upper lobe, with scattered deposits in the other lobes, the opposite lung, and a few in the abdominal organs.

cance, its course has almost no diagnostic importance in early life. Especially should one beware of drawing the conclusion that, because the fever is not hectic, therefore there is no breaking down of the lung.

Sweating belongs only to the late stage of the disease, and is usually associated with the hectic type of fever; both these are regular symptoms in children over seven years old, but not in very young children.

Wasting, like fever, is characteristic of all active tuberculous processes. Whenever they are associated, tuberculosis should always be suspected, no matter how obscure the other symptoms may be. The wasting is not always rapid, but it is usually continuous while fever lasts. During the periods of temporary improvement, children may not only cease to lose, but may actually gain in weight. In the early stage of the disease, wasting is especially suggestive when it continues without apparent cause after measles or pertussis, or when it persists under other circumstances in spite of a good appetite and apparently good digestion. It may at first be so slight as not to be noticed unless the scales are employed. In obscure cases this steady loss of weight is a point of much diagnostic value, and is frequently overlooked. Toward the close of the disease there is rapid and frequently extreme emaciation.

Cough, although almost invariably present, shows no peculiarities. It may be hard, dry, or suppressed; it sometimes occurs in paroxysms re-

sembling pertussis, which may or may not depend upon the presence of enlarged bronchial glands.

Expectoration is absent in infants, the matters coughed up being swallowed. In children over seven years old, we often get a profuse mucopurulent expectoration, but it is very exceptional below this age.

Hæmoptysis is a rare symptom, but not unknown even in young children. Hænoch has reported a case of fatal hæmoptysis in a child ten months old, where the hæmorrhage was due to the rupture of an aneurism in the wall of a cavity. Herz, in 247 clinical cases of tuberculosis in children, records 8 of hæmoptysis—4 of them under five years, and the youngest only eighteen months old. The records of 131 autopsies on tuberculous children in the Pendlebury Hospital, show that hæmoptysis was four times a cause of death; two of these patients were under five years, and one was only twelve months old. I have never met with a case of hæmoptysis under five years old. As in adults, fatal hæmoptysis is usually due to the opening of a large vessel by ulceration in the wall of a cavity, which is sometimes in the lung and sometimes in one of the bronchial glands.

The respiration in all cases of tuberculous pneumonia is accelerated, and usually out of proportion to the rise in temperature. As the lung becomes more and more extensively invaded there is constant dyspnoea. The pulse is rapid in the early stage, and continues so throughout the disease; toward the end it becomes weak and irregular. Irregular respiration and a slow, irregular pulse, may occur at any time from the development of cerebral complications.

Pleuritic pains in the chest are not frequent in children. Gastro-intestinal symptoms, such as indigestion, vomiting, diarrhoea, etc., are generally present, but are not peculiar in this disease. They usually depend upon the patient's general condition, only exceptionally upon tuberculous disease of the stomach or intestines. The characteristic symptoms of intestinal tuberculosis—abdominal pain, tenderness, uncontrollable diarrhoea, and intestinal hæmorrhage—are not often met with in children under five years. With such symptoms, and sometimes when they are doubtful or absent, careful palpation of the abdomen may disclose the presence of enlarged mesenteric glands. When these are not readily felt through the abdominal walls, they may sometimes be discovered by a rectal examination after the method of Carpenter (London).

The spleen is often enlarged, sometimes very much so, but this does not occur with sufficient frequency to be of much diagnostic value. It may be due to tuberculous deposits, to causes connected with the lungs or heart, or to fever. The liver is never enlarged from tuberculous deposits, but may be so from amyloid or fatty degeneration, or from obstructed circulation, as in the case of the spleen.

Dropsy is rare and seen only toward the close of the disease. It may depend upon anæmia, upon complicating nephritis, especially amyloid de-

generation, upon cardiac or pulmonary conditions leading to interference with the return circulation, or upon pressure of tuberculous retro-peritoneal or mesenteric glands upon the inferior vena cava. Clubbing of the fingers is occasionally seen in cases running a very protracted course, and is due to obstructed circulation.

Anæmia is commonly associated with wasting, and it is of special importance where the latter is slight or absent. It is a frequent sequel of acute disease in infancy when not dependent on tuberculosis; when, however, it is associated with low fever, cough, and persistence of râles in the chest, it should always excite apprehension.

3. Chronic Tuberculous Pneumonia.—In young children this is a chronic interstitial pneumonia associated with tuberculous deposits. These cases have usually had their beginning in one of the more acute forms just described. The primary attack runs a tedious, protracted course; there are a slow convalescence and apparent recovery, although this is not complete. Often a slight cough remains, or returns from the slightest exposure or other exciting cause. The child does not regain his former weight or vigour, and careful examination of the lungs shows that some abnormal signs remain. There are frequently present feeble breathing and slight dulness over the affected part of the lung, and occasionally friction-sounds may be heard.

After a few months, possibly, the child has another attack resembling the first and running the same tedious course. It is accompanied by fever, cough, and perhaps there is a fresh consolidation of some part of the lung, generally in the neighbourhood of the old disease. All active symptoms finally subside, and most of the signs of recent disease disappear; but it is usually found then that the lung is not quite in so good condition as it was before this second illness. The acute attacks may be repeated several times and pass under the name of bronchitis, broncho-pneumonia, or pleurisy. They may extend over a period of two or three years or even longer. The general health in the interval is not good, there being present in most cases anæmia, with the usual symptoms of malnutrition; the children are regarded as being very delicate.

The course of this disease thus differs in no essential particulars from that of simple chronic broncho-pneumonia (page 535); the physical signs likewise are identical in character, although they may differ in their location. They are generally found in the same situations as are the signs in the more rapid forms of pulmonary tuberculosis in early childhood. A fatal result in these cases is usually brought about in one of three ways: (1) by the development of acute tuberculous pneumonia or miliary tuberculosis of the lungs, occurring with the symptoms of one of the previous exacerbations which has come on without apparent cause or perhaps has followed an attack of measles or whooping-cough; (2) by tuberculous meningitis; (3) by a simple acute broncho-pneumonia.

Physical Signs of Tuberculous Pneumonia.—Speaking generally, there is no difference in a young child between the signs of a tuberculous and those of simple broncho-pneumonia except in their position; for cavities, although they are present at autopsy in most of the cases, are very rarely of such size and so situated as to be recognised during life. In children over seven or eight years old, and sometimes in those of five or six, the signs are essentially like those in adults.

By reference to the description of the lesions (page 1023) it will be noted that the upper lobes are the seat of the most advanced disease twice as frequently as the lower lobes, and the right lung rather more frequently than the left. When the disease is in the upper lobes it is rarely at the extreme apex, and when it is in the lower lobes it is very exceptional to find it at the base, posteriorly. The region most often involved is the middle zone of the lung. If the signs appear first behind they are, in the great majority of cases, in the interscapular space; if in the lateral part of the chest, they are in the middle or upper part of the axilla; if in front, they are in the mammary region, more frequently above than below the nipple, but rarely extending quite to the clavicle. In other words, it is near the root of the lung that the disease most frequently begins, spreading thence forward more often than backward. The explanation of this is found in the fact that the disease in infants and young children so often extends from the lymph nodes at the root of the lung to the lung itself. The physical signs themselves may be grouped under four heads, corresponding to the pathological conditions existing in the various stages of the disease—viz., (1) localized bronchitis; (2) partial consolidation; (3) complete consolidation; (4) excavation. The early signs in the first two stages are identical with those described in broncho-pneumonia (page 499), those of the third stage being the signs of the persistent form (page 502). As a rule, however, the transition of the signs from one stage to another is much slower in tuberculous than in simple broncho-pneumonia.

As stated in the description of the lesions, cavities are found in the lungs in the majority of cases of infants dying from tuberculosis of the lungs. It is, however, rare that they can be recognised in children under three years old. From three to eight years they give more positive signs, and after eight years practically the same signs as in adults. The reason why in infancy cavities are so seldom recognised during life is because they are generally small, often centrally located, nearly always filled with thick pus or cheesy matter, and rarely communicate freely with the bronchi. On the other hand, it is very common to find signs in young children which, if heard in adults, would be regarded as almost positive evidence of a cavity, although none is present. These signs are cracked-pot resonance and cavernous breathing. They are not usually due to bronchiectasis, since this condition belongs to chronic cases, and especially to older children; but most frequently to consolidation about a large bron-

chus superficially situated—viz., below the clavicle, high in the axilla and in the interscapular region. The wide area over which this broncho-cavernous breathing is heard, is one of the most striking points of difference from the signs of a cavity.

Course, Duration, and Termination.—Whatever may be the evolution of the symptoms, and the variations are almost endless, the cases fall readily into two groups,—those in which the progress is rapid and steady and those in which it is slow and intermittent. The duration of the first group is from four to eight weeks. Fever is constant, wasting progressive, and the physical signs show a steady advance of the disease in the lungs. Dyspnœa becomes severe and constant; the pulse grows more and more rapid and feeble; and death occurs from exhaustion, pulmonary œdema, or syncope, less frequently from meningitis.

In the second group the duration is from two to six months. The course can not better be described than as a succession of attacks of broncho-pneumonia, sometimes separated by an interval of several weeks, at other times one coming on before the first is fairly over. During exacerbations the symptoms resemble those of the first form, there being marked fever, wasting, cough, and dyspnœa. The child may seem hopelessly ill when, without any special reason, a change for the better occurs, the acute symptoms abating and the signs of consolidation in great measure disappearing. Toward the end of the disease the pulmonary and constitutional symptoms become constant, and frequently there are added symptoms due to extension of the tuberculous process to other parts of the body—the brain, peritonæum, intestines, mesenteric glands, etc. These cases die, as do the more acute ones, from the local disease in the lungs or from general infection.

Diagnosis.—The evidence upon which a diagnosis of tuberculosis is made, is of two kinds,—that which relates to the patient and that which relates to the local disease. In any case, a diagnosis is reached by weighing the evidence as a whole rather than by relying upon the presence of particular symptoms or physical signs. One should investigate the family history, surroundings, and previous condition of the patient; also the mode of onset, and course of the disease, and consider the evidence afforded by the examination of the patient.

A careful examination of the family history should be made to determine, first the existence of phthisis in the parents or in other members of the family, near or remote. Children more often inherit tuberculosis from the mother than from the father, and are more likely to contract it from her, owing to the closer contact. It is not enough simply to investigate the question of phthisis. Inquiry should be made regarding meningitis, disease of the cervical glands, spine, hip, knee, or ankle, especially in the other children of the family. These points are important not only to establish the fact of heredity but also the probable chances of exposure.

Other conditions favourable for acquiring the disease should be considered, such as in a private family exposure to nurses or other members of the household; also whether the surroundings have been such as would give opportunities for infection, as in cases where a child has been reared in a tenement house, or has been long an inmate of a hospital or other institution. In the child's previous history, it is important to know whether there have been other manifestations of tuberculosis in the cervical glands, spine, hip, knee, or ankle, or the skin; also whether he has been liable to attacks of severe or protracted bronchitis or broncho-pneumonia. If he has had measles or pertussis, it is important to know whether they were severe, accompanied by pulmonary complications, or followed by a protracted cough or obscure fever. The child's general constitution should be considered, whether he is delicate, narrow-chested, poorly nourished, or anæmic.

In its symptoms and course it is with simple broncho-pneumonia that tuberculous disease is likely to be confounded, hence the important diagnostic points are those which distinguish these two processes from each other. The onset of simple pneumonia is usually rapid and often abrupt; tuberculous pneumonia, although it sometimes begins in one of these ways, usually develops gradually with constitutional symptoms preceding the local ones by several days or even weeks. When tuberculosis develops rapidly, the pulmonary symptoms and the physical signs may be identical in the two conditions. During the period of acute symptoms there is often nothing either in the constitutional or local symptoms to awaken suspicion. One may be struck with the disproportion between the general symptoms—loss of flesh, prostration, and temperature—and the local evidences of pulmonary disease. When the patient dies in the early acute stage the disease is rarely recognised, nor, indeed, can it be diagnosed with certainty. Usually it is not until the time for resolution to occur that the course of the disease suggests something different from broncho-pneumonia. The question then arises whether we have to deal with a case of persistent broncho-pneumonia or with tuberculosis. It should be remembered that it is not infrequent for simple broncho-pneumonia to resolve slowly or to go on to the development of chronic interstitial pneumonia; and that local conditions as determined by physical signs, which in adults would be regarded as certainly tuberculous, very often in children are simple processes.

Often the course of the disease, after the first acute period has passed, furnishes further evidence to clear up the diagnosis; but not necessarily, for in tuberculosis it may be steadily downward, or it may be marked by periods of remission and exacerbation, and the same is true of simple pneumonia. Fever is a more constant symptom in tuberculosis, and it is usually higher than in persistent broncho-pneumonia; but the exceptions are so many and the variations so wide that it is not safe in young children

to lay very much stress upon the temperature curve. Anæmia and wasting are more marked in tuberculosis, and in most cases progressive. A copious muco-purulent expectoration is seen almost as frequently in pneumonia as in tuberculosis; but in neither disease is it common under five years. The presence of the bacillus tuberculosis in the sputum is, of course, positive evidence of tuberculosis.

Simple broncho-pneumonia may affect any part of the lungs, but by preference the lower lobes posteriorly. The signs of tuberculosis may likewise be found anywhere, but most frequently in the anterior part of the lung, the mammary region, the axillary margin, or the apex; if posterior, the signs are usually at the apex or in the interscapular region. From the character of the physical signs, no inference can be drawn unless a cavity can be positively made out; but when the process has advanced to that stage, the diagnosis is generally plain from the general symptoms.

Meningitis developing during a pulmonary disease of doubtful character, is generally tuberculous, and its occurrence is usually to be interpreted as establishing the tuberculous nature of the process in the lungs; but this is not invariable, as simple meningitis may follow simple pneumonia, as I have more than once seen proven by autopsy, when both were regarded during life as tuberculous. The development of cheesy lymph glands in the neck, the groin, or axilla, or the presence of symptoms pointing to enlargement of the bronchial glands, or those of chronic peritonitis with or without ascites, or intestinal hæmorrhage,—all point strongly to tuberculosis.

If the acute symptoms begin during measles and persist, they may be due either to broncho-pneumonia or to tuberculosis. If, however, they begin insidiously during convalescence from measles, they are very probably due to tuberculosis. If the symptoms begin acutely during pertussis, they may be due to simple broncho-pneumonia or a tuberculous process; but if they develop gradually and insidiously after pertussis, the disease is probably tuberculosis. It should not be forgotten, however, that it is not uncommon for simple broncho-pneumonia occurring with pertussis, to persist until the attack of pertussis has subsided. I have seen several such cases in which consolidation has lasted two or three months and yet cleared up entirely.

If the child was previously healthy and living in good surroundings, and if the disease began with acute symptoms, the process is simple pneumonia in nine cases out of ten, no matter how irregular its course, how prolonged its duration, or what the physical signs. The physician will more frequently be right in his diagnosis if he bases it upon the general condition and previous history of the patient, than upon the special symptoms of the disease or the physical signs. Still, after all has been said, the diagnosis is in all cases difficult, and in some, particularly the more

chronic ones, a positive diagnosis is impossible, as no one knows so well as he who has an opportunity to follow his cases to autopsy.

III. CHRONIC PHTHISIS.—This form of tuberculosis, with its chronic hectic fever, slow cavity formation, progressive emaciation, night sweats, etc., is very rarely seen before the fifth year, and it is not at all frequent until the tenth or twelfth year. In its symptoms, course, termination, and physical signs, it resembles the same disease in adults, and need not be described at length here.

IV. TUBERCULOSIS OF THE BRONCHIAL LYMPH NODES (BRONCHIAL GLANDS).—This condition is usually associated with some form of pulmonary tuberculosis, but it may exist as the most important and sometimes as the only tuberculous lesion.

Its symptoms are usually associated with those of pulmonary or general tuberculosis; but they may occur when the pulmonary changes are too few to be recognised either by symptoms or physical signs. From the great frequency with which this lesion is found in infants and young children, it might be expected that local symptoms would be common in such patients. They are, however, in my experience, quite exceptional. Most of the cases in which well-marked symptoms occur are in children over two years old, and it is between the third and tenth years that they are usually seen. In infancy, although these glands are almost invariably affected, death in the great majority of cases occurs from the pulmonary disease, before the later changes in the glands have had time to develop.

General symptoms indicating a tuberculous cachexia may or may not precede the local ones. The latter are chiefly mechanical, and depend upon the size of the glands and upon their anatomical relations, and very little or not at all upon the nature of the changes in them. The most important relations, so far as the production of symptoms is concerned, are those which they bear to the pneumogastric and recurrent laryngeal nerves, the superior vena cava, the trachea, and bronchi; those less important are to the aorta, pulmonary artery, and œsophagus.

Pressure upon or irritation of the pneumogastric or recurrent nerves produces cough, dyspnoea, and sometimes a change in the voice. The cough is hoarse, persistent, and teasing, and frequently occurs in paroxysms which in many respects resemble those of pertussis, but it lacks the characteristic whoop, and is not accompanied by the expectoration of the mass of tenacious mucus. These paroxysms are severe and often prolonged, but careful observation shows distinct differences from those of pertussis, though by an unfamiliar ear the two are easily confounded. The dyspnoea, like the cough, is paroxysmal, and sometimes strongly resembles ordinary spasmodic croup; at other times it is like a severe attack of asthma. Such symptoms may come and go, but they are frequently prolonged, and usually in the interval between the severe seizures the patient is not wholly free from dyspnoea. Although the chief cause of dyspnoea is no doubt

nerve irritation, it may be due in part to pressure upon the trachea or one of the large bronchi. In dyspnoea from pressure on the trachea the head is usually thrown back, and the obstruction is more frequently on expiration than on inspiration.

After such symptoms as those mentioned have existed for a few days or weeks, and in some cases without any warning, there may occur a sudden attack of asphyxia which may prove fatal. This is generally due to ulceration of a caseous gland into the trachea or a large bronchus and the escape of a large mass into the air passages, where it produces the same effects as any other foreign body.

Loeb has collected fifteen cases of this description, a summary of which gives a good idea of the circumstances under which this accident usually occurs: In four cases death took place in the first attack of suffocation, the only previous symptom having been cough; in three there had been a number of milder attacks extending, in two of the cases, over a considerable period before the occurrence of the fatal one; in three, death occurred in the first attack, in children who had no previous cough and who were apparently healthy; in one, the fatal attack came on during pertussis. In the majority of the cases, death followed in from five to ten minutes from the first symptom; in a few the patients lived for an hour. In rare cases after ulceration into the trachea, the patient has coughed up a large quantity of foul pus, and recovered.

Pressure upon the superior vena cava is usually associated with spasmodic dyspnoea and cough, and causes cyanosis of the face and blueness of the lips. There is frequently a puffiness of the face, and there may be marked œdema. The coexistence of cyanosis with such œdema, when the urine is free from signs of renal disease, should always lead one to suspect pressure at the root of the lung. In some rare cases the interference with the return circulation has been so marked that meningeal hæmorrhage has resulted. By a process of ulceration set up by these glands they may open, not only into the air passages, but into the pericardium, the œsophagus, or any of the large vessels. The last mentioned is usually followed by instant death. Aldibert reports two cases in which the pulmonary artery was opened, death occurring from hæmoptysis, as there was also a communication with one of the large bronchi. In Vogel's case the subclavian vein was perforated, and death resulted from the entrance of air. If ulceration takes place into the surrounding connective tissue, a mediastinal abscess may result, producing any of the pressure symptoms noted above, and, in addition, dysphagia from pressure on the œsophagus. Such an abscess may point in the supra-sternal notch; it may open through the chest anteriorly between the ribs or at the xiphoid cartilage; or it may burrow along the œsophagus to the peritoneal cavity. As a rule, however, patients die of general tuberculosis before the local conditions have advanced so far.

Physical Signs.—In order to produce physical signs, the mass of tuberculous lymph nodes must be large enough to form a mediastinal tumour, or so situated as to produce pressure on the trachea or bronchi. As a rule, the signs are more characteristic behind than in front. Percussion may give dulness anteriorly over the first piece of the sternum or posteriorly along one or both sides of the spine from the second to the fifth dorsal vertebra; the dulness is rarely complete. Auscultation posteriorly may give in the most marked cases amphoric or cavernous breathing, or exaggerated bronchial breathing with prolonged expiration, in those which are less pronounced. Large, moist râles are sometimes heard. The auscultatory signs are so like those of a cavity that it is often difficult to believe that a cavity does not exist. The sounds heard appear to be those produced in the trachea and bronchi transmitted to the ear with great exaggeration by the mass of lymph nodes which surrounds them and fills the space between them and the chest wall. When the head is thrown back a venous hum may sometimes be heard. If one of the primary bronchi or one of its lobar divisions is compressed, there may be very feeble respiration over one lung or one lobe; if the pressure is sufficient to prevent the entrance of air, or if one of these large tubes has been plugged by a caseous mass, there is an absence of respiratory murmur over a single lobe or an entire lung. This sign is of great diagnostic value, but it is not often present.

Diagnosis.—Enlargement of the bronchial glands to a sufficient degree to produce symptoms, may occur in syphilis, in Hodgkin's disease, and in various forms of malignant disease of the mediastinum. A certain amount of swelling is seen in nearly all cases of simple bronchitis or pneumonia, especially in those running a subacute or chronic course. Whether this simple hyperplasia is ever sufficient to cause such symptoms as those mentioned is exceedingly doubtful. I have myself never known it to produce anything more marked than a spasmodic cough. The great infrequency of other forms of enlargement to a sufficient degree to be of clinical importance, usually warrants us, from the symptoms mentioned, in making the diagnosis of tuberculosis. The development in a child of a chronic abscess in the anterior mediastinum, is almost always due to tuberculous glands; and so is one in the posterior mediastinum, provided Pott's disease can be excluded.

The most important points for diagnosis are the association of a spasmodic cough with paroxysms of dyspnoea resembling asthma or croup, and œdema or congestion of the face. More stress is to be laid upon the symptoms than upon the physical signs; the latter are at most only confirmatory. The chief difficulty in diagnosis is found in those cases which present few or no other signs of tuberculosis, and which come first under observation with attacks of dyspnoea or asphyxia resembling laryngeal stenosis. In many such cases tracheotomy has been done without

finding any cause for the dyspnœa, the autopsy showing it to be due to ulceration and impaction of a caseous gland.

General Prognosis of Tuberculosis.—The outlook for a young child with general or pulmonary tuberculosis is always bad. So long as the disease remains confined to the lymph nodes, the child is not usually in danger, except from accidents connected with their softening and ulceration, which after all are rare. Spontaneous cure may occur in these glands in the same way as in others in the body—viz., by encapsulation, calcification, etc. Such a result is no doubt a very frequent one; exactly how often it occurs it is impossible to say. But when once the disease has gained any headway in the lung itself, its steady advance is almost certain in a young child. In those who are older and have more resistance the chances of an arrest of the process are much greater.

If the bacilli have gained entrance into the body in any considerable numbers, even though they are shut up in an encapsulated, caseous, bronchial gland, the patient is never free from the danger of general infection.

Prophylaxis.—The prevention of tuberculosis must have constant reference to its cause. The first essential is the destruction of the tubercle bacilli wherever they exist. Since most of the germs existing in the air are derived from the sputum of patients affected with pulmonary tuberculosis, it should be insisted upon, everywhere and at all times, that the sputum from such cases should be collected in special cups or cloths and destroyed either by germicides or by fire. The next point is to avoid needless exposure. A tuberculous mother should on no account nurse her child nor kiss it upon the mouth. A wet-nurse likewise should be free from any tuberculous taint. No nurse or other care-taker should ever be employed about children who has, or ever has had, pulmonary tuberculosis. It is wise to exclude also those who suffered when children from tuberculosis of the bones or the cervical glands, although the danger from such persons is extremely slight. If active tuberculosis exists in any member of the family, a young child should be kept away from the room, and if possible should not reside in the house. On no account should infected persons be allowed to kiss children or sleep in the same bed with them. The danger from drinking-cups and other dishes should not be forgotten. A tuberculous person should either have his special dishes, or the utmost care should be taken to boil all those which he has used. Cows whose milk is used for children should be under regular veterinary inspection and should have passed the tuberculin test. In any case where the slightest doubt regarding the health of the cows exists, or where the source of the milk is unknown, the milk should be heated to a temperature of 167° F. for twenty minutes. The danger of infection through the alimentary canal is very much less than through the respiratory tract, and consequently the precautions first mentioned are much more impor-

tant than those relating to the food, although the latter should on no account be neglected.

In the case of delicate children and those of tuberculous parents or with other tuberculous relatives, everything possible should be done to fortify them against the disease. They should be kept under more or less constant medical supervision, as regards their clothing, manner of life, etc., and should take cod-liver oil every winter. Every attack of bronchitis or broncho-pneumonia should be watched with the greatest solicitude. Exposure to measles or pertussis should especially be avoided. The country rather than the city should be chosen for residence, and the child should spend the winter and spring in some warm, dry climate, such as that of southern California, or the interior of South Carolina, or Lakewood, N. J. Parents should be distinctly taught that watchfulness and care do not mean coddling or the keeping of children in the house the greater part of the time. Such children should live as much as possible in the open air, and every form of sport encouraged which tends to keep them there. Overheated houses are one of the most prolific agencies in perpetuating a delicate condition of health. Plenty of fresh air in sleeping apartments should always be insisted upon. All catarrhal troubles of the nose and pharynx should receive early and prompt attention, especially should hypertrophied tonsils and adenoid growths of the pharynx be removed, since these are conditions which form a most favourable nidus for the growth of tubercle bacilli.

Treatment of General and Pulmonary Tuberculosis.—If fresh air and a proper climate are necessary for the cure of this disease in adults, they are tenfold more necessary in the case of children. Without them there is little hope for a child with active pulmonary tuberculosis. Nowhere do these cases do so badly as in a hospital located in a city, and no class of hospital cases do worse than these. The same regions that are beneficial for adult cases usually agree with children, with the exception that the latter, as a rule, do better in a warm than in a cold climate. Plenty of fresh air and sunshine are essential. A child must be where he can be kept in the open air for at least several hours each day, in spite of fever, cough, or other acute symptoms.

For the most acute cases where the children are confined to the bed, the largest, best-ventilated, and sunniest room available should be secured, and a window should be open the greater part of the time. The general management of such cases is the same as for those with acute pneumonia.

No specific remedy for tuberculosis has as yet stood the test of experience. The diet is a matter of the utmost importance. Tuberculous patients must be fed like most other sick children, care being taken not to disturb the digestion by the unnecessary use of drugs. For a staple article of diet, milk is the best, and where this is not well borne some of its substitutes—kumyss, matzoon, etc.—may be tried. Cream is almost as use-

ful as cod-liver oil, and should be given in one form or another whenever the child can take it.

The two drugs which are most useful are creosote and cod-liver oil. Creosote may be given both by the stomach and by inhalation, as in cases of pneumonia. By the stomach there may be used for older children, the shellac-coated pills containing one or two drops of creosote; for those who are younger, it may be given in combination with the liquid peptonoids or in an emulsion with cod-liver oil. It is seldom possible to give as a single dose more than half a drop to a child of two years; one of five years, two drops may often be given. It should be continued for a long period. Cod-liver oil is usually best given in a fresh emulsion, although some children bear the pure oil better than any other preparation. Inunctions of this or other oils are of some value when it is not well tolerated by the stomach. Arsenic, iron, and the compound syrup of the hypophosphites are all useful as general tonics, but as specifics their action is very questionable.

When symptoms pointing to tuberculosis of the bronchial glands are present, the syrup of the iodide of iron should be used in the same way as in disease of the cervical glands. When they ulcerate into the trachea or larger bronchi, they generally cause death, no matter what is done. There are on record a few cases in which tracheotomy has been of service in this condition, but in the great majority it accomplishes nothing.

CHAPTER XI.

SYPHILIS.

SYPHILIS is a communicable disease due to a specific poison. Although a certain bacillus, first described by Lustgarten, is quite generally found in syphilitic tissue, it is not established that this bacillus is the cause of the disease.

In infancy and childhood both the acquired and the hereditary forms of syphilis are seen.

ACQUIRED SYPHILIS.

While acquired syphilis is very much less frequent than the hereditary variety, it is by no means a rare disease in early life. It is not improbable that some of the manifestations of syphilis in later childhood which are usually denominated "late hereditary syphilis," are really due to the acquired form.

Etiology.—An infant may be infected by its mother during parturition; but this is extremely rare and can take place only when there are lesions upon the mother's genitals. Infection is more likely to

be from a mother who contracts syphilis subsequently to the birth of the child, and may occur through nursing or accidental contact by kissing, etc. In either of these ways children may be infected by wet-nurses, or from a venereal sore upon the nipple. Whether syphilis can be communicated through the milk when the nipple is perfectly healthy and free from fissures, is somewhat doubtful.

Syphilis may be communicated directly from a syphilitic child to one who is healthy by kissing, sexual contact, or indirectly by means of bottles, spoons, cups, clothing, etc. The latter mode of infection is most likely to occur in institutions. Vaccination was formerly a not infrequent mode of communicating syphilis, but since the general introduction of bovine virus this is very rarely seen. Cases have been recorded by Taylor, Hutchinson, and others where the disease has been conveyed by the rite of circumcision, either from the mouth or the instruments of the operator.

The relative frequency of the different sources of infection is shown by Fournier's statistics of forty cases: The source of infection was the parents in nineteen; nurses, in eight; servants, in four; sexual contact, in four; vaccination, in two; other children, in two; a physician, in one. The ages at which the disease was acquired in this series of cases were as follows: during the first year, nineteen; during the second year, ten; during the third and fourth years, seven; from the fifth to the fourteenth years, six.

Symptoms.—The symptoms of acquired syphilis in children are in all respects similar to the same disease in the adult. A primary sore is present at the site of infection, which is most frequently the lips, the mouth or some part of the face; very rarely is it seen on the genitals. There are very few individual symptoms belonging to hereditary syphilis which may not also be present when the disease is acquired. Its course, however, is very much milder in the latter and a fatal termination is rare. Fournier states that of his forty-two cases only one died of marasmus. This marked contrast to hereditary syphilis is due chiefly to the fact that in the acquired variety the infant is rarely affected during the early months of life, a time when hereditary syphilis is so very fatal.

Tertiary symptoms may appear at any time from three to twenty years after the original infection.

The treatment is the same as in hereditary syphilis.

HEREDITARY SYPHILIS.

Etiology.—A child may inherit syphilis from both parents or from either separately. If both parents are syphilitic, the child is usually but not invariably so. The symptoms, however, are not more severe than when the inheritance is from one parent only. The likelihood of transmission depends upon the stage of the disease in the parents. If both

are suffering from secondary symptoms, transmission is almost certain. If active treatment has been employed for several months, if the child is born at a period when no active symptoms are present, or if the symptoms are of a tertiary character, the offspring will probably escape. First-born children are more likely to suffer severely from syphilis than the later ones, provided infection of the parents has taken place prior to the birth of all the children.

Infection from the father.—Syphilis may be inherited from the father alone. In this case the disease is probably communicated directly from the semen to the ovum. It is more likely to be transmitted from the father than from the mother, as the child is frequently syphilitic when the mother has few or no active symptoms. Of twenty cases observed by Meyer in which the father alone was syphilitic, the fœtus was discharged macerated in eleven cases, and nine children were born with congenital syphilis, all but one dying soon after birth. It is possible, though rare, for the father to convey syphilis when he is free from symptoms, or when he is suffering from tertiary symptoms only.

Infection from the mother.—It is certain that syphilis may be transmitted when the mother alone is diseased, as is shown by cases where women who have acquired syphilis while wet-nursing infected children, have subsequently borne syphilitic children, the father remaining healthy. If the mother only is syphilitic the probabilities of transmission to the child appear to be considerably less than if the father alone is affected. If the mother's symptoms are tertiary the child will probably escape.

Both parents healthy at the time of conception and the mother infected during pregnancy.—Under these conditions the child may or may not be syphilitic. Transmission to the child is much less likely to occur if the mother is infected during the last two months of her pregnancy than earlier, although, as Hutchinson's cases conclusively show, there is no certainty that the child will escape. Diday states that if the mother is infected before the fourth week and proper treatment is instituted, the child will usually escape on account of the relation of the embryo to the maternal circulation during this early period.

Can a healthy mother bear a syphilitic child?—In 1837 Colles enunciated the following proposition, the truth of which has been abundantly verified since his time: "A new-born child affected with inherited syphilis, even although it may have symptoms in the mouth, never causes ulceration of the breasts which it sucks if it be the mother who suckles it, although continuing capable of infecting a strange nurse."

Caspary inoculated with syphilis a woman, apparently healthy, who had aborted with a syphilitic child; the result was negative. A similar experiment was made by Neumann, with a like result. Vidal reports a case of an apparently healthy woman who had a syphilitic child by an infected husband; later, by a second husband who was free from syphilis,

she had a syphilitic child. The conclusion seems irresistible that the carrying of a syphilitic child gives immunity to the mother against the disease, and that this immunity is due to the fact that she herself suffers from syphilis, or a modification of that disease. According to Hutchinson, the modified syphilis acquired by a woman under the circumstances mentioned, bears to syphilis acquired from a chancre a somewhat similar relation to that which vaccinia bears to smallpox. The mother under these circumstances can not be inoculated, either by her syphilitic nursing-infant or artificially.

Lesions.—Death may be due to syphilis, and yet the autopsy may reveal no characteristic anatomical changes, and in fact there may be no demonstrable changes in any of the organs. This is sometimes the case in children dying from syphilis soon after birth, but it is especially likely to be the case with infants who die from syphilitic marasmus during the first few months. Syphilis in these cases acts more as an indirect than as a direct cause of death. The most important lesions of hereditary syphilis are found in the bones, liver, spleen, and mucous membranes.

Bones.—In the case of a syphilitic fœtus, a stillborn child, or one dying soon after birth, the changes in the bones are more uniformly present than are any other lesions. They are in fact rarely wanting, and it is by them usually that syphilis is recognised post mortem. These early changes were first fully described by Wegner, and since then have been studied by Kassowitz, Taylor, and others. The long bones are principally affected, the most important changes being found at the junction of the shaft with the epiphyseal cartilage. The lesion is termed an epiphyseal osteo-chondritis or acute epiphysitis. There are in the early stage congestion, swelling, and cell proliferation, which may be followed by separation of the epiphysis, suppuration in the neighbouring joint, osteomyelitis, and necrosis. These changes, as well as those belonging to late syphilis, are more fully considered under Diseases of the Bones (page 851).

Liver.—This is probably more frequently involved in the fœtus and newly-born infant than any other organ. The syphilitic lesions of the liver have been studied very fully by Hudelo.* He describes as present in the youngest infants an interstitial hepatitis, a gummatous hepatitis, and a combination of the two varieties.

In the interstitial form, which is most frequent in infancy, there are first a congestion and swelling of the organ, with the exudation of leucocytes in groups. The liver is enlarged, frequently very much so, but presents few other gross changes. Later there is increased exudation between the liver cells, new connective tissue forms, and atrophy of the liver cells takes place, with obliteration of some of the portal and hepatic vessels. This process may be diffuse, but it is usually in patches. Groups

* Monograph, Paris, 1890.

of miliary syphilomata may also be found. If the process is diffuse, the liver is large, firm, and of a grayish-yellow colour. If it is localized, the affected areas are yellow or gray and the other parts are normal.

The gummatous form is not frequent in early infancy, but belongs to a little later period. In this there may be miliary syphilomata with interstitial changes, and in addition the formation of small or large gummatous tumours, which may be softened at the centre. They are surrounded by zones of new connective tissue and the liver cells are atrophied. Amyloid changes may be present.

In the late form of hereditary syphilis, usually seen in children over four or five years old, the liver is rarely affected. Hudelo was able to collect but forty-seven such cases. The lesions resemble those of the congenital variety. There are found cirrhotic changes, which may be diffuse or circumscribed, and gummatous deposits, which vary from a minute size to that of a cherry; there may be amyloid degeneration.

Spleen.—This is almost invariably enlarged in newly-born children with syphilis and in syphilitic fœtuses, but nothing characteristic is found under the microscope (Birch-Hirschfeld). In older children the enlargement of the spleen is apt to be greater than at birth; the organ may be the seat of interstitial changes, and sometimes there may be gummatous deposits. These changes are rare in children under two years of age.

Respiratory system.—In syphilitic infants which are stillborn and in those which die soon after birth, there is frequently found in the lungs what is known as “white pneumonia.” This process consists, according to Hillier, in fatty changes in the epithelium of the air vesicles; with this there is associated a certain amount of interstitial pneumonia, which is chiefly peri-bronchial. In older cases the interstitial pneumonia is extensive, and the lungs may be the seat of gummatous deposits, which soften and form small cavities. Accompanying these changes there may be bronchiectasis, emphysema, and the usual secondary lesions which follow chronic interstitial pneumonia. In syphilitic infants there is a strong tendency for all inflammations of the lungs to become chronic.

The trachea and bronchi are in rare cases the seat of stenosis, which results from cicatrization following the softening of gummatous deposits in their walls. Lesions of the larynx (page 457) are also infrequent. There is usually perichondritis, which more often involves the epiglottis than any other part, and sometimes there is the formation of papillomatous masses; but ulceration and stenosis are both rare.

The nasal mucous membrane in the early stage of the disease is very constantly the seat of a chronic catarrhal inflammation, which may be accompanied by superficial ulceration. In the late cases there is deeper ulceration, from the breaking down of gummata, with extension to the periosteum, cartilages, and bones, causing perforation of the septum, necrosis of the bones, etc.

Nervous system.—Syphilitic lesions of the brain and cord are rare in children as compared with adults, and they are especially so in infancy. The most characteristic cerebral lesion of the newly-born child is hydrocephalus, which may depend upon ependymitis, as in two cases reported by D'Astros, the disease proving fatal in the second month. Syphilitic meningitis is exceedingly rare under two years. There is occasionally seen in young infants a chronic basilar meningitis (page 721) of syphilitic origin. Chronic pachymeningitis associated with gummata has been observed as early as the fourth year. Money (London) has reported a case with symptoms beginning at eleven months, in which there was chronic meningitis with great thickening of the dura mater and cerebral sclerosis. A few other cases of a similar nature have been recorded.

Syphilitic endarteritis of the brain has been observed by Chiari in a child only fifteen months old. In this case there was chronic meningitis, with endarteritis, thrombosis, and minute spots of yellow softening. Gummata are very rare before the fourth year, although Barlow's patient with multiple gummata at the base, was only fifteen months old. Nearly all the syphilitic lesions of the nervous system which are seen in adult life have been observed in childhood, although they are infrequent, and in young children they are extremely rare.

Digestive system.—Chronic catarrhal pharyngitis is almost a constant symptom of the early cases. Later there is seen superficial or deep ulceration of the pharynx, tonsils, or fauces, which may lead to perforation of the soft palate or to the formation of condylomata.

There are no important lesions of the stomach or intestines either with early or late syphilis. The rectum is occasionally the seat of ulceration, and condylomata may form even in young children.

Organs of special sense.—Otitis is a frequent accompaniment of the early syphilitic pharyngitis. It is very likely to become chronic, and in many cases results in a permanent impairment of hearing. Iritis is relatively rare in children, but it may occur even in intra-uterine life, as shown by the presence of adhesions in newly-born children. It is usually seen in infants four or five months old, and is always serious. Interstitial keratitis occurs frequently as a late manifestation of syphilis. Choroiditis and optic neuritis are both occasionally seen, but they are rare.

Genito-urinary organs.—Nearly all these may be affected, but generally in the late period of the disease. There may be chronic interstitial nephritis and more rarely gummatous deposits in the kidney, interstitial changes in the suprarenal bodies, and orchitis, which usually affects the body of the organ, rarely the epididymis; it is generally an interstitial inflammation, with or without gummatous deposits.

Among the less frequent visceral lesions may be mentioned, abscesses of the thymus, which are usually small and multiple; enlargement of the pancreas, with an increase of connective tissue and glandular atrophy; and

chronic peritonitis. The lesions of the mucous membranes will be considered under Symptoms.

Symptoms.—As the result of syphilis, abortion may take place at any period of pregnancy, with the discharge of a dead or macerated fœtus, or the child may be stillborn at term, or it may be born alive prematurely, but with so feeble a vitality that it survives but a few hours. Under these circumstances it is often difficult and sometimes impossible to decide positively with reference to the existence of syphilis. Maceration of the fœtus or peeling of the skin is no proof, and even the examination of the internal organs may not be conclusive. Lomer examined 43 fœtuses, all dying before the thirtieth week of pregnancy; he found the spleen and liver enlarged in all, and marked bone changes in 21. Birch-Hirschfeld examined 108 newly-born syphilitic infants; he found the spleen invariably enlarged; typical bone changes were present in 35, but in many cases the bones were normal. Mervis, from an examination of 92 syphilitic fœtuses, states that no eruption upon the skin was found earlier than the eighth month.

Symptoms are present at birth in only a small number of cases. In such there is usually a very severe degree of infection, and the infants do not often live more than a few days. Upon the skin there may be seen an eruption of pustules, papules, or bullæ. The bullæ are usually upon the soles and palms, but may be found upon other parts of the body. The name "syphilitic pemphigus" is often given to this condition. Pemphigus in the newly born, however, is not invariably due to syphilis, but may be present in other conditions of low vitality. The bullæ are at first small, and then coalesce and form larger ones two inches or more in diameter. They contain a turbid serum which is sometimes tinged with blood, and sometimes yellow from pus. Pustules, when present, are usually seen upon the face or scalp. The general appearance of these infants is wretched in the extreme. The body is wasted, the skin wrinkled, and temperature subnormal. The spleen is usually enlarged and often the liver also. They suck feebly or not at all, and usually die from inanition within two weeks.

In the great majority of cases the infant appears healthy at birth, and continues so for a variable time before the manifestation of the characteristic symptoms of syphilis. As a rule, the more intense the infection, the earlier the symptoms make their appearance. The earliest symptoms are generally seen between the second and the sixth weeks. If three months pass without evidence of syphilis, the child may be considered safe, the exceptions to this rule being very few. Miller * (Moscow) gives the following statistics of the time of beginning of symptoms in 1,000 cases:

* Jahrbuch für Kinderheilkunde, Bd. xxvii, S. 359.

Symptoms appeared during the first week.....	85	eases.
“ “ “ “ second week.....	138	“
“ “ “ “ third week.....	240	“
“ “ “ “ fourth week.....	177	“
“ “ “ “ fifth week.....	86	“
“ “ “ “ sixth week.....	54	“
“ “ “ “ seventh week.....	30	“
“ “ “ “ eighth week.....	50	“
After the eighth week.....	140	“

Sometimes the constitutional symptoms—wasting, cachexia, etc.—are noticed before the local ones, but usually this is not the case. Generally the first symptom is the coryza or “snuffles,” which resembles an ordinary cold in the head, except that it persists. It is accompanied by a hoarse cry, indicating that the larynx participates in the catarrhal inflammation. Soon the eruption makes its appearance, being generally first seen upon the hands and face. Fissures and mucous patches may be seen upon the lips, about the anus, etc. With these symptoms there is often slight fever, the temperature usually ranging from 99° to 101° F. There may also be observed excessive tenderness about the shoulders, elbows, wrists, or ankles, due to acute epiphysitis, which may cause the child to cry from the slightest amount of handling, and the limbs may be moved so little that paralysis is suspected. There may be swelling near any of the joints mentioned.

In a severe case, as these local symptoms develop, the infant's general nutrition suffers in a very marked way. It loses steadily in weight; it becomes extremely anæmic; it whines and frets almost continually, but especially at night. The facies is so characteristic as to be almost diagnostic; the features have a pitiful, drawn expression; and the face is wrinkled, giving the infant the look of being very old. The skin has a peculiar sallow colour, which has been well described as *café au lait*. The symptoms may continue until a condition of extreme marasmus is reached, and death occurs from inanition, exhaustion, or from some intercurrent affection of the lungs or digestive organs.

In the milder forms of infection the severe constitutional symptoms described are not seen, although the local evidences of disease are almost as marked as in the cases just described. The severity of the symptoms is also much modified by treatment, especially when this is begun at an early period.

The most important local symptoms are the coryza, eruption, fissures about the mouth and anus, mucous patches, painful swellings at the extremities of the long bones, pseudo-paralysis, and onychia.

Coryza.—In most of the cases this is the first symptom. Beginning like an ordinary catarrh, it is distinguished by its severity and its persistence. There is a copious discharge of mucus and serum, sometimes of

mucopus, and often it is tinged with blood. Thick crusts form, which produce the usual symptoms of nasal obstruction; there is great difficulty in nursing; the infant breathes through the mouth, and the mucous membrane of the mouth is dry, causing great discomfort. If untreated, the process, which at first involves the mucous membrane only, may extend to the submucous tissue, causing ulceration; but the cartilages and the bones of the nasal fossæ are not involved till a later period in the disease.

The nasal catarrh is associated with more or less laryngitis. This causes hoarseness, which at times may amount almost to complete aphonia. There are very rarely symptoms of laryngeal stenosis. Dillon Brown has, however, reported one case in an infant six weeks old, which recovered after intubation.

Eruption.—This usually occurs after the coryza has lasted about a week; but the two may come at the same time; or the coryza may be absent or so slight that the rash appears to be the first symptom.

Occasionally there is seen a diffuse blush or roseola, but more frequently the eruption is macular, occurring in small, dark-red spots about the size of the infant's finger nails, usually circular and often slightly elevated; there is no surrounding inflammation, and rarely any itching. It is usually most abundant upon the face, the neck, and the anterior surface of the upper and lower extremities, especially the hands and feet, not infrequently extending over the entire body, although it is generally scanty over the shoulders and back. When it first appears the colour is bright, but gradually becomes of a dusky-red or coppery hue. After a little time very fine scales may be seen upon the surface of the red patches. The rash comes out slowly, usually requiring from one to three weeks for its full development. It fades gradually, leaving a coppery discoloration of the skin, which continues for a long time. The duration of the eruption is from three to eight weeks. It is shorter if active treatment is employed.

A papular eruption is rarely seen alone, but is usually associated with the macular variety. The papules are of a brownish colour and are hard. They are seen most frequently upon the palms and soles, and occurring alone they are not characteristic.

A squamous eruption is frequently seen upon the palms and soles, but very rarely elsewhere. In a few cases this scaliness forms the most distinctive feature of the cutaneous lesion.

Fissures and mucous patches.—These are among the most diagnostic features of early hereditary syphilis. Fissures are most frequently seen on the lips and about the anus, but they may occur about the nostrils and occasionally elsewhere. The fissures of the lips are really linear ulcers, and are distinguished by their persistence in spite of local treatment. They are multiple, deep, painful, and bleed easily. Those at the angle of the mouth are especially troublesome.

Mucous patches may develop from fissures, but more frequently from

papules which are situated in regions where they are exposed to constant moisture and friction. They are very common upon the muco-cutaneous surfaces and wherever the skin is especially thin. The situations where they are most apt to be seen are about the lips, anus, scrotum, and vulva, but they may also be found behind the ears, between the toes, in the folds of the groin, axillæ, or buttocks. In size they vary from an eighth to half an inch in diameter; they are whitish in colour, have rounded borders, and are raised rather than excavated; they never extend deeply.

With these lesions there may be associated ulcers upon any of the mucous membranes, but they are most frequently seen in the mouth or on the genitals. The usual seat in the mouth is on the inner surface of the lips, the tongue, palate, or fauces; they are seldom symmetrical, and while they extend superficially they are never deep.

Hæmorrhages.—They are generally associated with the lesions of the mucous membranes, but sometimes occur without them. Slight bleeding from the nose and lips is not uncommon in ordinary cases of syphilis, and all hæmorrhages of the newly born are more frequent in syphilitic than in other children. Fischl has reported seven cases of multiple hæmorrhages in the newly born, associated with other symptoms of congenital syphilis. Mracek noted hæmorrhages in thirty-three per cent of 160 autopsies on syphilitic stillborn infants or those dying soon after birth. Examination of the blood-vessels in some of these cases showed infiltration of their walls and narrowing of their lumen. The vascular changes were thought to be the cause of the bleeding.

Nails.—The nails present several peculiarities in syphilitic infants. There may be a disease of the matrix resulting in suppuration and exfoliation of the nail—a true onychia. Sometimes the nails are repeatedly exfoliated; at other times they are deeply wrinkled or furrowed; or the dorsum is very much arched, and the nail appears as if it had been pinched near the matrix by a pair of forceps. Such nails are often expanded toward the extremity, and may be decidedly claw-shaped; they are frequently opaque, sometimes having a purplish discoloration; they may be short and split into layers. The most characteristic appearance is the narrow, pinched, claw-shaped nail; this is an early symptom of some diagnostic importance. The hair and eyebrows frequently fall out completely. This symptom is not usually present in very early infancy.

Pseudo-paralysis.—This is due to acute epiphysitis, and it may be the first symptom of hereditary syphilis to attract attention. It is usually noticed when the infant is a few weeks old that one or sometimes both arms are not moved, and that the parts are tender and painful when handled. The condition is easily confounded with peripheral birth palsies. The arm is very frequently held in marked inward rotation with the palm looking outward, resembling the position in Erb's palsy;

but careful examination makes it evident that the loss of power is only apparent, and that it is due either to the pain which motion produces or to epiphyseal separation. A history will usually be obtained that loss of power did not exist at birth, but developed subsequently. The electrical reactions in these cases are normal, and the rapid improvement under mercurial treatment is always diagnostic. The lesions of the viscera in early syphilis rarely give rise to any marked signs or symptoms, with the exception of the spleen, which is almost invariably found enlarged.

Late Hereditary Syphilis.—These symptoms may come on at any period during childhood or about the time of puberty, but very rarely at a later time than this. They are seen both in those who have had the usual symptoms of hereditary syphilis in early infancy, and in others where the most careful examination into the history fails to disclose any symptoms whatever of early syphilis. It is fair to assume in such cases either that early symptoms were absent or that they were of trivial importance. It is still a matter of dispute whether these late symptoms should be regarded as hereditary, tertiary syphilis, which has not previously given signs, or as the late stage of ordinary syphilis in which the early symptoms have been overlooked. It is certain that the symptoms are quite as apt to be severe when there is no history of early syphilis as when this has been typical. It is quite possible that some of these may be the late manifestations of the acquired syphilis not recognised in the early stage.

Late hereditary syphilis shows itself by symptoms which in acquired disease would be classed as tertiary. The most characteristic are the affections of the teeth, the bones, gummatous deposits in the solid viscera, the skin, or mucous membranes, the breaking down of which may lead to ulceration.

Teeth.—There are no peculiarities in the first teeth of syphilitic children except their proneness to early decay. They are rather more likely to appear early than late. Hutchinson states that there occasionally occur abscesses of the gum in young infants, on opening which the crown of the milk-tooth, usually an upper central incisor, may be removed.



FIG. 180.—Typical "Hutchinson's teeth." (After Fournier.)

The characteristic teeth of syphilis are those of the second set. In estimating the diagnostic value of these changes, only the upper central incisors are to be relied upon; these are the test teeth. Although changes are frequently seen in other teeth, they are not always diagnostic. Typical syphilitic teeth, according to Hutchinson, have each a single notch in the centre of the edge (Fig. 180). The notch is usually shallow and more or less crescentic in shape. The enamel is generally deficient in the centre of the notch, and the tooth here is apt to be discoloured. The teeth are dwarfed,

both as regards their length and width. They often taper regularly from the base to the edge, giving rise to the term "screw-driver teeth" (Fig. 181). The teeth are not so flat as the normal incisors, but somewhat rounded and peg-like. They are not properly placed, but incline either toward or away from each other. They are seldom large enough to touch the adjacent teeth on both sides.

Although Hutchinson's teeth may generally be taken as conclusive evidence of syphilis, they are not invariably so, as Keyes and others have shown. It is to be remembered in this connection that the absence of changes in the teeth is of no importance whatever as evidence that syphilis is not present. Hutchinson states that they are wanting in more than half the cases.

Bones. — The form of disease which is usually seen at this period is an osteo-periostitis, affecting principally the shaft of the long bones and the cranium. It has already been described (page 853).

Lymph nodes. — They are much less frequently affected than in adults, and in early infancy they are seldom involved. In most cases after the first year there may be found a moderate degree of enlargement of the post-cervical and epitrochlear glands, swelling of the latter having considerable diagnostic value. They are situated just above the internal condyle of the humerus, and under normal conditions can scarcely be felt. In syphilitic children they may be as large as a pea or a small bean; sometimes two or three of them can be distinguished. They are so rarely enlarged from other constitutional conditions that, provided no local cause for the swelling exists, they should always create a suspicion of syphilis. The post-cervical glands are frequently affected, but are not so diagnostic. The degree of enlargement is rarely great. Occasionally there are seen in the neck large masses of swollen lymph glands which resemble tuberculous swellings. They are, however, very rare.

Special senses. — The most frequent affection of the eye in late syphilis is interstitial keratitis, the close connection of which with hereditary syphilis was first pointed out by Hutchinson. It is usually found associated with the typical notched teeth. The diagnostic value of keratitis in syphi-



FIG. 181.—Syphilitic "screw-driver teeth." Boy nine years old. (Same patient as Fig. 145.)

lis is denied by Fournier, who states that, while often syphilitic, it is not infrequently due simply to malnutrition. Both eyes are usually affected, and in all degrees of severity, from a slight haziness of the cornea to complete opacity. However, with an early diagnosis and prompt treatment, recovery may be expected in most cases.

Chronic otitis may be a result of the acute process seen in early infancy. There is nothing peculiar about the inflammation in these cases. A form of deafness occurs in older children, which Hutchinson states is almost invariably due to syphilis. Its onset is quite sudden, without pain and frequently without discharge. The loss of hearing is apt to be permanent, and if it occurs early in childhood it is a cause of deaf-mutism.

Skin.—The most important of the later manifestations of syphilis consist in the formation of subcutaneous gummata. In the early stage they are indurated, elastic, of a grayish colour, with red borders. Under treatment they disappear quite rapidly by absorption; but when neglected they break down, leaving large deep ulcers. These ulcers are quite characteristic in appearance, but may be confounded with those due to tuberculosis. The syphilitic ulcer has rounded, thickened, indurated borders, and a base which is depressed and has the appearance of being scooped out. It is sometimes covered by hard crusts and is surrounded by a red areola. It leaves a smooth white scar. The most frequent situation is upon the face and upper part of the legs or thighs. Tuberculous ulcers have usually soft, flat edges, and do not extend so deeply; they are more irregular in outline; the cicatrix left is of a purplish colour, which becomes red and slowly fades. Tubercle bacilli may be found. Sometimes it is only by the effect of treatment that the diagnosis can be made between these two lesions.

Nose and palate.—Disease of these parts generally begins as the breaking down of gummatous deposits in the mucous membrane. The nose may in consequence be the seat of a protracted fetid discharge (*ozæna*). The disease may take on a destructive form of ulceration which is at times phagedenic, and may cause rapid destruction of the nasal cartilages and bones, perforation of the septum, and occasionally of the floor of the nasal fossæ. There may be necrosis of the turbinated bones, the vomer, or the ethmoid. In the most severe forms the nose may be almost destroyed in the course of a few weeks. There may be at the same time deep ulceration of the soft palate, leading to perforation. In a young person this is almost invariably due to syphilis. In many particulars these ulcerations of the nose and palate resemble lupus; they are distinguished by the rapidity of their progress, syphilis often doing as much damage in weeks as is done by lupus in years (Hutchinson).

Other symptoms.—Syphilitic disease of the larynx and bronchi is rare in childhood. The former (page 457) may give rise to hoarseness or

aphonia and occasionally to stenosis; the latter * to a chronic cough and asthmatic attacks. There are no characteristic symptoms belonging to syphilis of the lungs. The different lesions of the central nervous system which may be due to syphilis are all quite rare. The forms have already been mentioned, and their symptomatology is discussed in Diseases of the Nervous System.

The only visceral changes which aid much in diagnosis are those of the liver and spleen. The liver is often enlarged, sometimes to a marked degree, and occasionally there is ascites, but very seldom jaundice.

Enlargement of the spleen is a very frequent symptom—in fact, it is almost constant during active syphilitic disease. I have several times seen it so swollen as to form an abdominal tumour of considerable size. In one case, in a boy three years old, the spleen extended five inches below the free border of the ribs, quite to the crest of the ileum. It was associated with moderate enlargement of the liver, as is usually the case.

In addition to the local symptoms of late hereditary syphilis enumerated, there are others of a general character which are quite as important. The body is usually undersized; the constitution is delicate, and shows but little resistance to all forms of disease; puberty is frequently delayed, and the development of the breasts and the genital organs often imperfect; anæmia is usually present, and the skin has a sallow appearance. Mentally, many of these children are somewhat deficient, and in a few instances they become idiotic, epileptic, or the subjects of dementia.

Diagnosis.—The diagnosis of early syphilis in most cases is not difficult. The coryza, eruption, labial fissures, mucous patches about the anus and genitals, and general cachexia,—all form a picture which it is difficult to mistake. In irregular cases the diagnosis is easy just in proportion to the number of the foregoing symptoms which are present. Special care should be taken not to confound the moist papules of simple intertrigo upon the buttocks or thighs with those of syphilis.

In late syphilis the following symptoms are the most reliable for diagnosis: notching of the teeth, falling in of the bridge of the nose, interstitial keratitis, deafness not traceable to ordinary otitis, enlargement of the spleen and epitrochlear glands, ulceration of the palate or nose, the sabre-like deformity of the tibia, and nodes upon the tibia or cranium.

Prognosis.—Generally speaking, the prognosis is much worse in infantile syphilis than in that of adults. In infancy it is much worse when hereditary than when acquired, for the reason that often the child who is the subject of hereditary syphilis has been affected by the poison from the very beginning of its existence, and this has modified its entire development.

* See A. Seibert, M. D., in Archives of Pediatrics, vol. ix, for a report of four cases and others collected from literature.

The results of 206 syphilitic pregnancies observed by Jullien (Paris) were as follows: abortion occurred in 36, stillbirths in 8, and 69 children died soon after birth, making a total mortality of 55 per cent; 50 were living and syphilitic; only 43 living and in good health. Still worse were the results in cases observed by Le Pileur: of 154 pregnancies in syphilitic women, there were 120 abortions or stillbirths, 26 children died soon after birth, and only 8 survived. The statistics of the Foundling Asylum in Moscow for ten years showed that of 2,038 syphilitic infants the mortality was over 70 per cent.

Such a mortality as that indicated in the above statistics is seen only in institutions where little or no previous treatment has been employed. In private practice certainly nothing approaching it occurs.

In addition to those who die early as the result of syphilitic infection, there must be added many whose constitutions are so impaired by syphilis that they fall an easy prey in infancy to pneumonia, diarrhoea or other forms of acute disease. The remote effects of syphilis in infancy it is hard to estimate; it exerts a modifying influence upon the constitution in childhood and even throughout the life of the individual.

The prognosis in an individual case depends upon the age at which the symptoms develop, the time when treatment is begun, upon its thoroughness, and upon the surroundings and mode of nourishment of the child. The outlook is better the longer after birth the first symptoms appear; it is also better in infants who are nursed than in those who are artificially fed.

As compared with syphilis of the adult, relapses are rare, and when they occur early they are nearly always the result of insufficient treatment. If proper early treatment is carried out, the severe late symptoms are rare; patients are usually free from all symptoms until six or seven years old, or until near the time of puberty—two periods when they are likely to develop.

The prognosis is better in the later children of syphilitic parents than in the earlier ones, provided infection has preceded the birth of all the children. This fact illustrates the general tendency of the syphilitic poison to diminish in virulence as time passes, even without treatment. The following instance cited by Bertin well illustrates this point:

In the first pregnancy, the child died at the sixth month; in the second, at the seventh month; in the third, at seven and a half months; in the fourth the child was born at term, and lived eighteen days; in the fifth it lived six weeks; in the sixth the child lived four months, without treatment.

Prophylaxis.—No infected person should be allowed to marry until at least two years have passed after the initial sore, steady treatment being continued meanwhile; nor if there are any active symptoms, no matter how long a time has elapsed since infection. There is no certainty in either case that the child will escape.

The mother should be treated during her pregnancy: (1) if she is syphilitic, whether the disease was acquired at the time of conception or subsequently; (2) if the father is known to be suffering from syphilis, whether the mother has symptoms or not; (3) if the mother has previously shown signs of syphilis, but has had no active symptoms for a considerable period. In all these conditions if efficient treatment is carried on throughout pregnancy there is a strong probability, but in no case a certainty, that the child will escape. The third condition mentioned is the one in which treatment is most likely to be neglected, especially if the mother has previously borne a child who was not syphilitic. Syphilis, however, shows a strong tendency to reappear and become active during pregnancy, even though it has been long quiescent, as the following case cited by Diday shows:

A woman who had lost seven children from syphilis was put under treatment during the eighth pregnancy; result—child born healthy, and continued so. In the ninth pregnancy treatment was continued with a like result; in the tenth pregnancy, no treatment, child syphilitic, dying when six months old; in the eleventh pregnancy, treatment repeated, child healthy.

The danger of infection during labour is slight. If there are upon the genitals of the mother either a chancre or syphilitic ulcers, they should be thoroughly cauterized before labour.

As the greatest danger of infecting a child after birth is from its parents or a wet-nurse, syphilitic parents should be duly warned of the danger to their children, and especially should be cautioned against kissing them or sleeping in the same bed with them. The utmost care should be exercised to prevent a healthy child from being infected by a syphilitic nurse. A nurse should never be accepted without a thorough examination, no matter how clear a history may be given. As a syphilitic child in the household may be the means of infecting other children, the same precautions should be taken as in the case of other contagious diseases. The chief danger to other children comes from kissing or from using bottles, spoons, or cups which have been infected; as the syphilitic infant is chiefly dangerous on account of the lesions in the mouth. Trouble most frequently occurs because of ignorance regarding the nature of the disease. It is possible for a syphilitic child to nurse a healthy woman without communicating syphilis, if the child's mouth is treated and the nipple not allowed to become fissured; but it is an experiment which should never be tried.

Treatment.—This should always be begun as soon as the first positive symptoms of syphilis appear. Under certain circumstances it may be advisable not to wait for symptoms; as, for example, where both parents have recently suffered from active symptoms, where previous children have died soon after birth, or where, with marked symptoms in the par-

ents, the child exhibits the cachexia of syphilis, but no definite local symptoms. Such anticipatory treatment need not be continued longer than six weeks unless symptoms appear.

The indirect treatment, designed to reach the child through the mother's milk, has fallen into deserved disuse, as it is very uncertain and altogether unsatisfactory.

Mercury is as much a specific for hereditary as for acquired syphilis. There are many ways of introducing it into the system: it may be given by inunctions, by the mouth, by fumigations, by baths, or hypodermically. In most cases inunction is the manner to be preferred in young infants. Gr. x of mercurial ointment, diluted with the same amount of vaseline, may be rubbed daily into the palms, soles, axillæ, or the inner surface of the thighs. It is advisable to change the place of inunction from day to day; and if this is done, it is extremely rare that erythema is produced. If for any reason inunctions are objectionable, as they may be where the family are to be kept in ignorance of the treatment, either the gray powder or the bichloride may be given by the mouth. The usual dose of the gray powder should be gr. j four times a day; that of the bichloride gr. $\frac{1}{60}$ four times a day, always well diluted. It is rare that larger doses are advisable. When the symptoms are urgent, it is often best to substitute calomel for a few weeks, as the system can usually be brought more rapidly under the influence of mercury by this than by the other preparations mentioned; gr. $\frac{1}{10}$ four times a day is the usual dose required. Other methods of administration and other preparations offer no advantages, and have some very obvious disadvantages.

The iodide of potassium is to be used, either alone or in combination with mercury, whenever such lesions exist as are classed among adults as tertiary. This includes all the late manifestations, and the earlier ones whenever the bones or viscera are affected. The iodide is usually well borne by children, and may be given in almost any desired dosage. In infancy it is rare that more than twenty grains daily are required, but in older children the necessary amount may be from one to two drachms daily. It should always be given largely diluted.

The duration of mercurial treatment should be at least one year. The doses during the last six months may be reduced to one half or one third those employed while active symptoms are present. Treatment should be longer than a year if symptoms exist. It is often better not to give the mercury continuously, but with short periods of intermission.

The tonic treatment of syphilis is important and should not be neglected. After specific treatment has been carried on for a time, particularly if rapidly pushed, the child often becomes anæmic, and suffers greatly from general malnutrition. Under such circumstances also it is often wise to discontinue mercury altogether for a time, or at least to reduce the dose very much, and administer cod-liver oil, iron, wine, and other

tonics. Such a change is frequently found to act most beneficially, even when lesions are present, which perhaps have been very little or not at all affected by the specific remedies employed. A judicious combination of specific and tonic treatment is required in every case, whether the remedies are given simultaneously or alternately.

Local treatment.—Ulcerative lesions of the skin require cleanliness, dusting with calomel or iodoform, or bathing with the black wash. Mucous patches should be dusted with equal parts of calomel and bismuth. Fissures and ulcers of the mucous membranes should be treated by nitrate of silver. Phagedenic ulcers of the palate or nose should be cauterized with nitric acid or the acid nitrate of mercury. The late syphilitic ulcers of the skin, due to the breaking down of gummata, should be treated with iodoform.

CHAPTER XII.

INFLUENZA.

Synonym: La grippe.

INFLUENZA is an infectious, communicable disease, which is now generally admitted to be due to the bacillus described by Pfeiffer in 1892. It is a serious disease in children chiefly from its tendency to complications of the upper and lower respiratory tracts, in which respect it closely resembles measles.

Etiology.—Besides the bacillus of Pfeiffer, there are frequently found, either associated or separately, in the organs of patients dying from influenza, the streptococcus and the diplococcus pneumoniae, for the development of which influenza creates conditions in the highest degree favourable.

Influenza prevails epidemically, and after epidemics it may be endemic for a number of years. In New York the disease has been present, according to Loomis, for at least twenty-five years, although it attracted little attention under the name of influenza until the great epidemic of 1891. Epidemics prevail chiefly in winter and spring. All ages are liable to the disease, infants under one year least so, and in some epidemics they may escape altogether. The disease has, however, been observed in infants only a few days old, where the mother was suffering from it at the time of delivery. The children most frequently affected are those from two to ten years of age.

The period of incubation is uncertain. It is usually short, being generally believed to be from one to seven days. No immunity is afforded by one attack; recurrences and second attacks are not uncommon in the

same epidemic, and a patient who has once had influenza seems to be more susceptible to the disease in consequence.

Lesions.—There are no characteristic lesions of influenza; those which are most frequently found are due to catarrhal inflammation of the respiratory or the digestive tract. In some cases only the upper respiratory tract is involved, in which case the disease often spreads to the middle ear; in others, only the lower respiratory tract, this in infancy usually spreading rapidly to the lungs, and resulting in broncho-pneumonia. Inflammation of the stomach and intestines is much less frequent and, as a rule, less severe. This will be considered more fully under Complications.

Symptoms.—The symptoms of influenza are due to the systemic effects of a general poison, and to certain local congestions and inflammations which are regarded as complications. The two classes of symptoms—the general and the local ones—are found in all possible combinations.

1. *The mild, uncomplicated variety.*—This lasts from two to five days, occasionally a week. The onset is usually abrupt, with chilliness, muscular pains, and sometimes vomiting. The temperature ranges from 101° to 103° F. Even though the fever is not high, the prostration is considerable, and children are often ill enough to remain in bed for several days. The usual general symptoms which accompany fever are present. After the fever has subsided, the child is left weak and anæmic; convalescence is frequently protracted, and it may be three or four weeks before the general health is regained. This is the most common variety seen, the essential symptoms being fever and prostration without evidences of local inflammation. Often there is in addition a mild coryza at the outset and a slight but persistent cough.

2. *Uncomplicated cases of the severe type.*—These are not frequent in children. They are characterized by high temperature, severe toxic symptoms, and great prostration. They closely resemble cases of pneumonia, with the exception that the local symptoms and physical signs in the chest are wanting. The onset is usually abrupt with vomiting and headache, sometimes even with convulsions. The temperature ranges from 102° to 106·5° F. It more often remains steadily high than fluctuates widely. In three cases recently observed I have seen a temperature over 106° F. in uncomplicated influenza. Marked nervous symptoms are usually present; there may be headache, photophobia, delirium, stupor, opisthotonus, and convulsions,—strongly suggesting meningitis, but all usually lasting but a day or two. In other cases the tongue has a brown coating, the lips are dry and parched, the pulse is weak and rapid, and other symptoms of the typhoid condition are present. The duration of these severe attacks is from two to five days, where no complication develops; a slight fever may, however, continue for a week, or even two weeks, gradually subsiding until it reaches the normal. Although the

symptoms are very alarming, the attacks are seldom fatal unless pneumonia develops; but it is a long time before the full effects of such an illness have entirely disappeared.

3. *Cases complicated by catarrhal inflammation of the upper respiratory tract.*—In this group there are added to the general symptoms of the mild uncomplicated variety, a severe coryza, with pharyngitis and often stomatitis. The catarrhal symptoms differ from ordinary catarrh of these mucous membranes chiefly in severity. They are also likely to be more prolonged, and there is a greater tendency to involve the ears and the cervical lymph nodes. The usual symptoms of acute rhino-pharyngitis are present with its serous, sero-mucous, or muco-purulent discharge. The whole pharynx may be the seat of an acute, erythematous blush, or the mucous membrane may present a granular or spongy appearance. The tonsils are red; occasionally there is follicular tonsillitis; rarely membranous patches. The nostrils and upper lip are often excoriated from the nasal discharge. The mouth may be the seat of a simple or a herpetic stomatitis with superficial ulceration. These catarrhal symptoms are usually severe for three or four days, and gradually subside. In infants the temperature may be 104° or 105° F. at the outset, but continues high only for a day or two. In older children the temperature ranges from 100° to 102° F.

There are two complications which in infancy are very frequent,—otitis and cervical adenitis. Otitis may be either catarrhal or purulent. It runs the usual course of otitis following simple catarrhal processes of the pharynx, and usually terminates in complete recovery. Exceptionally these cases may go on to the development of chronic otitis, or the disease may extend to the mastoid cells. In addition to the severe cases, there are frequently seen attacks of catarrhal deafness from inflammation of the Eustachian tube. Pain in this form is less severe, and may be absent; there is no increased fever. Deafness is the chief symptom, and in most cases it disappears spontaneously.

The adenitis usually involves either the lymph nodes situated below the ear and behind the angle of the jaw, or those of the retro-pharyngeal region. The inflammation runs the usual course of such inflammations when associated with other diseases.

4. *Cases with broncho-pulmonary complications.*—A moderate amount of inflammation of the mucous membrane of the larynx, trachea, and large bronchi occurs in most of the cases of influenza. In the more severe forms, broncho-pneumonia or lobar pneumonia often develops. Sometimes the pulmonary symptoms do not appear for two or three days, or even a week; at other times they are coincident with the development of the fever and other constitutional symptoms, and, except for the prevalence of influenza, this would not be considered a factor in these cases. A striking feature in these attacks is that the temperature, prostration,

and cerebral symptoms are out of all proportion to the pulmonary signs and symptoms.

The broncho-pneumonia complicating influenza may not differ essentially from the ordinary types, except that the proportion of cases which

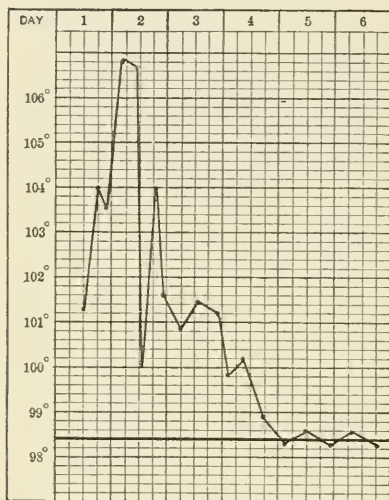


FIG. 182.—Acute broncho-pneumonia, abortive type, complicating influenza, in an infant six months old. The entire left lung posteriorly, was involved.

do not go on to the development of areas of consolidation, is larger than is seen under most other conditions. If lobar pneumonia develops, it frequently runs its regular course. But besides these two varieties of pneumonia, quite a large number of cases of an irregular type are seen with influenza. These are often of short duration, but accompanied by extremely high temperature (Fig. 182). In many cases there is an excessive amount of pleurisy, so that the process is really a pleuro-pneumonia. In an epidemic occurring in the New York Infant Asylum in the winter of 1891 and 1892 nearly every pneumonia was of this type, and in a few weeks there were about twenty cases, all of a very severe form. This is often followed by empyema.

5. *Cases with gastro-enteric complications.*—Vomiting and diarrhœa are frequent at the beginning of influenza, and in some cases, especially in infants, they may be the predominant symptoms of the attack. The stools may be large and fluid, or they may contain mucus and even blood, and be passed with pain and tenesmus,—the symptoms being those of an acute gastritis or of ileo-colitis of moderate severity. The duration of these attacks is usually three or four days, and except in very young or delicate children they are rarely fatal. In older children there may be initial vomiting, abdominal pain, tympanites, protracted diarrhœa, and other symptoms strongly suggestive of typhoid fever.

6. *Influenza in very young infants.*—The severe cases in infants under six months old often present peculiar features. Even though the temperature is frequently but little above the normal, the prostration is extreme. The eyes are sunken, the face is pale, there is marked apathy, and food is often refused altogether. In other cases there are cyanosis and very rapid respiration, indicating acute congestion of the lungs, although no abnormal signs are present, except very feeble breathing sounds. Nearly always there is a disturbance of digestion, with vomiting and undigested stools. Death may occur in two or three days; sometimes it is postponed

for a week, the chief symptoms being gradually increasing prostration, and finally collapse, without the development of any marked local evidences of disease. The system seems in these cases to be overpowered by the intensity of the poison. In other cases pneumonia develops, and from this death occurs.

Complications and Sequelæ.—The most frequent ones—pneumonia, otitis, acute adenitis, and gastro-enteritis—have already been considered. Cutaneous eruptions are not infrequent, and are often very puzzling. There may be a general eruption resembling urticaria, or an erythema which sometimes simulates measles, but more frequently scarlet fever. These eruptions are irregular in their course and often in their distribution, and are not followed by desquamation. In most of the cases with high temperature the urine contains albumin; although nephritis is rare, one should be on the watch for it even in young children. I have once seen acute pyelitis as a complication. The nervous sequelæ of adults—mental disturbances, multiple neuritis, etc.—are extremely rare in childhood, although they have been observed. One of the most frequent sequelæ is marked anæmia; this is well-nigh constant after a severe form of the disease. Following the disease of the mucous membranes, there may be enlarged tonsils, adenoid growths of the pharynx, or chronic enlargement of the cervical lymph glands. Attacks of influenza bear the same relation to the development of tuberculosis as do those of measles.

Convalescence after influenza is usually very slow, and it is often many months before the full effects of a severe attack have disappeared. A recurrence of the symptoms before complete recovery is not uncommon, and often second attacks during the same season are seen. For a long time the mucous membranes are in an extremely sensitive condition. Relapses are often brought about by slight exposure before the symptoms have quite disappeared, and I have often seen them occur simply from airing an infant in the room.

Diagnosis.—This is usually easy when the disease is epidemic. The sporadic cases often present great difficulties, particularly in the early part of the disease. It is often impossible to tell for two or three days whether the case is one of pneumonia, malaria, or influenza. In most of the severe cases I have seen, pneumonia has been the diagnosis first made; it is only by the course of the disease and the absence of any physical signs that influenza can be distinguished from pneumonia. From malaria, influenza is differentiated by the course of the temperature, the absence of enlargement of the spleen and of the plasmodium in the blood. The cerebral symptoms may lead to the diagnosis of meningitis; the catarrhal symptoms, to a suspicion of measles; and the vomiting, high temperature, and erythema to a diagnosis of scarlet fever. In all these cases it is only the course of the disease which clears up the diagnosis. Influenza is characterized most of all by severe constitutional

symptoms, without the development of any signs of local disease, while it lacks the characteristic symptoms of the other fevers mentioned.

From ordinary catarrh, influenza differs only in its high communicability, its severity, and the frequency with which it is complicated by otitis, adenitis, and pneumonia. Mild cases when not epidemic can not be diagnosed from simple catarrh of the respiratory tract.

Prognosis.—As a rule, the type of influenza seen in children is milder than that which occurs in adults. In the case of children previously healthy, few die except from pulmonary complications, while the great majority of attacks are mild and recover promptly. In infants the tendency to pulmonary complications is much greater than in older children. Uncomplicated cases are seldom fatal, except in infants under six months old; and even though the temperature is very high and the symptoms severe, recovery may usually be predicted so long as there is no evidence of serious complications. The prognosis of the pneumonia of influenza is rather worse than that of simple broncho-pneumonia, and depends chiefly upon the age of the patients affected. In a word, influenza is particularly serious in the very young, or when there are pulmonary complications, but rarely otherwise. In infants the constitutional depression which results may be the beginning of a condition of malnutrition which goes on to the development of marasmus; or a child falls an easy victim to some other form of acute disease. The remote effects of influenza may therefore be serious, even though the attack itself is not especially severe.

Treatment.—The communicability of the disease makes it desirable that cases of influenza should be isolated whenever this is practicable, and particularly that delicate children, or those prone to pulmonary disease, should not be exposed to it.

The disease appears to be self-limited, running its course, when uncomplicated, in from three to seven days. As there is no specific for it, the indications are to sustain the patient, to make him comfortable during the attack, and to prevent so far as possible the occurrence of complications. Every child with influenza should be put to bed and kept there so long as any elevation of the temperature continues. At the outset the bowels should be opened by castor oil or calomel, and means used to induce free perspiration, such as the use of hot drinks, the hot pack, or small doses of Dover's powder in combination with phenacetine. A very high temperature should be relieved by cold sponging or the cold pack, precisely as in pneumonia, but large doses of antipyretic drugs are to be avoided. The nervous symptoms—restlessness, pain, headache, and other disturbances—are best controlled by phenacetine in combination with codeine—e. g., to a child of one year, phenacetine gr. j, codeine gr. $\frac{1}{4}$, every three or four hours. Double the dose may be given to a child of four years. Alcoholic stimulants are required whenever the pulse shows signs

of weakness, as it does in most of the severe cases, and in most young infants. They should be given according to the same rules as in pneumonia. Next to alcohol, strychnine is the most valuable heart stimulant.

In older children there is a decided advantage in the use of moderately large doses of quinine—e. g., gr. ij, four or five times a day, to a child five years old; but in infants this had best be omitted, on account of its tendency to upset the stomach. The cough which so often persists after influenza is best controlled by cod-liver oil and creosote, used as after acute bronchitis. With persistent bronchitis which resists ordinary remedies, a patient should be sent to a warm, dry climate. The complications of influenza are to be treated as they arise, in the same manner as when they occur under other conditions. In all cases careful feeding in accordance with the general rules laid down for feeding in acute diseases, good nursing, and care to avoid exposure during convalescence, are essentials in treatment. One should be particularly anxious about patients who have a strong tendency to tuberculosis, and such cases should be watched with the greatest solicitude.

In prolonged or constantly recurring attacks nothing is of much avail except a change of air. If this is impossible, a child should be frequently removed from one apartment to another, as re-infection often appears to take place from the sick-room.

CHAPTER XIII.

MALARIA.

MALARIA is a general infectious disease due to the presence in the blood of a specific organism known as the *plasmidium*, or *hematozoön malarie*. It manifests itself in children by the ordinary acute febrile attacks which are seen in adults and by chronic malarial poisoning. Both of these forms may present certain peculiar symptoms dependent upon the age of the patient.

Etiology.—The hematozoön malarie was discovered by Lavanan in 1881. It is a parasite of the blood and belongs to the group of the protozoa.* The anæmia of malaria results from the extensive destruction of the red corpuscles caused by the growth of the parasite. How it enters the blood is as yet undetermined.

Malaria affects all ages, even the newly-born infant. We must accept

* For a description of the plasmidium, methods of staining, etc., see James, New York Medical Record, 1888; Councilman, The Medical News, January 15, 1887; or Thayer and Hewetson, Johns Hopkins Hospital Reports, vol. v, 1895.

with some allowance the statements made by the older writers upon the subject of intra-uterine infection, but in the following case occurring in the practice of my associate, Dr. Crandall, there seems little doubt that the disease was contracted *in utero*: For ten days before delivery the mother had suffered from a tertian intermittent of moderate severity. Eighteen hours after birth the child was noticed to have cold hands and feet, blue lips and nails, and a pinched face. These symptoms lasted about half an hour and were followed by a distinct fever. Upon the following day the paroxysm was repeated. Examination of the blood of both mother and child was made by Dr. Walter James, who found the malarial organisms in both cases.

Malaria is more frequently overlooked in young children than in later life, from the fact that its forms are more irregular, and this has led to the belief that young children are less liable than adults to the disease. I believe, however, the opposite to be the case. In a large number of instances where families have been exposed to malarial poisoning I have noted that the young children were frequently the first to show the symptoms of the disease.

Malaria is an endemic disease prevailing in certain localities. In New York it rarely develops except in patients who live along the river fronts or in the districts contiguous to Central Park. In many of the suburbs malaria is exceedingly prevalent, and in them originate most of the cases coming under observation in New York. Malarial attacks may be seen at any season, but are more frequent in the fall and spring. They are particularly liable to occur when the general health of the patient is reduced by some other influence, especially by derangement of the digestive organs, and they often follow in the wake of other acute infectious diseases. The poison of malaria may remain latent in the system for an indefinite time, producing symptoms when the conditions favourable for its development are present.

Lesions.—Opportunities for a study of the peculiarities of the lesions of malaria in children are infrequent, especially in New York, as fatal cases are extremely rare. I have myself seen but two. As observed by others, the lesions do not differ in any marked way from the adult form of the disease. The most important changes are the destruction of the red corpuscles of the blood, enlargement, and in chronic cases hyperplasia with pigmentation of the spleen; less frequently pigmentation of the liver, kidneys, and brain. Pneumonia and gastro-enteritis are occasional complications.

Symptoms.—The clinical forms of malarial fever in children from six to ten years old, do not differ essentially from the same disease in adults. Both intermittent and remittent forms occur, the former being the type usually seen. Of the different varieties of intermittent fever, the quotidian (Fig. 183) is the most common, although the tertian (Fig. 184) is fairly frequent, but the quartan is extremely rare. The stages of the paroxysm

are generally well marked. The cold stage begins with a chill or vomiting, with headache, lassitude, and general pains. The hot stage is usually characterized by a higher temperature than in adults, and this is followed by the sweating stage, which is generally marked. The paroxysm may be

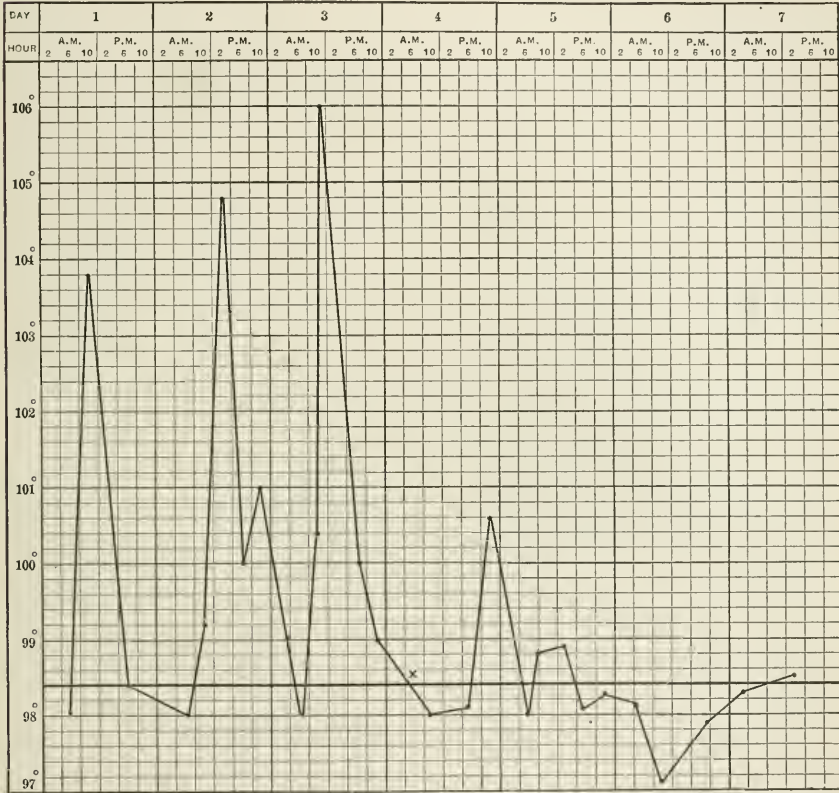


FIG. 183.—Typical malarial temperature, quotidian type, in a boy six years old. Each paroxysm preceded by a chill. It will be noticed that the temperature rose higher with each succeeding paroxysm; x marks the time when quinine was begun.

repeated every day or every other day until controlled by quinine, or the stages may become less and less distinct as the disease progresses until a more or less remittent type of fever develops. Less frequently the fever is remittent from the beginning and the constitutional symptoms are of greater severity. In this form there is marked prostration, the tongue is thickly coated, there are often tenderness and pain in the region of the liver, and occasionally there is slight jaundice.

In infants and very young children the peculiar types of malaria are seen. A well-marked intermittent fever with distinct stages is quite exceptional, most of the cases assuming more of a remittent type or an irregu-

lar form of intermittent (Fig. 185). The onset is usually abrupt with vomiting, a well-marked chill being rare. I have seldom seen a malarial chill in a child under five years old. This is replaced in infants by cold hands and feet, blue lips and nails, sometimes slight general cyanosis, pallor, drowsiness, and prostration. Vomiting was present in two thirds of my own cases.* Four times have I seen a malarial attack ushered in by convulsions.

The fever is relatively higher than in adults, rising rapidly to 104° or 105° F., occasionally to 106° or 106.5° F. This continues from four to twelve hours and gradually falls, usually to normal. The other constitu-

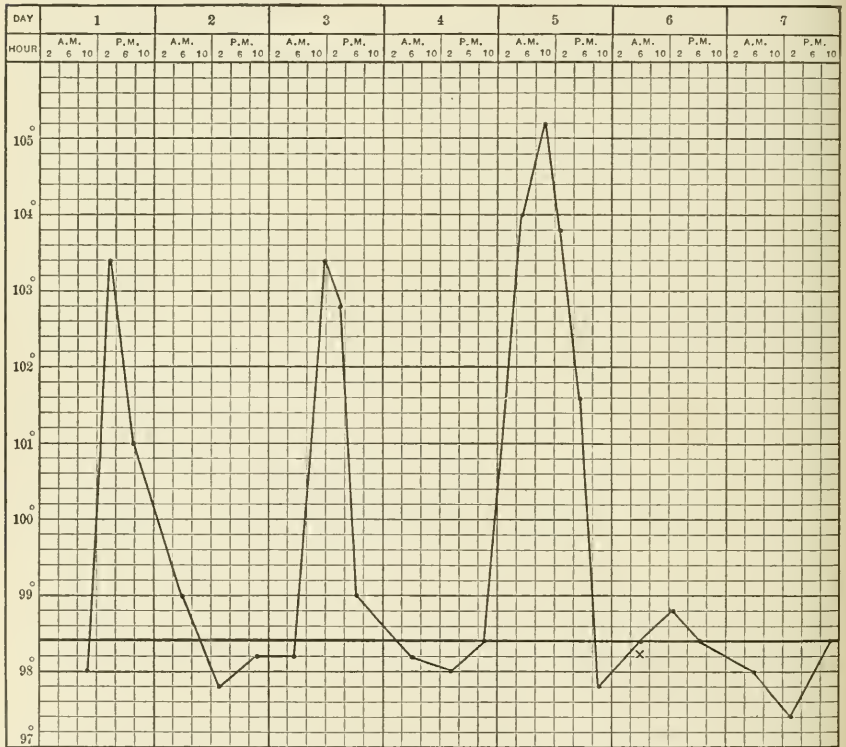


Fig. 184.—Typical malarial temperature, tertian type, in a boy five years old. Onset with vomiting and drowsiness, but no chill. This was an anticipating intermittent, the first paroxysm occurring at 3 P. M., the second at 12 M., the third at 10 A. M.; x marks the time when quinine was begun.

tional symptoms of the febrile stage are much less severe than in most diseases with the same elevation of temperature. The sweating stage is only

* The Symptoms and Diagnosis of Malaria in Children. The American Journal of Obstetrics and Diseases of Women and Children, Nos. I to IV, 1883.

slightly marked and is often absent altogether. With the fall in the temperature there is a gradual subsidence of all the other symptoms of the febrile stage.

After the first paroxysm the patient may be quite well for several hours or even for a day, when the second paroxysm occurs. This is generally not so well marked as the first one, the third may be even less so, and the case may resemble more and more one of continuous fever with wide oscillations in the temperature. In some cases it is remittent at first and later becomes intermittent, but it is very rare under either circumstances that the temperature does not touch the normal point at some time in the twenty-four hours. In infants the quotidian has been in my experience very much more frequent than any other type, the tertian being rare and the quartan almost unknown.

Enlargement of the spleen is present in the great majority of cases, and usually to a sufficient degree to be readily appreciated by examination. The most satisfactory method of examination is by palpation (page 832). A spleen which can be easily felt below the ribs (except in the rare cases in which the organ is displaced downward by some condition in the thorax) is enlarged. When it is not sufficiently enlarged to be readily felt by a practised observer under favourable conditions for examination, it is not large enough to be of any diagnostic importance. None of the other symptoms occurring in malarial fever are characteristic; they are quite similar to those which are seen in almost all febrile attacks. There are anorexia, coated tongue, constipation, and restlessness.

Masked or Irregular Forms of Malaria.—These are quite frequent in young children, and are due to the presence of certain special or uncommon symptoms which may readily lead to a mistake in diagnosis. They are more often seen than cases of true malarial cachexia.

Among the most frequent of the irregular forms are those relating to the nervous system. Headache is exceedingly common and is usually frontal. When severe and associated with continuous drowsiness, vomiting, and constipation, it may lead to a strong suspicion of tuberculous meningitis. Vertigo is not a frequent symptom, but it is sometimes very prominent. Pains in various parts of the body are very common. A sharp severe pain at the epigastrium is frequent at the beginning of a paroxysm. It is often associated with tenderness, but has no relation to vomiting. Less frequently, pain is localized in the region of the spleen or liver. Tri-facial neuralgia of malarial origin is rare in childhood. Aching or dragging pains in the muscles of the lower extremities are frequent symptoms during acute attacks, but they are of short duration, disappearing with the fever. They are to be distinguished from the acute lancinating pains of multiple neuritis, which is occasionally seen as a result of malarial poisoning. I have seen the latter in young children in three cases, and it has been observed by others. The pain is accompanied by tenderness of

the muscles and nerve trunks, and by loss of power, which is usually partial.

Spasmodic torticollis (page 683) I have seen in eight cases, in which the condition seemed very clearly to depend upon malaria. This was

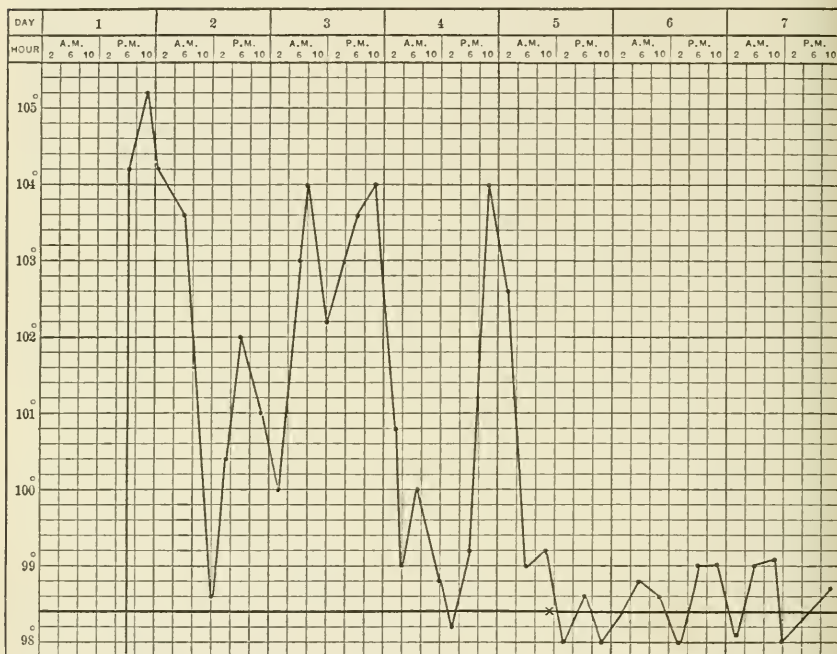


Fig. 185.—An irregular malarial temperature in a child nine months old. The paroxysm on the fourth day was accompanied by an attack of acute pulmonary congestion which came near being fatal; x marks the time when quinine was begun. Although the course of the temperature is irregular, it touched the normal line both on the second and fourth days.

shown by the fact that the spasm was intermittent, coming on every afternoon, but being absent in the morning; that it was accompanied by a slight rise in temperature, and usually by enlargement of the spleen; and that it was immediately controlled by quinine. This combination of symptoms seemed to be conclusive evidence of the malarial origin of the affection, although these cases were observed before the time when blood examinations were made.

Accompanying the paroxysm of malaria there is occasionally seen, more often in infants than in older children, acute pulmonary congestion (Fig. 185), which may give rise to obscure and often very alarming symptoms. There is an acute onset with vomiting and prostration, high temperature, cough, rapid respiration, and often slight cyanosis. On examination of the chest there is found feeble or rude respiration over one lung, or over both lungs behind, and sometimes coarse moist râles; these signs and symptoms may disappear in the course of a few hours with the

fall in temperature, to return with the next paroxysm, or if quinine is given they may disappear entirely.* This group of symptoms has often led to the mistaken opinion that the disease was pneumonia, which had been aborted by the administration of quinine.

Subacute or Chronic Forms of Malaria.—The most constant symptoms are anæmia, enlargement of the spleen, and slight fever. The anæmia is usually marked, often being extreme. The enlargement of the spleen is distinct, and easily made out by palpation, and sometimes is very great. The fever is often so slight as to be discovered only when the temperature is taken five or six times in the twenty-four hours. The other symptoms are of a very indefinite character; there may be slight œdema of the lower extremities, general muscular weakness, so that the child is easily fatigued, loss of appetite, coated tongue, constipation, headache, muscular pains, and often cough from a slight bronchitis. These symptoms may depend upon many conditions other than malaria, even when they are seen in a malarial district. The only positive evidence of malaria in such cases is the presence of the malarial organisms in the blood. Even the swollen spleen, anæmia, and slight fever, which are often looked upon as diagnostic, may be present in cases of anæmia with which malaria has nothing whatever to do.

Diagnosis.—The positive diagnosis of malaria rests upon the demonstration of the malarial organisms in the blood. They will be found in nearly all the cases when examined under favourable conditions, which are: (1) that the examination be made by one with considerable experience in searching for malarial organisms; (2) that the examination be thorough;

* The following case is a good example of this condition in its more severe form, and illustrates the difficulties in the diagnosis of malaria in infancy: A fairly nourished child, nine months old, who had been under observation in an institution for two weeks, was suddenly taken with vomiting and fever (Fig. 185). A cathartic was followed by a large undigested stool, and as the temperature then fell to normal, the attack was regarded as one of indigestion. On the third day the temperature was again high and accompanied by cough; coarse râles were found throughout the chest, and fine râles at the right base: it was then thought that pneumonia was developing. On the fourth day all the symptoms were so much improved that the infant was regarded as convalescent. At 6 P. M. the temperature was normal, and the infant went to sleep quietly. At 9.30 P. M. he awoke with a temperature of 104°, extreme restlessness, and marked dyspnoea. In half an hour his symptoms had increased to a point where he seemed likely to die. He became cyanotic, the respirations were of a panting character and rose nearly to 100 a minute, and he coughed with almost every breath; the pulse was scarcely perceptible. The severe symptoms continued for about an hour, then passed away gradually, and at the end of two and a half hours they had completely disappeared, and the child was in a quiet sleep which continued until morning. Malaria was now suspected, and the diagnosis established by the discovery of the plasmodium in the blood. The spleen was at this time much enlarged; the signs in the chest were those only of bronchitis of the large tubes. Quinine was now begun in full doses, and immediately controlled the temperature and the pulmonary symptoms.

(3) that it be made during the paroxysm; and (4) that no quinine shall have been previously given. Blood from the spleen is more certain to show the organisms than that from the finger; and if possible the examination should be of fresh blood as well as of dried specimens. While a positive result is conclusive, a negative one is not always so because of the impossibility of fulfilling all the above conditions. The technique of blood examinations is somewhat difficult, and for the great majority of the profession a diagnosis must for the present rest upon the other symptoms. These, in order of their importance, I place as follows: enlargement of the spleen; prompt curability (especially in cases of fever) by quinine; distinct periodicity in the symptoms; and a history of an exposure in a district known to be malarial. Particular importance is to be attached to the therapeutic test. Recent experience emphasizes more and more strongly the fact that quinine has very little influence upon fevers which are not malarial, and, conversely, that a fever immediately and permanently controlled by quinine is pretty certain to be malarial. The combination of all the above symptoms, even in the absence of an examination of the blood, may be regarded as sufficient to establish the diagnosis of malaria.

The cachexia and course of the temperature in septicæmia, pyæmia, broncho-pneumonia, tuberculosis, and empyema, may easily cause them to be mistaken for malaria. The fever and recurring chills of pyelitis are often attributed to malaria; as are also the heaviness, lethargy, headache, coated tongue, and slight fever of chronic intestinal indigestion. Many conditions accompanied by an enlarged spleen may be confounded with malaria, especially simple anæmia, leucæmia, rickets, and syphilis. While malaria may be multiform in its manifestations, the physician can fall into no more serious error than to regard all ailments with indefinite symptoms as malarial, neglecting careful physical examinations, by which means alone accurate diagnosis is reached.

Prognosis.—Although it is seldom fatal in itself, an attack of malaria in an infant may so undermine the constitution that the child may succumb to some other acute disease, usually of the lungs or intestines. Cases are often difficult to cure while the patient remains in the malarial districts, and while a constant absorption of the poison continues. Under other circumstances the prognosis of malaria is good.

Treatment.—The general treatment is symptomatic, and is to be conducted as in all acute febrile diseases. In the cold stage, stimulants or a hot bath may be required; in the hot stage, ice to the head and frequent sponging. The bowels in all cases should be freely opened, preferably by calomel.

Methods of administration of quinine.—For infants my own preference is to give the bisulphate in an aqueous solution, one grain to the teaspoonful, according to the age of the patient. Most infants take such a solution with less difficulty and vomit it less frequently than the

combinations with the various vehicles supposed to cover its taste. In the event of failure by this method, the same solution may be given *per rectum* through a catheter. It should then be more largely diluted with some bland fluid such as gruel, and in double the dose. This is necessary, not only because absorption is less certain and complete, but also because a rectal dose can seldom be repeated oftener than every five or six hours. There is sometimes an advantage in giving part of the quinine by the mouth and part of it by the rectum; should both fail it should be given hypodermically. For this purpose the bimuriate of quinine and urea, the hydrobromate, or the bisulphate may be used. The salt first mentioned is to be preferred on account of its greater solubility. The bisulphate is the most irritating of these preparations and there usually follows some induration at the site of its injection, which may last a long time. This method of administration will not often be required, but in certain cases it is invaluable. Injections should be made deeply in the buttock or thigh; if the needle is clean no abscess will result.

For children from two to seven years old the taste of quinine must be concealed. An aqueous solution may be mixed with the syrup of sarsaparilla, orange, or yerba santa; or the powdered salt may be given in suspension in the same vehicle, the mixture being made in both instances just before the dose is taken; otherwise the partial solution of the drug will render the whole dose exceedingly bitter. When the dose required is not large, as in the milder cases, the lozenges of the tannate of quinine combined with chocolate answer the purpose admirably, for these are so nearly tasteless that children will take them without difficulty. Each lozenge usually contains one grain of the tannate, which is equivalent to about one third of a grain of the sulphate of quinine. A similar lozenge containing one grain of the sulphate may be made, which is often taken by children without the slightest objection. The bisulphate may be given in solution by the rectum, or, better, at this age, in the form of suppositories; but, as in infancy, with urgent symptoms, it is better to resort at once to the hypodermic method in case of failure by the stomach.

For children over seven years old, the same methods of administration may usually be employed as in adults. It is always preferable to give quinine in solution, or if not so, in capsule, but never in pill form.

In a case with well-marked paroxysms the quinine should be given in the interval, with the largest dose about four hours before the expected paroxysm. In infancy this plan is sometimes impracticable, as frequent small doses are usually better borne by the stomach than a few large ones. If other methods of administration are employed, however, this should always be done. I have never succeeded in getting the physiological effects of quinine by inunction, though there are good observers who claim this result. It is certainly a very uncertain way of introducing quinine into the system.

Dosage.—Relatively much larger doses of quinine are required for young children than for adults. Except for its tendency to disturb the stomach, quinine is borne remarkably well by little patients. Generally too small doses are given. An infant of a year with a sharp attack of malarial fever will usually require from eight to twelve grains of the sulphate (ten to fourteen grains of the bisulphate) daily. Occasionally I have found it necessary to give double the quantity referred to, and I have seen no unpleasant cerebral symptoms. It is useless to expect to control an acute attack of malaria by such doses as one grain three or four times a day. Children from five to ten years old require almost as large doses as do adults. None of the substitutes for quinine are to be relied upon in acute cases.

In chronic cases, arsenic and iron are usually required in combination with smaller doses of the quinine than those mentioned. For children over seven years old, Warburg's tincture may be employed. In most chronic cases a cure can be effected only by a change of climate.

The marked and irregular manifestations of malaria are to be treated in the same manner as cases of malarial fever.

SECTION X.

OTHER GENERAL DISEASES.

CHAPTER I.

RHEUMATISM.

THE rheumatic diathesis manifests itself in children by quite a different group of symptoms from those seen in adults; for this reason the disease was formerly supposed to be a rare one in early life. It is only within recent years that its frequency and its peculiarities have come to be appreciated. For our present understanding of the subject we are indebted largely to the work of English physicians, especially Cheadle,* who has brought out more fully than any one else the close connection existing between many conditions formerly not regarded as rheumatic. One who has in mind only the adult types of articular rheumatism, and regards arthritis as a necessary symptom for a diagnosis, will overlook in early life many manifestations which are clearly the result of the rheumatic poison. There is seen at this period a group of clinical phenomena, which often occur in combination or in succession, whose association was not understood until they were all discovered to be related to rheumatism. Sometimes one member of the group and sometimes another is first seen, but when one has appeared others are likely soon to follow.

Rheumatism in childhood, then, is manifested not alone by arthritis with acute or subacute symptoms, but by a large number of other conditions which are not to be regarded in the light of complications, but rather as forms of the disease.

Etiology.—It is not in the province of this work to discuss the various theories regarding the nature of rheumatism and its exciting cause. The drift of medical opinion to-day is strongly toward the view that acute rheumatism is an infectious disease, probably of microbic origin, although the character of the micro-organism is as yet unknown. The excessive formation of acids in the system may be regarded as a result of the infection, or possibly as a condition necessary for the activity of the specific poison. Under five years of age articular rheumatism is rare, and in infancy it is extremely rare. I have, however, once seen in a nursing infant, }

* See the Harveian Lectures, 1889.

a little more than a year old, a typical attack of rheumatic fever with multiple joint lesions, and undoubted cases have been reported at as early an age as six months. Still, all these are very exceptional, and one should be wary of diagnosing rheumatism during the first two years of life.

After the fifth year both the articular and the other manifestations of rheumatism become more common, and occur with increasing frequency up to the time of puberty.

Heredity is a very important etiological factor, and in fully two thirds of the cases that have come under my care, a rheumatic family history was obtained. Of the other important causes, the most frequent are living in damp dwellings, direct exposure to cold and wet, poor hygienic surroundings, and insufficient food. While seen among all classes, rheumatism is more common among those who are badly housed.

Attacks of rheumatism are seen at all seasons, but are much more frequent in the spring months. One attack strongly predisposes to a second, and in most cases there is a history of a large number of attacks of greater or less severity. Among my own patients, girls have been affected with greater frequency than boys.

Symptoms.—*The general and articular manifestations.*—The clinical types of rheumatism in children present very notable contrasts to those seen in adults. A typical attack of acute articular rheumatism such as is seen in adult life, with a sudden onset, high temperature, severe inflammation of several joints, profuse acid perspiration, and occasional delirium, is rarely seen in a child under eight or ten years old. In most of the attacks in childhood the onset is not very acute, the temperature is but slightly elevated—only 100° or 101.5° F.—the swelling and pain are moderate, and the redness is often absent. The number of joints involved is generally small, those most frequently affected being the ankles, the knees, the small joints of the foot, the wrists, or the elbows. These symptoms are often not severe enough to keep the patient in bed, and only the pain in the joints of the lower extremities prevents him from walking. The duration of these attacks is from one to three weeks, and in the course of a month most of them recover even without treatment.

Not infrequently the symptoms are limited to a single joint, usually the hip, knee, or ankle. Possibly the joints of the upper extremity are affected oftener than would appear, but disease here is much more likely to be overlooked than when lameness is present. The swelling is moderate and may not be evident except on a close examination; in some cases there is none. There is stiffness of the joint, as shown by lameness, and there may be so much pain and soreness that the child refuses to walk altogether. Muscular spasm about the affected joint is often marked, and may be the most striking objective symptom. The tenderness is sometimes localized, but it may affect the ligaments, tendons, and even the muscles. These symptoms may persist for two or three weeks and lead to the

suspicion of incipient tuberculous disease of the joint. Rheumatism is distinguished by its more acute onset and usually by the presence of slight fever; some elevation of temperature being the rule, though it is not often much over 100° F. A family history of rheumatism, or a history of previous similar attacks in the patient affecting the same or other joints, or other manifestations of rheumatism, are also of assistance in the diagnosis. Occasionally all doubt is removed by the disease extending to other joints, or by the development of endocarditis. In some cases the symptoms are less in the articulation than in the muscles, and they are dismissed as simply "growing pains," having nothing characteristic about them except their occurrence in damp weather.

Cardiac manifestations.—These may occur where the articular symptoms are very mild, and in some cases where they are entirely absent. The most frequent is endocarditis. This is much more often seen in the acute rheumatism of children than of adults, and probably occurs in the majority of all severe cases; if it does not come in the first attack, it is likely to be seen in the later ones. It frequently occurs with a mild rheumatic arthritis, often being unnoticed until valvular disease of considerable severity has developed. Sometimes there is only high fever with severe constitutional symptoms of an indefinite character, but no arthritis, and no suspicion that the attack is rheumatic until endocarditis is discovered. Such cases are not infrequent. If the patients are kept under observation, articular symptoms are almost certain to develop later, and often there are other manifestations of rheumatism, especially chorea.

Pericarditis is less frequent than endocarditis, and usually occurs in children over seven years old. It is often associated with endocarditis. The most characteristic form of inflammation in early life is a subacute, dry, fibrous form, often resulting in great thickening with extensive adhesions, and frequently in obliteration of the pericardial sac. When once started it shows a strong tendency to recurrence and persistence.

The heart is so frequently affected in the rheumatism of childhood that it should be closely watched whenever articular symptoms are present, no matter how mild they may be; and not only in these cases, but in all the conditions hereafter enumerated with which rheumatism is likely to be associated.

Inflammations of other serous membranes—the pleura, peritonæum, and pia mater—were much more frequently ascribed to rheumatism in the past than now. There is little doubt that on rare occasions any one of these may be due to rheumatism. The pleura is most often involved, but even this is rare in young children.

Torticollis when it occurs acutely is frequently rheumatic. This form is characterized by its sudden development, continuous spasm, the great amount of muscular soreness, the moderate pain, and the fact that it usually disappears spontaneously after a few days. It is often seen in con-

nection with a rheumatic sore throat. Other manifestations of muscular rheumatism are less characteristic and usually affect the muscles of the extremities.

Anæmia is almost invariably seen in rheumatic patients, both during and between the attacks. The effect of the rheumatic poison upon the blood resembles that of malaria. The presence of anæmia is so evident and its degree often so marked, that one may have great difficulty in distinguishing cardiac murmurs which are hæmic from those due to endocarditis.

Chorea.—In the article upon Chorea (page 674) I have already discussed the association of that disease with rheumatism and expressed my own belief in a very close relationship existing between them. Not very infrequently chorea is the first manifestation of the rheumatic diathesis, to be followed soon by articular symptoms or by endocarditis without such symptoms. In other cases chorea and acute endocarditis occur together without articular symptoms, or all three may be associated. Whichever of the three conditions is first seen, the physician should always be on the lookout for the others. The frequency of rheumatism in choreic patients has been variously estimated by different observers; in my own cases over fifty-six per cent gave unmistakable evidences of the rheumatic diathesis.

Tonsillitis.—Children who are the subjects of frequent attacks of acute tonsillitis and pharyngitis should be regarded as possibly rheumatic, and should be closely watched for other signs of that disease. A careful examination of the family history usually reveals other evidences of rheumatism. Acute tonsillitis often ushers in an attack of rheumatic endocarditis or arthritis, and in one of my own cases a cardiac murmur was discovered after an ordinary attack of tonsillitis in a patient whose heart previously was normal and who had exhibited no articular symptoms. Of the different forms of tonsillitis, quinsy is most closely associated with rheumatism.

Subcutaneous tendinous nodules.—General attention was first drawn to these as a manifestation of rheumatism by Barlow and Warner, in 1881, who described them as “oval, semi-transparent, fibrous bodies like boiled sago grains.” They are most frequently found at the back of the elbow, over the malleoli, at the margin of the patella; occasionally on the extensor tendons of the hands, fingers, or toes, or over the spinous processes of the vertebræ or the scapulæ. They are composed of fibrous tissue, and vary in size from a large pin’s head to a small bean, sometimes being as large as an almond. The nodules may come in crops, lasting for a few weeks and then disappearing, or they may last for months. An eruption of nodules is usually coincident with other rheumatic manifestations. These nodules are better felt than seen, although, as Cheadle observes, they are visible if the skin is tightly drawn. They are certainly not common in this country; notwithstanding that I have made it a rule to exam-

ine rheumatic patients for them, I have seen them but seldom, and they have been marked in only two or three cases. This, I think, has also been the experience of most observers in New York. From published reports, however, they appear to be much more frequent in England. There can be no doubt regarding the connection of these nodules with rheumatism.

Erythema.—The connection between rheumatism and the various forms of erythema—marginatum, papulatum, and nodosum—has been very clearly shown by Cheadle. None of these are frequent conditions in childhood, but when seen they should always suggest rheumatism.

Purpura.—The association of purpura with rheumatism is so often seen that there can be little doubt of the close connection between the two conditions. Rheumatic purpura, however, is quite distinct from the other forms of purpura, and is a much less frequent disease.

Diagnosis.—In order to recognise rheumatism in a child, one must free his mind from preconceived notions of the disease drawn from its manifestations in adults, as very few cases correspond to the adult type of acute rheumatism. In early life the disease is recognised not by any one or two special symptoms, but by the association or combination of a number of conditions which may appear unrelated. In determining whether or not any given set of symptoms is due to rheumatism, one should consider: (1) The family history, since in early life heredity is so important an etiological factor; (2) the previous history of the patient, not only as regards articular pains and swelling, the slight joint-stiffness without swelling, the indefinite wandering pains of damp weather, and the so-called growing pains, but also the previous existence of chorea, frequent attacks of tonsillitis, torticollis, or erythema; (3) the examination of the patient, which should include a careful search for tendinous nodules, as well as a thorough examination of the heart for signs of endocarditis or pericarditis, and, in cases which are at all acute, the temperature. In doubtful cases with non-articular symptoms much importance is to be attached to the presence of slight fever, the abrupt onset, and tenderness of the neighbouring muscles and tendons,—all occurring without a history of traumatism. Rheumatism is more often overlooked than confounded with other diseases; although in childhood multiple neuritis and tuberculous and syphilitic bone disease are often mistaken for it, and in infancy the same is true of scurvy. The extreme infrequency of rheumatism during the first two years of life should always make one skeptical regarding it. In an infant, when the symptoms are confined to the legs and are not accompanied by fever, they are almost certain to be due to scurvy even though the gums are normal and ecchymoses have not yet appeared (page 213).

Prognosis.—Rheumatism in a child is in itself seldom if ever dangerous to life. In the great majority of cases the articular symptoms soon

disappear, even without special treatment. The danger from the disease consists in its cardiac complications. One attack of rheumatism is almost certain to be followed by others, and when once the heart has been affected its lesions are likely to increase with each recurrence of the disease.

Treatment.—Rheumatism in children derives its chief importance from its relation to cardiac disease. Cardiac complications are so frequent and so serious that everything possible should be done to avert rheumatism from those who by inheritance are especially predisposed to it, to prevent its recurrence in a child who has once had the disease, and during an attack to prevent the heart from being involved. The relation of diet to rheumatism is very imperfectly understood; but it is certainly a fact that rheumatic children do much better upon a diet composed largely of nitrogenous food, where starches are restricted in amount, than the reverse. Milk should be freely given in all cases. The underclothing should be of flannel during the entire year, in summer the lightest weight being worn. The feet should be carefully protected, and exposure in damp weather avoided. In-door occupations should be chosen for rheumatic boys.

The tendency to recurrence is so strong in this disease that a child of rheumatic antecedents, who has shown in the various ways mentioned a marked predisposition to rheumatism, and who has had an attack, even though a mild one, should, if possible, spend the winter and spring in some warm, dry climate, or even remain there permanently. Otherwise in most such children, it is only a question of time when, with the repeated attacks, the heart will become involved.

To avert the danger of cardiac complications during an attack of rheumatism, or to limit their extent, there are two things which should invariably be insisted on: first, to confine to the house and in a warm room every child with rheumatic pains, no matter how mild; secondly, if fever is also present, to keep the child in bed while it continues, even though it may never be above 100° F. Absolute rest and the equable temperature thus secured are unquestionably of more importance than anything else in protecting the heart during a rheumatic attack. With these precautions must be combined an early diagnosis. In very many, perhaps in most cases, the harm is done before the true nature of the disease is suspected, the symptoms being dismissed as of slight importance because the articular manifestations are not very severe. Children who have once had rheumatism should be closely watched during chorea and other diseases related to rheumatism, the heart should be frequently examined, and the physician should be on the alert for the first articular symptoms.

Aside from the measures just mentioned, the treatment of rheumatism in childhood is to be conducted very much like that of adult life. In the most acute attacks either salicylate of soda, oil of wintergreen, or salicin should be given; as the majority of cases are not very acute, marked improvement is by no means always obtained by these drugs. Alkalies

should be given in all cases, but particularly in those in which there is hyperacidity of the urine. Either the acetate or citrate of potassium or the bicarbonate of sodium may be used, a sufficient quantity being administered to render the urine alkaline. u

Quite as important as these drugs is the use of general tonics, particularly iron and cod-liver oil. These should be given not only between attacks to fortify patients against their recurrence, but also in subacute cases which are sometimes influenced very little or not at all either by salicylates or alkalies.

CHAPTER II.

DIABETES MELLITUS.

IN this chapter will be attempted only a description of the peculiar features which diabetes presents when affecting young patients. It is a very infrequent disease in children. Of 1,360 cases of diabetes collected by Pavy, only eight were under ten years of age. In a series of 700 cases collected by Prout, only one case was under ten years. In a series of 380 cases collected by Meyer, only one case was under ten years of age.

Etiology.—Stern, in a series of 117 collected cases of diabetes in children, states that 47 were females and 31 males, the sex in the other cases not being given. Although extremely rare, cases have been observed during the first two years, and even during the first year of life. Statistics on this point are not altogether trustworthy, since some cases of temporary glycosuria have certainly been included.

Among the etiological factors, heredity is one of the most important. Pavy reports the case of a child dying of diabetes at two years in whose family the disease had existed for three generations. Inherited gout, insanity, and nervous diseases generally, may be looked upon as factors in the production of diabetes. Several of the cases reported in children have been preceded by injuries received upon the head. In a few cases the disease has followed the consumption of large quantities of sugar for a long time. In very many cases no adequate cause can be found.

Symptoms.—The most important early symptoms are thirst, polyuria, and wasting; their development is often quite rapid. The thirst is intense, often leading children to drink four or five pints of fluid a day. The amount of urine passed varies from one to eight quarts daily. The specific gravity is from 1,026 to 1,040, and the amount of sugar is from five to ten per cent, rarely more. Albumin is not infrequently present. Incontinence of urine is an important symptom, and often one of the earliest to be noticed. The wasting is usually quite rapid, so that a child may lose as much as six or eight pounds in a month. It is generally ac-

accompanied by anæmia. The appetite may be poor; at times, however, it is voracious. Other symptoms of less importance are a dry mouth, scanty perspiration, irregular sleep, occasional epistaxis, furuncles and abscesses, decayed teeth, and genital irritation.

The course of the disease is much more rapid in children than in adults, and, as a rule, the younger the child the more rapid its progress. The majority of cases prove fatal in from two to four months from the time the symptoms are sufficiently marked to make the diagnosis possible. Very few last more than six months; occasionally, however, one of the milder type may be prolonged from one to two years.

The progress of the disease is marked by continuous wasting, which may result in a marked degree of marasmus, and prove fatal. Some are carried off by intercurrent pneumonia or tuberculosis, but the majority die comatose. When coma develops, the case may be considered hopeless, and death is likely to be postponed but a few days. The cause of diabetic coma has not yet been satisfactorily explained, but it is usually believed to be due to acetonæmia.

Diagnosis.—Diabetes is apt to be overlooked, because of the common neglect of urinary examinations in children. The prominent symptoms—thirst, polyuria, and wasting—when associated, should always attract attention. Incontinence of urine, accompanied by marked wasting, is always suspicious. In some cases genital irritation may be the most prominent early symptom. A positive diagnosis is made only by an examination of the urine.

Prognosis.—In few diseases is the prognosis so bad as in diabetes in children. So high an authority as Senator declares that diabetes in children is hopeless and all treatment is useless. From a study of seventy-seven cases, Stern reaches the same conclusion. There are, however, cases on record in which recovery is believed to have taken place, even when the amount of sugar passed was large.

Treatment.—The indications for treatment are the same in children as in adults: first, diet; secondly, stimulants; thirdly, general hygienic measures; and, finally, the use of drugs, of which at the present time the favourites are codeine, salicylate of soda, and the bromide of arsenic.

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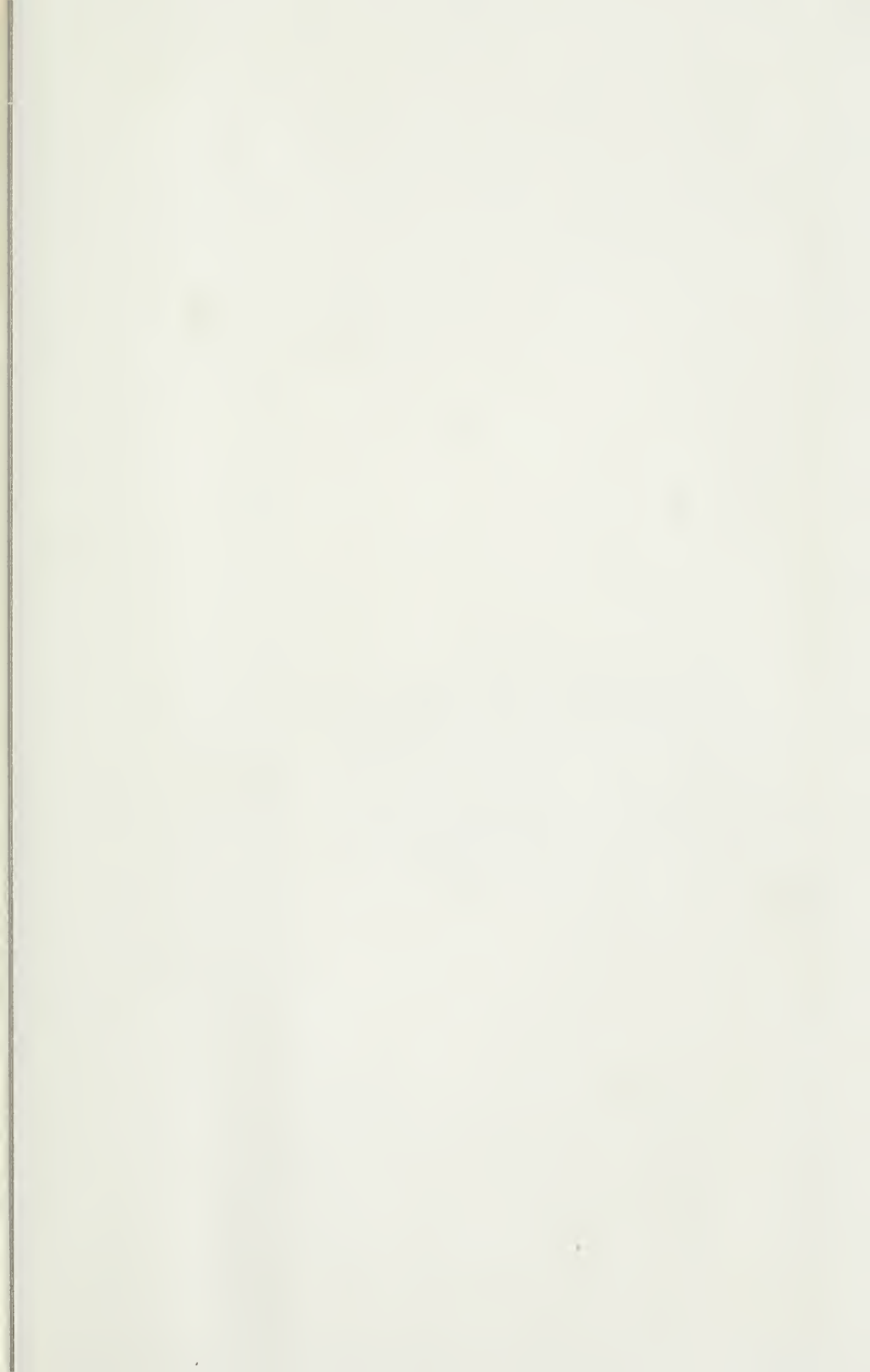
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