Diagnosis.—The onset and general symptoms may not at first be distinctive. At the beginning of an epidemic the cases are usually regarded as anomalous typhoid; but once the typical course is followed in a case the diagnosis is clear. The blood examination, which should be made in all doubtful cases of fever, affords a definite criterion by which the diagnosis can readily be made.

Treatment.—The paroxysm can neither be cut short nor its recurrence prevented. It might be thought that quinine, with its powerful action, would certainly meet the indications, but it does not seem to have the slightest influence. The disease must be treated like any other continued fever by careful nursing, a regular diet, and ordinary hygienic measures. Of special symptoms, pains in the back and in the limbs and joints demand opium. In enfeebled persons the collapse at the crisis may be serious, and stimulants with ammonia and digitalis should be given freely.

IV. SMALL-POX (*Variola*).

Definition.—An acute infectious disease characterised by an eruption which passes through the stages of papule, vesicle, pustule and crust. The mucous membranes in contact with the air may also be affected. Severe cases may be complicated with cutaneous and visceral hæmorrhages.

Etiology.—It has not yet been determined in what country small-pox originated. The disease is said to have existed in China many centuries before Christ. The *pesta magna* described by Galen (and of which Marcus Aurelius died) is believed to be small-pox. In the sixth century it prevailed, and subsequently, at the time of the Crusades, became widespread. It was brought to America by the Spaniards early in the sixteenth century. The first accurate account was given by Rhazes, an Arabian physician who lived in the ninth century, and whose admirable description is available in Greenhill's translation for the Sydenham Society. In the seventeenth century a thorough study of the disease was made by the illustrious Sydenham, who still remains one of the most trustworthy authorities on the subject.

Special events in the history of the disease are the introduction of inoculation into Europe, by Lady Mary Wortley Montagu, in 1718, and the discovery of vaccination by Jenner, in 1798.

Small-pox is one of the most virulent of contagious diseases, and persons exposed, if unprotected by vaccination, are almost invariably attacked. There are instances on record of persons insusceptible to the disease. It is said that Diemerbrock, a celebrated Utrecht professor in the seventeenth century, was not only himself exempt, but likewise many members of his family. One of the nurses in the small-pox department of the Montreal General Hospital stated that she had never been successfully vaccinated,

and she certainly had no mark. Such instances, however, of natural immunity are very rare.

Age.—Small-pox is common at all ages, but is particularly fatal to young children; thus, in the Montreal epidemic of 1885, 86 per cent of the deaths were of children under ten years of age. The *fœtus in utero* may be attacked, but only if the mother herself is the subject of the disease. The child may be born with the rash out or with the scars. More commonly the fœtus is not affected, and children born in a small-pox hospital, if vaccinated immediately, may escape the disease; usually, however, they die early.

Sex.—Males and females are equally affected.

Race.—Among aboriginal races small-pox is terribly fatal. When the disease was first introduced into America the Mexicans died by thousands, and the North American Indians have also been frequently decimated by this plague. It is stated that the negro is especially susceptible.

The Contagium develops in the system of the small-pox patient and is reproduced in the pustules. It exists in the secretions and excretions, and in the exhalations from the lungs and the skin. The dried scales constitute by far the most important element, and as a dust-like powder are distributed everywhere in the room during convalescence, becoming attached to clothing and various articles of furniture. The disease is probably contagious from a very early stage, though I think it has not yet been determined whether the contagion is active before the eruption develops. The poison is of unusual tenacity and clings to infected localities. It is conveyed by persons who have been in contact with the sick and by fomites. During epidemics it is no doubt widely spread in street-cars and public conveyances. It must not be forgotten that an unprotected person may contract a very virulent form of the disease from the mild varioloid.

The disease smoulders here and there in different localities, and when conditions are favorable becomes epidemic. Perhaps the most remarkable instance in modern times of the rapid extension of the disease occurred in Montreal in 1885. Small-pox had been prevalent in that city between 1870 and 1875, when it died out, in part owing to the exhaustion of suitable material and in part owing to the introduction of animal vaccination. The health reports show that the city was free from the disease until 1885. During these years vaccination, to which many of the French Canadians are opposed, was much neglected, so that a large unprotected population grew up in the city. On February 28th a Pullman-car conductor, who had travelled from Chicago, where the disease had been slightly prevalent, was admitted into the Hôtel-Dieu, the civic small-pox hospital being at the time closed. Isolation was not carried out, and on the 1st of April a servant in the hospital died of small-pox. Following her decease, with a negligence absolutely criminal, the authorities of the hospital dismissed all patients presenting no symptoms of contagion, who could go home. The

disease spread like fire in dry grass, and within nine months there died in the city, of small-pox, 3,164 persons.

The nature of the contagion of small-pox is still unknown. Weigert and others have described micro-organisms in the pock, but they are the ordinary pus cocci, and the part which they play in the affection is by no means certain. Still less definite are the observations on the occurrence of sporozoa in the pocks. It is not a little remarkable that in a disease which is rightly regarded as the type of all infectious maladies, the specific virus still remains unknown.

Morbid Anatomy.—A section of a papule as it is passing into the vesicular stage shows in the *rete mucosum*, close to the true skin, an area in which the cells are smooth, granular, and do not take the staining fluid. This represents a focus of coagulation-necrosis due, according to Weigert, to the presence of micrococci. Around this area there is active inflammatory reaction, and in the vesicular stage the rete mucosum presents reticuli, or spaces, which contain serum, leucocytes and fibrin filaments. The central depression or umbilication corresponds to the area of primary necrosis. In the stage of maturation the reticular spaces become filled with leucocytes and many of the cells of the rete mucosum become vesicular. The papillæ of the true skin below the pustule are swollen and infiltrated with embryonic cells to a variable degree. If the suppuration extends into this layer, scarring inevitably results; but if it is confined to the upper layer, it does not necessarily follow. In the hæmorrhagic cases, red corpuscles pass out in large numbers from the vessels and occupy the vesicular spaces. They infiltrate also the deeper layers of the epidermis in the skin adjacent to the papules. Frequently a hair-follicle passes through the centre of a papule.

In the mouth the pustules may be seen upon the tongue and the buccal mucosa, and on the palate. The eruption may be abundant also in the pharynx and the upper part of the œsophagus. In exceptionally rare cases the eruption extends down the œsophagus and even into the stomach. Swelling of the Peyer's follicles is not uncommon; the pustules have been seen in the rectum.

In the larynx the eruption may be associated with a fibrinous exudate and sometimes with œdema. Occasionally the inflammation passes deeply and involves the cartilages. In the trachea and bronchi there may be ulcerative erosions, but true pocks, such as are seen on the skin, do not occur. There are no special lesions of the lungs, but congestion and broncho-pneumonia are very common. The liver is sometimes fatty. A diffuse hepatitis, associated with intense congestion of the vessels and migration of the leucocytes, has been described; Weigert has noted small areas of necrosis.

There is nothing special in the condition of the blood, and even in the most malignant cases there are no microscopic alterations. In the blood-drop, however, it will be seen that the corpuscles, instead of forming

rouleaux, aggregate together in irregular clumps. The heart occasionally shows myocardial changes, parenchymatous and fatty; endocarditis and pericarditis are uncommon. French writers have described an endarteritis of the coronary vessels in connection with small-pox. The spleen is markedly enlarged. Apart from the cloudy swelling and areas of coagulation-necrosis, lesions of the kidneys are not common. Nephritis may occur during convalescence. Chiari has called attention to the frequency of orchitis in this disease. There are scattered areas of necrosis with cell infiltration.

In the hæmorrhagic form extravasations are found on the serous and mucous surfaces, in the parenchyma of organs, in the connective tissues, and about the nerve-sheaths. In one instance I found the entire retroperitoneal tissue infiltrated with a large coagulum, and there were also extensive extravasations in the course of the thoracic aorta. Hæmorrhages in the bone-marrow have also been described by Golgi. There may be hæmorrhages into the muscles. Ponfick has described the spleen as very firm and hard in hæmorrhagic small-pox, and such was the case in seven instances which I examined. The liver has been described as fatty in these rapid cases, but in five of my seven cases it was of normal size, dense, and firm. In two it was large and fatty; but one man had necrosis of the tibia, and the other was a drunkard. The ecchymoses are scattered over the meninges of the brain and cord, and in one case there was a clot in the right ventricle. In five of the cases there were areas of hæmorrhagic infarction of the lung. In four instances the pelves of the kidney were blocked with dark clots, which extended into the calices and down the ureters. In one instance the coats of the bladder were uniformly hæmorrhagic and not a trace of normal tissue could be seen. The extravasations in the mucous membrane of the stomach and intestines were numerous and large. Peyer's glands were swollen and prominent in four instances.

Symptoms.—Three forms of small-pox are described:

1. *Variola vera;* (*a*) Discrete, (*b*) Confluent.
2. *Variola hæmorrhagica;* (*a*) Purpura variolosa or black small-pox; (*b*) Hæmorrhagic pustular form, variola hæmorrhagica pustulosa.
3. *Varioloid*, or small-pox modified by vaccination.

1. **Variola Vera.**—The affection may be conveniently described under various stages: (*a*) *Incubation.* This is variously estimated at from seven to twelve days, or even longer. I have seen it develop on the eighth day after exposure to infection, and there are well-authenticated instances in which the stage of incubation has been prolonged to twenty days. It is unusual for patients to complain of any symptoms in this stage.

(*b*) *Invasion.*—In adults a chill and in children a convulsion are common initial symptoms. There may be repeated chills within the first twenty-four hours. Intense frontal headache, severe lumbar pains and vomiting are very constant features. The pains in the back and in the

limbs are more severe in the initial stage of this than of any other eruptive fever, and their combination with headache and vomiting is so sug-

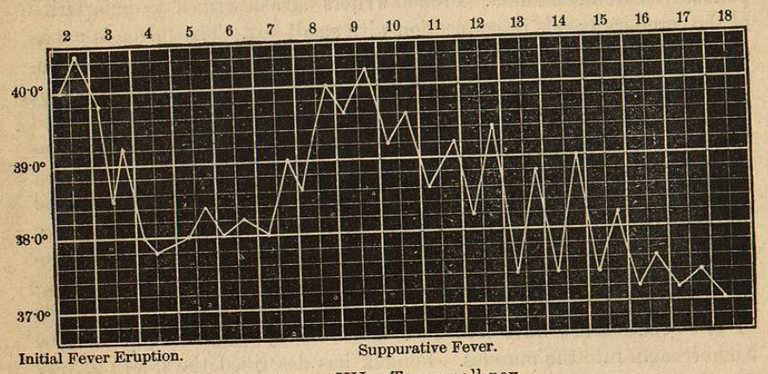

CHART VII.—True small-pox.

gestive that in epidemics precautionary measures may often be taken several days before the eruption decides positively the nature of the disease. The temperature rises quickly, and may on the first day be 103° or 104°. The pulse is rapid and full, not often dicrotic. In severe cases there may be marked delirium, particularly if the fever is high. The patient is restless and distressed, the face is flushed, and the eyes are bright and clear. The skin is usually dry, though occasionally there are profuse sweats. One cannot judge from these initial symptoms whether a case is likely to be discrete or confluent, as the most intense backache and fever may precede a very mild attack. Convulsions are not uncommon in children.

In this stage of invasion the so-called initial rashes may occur, of which two forms can be distinguished—the diffuse, scarlatinal, and the macular or measly form; either of which may be associated with petechiæ and occupy a variable extent of surface. In some instances they are general, but as a rule they are limited, as pointed out by Simon, either to the lower abdominal areas, to the inner surfaces of the thighs, and to the lateral thoracic region or to the axillæ. Occasionally they are found over the extensor surfaces, particularly in the neighborhood of the knees and elbows. These rashes, usually purpuric, are often associated with an erythematous or erysipelatous blush. The scarlatinal rash may come out as early as the second day and be as diffuse and vivid as in a true scarlatina. The measly rash may also be diffuse and identical in character with that of measles. Urticaria is only occasionally seen. It was present once in my Montreal cases. Apparently these initial rashes are more abundant in some epidemics than in others; thus they were certainly more numerous in the Montreal epidemics between 1870 and 1875 than they were in the more extensive epidemic in 1885. They occur in from 10 to 16 per cent

of cases. In the cases under my care in the small-pox department at the Montreal General Hospital the percentage was 13.* As will be subsequently mentioned these initial rashes have considerable diagnostic value.

(*c*) *Eruption.*—(1) In the *discrete form*, usually on the fourth day, small red spots appear on the forehead, particularly at the junction with the hair, and on the wrists. Within the first twenty-four hours from their appearance they occur on other parts of the face and on the extremities, and a few are seen on the trunk. As the rash comes out the temperature falls, the general symptoms subside, and the patient feels comfortable. On the fifth or sixth day the papules change into vesicles with clear summits. Each one is elevated, circular, and presents a little depression in the centre, the so-called umbilication. About the eighth day the vesicles change into pustules, the umbilication disappears, the flat top assumes a globular form and becomes grayish yellow in color, owing to the contained pus. There is an areola of injection about the pustules and the skin between them is swollen. This maturation first takes place on the face, and follows the order of the appearance of the eruption. The temperature now rises—secondary fever—and the general symptoms return. The swelling about the pustules is attended with a good deal of tension and pain in the face; the eyelids become swollen and closed. In the discrete form the temperature of maturation does not usually remain high for more than twenty-four or twenty-six hours, so that on the tenth or eleventh day the fever disappears and the stage of convalescence begins. The pustules rapidly dry, first on the face and then on the other parts, and by the fourteenth or fifteenth day desquamation may be far advanced on the face. There may be in addition vesicles in the mouth, pharynx, and larynx, causing soreness and swelling in these parts, with loss of voice. Whether pitting takes place depends a good deal upon the severity of the disease. In a majority of cases Sydenham's statement holds good, that "it is very rarely the case that the distinct small-pox leaves its mark."

(2) *The Confluent Form.*—With the same initial symptoms, though usually of greater severity, the rash appears on the fourth, or, according to Sydenham, on the third day. The more the eruption shows itself before the fourth day, the more sure it is to become confluent (Sydenham). The papules at first may be isolated and it is only later in the stage of maturation that the eruption is confluent. But in severer cases the skin is swollen and hyperæmic and the papules are very close together. On the feet and hands, too, the papules are thickly set; more scattered on the limbs; and quite discrete on the trunk. With the appearance of the eruption the symptoms subside and the fever remits, but not to the same extent as in the discrete form. Occasionally the temperature falls to normal and the patient may be very comfortable. Then, usually on the eighth day, the temperature again rises, the vesicles begin to change to

*The Initial Rashes of Small-pox. Canada Medical and Surgical Journal, 1875.

pustules, the hyperæmia about them becomes intense, the swelling of the face and hands increases, and by the tenth day the pustules have fully maturated, many of them have coalesced and the entire skin of the head and extremities is a superficial abscess. The fever rises to 103° or 104°, the pulse is from 110 to 120, and there is often delirium. As pointed out by Sydenham, salivation in adults and diarrhœa in children are common symptoms of this stage. There is usually much thirst. The eruption may also be present in the mouth, and usually the pharynx and larynx are involved and the voice is husky. Great swelling of the cervical lymphatic glands occurs. At this stage the patient presents a terrible picture, unequalled in any other disease; one which fully justifies the horror and fright with which small-pox is associated in the public mind. Even when the rash is confluent on the face, hands, and feet, the pustules remain discrete on the trunk. The danger, as pointed out by Sydenham, is in proportion to the number upon the face. "If upon the face they are as thick as sand it is no advantage to have them few and far between on the rest of the body." In fatal cases, by the tenth or eleventh day the pulse gets feebler and more rapid, the delirium is marked, there is subsultus, sometimes diarrhœa, and with these symptoms the patient dies. In other instances between the eighth and eleventh day hæmorrhagic symptoms develop. When recovery takes place, the patient enters on the eleventh or twelfth day the period of—

(*d*) *Desiccation.*—The pustules break and the pus exudes and forms crusts. Throughout the third week the desiccation proceeds and in cases of moderate severity the secondary fever subsides; but in others it may persist until the fourth week. The crusts in confluent small-pox adhere for a long time and the process of scarring may take three or four weeks. The crusts on the face fall off, but the tough epidermis of the hands and feet may be shed entire. We had in the small-pox department of the Montreal General Hospital several moulds in epithelium of the hands and feet.

2. **Hæmorrhagic small-pox** occurs in two forms. In one the special symptoms appear early and death follows in from two to six days. This is the so-called petechial or black small-pox—*purpura variolosa.* In the other form the case progresses as one of ordinary variola, and it is not until the vesicular or pustular stage that hæmorrhage takes place into the pocks or from the mucous membranes. This is sometimes called *variola hæmorrhagica pustulosa.*

Hæmorrhagic small-pox is more common in some epidemics than in others. It is less frequent in children than in adults. Of twenty-seven cases admitted to the small-pox department of the Montreal General Hospital there were three under ten years, four between fifteen and twenty, nine between twenty and twenty-five, seven between twenty-five and thirty-five, three between thirty-five and forty-five, and one above fifty. Young and vigorous persons seem more liable to this form. Several of my cases were above the average in muscular development. Men are more frequently affected than women; thus in my list there were twenty-one males and only six females. The influence of vaccination is shown in the fact that of the cases fourteen were unvaccinated, while not one of the thirteen who had scars had been revaccinated.

The clinical features of the forms of hæmorrhagic small-pox are somewhat different.

In *purpura variolosa* the illness starts with the usual symptoms, but with more intense constitutional disturbance. On the evening of the second or on the third day there is a diffuse hyperæmic rash, particularly in the groins, with small punctiform hæmorrhages. The rash extends, becomes more distinctly hæmorrhagic, and the spots increase in size. Ecchymoses appear on the conjunctivæ, and as early as the third day there may be hæmorrhages from the mucous membranes. Death may take place before the rash appears. This is truly a terrible affection and well developed cases present a frightful appearance. The skin may have a uniformly purplish hue and the unfortunate victim may even look plum-colored. The face is swollen and large conjunctival hæmorrhages with the deeply sunken corneæ give a ghastly appearance to the features.

The mind may remain clear to the end. Death occurs from the third to the sixth day; thus in thirteen of my cases death took place on or before this date. The earliest death was on the third day and there were no traces of papules. There may be no mucous hæmorrhages; thus in one case of a most virulent character death occurred without bleeding early on the fourth day. Hæmaturia is perhaps most common, next hæmatemesis, and melæna was noticed in a third of the cases. Metrorrhagia was noticed in one only of the six females on my list. Hæmoptysis occurred in five cases. The pulse in this form of small-pox is rapid and often hard and small. The respirations are greatly increased in frequency and out of all proportion to the intensity of the fever. In the case of a negro, whose respirations the morning after admission were 32 and temperature 101°, after examining the lungs and finding nothing to account for the increased breathing, my suspicions were aroused, and even on the dark skin I was able on careful inspection to detect hæmorrhages in and about the papules.

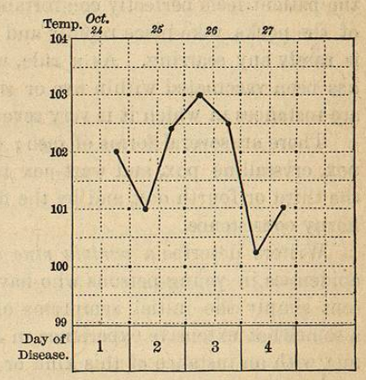

CHART VIII.—Hæmorrhagic small-pox.

The annexed chart is from a case of malignant small-pox which came on abruptly on Thursday, October 24, 1874, and which terminated early on the fourth day. It shows the moderate temperature range.