

neuroglia cells were markedly increased. The columns of Meynert in the cortex cerebri were distinctly evident, thus contrasting with the appearance of the brain in general paralysis. The cells themselves throughout the whole nervous system showed a uniformly dull, diffuse, staining reaction, and in none of the cells were the Nissl granules evident. This change was undoubtedly due to the hyperpyrexia during the last hours of life. In Case II, the cells for the most part presented a normal outline and exhibited Nissl granules on the dendrons and in the body of the cell. In the medulla, however, a considerable number of cells showed chromolytic changes, and to a less degree changes were found in the motor cells of the anterior cornua. The cells in the left hemisphere showed degenerative changes in sections of the motor area, Meynert's columns were not distinctly visible, and many of the cells seemed atrophied and broken up. Fibres: Sections of the brain and cord were stained by Marchi and Marchi-Pal methods. Nothing abnormal was found in Case I, except perhaps that the tangential fibres were not so numerous as in the normal cortex cerebri. In Case II, there was obvious wasting of the tangential fibres in both hemispheres, but especially of the left. There was slight sclerosis of the crossed pyramidal tracts of the cord, more marked on the right side, and also a number of recently degenerated fibres were exhibited by the Marchi method. The arteries of the central nervous system exhibited no trace of endarteritis. In the choroid plexus there were numerous microscopical psammomata. The central canal of the spinal cord was filled up with proliferated glia tissue. The posterior spinal ganglia showed the same appearances around the vessels, but the ganglion cells in Case I, only showed the diffuse staining of hyperpyrexia, and in Case II, exhibited a fairly normal appearance. . . . The symptoms which were, however, present in both patients, and characteristic of the disease—namely, progressive drowsiness and lethargy, and the progressive weakness in body and mind, without any distinct paralysis or mental disability—could best be accounted for by supposing that the metabolism or functional activity of the neurons as a whole was affected injuriously by some toxic product either circulating in the blood or existing in the cerebrospinal fluid; that this toxic agent, whatever it might be, occasioned great proliferation of mononuclear leucocytes beneath the pia-arachnoid and in the perivascular lymphatics. It might, however, be supposed that the functions of the nervous system were affected by an interference with their nutrient lymph supply, owing to the perivascular lymphatics being filled with leucocytes. The liver, kidneys, lungs, pituitary body, spleen, lymphatic glands, and duodenum were also examined. The results were for the most part, with the exception of the duodenum and lymphatic glands, negative. The lymphatic glands were much enlarged owing to great increase of lymphocytes. Sections of duodenum showed a large number of lymphocytes, and a proliferation of the same in the lymphoid nodules.

In addition to the above, Dr. Mott furnished a much fuller report, with illustrations, to the *British Medical Journal* for December 16th, 1899. To this the reader, in search of further details, is referred.

TREATMENT.—This has, so far, been most unsatisfactory. Purgatives, tonics, quinine, and arsenic have all been tried, but without much effect on the death rate. Among the newer suggestions are: (1) Hypodermic injections of testicular extract; (2) venesection of about one-fourth of a litre per week, followed by injection of an artificial serum, the object being gradually to free the blood from the *Filaria perstans*; (3) thyroid extract; (4) electricity over the spine. Probably the best that can be done will be found along the lines of hygiene, nursing, and feeding.

R. J. E. Scott.

SMALLPOX.—DEFINITION.—Smallpox is an acute, contagious, febrile, exanthematous malady, characterized by an eruption which passes through four stages of development, *i. e.*, macule, papule, vesicle, and pustule.

The initial symptoms are, ordinarily, chill, fever, headache, lumbar pain, and vomiting. The fever disappears when the eruption appears, and recurs when the latter has reached the pustular stage. The period of incubation varies from seven to twenty-one days.

HISTORY.—Though an ancient disease, its origin is unknown. DeHaen, Willan, Moore, and Barron contend that it was known to the ancient Greeks and Romans; Friend, Mead, Good, and Adams deny this assertion. Rhazes, an Arabian physician, who practised medicine about the year 910 A. D., was one of the most celebrated of the earlier writers on smallpox. When we consider the date of his writings and the state of medical knowledge at that time, it will be seen that he delineated the natural history of the disease with remarkable accuracy. Rhazes contends that Galen was familiar with the malady, and cites extracts from his first, fourth, ninth, and fourteenth books as evidence of the fact. He also mentions Ahrún, of Alexandria, and Mesue, of Bagdad, among the other early writers on variola. It is, however, commonly agreed among historians of medicine that this disease cannot with certainty be traced to a period anterior to the Christian era. Since smallpox first attacked mankind it has never wholly disappeared, and from Europe and Asia has been carried all over the world. It appeared in England in the first part of the thirteenth century, and in Germany in the latter part of the fifteenth. It was imported into the United States soon after the discovery of America. It reached Mexico in 1527. Smallpox is a malady to which the human race is well-nigh universally susceptible, probably not more than one in a thousand persons being naturally immune. In consequence of the universal susceptibility of unvaccinated persons, and the neglect of vaccination in almost all communities, smallpox smoulders in different localities, and at varying periods breaks loose from these endemic foci and assumes epidemic proportions in municipalities, States, and nations.

Like all other contagious maladies epidemics of smallpox differ markedly one from another, not only in the amount and character of the eruption, but in the character and intensity of symptoms, and in mortality as well. For centuries prior to Jenner's discovery of vaccination (1796) smallpox was regarded as the king of fatal diseases. M. de La Condamine, writing of this malady, says that it was the cause of one-tenth of all the deaths among mankind. He also says: "Among those who outlive it, many, either partially or totally, lose their sight or hearing; many are left consumptive, weakly, sickly, or maimed; many are disfigured for life by horrid scars, and become shocking objects to those who approach them. Immense numbers lose their eyesight by it." Black, Frank, and other reputable writers on this disease state that it caused half a million deaths annually in Europe prior to general resort to vaccination. The great English historian Macaulay, in speaking of this malady in England, says: "The havoc of the plague had been far more rapid, but the plague visited our shores only once within living memory, but the smallpox was always present, filling the churchyards with corpses, leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to her lover."

Rosen says that one-tenth of the deaths in Sweden resulted from smallpox. Simon says that this disease concurred with fire, and sword, and famine to depopulate St. Domingo.

In an epidemic of smallpox in Mexico in the sixteenth century 3,500,000 of the inhabitants died in a few years, leaving in some places scarcely enough people alive to bury the dead. Prescott ("Conquests of Mexico," vol. vi.) describes this epidemic as "sweeping over the land like fire over the prairies, smiting down prince and peasant, leaving its path strewn with the dead bodies of natives who perished in heaps like cattle stricken with the murrain." Smallpox invaded Brazil in 1653, and in some instances whole races of men died of the malady.

In a few years the Province of Quito lost 100,000 of her Indian population by this disease. Iceland had been invaded by smallpox seventeen times prior to 1707, and desolation and ruin followed in its wake for years, causing in the year 1707 the death of 18,000 out of a total population of 50,000. The terrible fatality of the disease in Greenland in 1707 is evidenced by the following extract from Crantz's "History of Greenland": "Empty, depopulated houses and unburied corpses, some within and some without the houses, were commonly encountered. In one island they found one girl with the smallpox on her, and her three little brothers; the father, having first buried all the people in the place, had laid himself and his smallest sick child in the grave, raised with stones, and ordered the girl to cover him." In 1734 Greenland lost two-thirds of her population from smallpox. From authentic sources it is learned that in one epidemic of this malady one-sixth part of the inhabitants of Ceylon died. Siberia had a similar experience, and Kamchatka has suffered in like manner. Captain Cook ("Voyages to Pacific Ocean," 1785), speaking of the first appearance of smallpox (1767) in Kamchatka, describes it as "marking its progress with ravages not less dreadful than the plague, and seeming to threaten their extinction." M. de La Condamine says that prior to vaccination one-tenth of all the deaths in France were from smallpox. In 1805 M. Laborde says: "I had been a witness of the variolous epidemic which had, in 1792, swept off one-fourth of the population of the Isle of France." North America has been fearfully scourged by smallpox; whole tribes of our Indian population were almost literally extinguished by it. McKenzie says of the disease among the Indians: "It was as a fire consuming the dry grass of the field. The infection spread with a rapidity which no flight could escape, and with a fatal effect which nothing could resist." Godfrey says that 2,000,000 of the inhabitants of the Russian empire died of smallpox in a single year. Sir Gilbert Blaine says: "When there was no vaccination in our navy, one-fifth of all the men enlisted died of smallpox." Mr. Makena describes an epidemic of this disease in the Argentine Confederation from 1846-48, as "sweeping with the wings of death over that enormous tract of country from the seaboard of the Atlantic on the East to the cordillera of the Andes on the West." Alexander Wheeler, of England, an ardent antivaccinist, says: "In 1875 smallpox carried off 101,397 inhabitants of India." Hirsch says that between 1866 and 1869 smallpox killed 140,000 natives in Bombay and Bengal. In the whole of India (1873-74) 500,000 inhabitants died of this disease.

An exhaustive account of the various epidemics of smallpox is, of course, not to be expected in a limited article. The instances above quoted are presented in order to show how malignant smallpox commonly was in prevaccinal times, as well as the present, in a population unprotected by vaccination. The instances cited are entirely authentic, and justified Macaulay in styling smallpox "the most terrible of all the ministers of death." It, however, would be wholly erroneous to contend that all epidemics of smallpox had been as pernicious as the ones above cited. It is an incontestable fact that throughout the entire written history of this malady individual epidemics have differed markedly one from another, not only in mortality, but in the quality and quantity of the eruption and the other attendant symptoms. In some epidemics a large percentage, and in others the largest percentage, of cases of smallpox were of the mildest type—varioid as it is called—and this resulted, not, as some text-writers assert, in consequence of previous vaccination or a prior attack of smallpox, but from an inexplicable partial natural immunity of populations more general at one period than at another, for this disparity of different epidemics as to mortality, quality, and quantity of eruption, and other symptoms was noted prior to vaccination. I cite three instances from a number at hand. George Cleghorn, M. D., in his book on the "Epidemic Diseases of Minorca," says: "The smallpox were twice epidemical in Minorca while I re-

sided there, *viz.*, in 1742 and 1746. About the middle of March, 1742, the smallpox broke out in Minorca, to the great consternation of the natives who had not seen them since the year 1725, but well remembered the destruction which they then occasioned. During the first six or eight weeks (1742) the distemper was favorable and seldom proved fatal; but its virulence increased with the heat of the weather, so that in June and July it was not uncommon, both at Mahon and Ciudadella, to bury ten or twelve a day. Nevertheless, in proportion to the numbers not many died, and what mortality there was happened chiefly among children at the breast and the common soldiers." Of the epidemic of 1745-46 he says: "Then they (the smallpox) travelled northward to Ciudadella, and disappeared in the spring, having carried off almost all of the children who survived the chincoch and the summer fevers. It was, however, very remarkable that the longer the infection continued in the island the milder it became, so that there was much less mortality in the northern part than in the southern, where it first broke out." He then cites the fact that in 1846 at St. Phillip's Castle three-fourths of the smallpox patients died.

In the early part of 1898 smallpox appeared in several of the Southern States. The first case in this city (Augusta, Ga.) was detected May 5th, 1898, the patient having contracted the disease in South Carolina. The malady spread from one State to another until it invaded all sections of the United States. The disease is said to have been brought to this country from Cuba, it having been prevalent there during the Spanish-Cuban war. In a large number of communities it assumed epidemic proportions by reason of the fact that physicians failed to recognize its nature until it had attacked a large number of the inhabitants. Cases of the disease were observed by me in citizens of twelve counties in Georgia and four counties in South Carolina. In each and all of the communities in which I encountered the disease it was, in my experience, unprecedentedly mild and irregular both as to constitutional symptoms and quantity and quality of eruption, and equally strange was the further fact that while perhaps one-sixth of the cases were either confluent or semiconfluent in type, the vast majority of discrete and semiconfluent cases went on to and through the purulent stage without secondary or maturation fever. This fact was ascertained by repeated daily observations with the thermometer. Again, not more than five per cent. of confluent cases terminated fatally. In the confluent and semiconfluent cases pitting of the face was in about the percentage usually attendant on severer epidemics. The disease was confined almost exclusively to the unvaccinated. No one of the four hundred and twenty-nine cases coming under my observation during the last four years had a typical vaccine scar. Ten of them had a scar, and claimed to have been vaccinated from ten to twenty years previously, but in no one of them could I say from the cicatrix that the patient had undergone vaccination.

The initial symptoms of the malady were headache, lumbar pain, chill, fever, and vomiting, and these symptoms were as commonly complained of by those having the disease mildly as by those who had the severer types. In those who had the disease mildly, *i. e.*, about two-thirds of the cases, the constitutional symptoms disappeared wholly when the eruption appeared, and these patients then went to work or visited their friends. I found a large per cent. of them at work in the fields, shops, and other industrial pursuits while the eruption of smallpox was in full bloom on them. Two of these patients after remaining at home three days resumed their work of delivering ice to our citizens. Others were apprehended on the public thoroughfares or in houses where they were visiting. These individuals claimed that their disease was chickenpox, and in not a few instances had been so informed by their physicians. In one case the total number of pustules on the patient's body was six, yet this patient gave rise to an epidemic of smallpox in the jail in our city. Another patient

had only twelve pustules, another twenty-four, another thirty-five, another forty-four, others had from fifty to sixty, others from seventy-five to one hundred, while still others had several hundred.

The disease attacked entire unvaccinated families, and it was a common experience to find all numerical grades of eruption from fifty to one hundred on to discrete, semiconfluent, and confluent cases in one unvaccinated family. Several of the confluent and semiconfluent cases were in direct traceable connection with those who had respectively six, twelve, thirty-five, and fifty pustules. That the disease in America has been for the last four years unprecedentedly mild, when judged by fatality, is shown by the statistics of the United States Marine Hospital Service. The reports of this service show the following facts: 1899, total number of cases of smallpox 11,136, deaths 553; year 1900, cases of smallpox 20,362, deaths 819; six months ending June 13th, 1901, cases 28,257, deaths 486; from December 28th, 1901, to June 13th, 1902, cases 36,373, deaths 1,154. While the statistics above quoted are imperfect in that they do not represent the total number of cases nor the total mortality occurring in America, they are valuable in that they are made up from data furnished from all parts of the United States, and accurately show the mortality rate in the various localities from which these reports were obtained. The report of the Marine Hospital Service shows that for the term ending June 13th, 1902, smallpox was in existence in forty-three States and Territories in the United States. Of the 429 cases which occurred in this county during the last four years only 6 resulted fatally.

That the course of the disease was altogether atypical is shown by the fact that the initial symptoms constituted the major part of the attack of smallpox in nine-tenths of the cases observed by me. Other atypical manifestations of the malady were noted as follows: In not a few cases the eruption remained globular throughout its entire course, umbilication being wholly absent. In a still greater percentage of cases, although umbilication was present, a large per cent. of the eruption continued, globular through its entire course. Not uncommonly, in discrete cases, the vesicles were observed to have changed into pustules on the fourth day, and then rapidly desiccated, and in a few additional days began to drop from the body. In some instances semiconfluent cases did likewise, while in other instances, in both semiconfluent and confluent cases, the course of the eruption was as prolonged as that in severer epidemics. In semiconfluent and confluent cases pitting of the face was about in the percentage observed by me in former years, though in some cases of both of these varieties the eruption ran an exceedingly rapid course, desiccated and soon dropped off in large patches, leaving no sign of pitting. In a large proportion of the mild cases the exanthem did not pass through the various stages usually observed in the disease, but after developing in an abortive form promptly retrograded, leaving warty excrescences on the face which after several months disappeared and left no trace of disfigurement.

My experience with smallpox during the last four years may be summed up by saying that the cases of the disease varied from one another—from those showing the extreme limits of the severest and fatal types to the very mildest forms of varioloid in which but a few pustules evidenced the fact that I was dealing with smallpox. The variations in types of the malady were rarely ever sharply defined amidst the group of variolous affections ordinarily described in the books, but were rather a direct or an indirect change from one type to another, oftentimes so gradual as to be diagnosed by general outlines rather than by sharply defined outward appearances.

MORBID ANATOMY.—The only characteristic pathological lesion of smallpox is the exanthem. This passes through four stages, *i.e.*, macule, papule, vesicle, and pustule. In the white subject the macules consist of small, non-elevated red spots, which within forty-eight hours become elevated into papules, then develop into

vesicles, and later into pustules. In the negro the exanthem follows a similar course except as regards the redness of the macules and papules. In the hemorrhagic variety hemorrhage occurs in the skin, in the exanthem, in the mucous and serous membranes, and in the viscera. The eruption of variola appears on the skin and on the mucous membrane of the nose, mouth, pharynx, œsophagus, the genitalia, and occasionally of the larynx and trachea. If the suppurative process of the eruption does not invade the true skin, pitting will not result; if, however, it be involved, scarring of the part is inevitable. The morbid changes in the viscera of the smallpox patient show nothing peculiar to this disease, but are such as are common to most of the zymotic affections—*i.e.*, congestive, inflammatory, and degenerative changes.

ETIOLOGY.—Smallpox is contracted by breathing a confined atmosphere infected with the virus of the malady and by contact mediate or immediate, with an infected person, clothing, bedding, etc. It is a disease *sui generis*, and therefore can be propagated only by its own specific virus. (In regard to the nature of this, consult the article on *Protozoa* in Vol. VIII.) The contagious element is given off from the infected body by the breath, exhalations, secretions, and exanthem. Attempts to produce the malady by inoculations with the blood and secretions of smallpox patients have in some instances resulted negatively. The disease is, however, transmissible by inoculation of an individual with the contents of the pustule, yet this virus may be rubbed upon the skin with impunity unless the skin be abraded. If it comes in contact with the mucous membrane of an unvaccinated individual variola results. It has been claimed that smallpox is transmissible through the atmosphere. From long experience with the disease I am convinced that it never is air-borne. Our smallpox hospital has been for years located within one thousand feet of two populous blocks of our city, yet we have had but one case of the disease develop on these two blocks, and it was traced to an extraneous source. I am convinced that in every instance where it has been claimed that smallpox was disseminated through the atmosphere, it resulted from infected fabric having been scattered from time to time through the community, or from contact with individuals having the malady so mildly as to escape detection. I recently intercepted an individual having an extremely mild case of smallpox in the pustular stage, who, the whole night previous to his detection, had attended a ball. These extremely mild cases are frequent sources of dissemination of the disease. The virus of smallpox is tenacious of life when attached to fabrics, and when these have been packed away it has been known to retain its vitality for a year or more. It is therefore portable. Indeed, infected clothing, bedding, and other fabrics are frequent sources of extension of the disease. The contagion of smallpox infects an individual by passing into the system through the respiratory tract.

The character of an attack of variola as to lightness or severity varies with the then constitutional condition or degree of susceptibility of the individual. If an unvaccinated person be exposed to varioloid so mild that there may not be more than six pustules on the body, he may contract malignant smallpox therefrom, while, on the other hand, one who had never been vaccinated may be exposed to a malignant case of variola and only contract varioloid. This inequality of individual predisposition has been observed from the earliest period embraced in the recorded history of the disease. A fractional part of mankind seems to be wholly insusceptible to smallpox. I have met with two physicians who had never contracted the disease, although repeatedly exposed to it, and they possessed equal immunity to vaccination, as shown by failure of repeated efforts to inoculate them with vaccinia. These individual instances of immunity to smallpox and vaccinia are among the rarest of medical experiences, are in fact clinical curiosities, for it is a proven fact that susceptibility to both infections is well-nigh universal in man. Occasional instances are met with demonstrating that some individuals possess remarkable susceptibility to smallpox. I have encoun-

tered seven instances of second attacks of this malady. Three of them were cases of recrudescence; in the other four, all of whom were pockmarked by the first attack, a long number of years intervened between the attacks of smallpox, and two of these patients died. I have a photograph of one of the cases of recrudescence plainly showing the marks of the first attack while the pustules of the second infection were still adherent to the body of the patient. Second attacks of variola are, however rare, though a few cases are on record in which physicians have reported cases of third and even fourth attacks of the malady in the same individual.

A successful vaccination in the vast majority of instances is protective against smallpox during life, though in a minority the protective effect of vaccination decreases, and in some cases wholly disappears, in from ten to twenty years after it was done. I have never observed a case of smallpox or varioloid in a person with a typical scar of vaccination made within ten years, and I have carefully searched for such instances. The wife and six children of the superintendent of our smallpox hospital were successfully vaccinated, and though in constant contact with the patients they have never contracted smallpox. No vaccinated employee or officer of our hospital has ever contracted variola in any of its forms. In my experience a recent successful vaccination (*i.e.*, one made within five years) is as fully protective against smallpox as a previous attack of this disease is against a second one. If vaccination be done in infancy and repeated at puberty, such patient will prove immune to smallpox, though it would only be prudent for such a one to be promptly revaccinated if directly exposed to the former disease. I was vaccinated in infancy, and though I have repeatedly in the last thirty years made attempts at revaccination of myself, every such effort has failed.

Incubation.—The period of incubation varies from seven to twenty-one days. Ordinarily it is about twelve days. I have, however, repeatedly observed it to be as long as eighteen and twenty-one days. This latter fact is important in that it demonstrates the necessity of detaining suspects in isolation for a period of twenty-one days.

Types of Smallpox.—The Chinese described forty varieties of this disease. While the eruption of smallpox shows itself under a number of modifications from the several types ordinarily described by modern writers, it is not deemed necessary to describe the twenty or more varieties presented by the old writers. I shall describe the following types of the disease:

DISCRETE SMALLPOX.—**Symptoms and Course.**—The initial symptoms of this variety are chill, fever, vomiting, headache, and lumbar pain. Ordinarily the temperature reaches 102° or 103° F. on the first day of the attack, 103° or 104° F. on the second day, and on the third day it may be 105° or more. With the elevation of temperature the pulse becomes full and frequent, beating 120, 140, or even 160 per minute. Photophobia and sore throat now set in. The patient becomes restless or even delirious in consequence of the febrile movement and other constitutional disturbance. Convulsions are of frequent occurrence in children. The face becomes flushed, the conjunctivæ congested, and the carotids throb. Redness and swelling of the tonsils and soft palate take place at the end of the second day; this may extend to the larynx and cause hoarseness, and a shrill, harsh cough. At the end of the third day the fever and other constitutional disturbance have attained their maximum. At this time the eruption appears, and, as a rule, the fever and pulse-beats fall to the normal. The initial symptoms are usually quite severe, though their intensity is not always indicative of the grade of the attack, for it is frequently observed that the initial symptoms of extremely mild cases are of considerable intensity. At this stage of the disease no symptoms are present by which it may be diagnosed. The severe lumbar pain is, however, so characteristic that its presence should lead the physician to suspect the nature of the disease.

Stage of Eruption.—At the end of the third day of the fever the eruption commences on the face, scalp, neck, and wrists. When it first appears it is macular, *i.e.*, consists of red spots which simulate the exanthem of measles, and at this stage cannot be diagnosed from measles. During the succeeding day it spreads over all parts of the body. It commences on the mucous membrane of the throat before it attacks any other part of the body, but it is rarely first detected in this situation owing to the slight local disturbance which it causes in its incipency. On the third day the macules have changed into papules. The papules on the surface of the body impart to the sense of touch a feeling similar to that of shot beneath the skin. If the efflorescence be copious in the mouth it causes increased flow of saliva; in the pharynx it causes difficulty in swallowing; in the larynx, hoarseness and cough; on the conjunctivæ, lachrymation and photophobia. The papules persist for two days and, by elevation of the epidermis over the site of each papule, develop into vesicles. The individual vesicles are about the size of a split pea, contain a lactescent fluid, and become umbilicated. On the sixth day of the efflorescence the vesicles begin to lose their umbilicated appearance, rapidly assume a globular shape, and by the eighth day have changed into pustules. The skin surrounding the pustules becomes red, swollen, and edematous, each pustule has a broad base, and in cases of confluent or semiconfluent smallpox is closely set against or runs into its fellows. During this stage, in a full case of discrete smallpox, and in all cases of the confluent and semiconfluent varieties, the patient suffers from profuse salivation, swallowing is accomplished with great difficulty, the nose is filled with pustules, the voice is husky or inaudible, the cough croupy and distressing; the eyes are red, discharge a muco-purulent matter, and are extremely sensitive to light. When the exanthem covers the face, as it not infrequently does when the eruption is discrete on all other parts of the body, the face is swollen into a shapeless mass, the eyes are closed, and the features are so distorted as to render it impossible to recognize the patient. Secondary fever sets in upon the stage of pustulation being reached, a chill having preceded the fever. The fever is distinctly remittent in type, reaching its acme in the evening. The temperature in this stage is higher than in the initial fever, not infrequently reaching 106° F. when the fever is at its highest point. The pulse increases in frequency simultaneously with increase of temperature, ranging from 120 to 140 or 160 beats per minute. At this stage the patient is in the most critical period of the disease. The fever and other constitutional perturbation continue until the stage of desiccation has been completed. A subsequent marked elevation of temperature is suggestive of some complication, and its cause and significance should be promptly ascertained.

Stage of Desiccation.—The process of desiccation ordinarily commences on the twelfth day of the efflorescence, and follows in the order in which the eruption appeared. The desiccative process usually occupies from eight to fourteen days, the length of time being governed by the extent and degree of pustulation. The desiccative process on the palms and soles in some instances extends from four to six weeks. Just prior to or at the commencement of the desiccative process many of the pustules rupture and the exuded fluid dries into a yellowish or brown crust. As desiccation advances the swelling of the skin decreases and the constitutional disturbance abates. Cicatrization advances beneath the pustules or crusts, and ordinarily when these are thrown off there remains at the site of each pustule a reddish-brown or violet color in white subjects, and a white or black spot on negroes, with elevated margins and depressed centre. If only the superficial layer of the skin has been invaded these blotches sooner or later wholly disappear; if, on the other hand, the true skin has been invaded by the suppurative process the face will be permanently pockmarked. This description is an outline of discrete smallpox as it is ordinarily encountered among unvaccinated patients. Indi-

vidual cases, however, present the widest differences in severity and character under different constitutional conditions of patients, and in numerous instances during every epidemic the malady is so light in the amount of eruption and character of the symptoms that those suffering from it present but few if any of the typical symptoms of the malady, and may not even suspect the true nature of the disease. If such patients perchance consult a physician, he, unless practised in smallpox, diagnosticates the malady to be chickenpox or some other light affection, and the patients continue to attend to business throughout the entire course of the disease, and thus scatter it abroad in the community.

CONFLUENT VARIOLA.—This type differs from the discrete in that the eruption and constitutional symptoms are much more severe than in the latter. The initial fever is more intense and of shorter duration, usually lasting not more than two days. The initial fever frequently reaches 106° F. and then falls to 103° or 104° and continues at this height until secondary or maturation fever occurs. The fever of confluent smallpox is of the remittent type, and when the suppurative process is reached, not infrequently registers 107° or 108° F. The development of the eruption in this type occurs from twelve to eighteen hours earlier than in the discrete variety, and spreads over the body more rapidly, frequently appearing simultaneously on the face, trunk, and limbs. In the severest cases the eruption is so thickly set upon the entire body that each vesicle coalesces with its fellows. The skin is intensely swollen and the eruption may cover the entire body as a mask. Suppuration rapidly ensues in the vesicles, and the eyes, lips, nose, cheeks, ears, scalp, hands, feet, and genitalia present one horrid mass of deformity. Ordinarily, however, where there is a complete coalescence of the exanthem on the face it is semi-confluent on the other parts of the body. It may be stated as a rule that pustulation on more than one-half of the body results fatally. Confluent variola is a formidable malady, the mortality ranging from fifty to seventy-five per cent. In its onset, and throughout the entire course of the disease, the confluent type shows a marked difference from the discrete variety in intensity and character of all of the symptoms. In addition to the more violent fever and delirium the nervous and muscular systems show greater depression of vitality. The mucous membrane of the air tracts is attacked with greater severity, the eruption in the mouth and throat is confluent, and frequently a diphtheritic exudate covers the soft palate, tonsils, pharynx, and nasal cavities. The larynx is occasionally invaded by the exanthem and the severity of this invasion is not infrequently evidenced by the occurrence of submucous abscesses, necrosis of the cartilages, or œdema glottidis. The eyes, too, are more severely affected in this type; the eruption usually invades the ocular conjunctivæ, giving rise to inflammation of the lids, and frequently results in keratitis with perforation and loss of eyesight. In the mouth the severity of the disease is manifested by profuse salivation, by great difficulty in swallowing, and not infrequently by inflammation of the parotid glands. Confluent variola is prone to a number of complications, such as bronchitis, pneumonia, pleurisy, pericarditis, diarrhœa; albuminuria, abscesses, etc. So intense is this variety of variola that some patients die before the eruptive period has arrived, but the majority of those who die survive until the stage of desiccation has been reached, death resulting at this time usually from exhaustion, or from one of the numerous complications which beset this type of the disease. In those who survive, the process of desiccation is slowly accomplished, often extending over a period of four or five weeks. In this variety but few patients escape permanent disfigurement of the face from pockmarks. Convalescence, too, is quite slow, the patient often being troubled with boils and abscesses for several weeks after the exanthem has been thrown off.

HEMORRHAGIC VARIOLOID.—The difference between this and the other types of smallpox consists mainly in the character of the eruption, the spoliation of the blood,

the course of the fever, and the constitutional symptoms. It is simply a modification of variola vera. The hemorrhage into the eruption takes place under various circumstances. In some cases the exanthem becomes hemorrhagic upon the appearance of the papules, in others when the vesicular stage is reached, and in still others only when the pustules are fully formed. In some cases the entire exanthem is hemorrhagic, while in others one-half or even a very small portion of it is hemorrhagic. As a rule it begins in the eruption on the lower extremities. Petechiæ and ecchymoses usually appear between the efflorescences, and livid spots or patches are to be found on the mucous membrane of various parts of the body, particularly in the mouth and throat. Diphtheritic exudates frequently form on the tonsils, pharynx, and nasal cavities. The gums become spongy and bleed as in scurvy. Hemorrhages occur from the nose, stomach, lungs, kidneys, rectum, or uterus. The amount and persistency of the hemorrhage vary in different cases. There is no means of diagnosing this variety of variola until the hemorrhage has occurred. The initial fever is ordinarily mild, and throughout the subsequent course of the disease the temperature rarely exceeds 102° F. When the hemorrhage has been profuse the temperature falls to or below the norm. There is a marked contrast between the temperature and the pulse rate. While the temperature is but slightly above, at, or below the norm, the pulse is beating from 120 to 160 per minute. The breathing is rapid, the countenance pinched and sunken, and occasionally there is delirium, though as a rule the intellect remains clear. This is a very fatal form of the disease; fully ninety-five per cent. of the cases end in death.

MODIFIED VARIOLA.—Under this head are embraced all varieties of smallpox which depart materially from the course pursued by variola vera. These departures from type may consist in variations in the character and course of the eruption, or in the symptoms of the malady, or in both; in a word, it embraces all abortive forms of smallpox. These varieties are usually designated varioloid. Varioloid may be defined smallpox modified by a previous attack of the disease, by a previous attack of vaccinia, or by an unusual degree of personal insusceptibility. There is no ground whatever for the old claim that varioloid is essentially different from variola vera. Varioloid, it is true, is milder in its course and shorter in duration than variola vera, and presents many striking departures from the ordinary course of the latter disease. That it is, however, the same disease as variola vera is constantly being demonstrated by the fact that individuals contract all other grades and varieties of smallpox by contact with individuals affected with varioloid. The duration of the initial fever of the latter variety is rarely beyond two days and the temperature seldom exceeds 102° F., falling, as a rule, to the norm at the end of the second day. With the disappearance of the initial fever the patient is convalescent and generally able immediately to return to business. In rare instances the initial fever is as high as in variola vera, yet it persists for only two days. Secondary fever is extremely rare, and when present seldom continues beyond twenty-four hours. The eruption differs in its character and development from that of unmodified smallpox. In varioloid the efflorescence appears simultaneously on all parts of the body, and it rarely passes through all the stages characteristic of variola; it may not go beyond the vesicular stage and then rapidly desiccate. Not infrequently the eruption goes on through the pustular stage, but the pustules are dwarfed, and while they are surrounded by a red areola the skin is neither tense nor swollen, and the pustules rapidly dry up and fall from the body. Desiccation usually commences from the fifth to the seventh day of the eruption. Pitting is rare in varioloid, but in some instances the face is left pockmarked. When the eruption of varioloid passes through all the stages of variola it is differentiated from the latter by the milder constitutional symptoms and by the smaller number and abortive forms of the pocks of varioloid. Varioloid is devoid of fatality.

Several other varieties of varioloid are encountered in every epidemic of smallpox. These are mainly: (1) Variola verrucosa. In this variety the eruption does not go on to well-formed pustules of smallpox, but stops with the development of solid papules with a vesicle at their summit, and on the site of each of which, after desquamation, a warty elevation of the skin is left. (2) V. pemphigosa. In this type the exanthem progresses regularly to the vesicular stage, when the vesicles become irregular bullæ with sero-purulent contents. (3) V. miliaris. In this form, while a portion of the eruption is that of regular and fully developed smallpox, the largest part consists of vesicles slightly larger than millet seeds. These vesicles, which are filled with a yellow fluid, progress no further than the vesicular stage, dry up and fall off. (4) V. siliquosa. In this variety the eruption develops regularly to the pustular stage, when the contents of the pustules are absorbed, leaving them with the appearance of empty shells. This variety is less often encountered than the three previously described.

Curschman, in discussing varioloid, has summed up the philosophy of the matter as follows: "It is generally conceded at the present time that varioloid is nothing more than a form of smallpox with a milder course and shorter duration, and, this view being accepted, it is readily seen that between varioloid and variola vera no absolute line of distinction can be drawn. During every epidemic of any considerable extent a number of cases are found which show a transition from one to the other form, and which, when we have followed their entire course, leave us in doubt as to whether we shall call them cases of variola or varioloid. The quantity or quality of the eruption is as far from being a good criterion in determining the nature of the affection as the presence or absence of the suppurative fever, which some consider decisive in this respect. This latter does not even depend entirely upon the intensity of the disease, but upon personal peculiarities, and particularly upon the sensibility of the person attacked. As regards the peculiar conditions under which varioloid occurs, it is important in the first place to observe that many persons who have never had smallpox nor have been vaccinated are only attacked by this form, on account of a natural slight susceptibility to the smallpox contagion. We accordingly find frequent mention made of cases in which the disease runs an extremely mild course."

Differential Diagnosis.—In diagnosing smallpox in any of its varieties time is an important factor. The chill, fever, headache, vomiting, and lumbar pain constitute a group of symptoms which should put the prudent physician on his guard when smallpox exists in the locality, yet the occurrence of this symptom complex would not justify him in committing himself unqualifiedly to the diagnosis of smallpox, even though it were known that the patient had never been vaccinated and had been exposed to the disease. Under such circumstances he should make a provisional diagnosis, isolate the patient, and await the development of the disease to a stage at which it can be diagnosed, *i.e.*, the vesicular stage. The wisdom of this course is attested by the experience of all hospital physicians. Marson, of the London Smallpox Hospital, says on this subject: "Upward of twenty diseases have been mistaken within the last few years, in the early stage of the disease, for smallpox, and the patients had been sent as having smallpox to the smallpox hospital." Under such circumstances the physician is guilty of malpractice, and can be held liable for damages. Such mistakes show ignorance or carelessness on the part of their authors. When the characteristic exanthem of smallpox has appeared, there are but few diseases liable to be confounded with it. These are chickenpox, pustular syphilis, pemphigus, impetigo contagiosa, and measles.

Diagnosis of Smallpox from Chickenpox.—A few modern writers contend that variola and varicella are one and the same disease, yet in the whole domain of medicine no proposition is better established than that each of these is a disease of its own kind, having its own specific

cause. By reason of the frequency of atypical cases of variola the differential diagnosis of such cases from varicella is at times quite difficult, and in all cases demands the exercise of prudence and judgment. While they are essentially different diseases they generally prevail simultaneously, and the vesicles of each counterfeit those of the other, yet when judged in connection with the symptoms and course peculiar to each disease they can be differentiated readily by one familiar with them. Smallpox is generally ushered in with a chill; varicella is not. Varicella is ordinarily unattended by an initial fever, and when it occurs it is very slight and disappears in twenty-four hours; but in variola, even in the lightest and most atypical cases, the fever reaches 102° F. and persists for two days. The initial stage of smallpox is attended by intense pain in the lumbar region; in varicella it is absent. Vomiting is a constant symptom in the early part of the attack of smallpox, and is rarely, if ever, present in varicella. It is, however, in the character of the eruption that the difference between these two diseases is most strikingly manifested. The smallpox eruption passes through four stages, *i.e.*, macule, papule, vesicle, and pustule; the macule persists for from twenty-four to forty-eight hours before being converted into a papule; the papule remains as such for forty-eight hours before being converted into a vesicle; the vesicle continues to retain this form for four or five days prior to becoming a pustule. In varicella the eruption is fully vesicular within twenty-four hours after the efflorescence first manifests itself. The vesicles of smallpox contain a lactescent fluid and appear to be deeply seated in the skin; those of varicella contain a serous-looking fluid and appear to be quite superficial. Indeed they present the appearance of having been produced by splashing hot water on the skin. In smallpox all of the pocks have a prominent red base, while in varicella the red base is slight if at all present. All smallpox vesicles develop into pustules, whereas in cases of chickenpox not more than one in fifty or one hundred does so. Umbilication occurs in the vast majority of smallpox vesicles, while but a small percentage of vesicles of varicella become umbilicated. Some text-book writers contend that umbilication never occurs in varicella. This is a mistake. Of the hundreds of cases of chickenpox observed by me I have never encountered one case in which a fractional part of the vesicles were not umbilicated; on the other hand, I have encountered cases of smallpox which never at any stage of the disease became umbilicated. Some writers contend that chickenpox never attacks an adult. This, too, is a mistake. I have repeatedly observed undoubted chickenpox in adults. I have, however, never known chickenpox attack a whole family of adults. This is an important diagnostic point in differentiating modified smallpox from chickenpox. Again, the eruption of chickenpox appears in several successive crops, while in smallpox there is but one. In varicella the major part of the eruption is upon the body, the back particularly, while it is sparse on the face and limbs. This rule is reversed in smallpox. It is well, however, to remember just here that in rare instances chickenpox is observed to be copiously scattered over the entire body. A few months ago I saw in consultation a case of chickenpox in a child about six years old in which the eruption was semiconfluent over every part of the entire body except the palms of the hands and soles of the feet; these were devoid of eruption. All of the children of this family had been vaccinated the previous year, and all of the others had light cases of varicella.

Diagnosis of Smallpox from Syphilis.—Occasionally it becomes necessary to differentiate smallpox from syphilitic eruptions. As health officer of this city (Augusta, Ga.) I have repeatedly been called upon to discharge this duty. With care and patience these diseases can be readily separated. Papular, vesicular, and pustular syphilides counterfeit the exanthem of smallpox. In either of these varieties of syphilitic eruption fever may coexist. Papular syphilides are devoid of the shotty feel