SMALLPOX AND CHICKEN-POX

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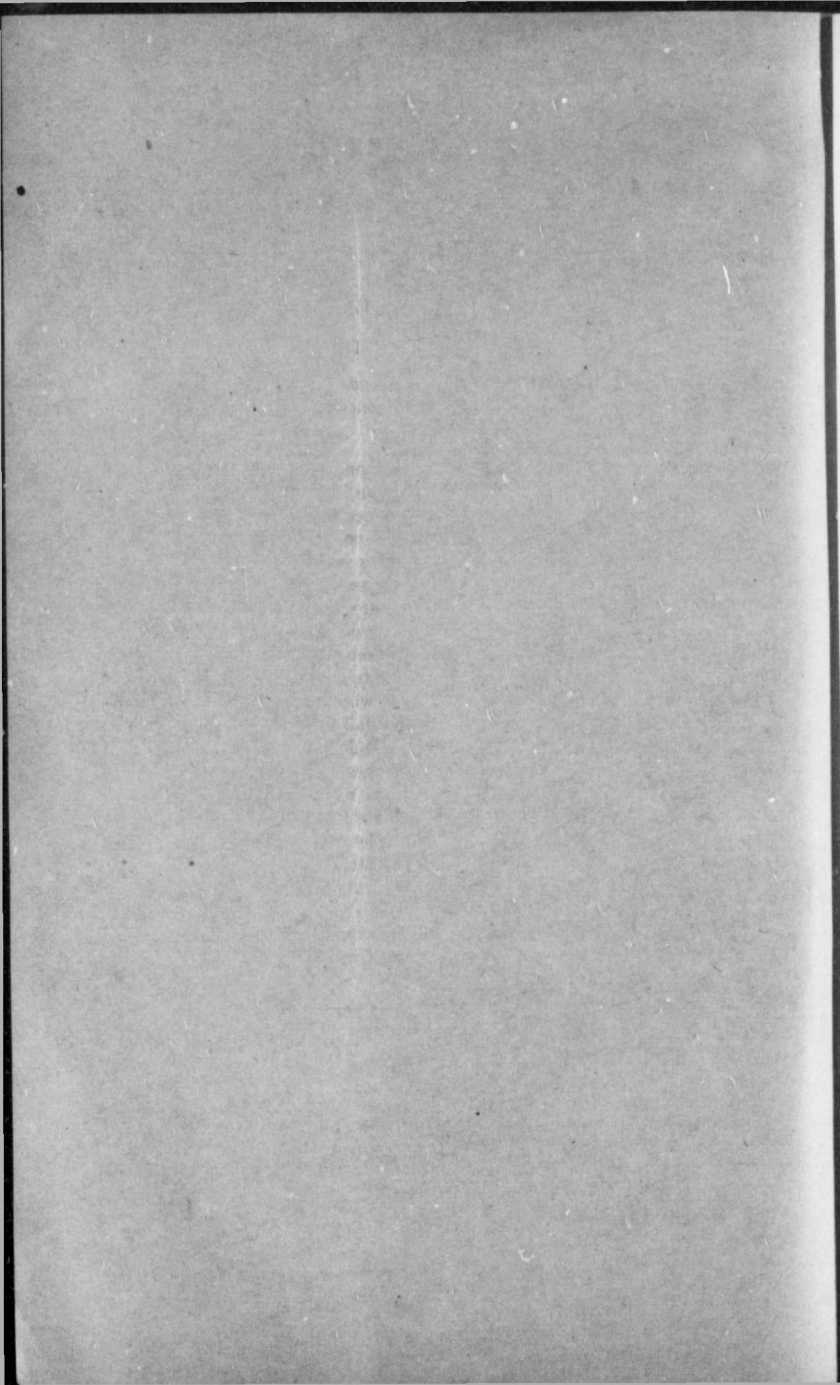

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THE spread of smallpox depends in part on wrong diagnoses; in part on concealment of cases; in part on the failure to report known or suspected cases; but chiefly on the neglect of vaccination. Mild cases often are confused with chicken-pox and, in general, many may not be seen by a physician unless a severe case calls for a general "round up," while many are never seen by physicians at all. Hence many alleged chicken-pox cases are smallpox and some alleged smallpox is really chicken-pox. The occasional failure to distinguish between mild smallpox and chicken-pox is due less to lack of information concerning smallpox than to unfamiliarity with, or disregard of, chicken-pox. The physician who has the chance to see either smallpox or chicken-pox should not fail to study minutely the lesions of the cases he encounters in correlation with the age of the lesions, especially during the acute stages.

Smallpox of the now prevailing type is regarded as a very trivial disease, because its physical injuriousness is far less than that of whooping-cough or measles; but from the standpoint of the future, its importance is enormous. Its existence means a large contempt for the disease, coupled with much disregard of vaccination.

The following figures* summarize the experience of Prague during twenty-one years with a severe type of smallpox; they need no comment:—Unvaccinated persons, 90,130; cases in unvaccinated persons, 7,642; deaths in unvaccinated, 2,224. Vaccinated persons, 3,005,578; cases in vaccinated persons, 8,178; deaths in vaccinated, 423.

Each 10,000 vaccinated persons yielded 27 cases and 1.4 deaths.

Each 10,000 unvaccinated persons yielded 830 cases and 247 deaths.

* Welch and Schamberg, "Acute Contagious Diseases."

The unvaccinated yielded, in proportion, 30 times as many cases and about 180 times as many deaths as did the vaccinated.

Clinical Types of Smallpox

Smallpox (variola) is one disease whatever its degree of severity. According to circumstances (the individual resistance of the particular patient, the individual virulence of the particular germ, and the size, probably also the frequency, of the dose) smallpox may affect different patients with different degrees of severity. Thus arise certain clinical types, with many degrees in each:

(*a*) Discrete smallpox, i.e., with the individual lesions well separated.

(*b*) Confluent smallpox, i.e., having the lesions fused together.

Most cases of smallpox show both discrete and confluent lesions. These terms are therefore relative, a discrete case usually showing some confluence and a confluent case usually showing some discrete lesions.

(*c*) Hemorrhagic smallpox, i.e., accompanied by hemorrhages into the skin. This is the type which is often called "black smallpox." Minor capillary hemorrhages are not infrequent in the severe types of smallpox and are usually unnoticed or disregarded. The term hemorrhagic is therefore also relative. The most striking form of hemorrhagic smallpox is that in which hemorrhages precede the eruption, death occurring promptly. Strictly speaking, these cases are *sine eruptione*, but only because the patient dies before the eruption has time to appear. The term *sine eruptione* is, in practice, restricted to cases in which the eruption fails to appear despite survival beyond the prodromal stage.

(*d*) Varioloid, i.e., smallpox modified as regards clinical symptoms by vaccination. Such modification occurs, first, when the absolute protection afforded by recent successful vaccination has partially run out, as it is likely to do after five to seven years from the date of vaccination, and secondly, when an unvaccinated person exposed to smallpox is vaccinated during the incubation period. If less than three days have elapsed since exposure, a successful "take" usually prevents an attack of smallpox entirely. If more than three but less than ten days have elapsed since exposure, a light attack (varioloid) is likely to supervene. If over ten days have elapsed, vaccination is unlikely to have any marked effect in modifying the subsequent attack.

Vaccination rarely takes in smallpox, if performed after the fever begins, and practically never, if performed after the eruption

appears. Ker states that a take following vaccination made for diagnostic purposes after the third day of the eruption conclusively eliminates smallpox. The proper thing to do is to vaccinate all exposed unvaccinated persons without regard to the time which is alleged to have elapsed since exposure.

(*e*) Abortive smallpox. A few persons are by nature wholly immune to smallpox. Some persons are by nature partially immune, sufficiently so to prevent the regular course of symptoms, but not sufficiently to protect them absolutely. In such persons, a very light attack with atypical lesions and quick recovery may occur. These cases are described as "abortive." Smallpox modified by artificial immunity (vaccination) is called varioloid; smallpox modified by natural immunity is called abortive.

(*f*) Smallpox without eruption. This form is probably due to a somewhat greater degree of partial immunity than that which yields the abortive form. The general disturbances, pain, fever, headache, etc., are similar to those of true smallpox, at least in the recognized cases, which are considered very rare. The chances are that abortive and *sine eruptione* varieties of smallpox are really not uncommon in smallpox outbreaks, just as similar forms of scarlet fever, diphtheria, measles, typhoid fever, etc., accompanying outbreaks of the latter diseases, are not uncommon, but these forms are usually unrecognized and therefore considered rare.

(*g*) Mild smallpox. This is as truly smallpox as are the types above described, and deserves equally a distinctive descriptive term. It presents difficulties in diagnosis only because of its mildness, not on account of any qualitative difference from the more typical strains. It is not varioloid, nor is it hemorrhagic, abortive, or *sine eruptione*. It is usually discrete, occasionally partially confluent.

Mild smallpox is true typical smallpox, but is "scaled down" in severity, in the number of lesions, and in duration. It does not "run to the time schedule" so closely as the more severe forms. The incubation period averages a day or two longer and is slightly more variable. The prodromal stage is often light, although also often severe, and is not usually observed to be as closely limited to two or at most three days as in the more severe forms. The lesions have the same relative distribution,* character and stages as the lesions of the severe type, but the duration of the different stages is apt to be shorter. Pustulation is moderate, light, or

*Provided there are lesions enough to furnish any basis for determining relative distribution.

even not appreciable and is not as a rule accompanied by marked secondary fever; crusting, decrustation, scabbing, etc., are relatively rapid in progress.

Too often the attempt is made to "size up" such a case on general principles and to regard it as not smallpox, merely because the symptoms are mild, the lesions few, and the course short. This policy throws all expert differentiation to the winds, abandons all exercise of professional observation, and adopts the lay attitude: "It is too mild for smallpox, therefore it is chicken-pox." As well might we follow the slogan of thirty years ago with regard to diphtheria: "The cases that die are diptheria; the others are not."

Differential Diagnosis of Smallpox

The most common differentiation called for is that between smallpox and chicken-pox. As German measles is to measles proper, and Duke's disease to scarlet fever, so is chicken-pox to smallpox—analogous to it, but wholly distinct from it. Neither protects against the other; neither ever produces the other; each breeds true. Clinically, the distinctions between mild cases of these diseases and their corresponding imitators are often somewhat difficult, to those whose experience is limited. *Both* diseases require intimate study, if reliable results are to be secured. In practice the most imporant points to consider in differentiating smallpox and chicken-pox are:—

1. History of association with frank cases within the incubation period.
2. Definite history of previous chicken-pox, smallpox, vaccination.
3. Date on which first fever, headache, etc., appeared.
4. Date on which lesions appeared.
5. Location of the first lesions noted.
6. Quantitative distribution of the lesions in relation to the covered and uncovered portions of the body.
7. Character of the individual lesions in correlation with the number of days they have been in existence.

In approaching the diagnosis of a doubtful case, the derivation of the present case from, or its ability to give rise to, a frank case, is extremely important, but such evidence may not be available. It also happens at times that the history concerning vaccination, the existence or character of prodromes or even the exact date of eruption is indefinite or unobtainable. In dealing with mild small-

pox, the history of a previous attack of chicken-pox or smallpox is often not very conclusive, since the previous attack, being subject to similar difficulties in diagnosis, may have been itself wrongly named at the time when it existed. Hence careful study of the distribution and especially of the character of the lesions themselves becomes of the greatest importance.

Differentiation of Lesions

On general survey the smallpox patient shows round lesions only,* not crenated at the margins, uniform in size, and unbroken. They are chiefly on the face and limbs. The chicken-pox patient shows round ***and oval*** lesions, usually crenated at margins, varying widely in size, and almost always more or less broken or disfigured; they are chiefly on the body.

On close examination the smallpox lesion is found relatively small, round, and, in the papular, vesicular, and pustular stages, very firm. It is deep-seated; the vesicles and pustules are therefore thick-walled, and consequently rupture only with great trauma; thus, very firm pressure and hard rubbing with the ball of the finger scarcely impress the smallpox papule, vesicle, or pustule at all. Of course it is ***possible*** to break the smallpox vesicle or pustule with the fingernail by firmly digging into the margin of the elevation. When this is done, the thick epithelial wall of the vesicle comes away, maintaining its shape, like the top of a neatly cut egg. In contrast, the chicken-pox vesicle, whatever its size, is like a half-balloon, thin-walled, tense, with clear contents, giving the "pearly" appearance, and is quickly broken down at the lightest touch, the collapsed wall being soft, flimsy, shapeless—a mere rag.

Naturally this differential point can be made use of only if intact vesicles can be found. This is seldom true in chicken-pox, if the eruption is of more than three or four days' standing, because the chicken-pox vesicles are so delicate that they are ruptured by the friction of clothing or other accidents, as well as by scratching. Hence, as a rule, very few or even no distended vesicles can be found in chicken-pox after the first two or three days, the lesions being either completely decapitated, showing merely small raw or crusted pits on the vertex of low, round, or oval elevations, or else pits of the same character, overlain by the macerated, opaque, white, shrivelled, wrinkled, empty, easily brushed off epithelial rag,

*The shapes of confluent lesions depend of course upon the number and position of the round lesions forming the margins of the confluent area.

representing the remnants of the previously distended and then, therefore, thin and transparent walls of the vesicle, now ruptured. The very fact that plentiful unruptured vesicles present themselves for examination is itself presumptive of smallpox, although this condition may be found in chicken-pox at times in the first day or two of the eruption. The presence of plentiful broken-down vesicles is itself strongly presumptive of chicken-pox. I have seen a plentiful crop of chicken-pox vesicles on the back which had been evacuated of their contents wholesale by rubbing the back firmly with oil or vaseline, at the height of the vesicular stage, to relieve itching. The oil or vaseline, rubbed in as the vesicles were emptied and smoothed down, had kept these "epithelial rags" in place and prevented them from drying out. The slippery oil prevented the examining finger from securing a foothold to dislodge the rag; and the vesicles, being already empty, could not be further emptied by pressure. This condition had led to the diagnosis of smallpox, on the ground that the "vesicles" were firm and resisted the efforts to break them down! It must be confessed that at a little distance the smooth, yellowish white caps, lying on the summit of the engorged bases of the vesicles, would have suggested at the first glance smallpox, but for their irregularity in size and shape. On close examination the differentiation was easy.

The reddened areolæ (halo) surrounding the pocks of the two diseases are often similar, but the smallpox areola (until secondary infection late in the disease may alter conditions) is generally narrow, and, since it surrounds a round lesion, is itself circular. The chicken-pox areola is usually wider, the depth of colour diminishes more gradually towards a more diffuse edge, and when the lesions are oval the areola corresponding to them is oval also. Finally the chicken-pox areola frequently, although by no means invariably, shows irregular flaming offshoots, which give the whole the appearance of a bright-red ragged star.

Some prevalent misconceptions concerning the differential diagnosis are:—

1. That chicken-pox occurs only in children. It is true that the vast majority of chicken-pox cases occur at or before twelve years of age, but cases in older children and even in adults are by no means uncommon. I have seen it in a woman of fifty-three; and in many young adults.

2. That smallpox does not invade the scalp. It is true that chicken-pox usually invades the scalp while smallpox sometimes does not, but the point is by no means final.

3. That smallpox alone invades the palms and soles. It is true that smallpox almost always invades the palms or soles, or both, but chicken-pox not infrequently shows one or more palmar or plantar lesions.

4. That smallpox alone presents lesions in the month. Almost every case of chicken-pox shows some mouth lesions.

5. That smallpox lesions are umbilicated (dimpled), while chicken-pox lesions are not. This last statement might be made almost without reservation, if confined strictly to the *vesicles* of the two diseases. But the umbilication of the smallpox vesicle disappears on pustulation (perhaps by liquefaction of the restraining bands which are supposed to produce the "dimple"), while the subsequent drying out of the pustule reproduces a pseudo-umbilication in the late pustular stage. The chicken-pox vesicle, being swept off or broken, leaves the slightly pitted summit of the papular base of the vesicle exposed. On drying, and especially after crusting, the lesion thus evolved often presents a certain dimple, sometimes mistaken for umbilication. This "umbilication" is wholly different in stage, cause, and structural features from the true umbilication of the smallpox vesicle, and should never be confused with it. It is not even analogous to the secondary umbilication of smallpox, for in the latter the epithelium covering the pustule is still intact, although dry.* Occasionally, one or more chicken-pox vesicles, at an early stage, may show a light dimpling, or even umbilication. A diagnosis should never be based on the condition of one or two lesions, but on the prevalent type. I have seen generalized vaccinia, developing eight days after vaccination, diagnosed by high authority as smallpox, and by other high authority as chicken-pox, both errors depending on attaching too much importance to the peculiar character of one or more lesions, while overlooking the predominant characteristics of the predominant type.

Occasionally chicken-pox vesicles of the forehead and especially of the palms or soles, may be found more deeply seated or having over them a tougher epidermal covering than usual. The only lesson of this fact is, that the lesions of the face, palms, and soles should not be used for the testing of the differential points.

Differential Diagnosis of Severe Smallpox, Mild Smallpox, and Chicken-pox

The case of SMALLFOX will show:—

*It is stated by J. M. Armstrong that smallpox *papules* under moderate magnification show umbilication also.

1. An incubation period (i.e., from exposure to earliest symptoms—not to eruption) of practically twelve days (in mild smallpox fourteen days). The incubation period can be determined accurately only in cases where known exposure occurs on a given date, with no exposure before or after, the date of earliest symptoms resulting from such exposure being also definitely fixed.

2. No definite history of previous attack of smallpox. When mild smallpox has prevailed for years, often confused with chicken-pox, and *vice versa*, this history is of little account, especially when the previous diagnosis was made, as often happens, by the laity. Examination for healed pits should be made. Round pits indicate smallpox; oval pits, clean cut, indicate chicken-pox. Confluent smallpox may yield pits of irregular shape. In mild smallpox, and in chicken-pox, pits of any kind may be few and small. Second attacks of smallpox are very rare although they are not unknown.

3. No history of successful vaccination within five to seven years. Careful examination for vaccination scars should be made.

4. Prodromes, lasting two or, at most, three days, headache, backache, fever, epigastric pain, chills, sudden severe onset. Mild smallpox sometimes presents very indefinite and trivial prodromes. When definite, a history of three or four days or more of prodromes may be offered. (See 5.)

5. First signs of eruptions on third or fourth day of attack. In mild smallpox the earlier eruption, when sparse, is often unnoticed for a day or so, thus prolonging the *observed* interval between onset and eruption.

6. Eruption beginning on face and wrists. In mild smallpox, the lesions are sometimes so few that the earliest ones are overlooked until the full crop has appeared.

7. Eruption most profuse on skin not covered by clothing, i.e., face and wrists; also the legs, despite the covering of the latter. In mild smallpox, with very sparse lesions, there may be too few lesions to permit any real comparison of relative abundance at different points.

8. Palms and soles often attacked. In mild smallpox, one or two lesions in one palm or one sole may be all that can be found in these locations.

9. Eruption develops in one crop, the lesions appearing steadily for twenty-four to forty-eight hours; the face lesions usually further developed than the body lesions. In mild smallpox aborted lesions, i.e., not following out the regular stages, are sometimes found.

10. ***Lesions round at all stages.*** Margins not crenated. All those of the same stage of development are usually of the same size.

The stages are:—(*a*) "Flea-bite" macules, each lasting twenty-four hours, exist during the first day of eruption (third day of disease). With the appearance of the eruption, the systemic symptoms improve; but with very mild prodromes, this improvement can hardly be observed. (*b*) "Shotty" papules (pimples), each lasting twenty-four hours, exist during the second day of the eruption (fourth day of disease). (*c*) Umbilicated "shotty" vesicles (blisters), each lasting twenty-four to seventy-two hours, exist during the third to fifth day of eruption (fifth to seventh day of disease). (*d*) Firm opaque pustules, each lasting four to six days, exist during the sixth to twelfth day of eruption (eighth to fourteenth day of disease). With pustulation, the secondary fever begins, but in mild smallpox pustulation is usually very innocuous and little or no secondary fever is observed. (*e*) Firm crusts appearing about the thirteenth day of eruption (fifteenth day of disease). Secondary or pseudo-umbilication, due to drying, may be found about this time. (*f*) Dense scabs and deep-seated, tenacious, "mahogany" plaques—the latter still covered with the original epthelial wall of the pustule, now flattened out again—developing as drying out continues. They are variable in duration lasting many days or weeks in severe neglected cases. In mild smallpox the absence of severe pustulation often obviates the formation of the deep-seated tenacious plaques. Those formed are rather superficial and are removable without great difficulty. It is to be noted that as some lesions develop earlier than others it is possible to have, during the first twenty-four to forty-eight hours of the eruption, macules and papules, and even vesicles together; during the next twenty-four to forty-eight hours papules, vesicles, and pustules; thereafter, however, vesicles and pustules alone, later followed by pustules and crusts, will be found; finally, crusts, scabs, and plaques, leaving pits as they disappear. In mild smallpox, aborted lesions sometimes add to the variety of conditions presented.

11. Pitting, especially following marked pustulation, is deep and permanent; the pits are red for months, then white. Unless extended by impetigo, or fused by confluence, the pits are round. Mild smallpox yields few and small pits only, as a rule.

The case of CHICKEN-POX will show:

1. Incubation variable, but from two weeks to seventeen days as a rule (see smallpox 1).

2. No definite history of a previous attack of chicken-pox (see smallpox 2).

3. A history of successful vaccination within five to seven years,

or a definite history of previous smallpox, practically eliminates smallpox, and therefore admits the possibility of a diagnosis of chicken-pox; absence of history of one or other or both of these does not, of course, eliminate chicken-pox.

4. No history of prodromes usually; if any, chiefly in adults, and for not over twelve hours preceding the eruption.

5. First signs of eruption *noticed* in first twenty-four hours of illness, i.e., the systemic disturbance is usually synchronous with or immediately precedes eruption.

6. Eruption beginning on back, chest, or face.

7. Eruption most profuse on skin covered by clothing, i.e., on the body.

8. Palms and soles may sometimes show lesions, less constantly and less abundantly than in smallpox, however.

9. Eruption appearing in successive crops, on successive or alternate days.

10. *Lesions round and oval*, with much variation in diameter, even at the same stages of development; margins often crenated (scalloped). Each crop passes quickly though the following stages: —(*a*) Macules, each lasting a few hours. (*b*) Soft, superficial papules (pimples), each lasting a few hours. (*c*) Clear, thin-walled, tense vesicles (blisters), each lasting a few hours. These are easily destroyed and leave then "cupped" or "pitted" elevations, raw, red, and weeping, but quickly crusted. When the vesicle is ruptured, without total removal of the cap, a white, opaque, shriveled rag of epithelium, lying more or less loosely over the pit, remains. (*d*) Theoretically, pustules follow. Practically, the vesicles are almost always destroyed before pustulation can occur. But I have seen a vesicle, on the back of a finger, and preserved from rupture by a plaster cast, develop into a tense, thin-walled, oval, half-balloon pustule, nearly a quarter of an inch long. (*e*) Crusts, lasting a shorter or longer time according to treatment, etc. Each crop completes its cycle in two to four days. In the first week macules, papules, vesicles, intact or broken, and crusts may be found together. Thereafter the earlier forms disappear, and in the second week crusts alone or in great predominance are found. The older lesions are very often complicated by presence of impetigo.

11. The pits are few and superficial, often oval. When extended by severe forms of the impetigo, which so commonly affects chicken-pox lesions during and after the second week, the pits may be irregular in outline.

General Observations

In smallpox the worst systemic disturbance and suffering are often found during the prodromes, and improvement, if only temporary, follows closely on the appearance of the eruption. Severe prodomes may be followed by either mild or severe eruption; mild prodromes, usually by mild eruption. The extent of the eruption on the face is a fair index of the general severity of the attack. In chicken-pox the practical absence of prodromes means that the first appreciable systemic disturbance, if there be any at all, begins with the eruption and continues for a few days thereafter.

In smallpox itching during the early stages of the eruption is not usually a marked symptom; nor does scratching injure the lesions much, on account of their deep-seated and tough-walled character. In chicken-pox itching is highly characteristic, and since the relatively superficial and thin-walled lesions are very fragile, they are easily destroyed, not alone by scratching, but by every form of contact. This feature is in itself of very strong diagnostic import.

In smallpox the thick walls of the pustule permit comparatively little evaporation; the pustule, in shrinking, shrinks into the skin, and a hard, opaque, brown, very tenacious scab is often formed. This is especially true of the lesions of the extremities, particularly of the palms and soles. In chicken-pox the vesicle, if not wiped off or collapsed early, shrinks by evaporation to a brittle, but still somewhat elevated cap, very easily broken off or dislodged. In mild and abortive smallpox and in varioloid similar caps are at times found on the *body*.

*General Differential Diagnosis of Smallpox**

During the invasive stage, and before the appearance of the prodromal rashes, the diagnosis must be made from other infectious diseases having an acute onset, i.e., measles, scarlatina, typhus, influenza, etc. Diagnosis at this stage depends primarily upon the presence of an epidemic, and the history of exposure within the appropriate incubation period. In the case of the diseases indicated below, the following points should also be considered:

SCARLATINA. With rash absent or "missed." Condition of tongue, cervical lymph-glands, tonsils, nose discharges, injection

*Modified from A. E. Thomas, "Public Health," Vol. xx.

of soft palate (enanthem), circumoral pallor, history of vomiting and sore throat. Backache, absent or slight.

Measles. Coryza, photophobia, lachrymation, Koplik's spots, backache absent or slight.

Typhoid Fever. Although this has not an acute onset, many cases when smallpox is rife are reported as smallpox. Attention should be paid to the gradual rise of temperature at onset, "step ascent" on the chart; early epistaxis or deafness, not common; Widal reaction; tympanites; condition of the tongue; spleen, stools.

Influenza. Here the diagnosis may be impossible until the time interval for the appearance of the rash has passed. The muscular soreness and prostration are both generally much more exalted in influenza than in smallpox. The history of exposure and the presence of an epidemic are of special importance here. The bacillus may sometimes be isolated from the sputum.

Meningitis. The history, with the presence of a possible cause, e.g., suppuration of the middle ear or a tuberculous focus in a lung, is important. The subsequent course, with the attending palsies, generally clears up the issue. Backache is uncommon.

Cerebrospinal Meningitis. Retraction of the head; rigidity of the neck muscles; Kernig's sign; possible presence of the coccus in the nasal discharge or in the fluid obtained by lumbar puncture.

After the appearance of the rash the diagnosis must be made from the following:—in all stages, chicken-pox, acne, syphilis, drug eruptions, glanders, scabies, lupus, especially on the face; in the papular stage, prodromal rash of measles, erythema nodosum, lichen planus; in the vesicular and pustular stages, herpes, erythema iris, and erythema bullosum; in the pustular stage, impetigo and pustular scarlet fever.

"Minnesota Method" of Controlling Smallpox

Much misunderstanding exists as to this method. It is commonly stated that "nothing is done for smallpox, there is no quarantine," etc., all of which is error. Under the regulations, the chief steps taken are:—

1. The patient is isolated in a suitable place, preferably with a vaccinated attendant.

2. All persons exposed to him on and after the date of earliest symptoms, at home, at work, etc., especially school children, are examined.

3. Of those exposed to the patient, all who can *prove* successful vaccination within seven years, or a previous attack of smallpox, may be dismissed. Those remaining must be vaccinated at once, or go into isolation for three weeks.

4. The premises where the smallpox patient is confined must bear a warning placard indicating that smallpox exists there.

5. Persons vaccinated successfully within seven years, those who have had smallpox, and those who, failing either, submit to immediate vaccination, may enter or leave the placarded premises without restriction.

6. Persons not thus protected, may enter the premises, but must then stay there, unless they become vaccinated.

7. In epidemics, teachers and children who have not been vaccinated, and who have not had smallpox must be excluded from school for three weeks.

These methods are so simple, just and efficient, placing the penalties only on those who refuse to be vaccinated, and removing all restrictions from those who submit, that they have been adopted gradually over wide areas in the United States. The carriage of smallpox by "third parties" is rare; vaccinated students are given every opportunity to see smallpox, and thus learn to make the diagnosis. Hundreds of students thus see the disease every year without instances of carrying the disease occurring.