T H E S I S

for
M. D. Degree

SMALLPOX.   A clinical study of about 2,000 cases

of the disease.

by

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D.P.H. (Camb.) 1901

October, 1905.

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LONDON, S.E.

INTRODUCTION.

During the recent epidemic of Smallpox in London
the following method of dealing with cases of the disease
was followed. The patient was removed by ambulance to the
Receiving-station of the Metropolitan Asylums Board, sit-
uated at South Wharf, Rotherhithe. There the patient
was examined by one of the Medical Officers of the Board,
and the diagnosis was either confirmed or revised. In the
former case the patient was at once placed on board an
ambulance steamer and conveyed down stream to the Hospital
Ships, moored at Long Reach, or to the Long Reach Hospital,
which is a temporary structure built on the river's bank
alongside of the Ships. There those patients who were
dangerously ill were detained, and the others were trans-
ferred as rapidly as possible to Gore Farm Hospital about
four miles inland. There they remained until the termina-
tion of the disease by recovery or death. Consequently,
all cases, except the rapidly fatal haemorrhagic and con-
fluent vesicular, passed rapidly through the Receiving
Station and Hospital Ships to Gore Farm Hospital. Local
cases arising in Dartford and in other places in the vic-
inity of Gore Farm Hospital were admitted direct to that
Hospital./

Hospital. These local cases numbered 532, and it is these that I propose specially to discuss, as they were the only cases which I had an opportunity of observing throughout their whole course. The statistics I have prepared refer exclusively to these cases. I am aware that for statistical purposes the number is very small, but they are the only cases of which I have a continuous record. My observations on the later stages of the disease and on treatment are drawn from a larger experience derived from the treatment of about 2,000 cases in my own wards.

For permission to record these cases I am indebted to the kindness of Dr. Frederick Thomson, Medical Superintendent of Gore Farm Hospital.

As in the other eruptive fevers the course of the disease may be divided into the following stages:-

1.   The latent period or period of incubation.

2.   The period of invasion.

3.   The eruptive period.

1.   <u>The latent period or period of incubation</u>.
This period commences at the moment of infection and ends on the appearance of the first symptom of intoxication. During this period a combat is proceeding between the vital protective forces of the individual and the small-pox/

smallpox virus. There is no outward manifestation of the struggle, and the infected individual presents neither subjective nor objective symptoms. The first manifestations of the disease appear when, the invading organism getting the upper hand, it manifests its presence by the usual symptoms of intoxication. The exact duration of this period was in many cases difficult to determine, as smallpox was widely dispersed over the district, and the individual source of infection difficult or impossible to trace. When, however, several cases occurred in the same family, or in the same house, the history was often clear, and pointed to twelve days being the almost constant duration of this period. In a few cases the period was as short as eleven and as long as thirteen days.

2.   The period of invasion. The latent period being over and the virus having gained the day, the first symptoms of intoxication appear. The onset is usually sudden, but is occasionally insidious. On the first day the temperature rises suddenly and to a considerable height, usually reaching and often exceeding 103° F. On the second day it may reach a little higher and remains elevated, with only slight morning remissions, throughout the whole period of invasion; but on or shortly after the appearance of the true eruption it rapidly subsides. The usual febrile symptoms/

symptoms of thirst, anorexia, hot moist skin, often with profuse sweating, lassitude, constipation, and full, rapid pulse, are well marked. Delirium in this stage is not uncommon. It is usually of the quiet muttering character, and is aggravated at night, or it may be confined to the night time. It is merely a febrile manifestation, and, except in very severe cases, passes off with subsidence of the temperature. The aspect of the patient during this stage is suggestive and worthy of note. He lies on his back with dull listless expression, taking little notice of his surroundings, and apparently caring little what happens to him. The muscles of expression are lacking in tone, and the lines of his face are more or less smoothed out. He is dull and apathetic, and his cerebration is sluggish, the reaction time being lengthened. His expression corresponds somewhat to that seen in the early stages of general paralysis of the insane. When spoken to, he is slow to understand, and his answers are rather laboured. If asked to hold out his hand, or to protrude his tongue, he does so slowly and with a considerable amount of tremor. This aspect of the patient, combined with a reliable history of contact, is very suggestive of smallpox. Besides the usual accompaniments of fever, there are other more or less constant initial manifestations. A careful analysis of the initial symptoms in the series of cases I am considering gives/

gives the following percentage incidence:-

Headache	91·4%
Backache	74·2%
Nausea	65·5%
Vomiting	45·5%
Pains in Limbs	31·4%
Vertigo	20·5%
Abdominal pain	20·0%
Abdominal tenderness	14·2%
Rigors	8·5%
General myalgia	2·8%
Diarrhoea	2·8%

The headache is usually frontal, but may be occipital or parietal, and is variously described as boring, throbbing, or as a continuous ache. It varies greatly in intensity. It is aggravated by movement. Backache also occurs in all degrees of intensity, sometimes being so severe as to cause the patient to shout and roll about in agony, at other times amounting to no more than aching and stiffness. The pain is usually lumbar or sacral, and may shoot down the thighs.

When vomiting occurs, it is usually severe, and may be accompanied by much retching.

With the exception of backache and vertigo, the incidence of these initial symptoms does not appear to me to/

to be greater than in other acute infectious diseases,
e.g. Scarlet fever. Backache again is at least equally
common in influenza. For these reasons the diagnostic
value of these symptoms alone appears to me to be slight.
If, however, they are supported by a history of contact,
and especially if accompanied by one of the initial rashes
about to be described, their value is greatly enhanced.
This stage ends with the appearance of the smallpox erup-
tion and simultaneously with or shortly after its appear-
ance the temperature falls, the pains and other distressing
symptoms abate, a sense of comfort is experienced, restful
sleep is obtained, and, except in severe cases, the patient
feels as if his illness was over. The duration of this
stage is remarkably constant. In the vast majority of cases
the eruption appears at the end of the second or beginning
of the third day. I have seen it as short as 24 hours,
and in one case, in which the history was apparently re-
liable, the rash did not appear until the seventh day of
invasion.

Initial rashes.   During this stage early or
initial rashes may occur. Broadly, they conform to three
types, viz., 1. Erythematous; 2. Haemorrhagic or purpuric;
3. Mixed rashes.

1.   Erythematous Initial Rashes. These rashes usually
appear/

appear towards the end of the first or during the second day of invasion. They are essentially evanescent and on disappearance leave no staining. They are not raised above the level of the surrounding skin. They appear to be of relatively infrequent occurrence, although, considering their transient character, they may be more common than examination of patients on admission to hospital leads one to suppose. In many cases they may have come and gone before the patient is admitted, and their presence would probably escape the notice of the unobservant smallpox patient. These rashes are usually of favourable omen. In 532 consecutive cases, initial erythemata were observed in seven cases only. These seven patients developed discrete attacks and they all recovered. Two distinct varieties of this initial erythema occur.

A. <u>Simple diffuse erythema</u>. This may be general or partial. The intensity of the erythema varies considerably but is usually slight. I am here leaving out of account the vivid brick red or lobster red erythema which ushers in the rapidly fatal toxaemic form of the disease. The erythema is nonpunctate differing therein from the erythema of Scarlet Fever. It fades completely on pressure, and when pressure is removed returns as a general blush and not in the fine discrete points or punctae which so characterise the rash of/

of Scarlet Fever. The erythema tends to be symmetrical, but is usually more pronounced on one side of the body than on the other. It may fade rapidly in one place and appear again in another. It shows a preference for certain situations notably the exterior surfaces of knees and elbows, the dorsal aspect of the wrists and feet, the dorsum of the great toe and the inner side of the foot. Apart from the vivid erythema of the highly toxaemic variety, I have not seen a general erythema affecting face, trunk, and limbs, but it may be distinguished from Scarlet Fever by its simple nonpunctate character and the absence of peeling tongue, faucial congestion, and gland swelling.

B. Scroll-like erythema. This bears a superficial resemblance to the erythema of measles and has been described as morbilliform. In its pink colour and blotchy character it certainly somewhat resembles the erythema of measles but there the resemblance ends. It differs from the erythema of measles in the essential point that it is not raised. If the observer closes his eyes and passes his finger lightly over the surface he is unable to determine when he has passed from an area of affected, to one of unaffected, skin. This erythema has been well described as a meshwork. The strands of the meshwork are large and broad, while the meshes are relatively small. The whole arrangement of the erythema is/

is more regular than in measles, and it attains its full development and spreads over the body more rapidly than in the latter disease. Coryza, sneezing and cough, so constant in measles, are absent, but there may be considerable suffusion of the eyes. Koplik's spots are absent.

In many cases these initial erythemata do not present any very marked or distinctive features and although, in cases of acute febrile nature, especially if combined with a history of contact, they would strongly suggest the possibility of smallpox, an absolute diagnosis could not be made until the appearance of the specific eruption.

2. _Petechial initial rash_. This is a more frequent, more characteristic and graver initial manifestation than the erythematous variety. It appears on the first or second day of disease, and consists of/extravasations of blood into the skin. On their first appearance these extravasations are discrete and form minute petechiae, but when closely set, as they increase in size their edges coalesce and irregular confluent patches are formed. When large, they may be slightly raised. In describing this rash, three points call for special consideration, namely, the number of foci, their shape and colour, and their distribution. The essential characteristic of this rash is that, although the elements may fade slightly, they do not disappear on pressure.

The number of foci. This varies within wide limits.
There may only be a few small very discrete petechiae
scattered irregularly over the surface of trunk and limbs,or
the number may be very large, producing large confluent
patches in the groins, and more discrete but still numerous
lesions on trunk and limbs,and especially in the axillae.
Between these two extremes all degrees of profusion are seen.

Shape and colour. Two varieties of petechiae are met
with. There are small bright red petechiae, usually circular
in outline, with sharply defined margins and seldom exceed-
ing in size a small split pea. They are invariably discrete.
The other variety consists of maroon or purple petechiae of
irregular shape, and varying in size from small petechial
points,like the bites of the body louse,to irregular purple
spots almost as large as a sixpence. Coalescence of these
larger petechiae often occurs,producing large purple patches
with irregular margins. These two varieties often occur
together, the bright red petechiae being interspersed amongst
the dark purple ones,and producing patches of reddish purple
hue, in which, however, the two separate elements can be
readily recognised. When the petechiae are numerous, of
large size and dark hue, they persist for some days after
the appearance of the specific eruption. They gradually
become lighter changing through grey and brown to yellow.
This/

This persistence enhances the value of these rashes as diagnostic signs. The colour of the petechiae is probably due to their depth in the skin, the extravasations of blood extending deeply being darker than the more superficial ones.

Distribution. Whilst the petechiae may occur on any part of the skin, they have distinct sites of election, showing a marked preference for the flexures, notably the groins and axillae, and, less markedly, the popliteal spaces and flexures of the elbows. By far the most frequent seat is the groins. There they cover a roughly triangular area. The triangle is inverted with its apex between the thighs at a point 2 to 3 inches below the perinaeum. The outer sides are fairly regular and extend outwards and upwards parallel to Poupart's ligament, to the neighbourhood of the great trochanters. The base consists of a more or less curved line extending across the abdomen at varying levels between the symphisis pubis and the umbilicus. The base is much less regular than the sides, and small scattered petechiae may be seen extending up to or even beyond the umbilicus. This area has been aptly described as "the bathing-drawers area." The petechiae frequently extend upwards with gradually diminishing intensity over the iliac crests and flanks, becoming more and more sparse as they reach the sides of the chest, where they may cease, to appear again in the axillae or/

or there may be a continuous series of petechiae from groin to axilla. In the axilla they affect all the walls of the cavity, extending on to the inner aspect of the arm and on to the skin covering the pectorales and latissimus dorsi muscles, so that on approximating the arm to the chest wall, groups of petechiae are seen both in front of and behind the arm. The extreme apex of the axillary cavity appears to be exempt from petechiae. I have never seen them in this situation in spite of careful search. In addition, there may be scattered discrete petechiae on neck, trunk and limbs. The small bright red petechiae may occur alone, and are then sparsely distributed over trunk and limbs.

3. <u>Mixed erythematous and petechial rashes</u>. Whilst a hard and fast line can be drawn between the erythematous and the petechial rash, the former disappearing on pressure and returning more or less rapidly when the pressure is removed, the latter being practically unaffected by pressure, cases occur in which both varieties of rash are present at the same time and even on the same area of skin. The erythema is usually partial, appearing in patches in groins, axillae, chest, back, forearms and legs. Dotted over the surface of the erythematous patch are petechiae varying in number, colour and size, but generally more profuse towards the centre than at the periphery of the patch. The erythema and petechiae/

petechiae have the characters already described. Naturally
the erythema disappears first, and leaving no stain, the
rash assumes the character of a simple petechial rash.
Mixed or petechio-erythematous rashes occurred in 10.7%
of the cases showing an initial rash.

In addition to these rashes, I have observed a condition
in half-a-dozen cases which I have not noticed in any other
disease. This consists of a circular patch of erythema
about $2\frac{1}{2}$ inches in diameter, lighter in colour at the edges
than in the centre, with a wheel 3 to 4 lines in diameter
of oval or circular shape occupying the centre of the patch.
There was a single patch in 5 cases, and two in the sixth
case. They were situated on the front of the chest in every
case except one, when the patch appeared on the back. They
appeared on the 3rd to 4th day and lasted about 24 hours.
Whether they possess any special significance, I know not.

3.   The Period of eruption. In the great majority of
cases the specific eruption appears in from 48 to 72 hours
after the onset of the initial symptoms. In 12 out of 532
cases i.e., in 2.2% the eruption appeared within 24 hours.
It is worthy of note that 11 of these cases developed modi-
fied discrete attacks and the 12th a modified confluent
attack. All 12 cases recovered. This seems to point to a
shortening of the period of invasion as a result of a partial
immunity/

immunity to the disease. The numbers, of course, are too small to warrant any definite conclusion being drawn. In a considerable number of cases, the appearance of the eruption was delayed until the 4th day, and in a few cases until the 5th. In one case, with an apparently reliable history, the eruption did not appear until the 7th day.

I propose first of all to describe the individual unmodified lesion, pointing out any variations due to its situation. I shall then describe the changes produced in the lesion by the presence of a partial immunity to the disease, and by other general and local conditions. The distribution of the lesions will next be considered, together with the factors which may disturb this distribution. This will simplify the description of the several types of the disease and prevent needless repetition.

Characteristics of the unmodified lesion.

A. On the skin.

The lesion appears first as a macule, and passes with great regularity through the successive stages of papule, vesicle, and pustule, eventually drying up, unruptured, or rupturing and forming a crust from the exuded contents of the pustule. After a varying period the crust or scab separates, leaving exposed a dull red, more or less glistening surface. The duration of each stage is very constant and, provided/

provided no disturbing factor is present, the lesions in proximity to one another are all at the same stage in development.

The macule. The macular stage is very short and usually escapes observation. The macule is a tiny red spot, not elevated above the surface of the surrounding skin, and disappearing on pressure. Very soon, within a few hours of the appearance of the macule, cell proliferation commences and the macule becomes a papule.

The papule. The papule is dull red in colour, hard, and distinctly raised. On stretching the skin over a hard underlying structure, as can be readily done on the forehead, and drawing the finger along the extended skin a distinct shotty feeling is experienced. If the papules are very numerous and closely set one against the other, the sensation conveyed to the finger is like that produced by drawing the finger over a piece of dressed pigskin. The papule steadily enlarges, each papule on a limited area of skin keeping pace with its neighbours until the spots appear distinctly raised on inspection alone. On grasping a papule between the finger and thumb it is found to be hard and unyielding and deeply embedded in the skin, which latter point is of great importance in diagnosis. The papule is conical, but not acuminate, having a distinctly rounded apex. The papular stage/

stage is also of short duration and within 24 hours of the appearance of the eruption vesiculation has commenced.

The vesicle. A small amount of clear serum is exuded, the corneified layer of epithelium is raised, and a small clear vesicle is formed on the summit of the papule. This steadily and uniformly enlarges,until in 5 days from the appearance of the eruption the vesicle is mature, and has replaced the papule with the exception of the base on which it rests. It greatly exceeds in size the papule from which it developed. When fully matured,the vesicle is circular with sharply defined margin, a clear glistening pellicle, of dull pearl colour, and with a distinct pink areola. In many of the vesicles,a distinct depression or dimple is formed at the summit, the depth of this depression varying in different vesicles. This dimple is termed the umbilicus, and the process is called umbilication. It is by no means a constant feature. In many cases this condition is entirely absent, and in those which show the condition,there is great variability in the number of lesions affected. Although vesicular and with distinctly fluid contents, the walls are stout, very considerable pressure being necessary to rupture them. They will withstand firm pressure between the finger and thumb. This is a very important point in the differential diagnosis between the lesion of smallpox and that of varicella. About the 5th day

a/

a slight milkiness or opacity appears at the summit of the vesicle, and radiating yellowish striae are seen extending towards the periphery. Gradually the vesicle becomes uniformly cloudy and then yellow, and by the end of the 8th or on the 9th day, the vesicle has become a fully developed pustule.

The Pustule. Although histologically degenerating, the lesion continues to increase in size. As it enlarges, it becomes more prominent and domeshaped, and the umbilicus, if present, disappears, the dimple being pushed out until the summit becomes perfectly regular. The walls become thinner, and the lesion is more easily ruptured. By this time inflammatory reaction has set in and the pustule is surrounded by a reddened, indurated, angry-looking areola of varying width. The pustule is now a miniature abscess, inflammatory reaction has set in, and if the contents of the pustule are not liberated, cellular degeneration takes place in the cutis vera, protective hyperplastic change takes place in the connective tissue, new fibrous tissue is formed, and subsequent scarring takes places on contraction of the fibrous tissue. Accompanying, and as a consequence of the inflammatory reaction, there is considerable oedema of the surrounding skin, especially on the face where the connective tissue is loose. The eyelids are so oedematous that they cannot be opened, and in a case with copious eruption and much/

much reaction the features are so altered that the individual is unrecognisable. By the end of the 8th day the pustule is fully matured, and in 2 or 3 days the final stages of rupture and desiccation of the exuded contents or desiccation without rupture takes place.

Desiccation. Whether or not rupture takes place depends largely on the nature of the overlying cuticle. Where the cuticle is thin, as on the face, and where the pustule is exposed to friction, rupture and heaping up of the yellow contents takes place. Where on the other hand the cuticle is thick and horny, as on the palms and soles, desiccation without rupture occurs, and dark brown spots result which are only slightly elevated and with well-defined margins. The crusts on the face are usually large, of bright yellow colour, heaped up in the centre, and with irregular margins. On the trunk and limbs the crusts are smaller, and more flattened, and sometimes lie at a lower level than the surrounding indurated areola, producing an appearance which has been aptly likened by Kaposi to a jewel in its setting.

Separation of crusts. In 2 or 3 days, in most cases, the crusts separate, and a pigmented patch of the colour of raw ham is left. When the inflammatory process has extended into and destroyed portions of the cutis vera, small ulcers may be left. More frequently a layer of fresh epithelium has formed under the crust, and flat or slightly raised reddish patches are/

are exposed. No permanent pitting results unless portions
of the true skin have been destroyed. The pigmentation
lasts for some months in severe cases. The pigmentation
gradually disappears, and the skin returns to its normal
state after varying intervals of time, except in those
cases when the true skin has been destroyed. In these
latter cases, the new fibrous tissue contracts, and white,
depressed, and often foveated scars are left.

B.   On Mucous membranes.

The lesion on mucous membranes passes through the same
process of development, but, on account of the structure in
which it occurs, the various stages are shortened and less
well-defined. Vesiculation soon takes place, pustulation
rapidly follows, and by the 5th or 6th day the thin pellicle
is ruptured, and a shallow ulcer remains instead of the crust
which is seen on the skin. These ulcers soon heal. The
extent to which the mucous membranes are involved is directly
proportionate to the profusion of the skin eruption. The
following mucous membranes may be involved:- buccal, lingual,
palatal, tonsillar, nasal, laryngeal, tracheal, conjunctival,
rectal, and vaginal. The ocular conjunctiva may be the seat
of lesions, but never the cornea. If the eruption is profuse,
there is, on the occurrence of pustulation, much accompanying
oedema and consequent narrowing of mucous passages.

<u>Variations in the lesion due to its situation.</u>

The characters of the lesion vary according to the portion of skin in which they develop. This appears to be due mainly to the histological character of the skin in the part affected. On the face, forearms, legs, backs of the hands, and dorsum of the foot, the cuticle is thin, and offers less resistance to distension by fluid than does the thicker skin on the back and thighs and the cornefied epidermis of the palms and soles. Consequently in these former situations the lesions are larger, more prominent, and more domeshaped. Lesions on trunk and thighs are smaller, more flattened, and, in the pustular stage, show less inflammatory reaction. The lesions on palms and soles present certain definite and constant features. These features, however, are not absolutely diagnostic, as they may also be observed in chickenpox. Very early in the eruptive period, their presence may be demonstrated and their position localised by tenderness being complained of at certain spots on drawing the finger firmly over palms and soles. There are also subjective sensations of pricking and tension. Very soon pink slightly-raised spots are seen. With the aid of a lens, these spots are noticed to present a ringed appearance roughly resembling a rifle target. What corresponds to the bull's eye of the target is occupied by a circular dusky red spot. The inner is represented by a narrow opaque whitish/

whitish ring separating the bull's eye from the outer ring.
The outer ring is less regular than the others, and consists
of a pink areola of varying width, with an irregular margin
fading away into the normal skin. The histological explana-
tion of these appearances is probably as follows: The central
red spot consists of the developing papule and the outer
ring is the areola which surrounds all smallpox lesions.
The inner whitish ring is probably a band of local anaemia
produced at the inner margin of the areola by the pressure
of the firm papule pushing its way through the hard and
tightly bound-down epidermis. When vesiculation has
occurred, the central spot becomes larger and of a dirty
greyish colour, and the contrast in colour between the red
centre and the whitish inner ring being lost, the latter
can no longer be distinguished. The lesion now consists of
a greyish centre surrounded by a pink areola. On the occur-
rence of pustulation, the centre becomes dull yellow in
colour, and the simple areola is replaced by a band of
inflammation. When pustulation is complete, these lesions
do not rupture, but the contents dry up in situ forming
yellow or chocolate brown cores or seeds. Some of them
dry up very slowly, and on digging out the seeds in the 4th
or 5th week, the contents may be found still semifluid and of
a pale straw colour. These lesions are just perceptibly
raised in the papular stage, and although they become a
little/

little more prominent during the late stages, they are always
flattened, and their convex surface might be described as
being a portion of the circumference of a circle having a
much greater diameter than in the case of lesions on face
and arms.

Modification of the lesion.

This may be brought about by general or local causes.

1.   General causes.

a. Modification due to a partial immunity to the
disease. This is by far the most important of the factors
producing modification. It is due to previous vaccination,
and may be present in very varying degrees. The patient
may be so far protected as to be susceptible to the disease
only in its most benign form, or the protection may be so
greatly diminished that the natural course of the disease
is hardly affected by its presence. The immunity conferred
by vaccination is specific, and is probably analogous to that
produced in animals by inoculations of attenuated virus,
the virus in this case being attenuated by passage through
the calf. After successful vaccination, the immunity is for
some time absolute, the individual being absolutely insus-
ceptible to the contagion of smallpox. In course of time
this acquired immunity gradually disappears, until, at
periods varying according to the efficiency of the vaccina-
tion and the susceptibility of the individual, the immunity
conferred/

conferred disappears, and should the individual be exposed
to the contagion of smallpox, he may contract the disease
in any degree of severity, and it will run its natural course
as in an unvaccinated individual. Revaccination at inter-
vals, however, completely restores the immunity so that the
well vaccinated and revaccinated individual passes through
life absolutely immune to the disease.

A partial immunity to the disease declares itself
mainly in a diminution in the number of lesions, and in a
shortening of the process of development of the individual
lesion. In individuals possessed of a considerable degree
of immunity, the lesions are few and discrete, and the disease
is benign. The course of the disease is also shortened,
vesiculation and pustulation occupy a shorter period and
are less pronounced, secondary fever is trifling, if present
at all, desiccation sets in speedily, and the patient is
never seriously ill, confinement to bed being almost un-
necessary. The first spots to appear always vesiculate
and usually pustulate, but in rare cases development ceases
with vesiculation and desiccation sets in. In other cases,
some of the papules which develop later seem to resolve
without progressing further than the papular stage. It ap-
pears as if the small amount of immunity necessary to com-
pletely protect the individual is manufactured in the first
few days of the disease, and the immunity being rendered
complete/

complete the morbid process is arrested. From this highly
modified variety all degrees of modification are met with,
until we arrive at cases in which it is impossible to de-
termine any change in the course of the disease. At this
point we must conclude that the immunity has vanished.
The border line, however, is not clearly defined and in
many cases it is difficult or impossible to determine
whether or not a slight degree of immunity exists.

B.   Modification due to a previous attack of smallpox.
Undoubted second attacks of smallpox are very rare. As a
rule, immunity acquired in this way lasts throughout life.
Although many patients state that they have previously
suffered from smallpox, enquiry usually shows the previous
attack to have been chickenpox. Amongst 10,000 cases treated
at Gore Farm Hospital, there was only one case in which there
was any proof that the patient had previously suffered from
smallpox. He was a man of 45 years of age who had been
isolated for smallpox about 20 years before, and who bore
scars which at all events presented a very strong resemblance
to those of smallpox. He developed a very discrete highly
modified attack. The immunity conferred follows the same
lines as in the previous variety.

C.   Modification due to malnutrition of the individual.
In old and debilitated patients, such as bedridden
senile/

senile cases, the development of the lesion is considerably affected. The lesions are less lusty, smaller, more flattened, and the inflammatory reaction round the pustules is much less acute. This is probably due to the histological characters of the skin in which they develop. The skin is dry and harsh, the loose cellular tissue is wasted, the cutaneous circulation is less free, cell proliferation is less active, and inflammatory reaction is consequently less marked. This condition is also seen in badly nourished tramps and in the subjects of chronic wasting diseases, such as pulmonary tuberculosis.

2. Local causes.

a. Modification due to chronic skin diseases. On portions of the skin affected by skin diseases e.g. eczema, the lesions are not only more numerous than on unaffected portions of skin, but the vesicles and pustules are larger, flatter, and tend more to confluence of their edges.

b. Modification due to skin irritants. Similar effects may be produced by skin irritants such as a mustard leaf or poultice, or from local pressure.

The Distribution of the Eruption.

This is a subject the importance of which, from a diagnostic standpoint, it is difficult to over estimate. The eruption of smallpox has a distribution which is peculiar/

peculiar to itself. It shows a marked preference for the face and scalp and for the limbs, and is most sparsely distributed on the trunk and especially on the abdomen. By this I do not mean that there are numerically more lesions on the face or limbs than on the trunk, but that the lesions are denser and more closely set, so that the face and scalp, or hands and feet, present more lesions than does a portion of the trunk having an equal superficial area. Not only is the eruption relatively more dense on the extremities than on the trunk, but the density on the limbs increases with distance from the trunk, so that the relative density on the hands is greater than that on the forearms and on the forearms than on the arms. Similarly there are more lesions on the feet than on the legs and on the legs than on the thighs. In other words, on examining the eruption on the limbs, the further you proceed from the trunk the more closely set are the lesions.

Factors which disturb the typical distribution.

1.   Local pressure. Parts of the skin which are unduly pressed upon are often the sites of a relatively excessive eruption of spots. The favourite sites in women are, round the leg from pressure of garters, and round the waist where many of their garments are tightly fastened. In men the pressure of braces on the shoulders or of a tight waist belt/

belt may produce a similar condition. I have seen a relatively copious eruption in the supraspinous region in a bricklayer due to the pressure of a hod. The site of the local aggregation points to the disturbing factor, and the apparent discrepancy is explained.

2. <u>Skin irritants</u>. These also tend to produce an aggravation of the eruption on the part irritated. Examples of this are a plaister (mustard), a blister, or a poultice. In neglected children, the irritation produced by a wet and dirty diaper sometimes causes a profuse eruption on the part irritated. The suckling mother may also have an aggravation of eruption round the nipple when that structure is sore and cracked. Here the history, the site, and the hyperaemia produced by the irritant provide the explanation.

3. <u>Chronic Skin Diseases</u>. On the portions of skin affected the eruption may be more dense. There again the explanation is at once apparent.

Only in a very small proportion of cases is the distribution at fault. In the majority of these cases, one of the disturbing factors just described will account for the apparent departure from type. In a very few cases, however, and these all of very discrete character, the relative density of the eruption on the limbs cannot be said to exceed that on the trunk, and in a still smaller number of cases the eruption/

eruption on the limbs becomes more discrete with distance from the trunk. These cases, however, are extremely rare, and are merely an example of the exception proving the rule. I can offer no explanation of this very occasional variation. Still, the distribution of the eruption remains the most important factor in diagnosis, and in the few cases in which it is at fault, we must fall back on the other more or less definite signs and symptoms.

The value of this factor in diagnosis rests on the following points:-

1. It is the most constant feature of the rash.

2. It is unaffected by modification due to a partial immunity to the disease.

3. Whilst liable to disturbance from various causes, these causes are usually easily recognised and eliminated.

4. Its distinguishing features remain throughout the whole eruptive period from papule to crust, whereas the crusts in many cases are not in themselves sufficiently definite to warrant a diagnosis of smallpox.

5. It is a matter of simple observation and presents no difficulty even to the observer who has no previous experience of smallpox. The lesion of a discrete highly modified attack of smallpox on the other hand often presents considerable difficulty in diagnosis, and here the experience of the observer comes to his aid.

There is also a more or less characteristic grouping of the lesions on the face. A marked aggregation of lesions is noticed, forming an irregular transverse band across the forehead about midway between the frontal eminences and superciliary ridges. There is also a relatively greater density of eruption in a roughly triangular area bounded by the ridge of the nose, the lower border of the orbit, and an imaginary line drawn from the alae nasi to the most prominent part of the malar bone. The other portions of skin covering the cheeks and lower jaw are relatively free from eruption. This grouping of lesions on the face is not an absolutely constant feature, some cases possessing it in much greater degree than others. In some cases, however, this local aggregation of lesions is very striking. On the other hand, a case which shows most of its lesions grouped on the forehead near the roots of the hair or over the lower jaw is probably not smallpox.

Priority of the eruption on some parts as compared with others.

That the eruption appears first on the forehead and possibly on the backs of the wrists is, in the majority of cases, an undoubted fact, and in no case have I seen the eruption appear on any part sooner than on the face. This priority, however, is not great and in 12 to 24 hours the eruption is fully out. This priority is apt to receive

undue/

undue prominence in the history given by patients as those
are the parts most open to observation, on the face by his
friends and on the wrists by himself. The eruption on the
face may throughout maintain a slight priority in develop-
ment, but this is not a very marked feature until about the
5th day of eruption, when, the lesions on the face develop-
ing more rapidly, they take a distinct lead over those on
the hands and feet which lag behind, so that the lesions
on the face may be fully pustular when those on the hands
are just commencing to pustulate. It is quite usual to
observe the lesions on the face ruptured and crusted when
those on the backs of the hands and dorsum of the feet are
still pustular and with their pellicles unruptured. This
priority in the development of the rash occurring later in
the disease, in one part as compared with another, is some-
times of importance from a diagnostic point of view, but it
is neither so constant nor so pronounced as to provide a
very important and reliable factor in diagnosis. Moreover,
whilst in unmodified cases this feature is fairly constant,
in cases which are much modified by vaccination and show a
very discrete and abortive rash, it is often impossible to
find any appreciable priority in development of the lesions
in one area as compared with those in another, and it is
in these latter highly modified cases that difficulty in
diagnosis is experienced.

Morbid anatomy of the lesion.

According to Unna, the upper prickle layer of the rete mucosum is the part first affected. The cells swell and assume a granular or opaque appearance, and the nuclei becomes less distinct, and take up stains badly. This change is probably due to the direct action of the toxines produced by the virus, which in process of cutaneous excretion exercise a deleterious action on the cells. As a result of the morbid process, a degenerative change takes place in the protoplasm of the cells, and coagulation occurs. Whilst some of the cells are slowly undergoing this coagulative change, others are being unduly pressed upon and lengthened out, forming irregular trabeculae, which extend from the summit of the lesion to its base, and form a network within the lesion. Serum is exuded, and fills the meshes of the network. The cells of the lower prickle layer next become affected, and undergo what is termed ballooning - colliquation, the cells swelling and forming hollow spheres. The reticulating colliquation occurs at the periphery, and the ballooning colliquation at the centre. Unna considers umbilication of the vesicle to be a result of these two processes. Ballooning colliquation is a slow process and produces only slight swelling of the cells. Reticulating colliquation on the other hand produces considerable swelling of the cells and is accompanied by epithelial oedema.

Hence/

Hence the periphery is rendered more prominent than the centre, and the depressed centre forms the umbilicus. Unna ascribes the formation of pus to two processes working together, namely intense inflammation and secondary infection by pyogenic organisms. This statement is, I think, open to question. I believe that the purulent change in the vesicle is entirely due to pyogenic infection from without, and that the intense inflammation is a direct consequence of the pyogenic invasion. I am led to this belief by the fact that I was able by thorough sterilization of the skin and subsequent repeated coating of the part with carbolised collodium coloured a deep red with an aniline dye, to prevent pus formation; the vesicles forming and drying up without the formation of pus, whilst the lesions on untreated portions of the skin went through the usual process of pustulation and crust formation. In the later stages of the epidemic I always used this treatment for the face, provided the patient came under observation in the papular or very early vesicular stage, with the result that by the 7th or 8th day of eruption, when the treatment was discontinued, the face was clear with the exception of the thin and shrunken cuticular covering of the vesicles, whilst the other lesions were fully pustular or in the incrustation stage. The contrast between the parts treated and those not so treated was very striking. Only very slight pigmentation

was/

was left behind. There was no scarring. I first treated the
patients by merely painting the face repeatedly with car-
bolised collodium, without previous sterilization of the
skin. This yielded no good results. I was merely imprison-
ing the pyogenic organisms already in and on the skin be-
neath the collodium dressing. When, however, careful ster-
ilization of the skin was first carried out and the paint
then applied, the results were excellent. The only lesions
which pustulated were those at the corners of the mouth,
nose, and eyes, where it was impossible to prevent pyogenic
infection. The pressure of the collodium covering also
appeared to limit to some extent the distension of the
vesicles. This treatment has no appreciable effect if the
vesicles are at all fully formed. The favourable time is
the papular stage.

If the lesion is not protected from infection through
the skin, pyogenic organisms find their way into the vesicle,
and a small abscess is formed. Inflammatory reaction with
its usual phenomena of increased arterial flow, dilatation
of capillaries, venous stasis, and transudation of red and
white blood corpuscles and blood serum takes place. If the
contents of the pustule are not liberated and the process
checked by phagocytosis and proliferation of cells, the cutis
vera is invaded, its cells are destroyed, and replaced by
fibrous tissue which contracts and leaves a depressed per-
manent scar. If the crusts do not separate readily from

the/

the face and are allowed to remain, more or less extensive ulceration may take place beneath the crust. Granulations form which soon become exuberant, and when the crust separates, prominent masses of granulation tissue remain, which on contraction form keloid scars. These scars cause much disfigurement. They are most apt to occur in severe confluent cases, and their favourite site is on the sides of the nose and adjacent portions of the cheeks where the eruption has been most dense.

In cases where the inflammatory reaction has not been great, the separation of the crust leaves a healed surface beneath, covered over by a thin layer of delicate epithelium. Where, however, there has been intense reaction and destruction of skin, little ulcers are left behind which rapidly heal under ordinary conditions of surgical cleanliness.

Types of the disease.

Having discussed the initial period, the characters, and distribution of the specific eruption, with the variations to which they are liable, the description of the different types of the disease is simplified and much needless repetition is avoided. Only the features peculiar to each type need be considered. Smallpox occurs in all degrees of severity, from the extremely toxic attack, which kills rapidly, by intense intoxication before the specific eruption has/

has time to appear, to the very mild and somewhat fanciful
"smallpox sine eruptione." Between these two extremes, all
degrees of severity are met with, not sharply differentiated,
but tending to merge one into another. With the exception
of the intensely toxic attack, which kills before the true
eruption appears, or only permits the patient to live until
the eruption has more or less perfectly declared itself,
the severity of the disease is in direct proportion to the
density of the eruption. Again, excepting the toxic attacks,
the density of the eruption forms the basis of a subdivision
into classes which is convenient for purposes of description.
In describing the different types of the disease, I will
deal exclusively with cases of natural or unmodified small-
pox, and will later discuss generally the changes which are
produced by the presence in the individual of a partial
immunity to the disease.

The following classification, having the several classes
arranged in descending degrees of severity, is convenient
for descriptive purposes.

Classification.

I. Toxic or malignant smallpox, commonly called haemorr-
      hagic smallpox.
   a. Toxic smallpox without specific eruption.
   b. Toxic smallpox with specific eruption.

II. Confluent Smallpox.

    a. Confluent in the vesicular stage.

    b. Confluent in the pustular stage.

III. Discrete smallpox.

IV. Smallpox sine eruptions.

I. Toxic or malignant smallpox.

Haemorrhage being merely a symptom expressive of the toxicity of the attack, and occurring as it does in all degrees of severity and in all classes of cases, it is misleading to limit the term haemorrhagic to any special class. I therefore use the term toxic to indicate the severe and rapidly fatal toxaemic attacks.

a. Toxic smallpox without specific eruption.

This is the most intensely toxaemic and rapidly fatal form of the disease. The intoxication is so severe that the patient succumbs to the virulence of the toxaemia before the specific eruption has time to appear. The initial symptoms are usually severe, and in many cases there is a very profuse purple initial groin rash. About the third day of invasion skin haemorrhages appear. Sometimes the first sign of haemorrhage is seen in the loose connective tissue of the eyelids, appearing as a slight bluish discolouration of the skin. In some cases a vivid bright red erythema of general/

general character appears, which at first fades slowly on
pressure. It rapidly becomes more intense, of a brick red
colour, and is practically unaffected by pressure. Haemorr-
hage rapidly proceeding, the colour quickly changes through
maroon to purple, until just before death the skin is of
a dusky black colour. Scattered irregularly over the
brick red or maroon coloured surface are cutaneous and sub-
cutaneous harmorrhages of greatly varying size and of deep
purple or black colour. They appear on face, scalp, trunk,
and limbs. The colour changes are gradual, one merging
into another. In some cases the changes are more rapid
than in others. In the most rapidly fatal cases the ob-
server can almost persuade himself that he sees the colours
changing under his eye. The following is the most rapidly
fatal case I have seen. The patient was an unvaccinated
male, 30 years of age. On admission he had a general bright
red erythema almost as vivid in colour as a boiled lobster.
He died 2½ hours later, the colour meanwhile having changed
through violet, maroon and purple to black. In other cases
this vivid erythema is absent. About the 3rd day, irregular
purple or slate-coloured patches appear scattered irregu-
larly over the surface. They vary greatly in size and shape,
and many of them coalesce at their edges forming large
irregular patches. In one case there was a large, almost
circular, plum-coloured area of haemorrhage on the abdominal
wall/

wall extending from the umbilicus to Poupart's ligament on the right side. It was of deepest colour in the centre, and faded somewhat at the margins. It consisted of one large sub-cutaneous haemorrhage, and was not formed by the union of several smaller ones. Haemorrhage occurs early beneath the ocular conjunctiva, which is soon ballooned out with blood, the chemosis being so marked that the membrane bulges far over the cornea leaving only the pupil visible as a small dark spot at the bottom of the cup formed by the distended conjunctiva. One author describes the patient as weeping tears of blood. This I have not seen. Bleeding also occurs from the mouth, nose, stomach, and bowels, and the urine is deeply stained with blood. In women there is profuse haemorrhage from the vagina. The mucous membrane of cheeks, gums, and palate is white and bloodless, bearing a close resemblance to wash-leather. In no other disease have I seen this wash-leather appearance of mucous membrane. It occurs early, and is a sign of considerable diagnostic value. The pulse is small and running, the skin cold and clammy, and the temperature only slightly if at all raised. The breath has a heavy sickening odour. The patient is distressed, breathing is sighing in character, and there is often great restlessness. Pain is not always a prominent feature, and some patients, who are within a few hours of death, state that, although distressed, they are not suffer-
ing

actual/

actual pain. In other cases pain is very severe, causing the patient to roll about in agony. The pain is generally referred to the back and abdomen. So intense is the pain that even large doses of morphia injected sub-cutaneously afford no relief. The mental condition is generally very clear. In most cases the patient fully realises the awful gravity of his condition, but in others, he refuses to believe that his end is near. Mild delirium is sometimes present but is exceptional. No specific eruption appears. In my series of cases all the patients in this class died on the 3rd or 4th day of disease. This variety of the disease is invariably fatal. The relative incidence amongst vaccinated and unvaccinated individuals was equal.

b. Toxic Smallpox with specific eruption.

In this variety, the course of the disease is not so rapid. The cutaneous and sub-cutaneous haemorrhage advances more slowly, the toxaemia is not quite so profound, and the patient survives long enough to allow the specific eruption to appear. These cases are almost invariably fatal, but some are less rapidly so than others. The patient may merely live long enough to permit a few papules to appear on face and wrists, or he may survive until the eruption is general. The virulence of this type is in direct ratio to the intensity of the haemorrhagic phenomena, and in inverse ratio/

ratio to the amount of true eruption. The more general the
specific eruption the longer is the duration of the disease.
Cases showing profuse eruption may live until vesiculation
is well-advanced, or even until pustulation is setting in.
Patients of the latter class are very restless, delirium is
usually a prominent symptom, is generally of acute maniacal
character, and lasts until the patient is moribund, when it
becomes quieter and of the low muttering variety. The
temperature is raised, sometimes to a considerable height.
Sub-vesicular and intra-vesicular haemorrhages may occur.
There is swelling and oedema of the skin in proportion to
the amount of true eruption present. Bleeding from mucous
surfaces occurs in this variety as in the former, but
haemorrhagic chemosis of the conjunctiva is less marked.
The patient takes nourishment badly, he resists treatment,
he exhausts himself in his maniacal excitement, his circu-
lation slowly fails, hypostatic congestion of the lungs
sets in, and death ensues from the 4th to the 9th day of dis-
ease. The average duration of disease in patients of this
class was $5\frac{1}{2}$ days. Two-thirds of the cases had been
vaccinated in infancy and one-third were unvaccinated.
The youngest vaccinated patient was a girl, aged 19 years,
who had only one very small plain vaccination scar. Only
one patient in this class recovered. He was an unvaccinated
male, aged 46 years. He had numerous large cutaneous
haemorrhages/

haemorrhages scattered over trunk and limbs, with bleeding from nose and mouth, blood stained sputum, and urine loaded with blood and of a deep port wine colour. He developed a copious eruption and ultimately recovered. He was seen early in the disease by several of my colleagues and we were all agreed that the case was hopeless.

II. Confluent Smallpox.

The characteristic of this class is that some of the lesions coalesce, their edges touching one another. The class is divided into two subdivisions. In one subdivision the lesions coalesce in the vesicular stage, and in the other not until the pustular stage.

a. Confluent in the vesicular stage.

The distinguishing characteristic of this class is that, on the occurrence of vesiculation, some of the vesicles coalesce. This is merely an expression of the density of the eruption, as the more general the coalescence the more profuse is the eruption. Further as, leaving out of account the toxic forms, the profusion of the eruption is a direct expression of the severity of the disease, the more general the coalescence the graver is the prognosis. All degrees of confluence are met with. In the most severe forms, the eruption is so profuse on the forehead that the lesions appear to touch one another even in the papular stage. In such/

such a case on stretching the skin over the forehead in
the papular stage and drawing the finger firmly over the
extended skin, the papules are so closely set as to impart
to the observing finger a sensation like that produced by
drawing the finger over a piece of dressed pigskin. In
these very severe cases, as vesicular distension increases
the confluence becomes very general, face, hands, arms,
legs and feet, being covered with confluent vesicles. As
the vesicles expand they become so merged in one another
that their individual outlines are rendered indistinct.
The vesicles are large and flattened, and the skin looks
like coarsely crinkled parchment. The vesicular contents
soon become milky, and if the patient lives long enough,
purulent. In many cases altered blood pigment appears in
the vesicles especially on face, hands, and arms, making
them appear of a prune juice colour. Vesicular confluence
is less marked on the thighs, chest and back, and on the
abdomen few if any of the vesicles coalesce. Friction of
the face, hands, and arms due to the restlessness and delirium
of the patient causes many of the vesicles to rupture, and
blood stained fluid exudes from them and coagulates on the
surface. In this variety the skin is so uniformly involved
that there is not much inflammatory reaction, and oedema is
not so marked as in the confluent pustular group. The eyelids
however are greatly swollen, and mucopurulent discharge
accumulates/

accumulates behind the swollen and closed lids escaping in small quantities at the canthi. The eruption is very profuse on the mucous membranes and there is much accompanying oedema of mucous membranes and submucous tissues with consequent narrowing of mucous passages. The nasal passages are blocked, swallowing is difficult, and the voice is hoarse and toneless. The lips are swollen, and the patient lies with parted lips, breathing heavily through his mouth. Profuse salivation is a constant feature. The tongue is swollen, dry, cracked, and covered with sordes. The breath is foul, and constipation is the rule. The temperature runs high with slight morning remissions. The pulse is rapid, small, and compressible, and, later, irregular. The general condition of the patient is that of intense toxaemia. One of the most constant and troublesome features of this form of the disease is delirium. It is usually of wild, noisy, delusional character. It renders nursing very difficult and trying, and in restraining the patient many of the vesicles are ruptured and raw bleeding surfaces exposed. I will deal more fully with delirium when discussing the general symptomatology. The patient gradually sinks, he lies lower in bed, his delirium becomes quieter, floccitatio and subsultus tendinum are marked, and he falls into a semi-conscious state which is the precursor of death.

Cases of this degree of severity, in my opinion, invariably die.

The fatal issue occurs sooner or later according to the age of the patient, his previous history as regards alcohol, and the violence and duration of his delirium. These cases show no modification due to the presence of a partial immunity to the disease. From this very severe and highly confluent variety, all degrees of vesicular confluence occur, until we arrive at cases in which only a few of the lesions on the face show confluence in the vesicular stage. These latter run practically the same course as cases which show confluence in the pustular stage only. In the intermediate stages, the outlook is still very grave, but, with youth and a temperate history on their side, some of these patients ultimately recover.

b.   Confluent in the pustular stage.

This variety differs from that just described in the fact that, the lesions being less numerous and less closely set together, vesiculation does not cause sufficient distension to bring the edges of the separate lesions into contact with one another. It is only on the occurrence of the increased distension consequent on pustulation, and in the regions of greatest density of the rash, that the coalescence of one lesion with another takes place. In this group, as in the former, there is great variation in the degree of confluence. In the most severe cases, the lesions are so closely set on face and extremities as just to escape

coalescence/

coalescence in the vesicular stage. On the occurrence of pustulation, however, the lesions run together, and face, hands, arms, ~~and~~ feet, and legs are more or less completely covered with confluent pustules. The confluence is always most marked on the face, next on arms and hands, then on feet and legs, and, least of all, on thighs and trunk. This is a necessary consequence of the distribution of the eruption as already described. These severe confluent pustular cases are grave, and many of them die late in the period of secondary fever from septic intoxication. At the other end of the scale are cases in which only a few pustules on the face coalesce, the other lesions remaining discrete. Between these two extremes, all degrees of pustular confluence are met with, and as the confluence becomes slight the danger to life becomes small.

On the appearance of the eruption with subsidence of the temperature and disappearance of initial symptoms, the patient feels comparatively well. The temperature generally remains slightly elevated, rising to about 100° at night and falling through about 1° degree in the morning. On the occurrence of pustulation, however, secondary fever sets in. The temperature rises steadily, until, when pustulation is complete, it has reached a considerable height. It usually assumes a septic remittent type. The intoxication of suppuration is added to the specific toxaemia of the disease. Oedema/

Oedema of the skin is marked, especially on the face. The
eyelids are so swollen that they cannot be voluntarily open-
ed, and can only with difficulty be slightly separated by
digital manipulation. Pus oozes out between the swollen
eyelids. The mucous passages are narrowed. Haemorrhage
may occur into some of the lesions. The haemorrhage may be
either intra-vesicular or intrapustular. This harmorrhagic
manifestation is of unfavourable import if many lesions are
affected, and if the haemorrhage occurs in the vesicular
stage, but it is by no means an invariably fatal sign. It
occurs in mild cases, on the legs of patients who have been
walking about with the eruption well out, e.g. in individuals
of the homeless class. Delirium occurs, but is neither so
frequent nor so pronounced as in the confluent vesicular
variety. It may occur by day, but is more frequent at night.
In drunkards, or even in those who habitually take consider-
able quantities of alcohol, but stop short of actual drunk-
enness, delirium often sets in early, is violent and pro-
longed, and rapidly exhausts the patient. In fatal cases, the
patient usually becomes restless and delirious, takes nour-
ishment badly, sinks into a low septic state, and dies from
the 11th to the 16th day. Shortly before death, hypostatic
congestion of the lungs often sets in, the pulse is small
and running, the first sound of the heart is weak or in-
audible, the temperature remains high with considerable
morning/

morning remissions and often reaches hyperpyretic registers
before death. In favourable cases, the patient passes through
a more or less severe attack of secondary fever, but on the
occurrence of rupture of the pustules and desiccation, the
temperature falls, oedema subsides, the tongue cleans and
becomes moist and, unless recovery is delayed by complica-
tions, convalescence is rapid. In this class, modification
due to the presence of a partial immunity to the disease
often cuts short the attack. The patient progresses as in
an unmodified attack until the 3rd or 4th day of eruption
when pustulation sets in, rapidly reaches its height, and
then the pustules either rupture or desiccate unruptured.
The period of secondary fever is thus much shortened and is
of much less intensity. Some cases show this modification
in considerable degree, others only slightly.

Intra-vesicular and intra-pustular haemorrhages.

These haemorrhages are so frequent in confluent cases
that they call for special description. Cases showing this
feature, however, do not call for description as distinct types
of the disease. The haemorrhages occur in all varieties of
the disease showing true eruption, from the toxic form with
specific eruption to the benign discrete variety. Their
prognostic significance depends largely on the time of their
occurrence, and the number and situation of the lesions
affected.

In the severe confluent vesicular variety intra-vesicular
haemorrhage is the rule rather than the exception, most
cases showing this feature in greater or less degree. The
haemorrhages may occur on face, trunk, and extremities. In
the severe confluent pustular type, intra-vesicular haemorr-
hages are less common, fewer lesions are affected, and these
are generally situated on the extremities. In the milder
confluent pustular cases haemorrhage into the lesions is
exceptional, and when it does occur, the number of foci is
small, and the haemorrhage is usually intra-pustular. In
discrete cases a few of these haemorrhages may occasionally
be found, but this is very rare and generally occurs in
patients of the homeless class, who have been walking about
for some days with the eruption upon them. The haemorrhages
are then found on the legs.

Intra-vesicular haemorrhages appear about the 3rd day of
eruption as a small dark spot in the centre of the vesicle.
This rapidly enlarges and the vesicle becomes plum or even
prune coloured. Intra-pustular haemorrhages are less common.
They appear soon after the commencement of pustulation, chang-
ing the yellow of the pustule to a dark brown or black
colour. A red petechial ring often surrounds the vesicle
or pustule. The following table shows the percentage
incidence and mortality of confluent cases without intra-
vesicular or intra-pustular haemorrhages, and also of those
showing/

showing these haemorrhages, in a series of 532 consecutive cases of smallpox:

	No. of cases	Percentage incidence	No. of deaths	Percentage mortality.
Total confluent cases	119			
Confluent cases without intravesicular or intrapustular haemorrhages.	72	60.5	19	26.4
Confluent cases showing intravesicular haemorrhage.	37	31.0	25	67.5
Confluent cases showing intrapustular haemorrhage.	10	8.5	6	60.0

From this table it will be seen that of all confluent cases those without intra-vesicular or intra-pustular haemorrhages are the most frequent, and that their percentage mortality is relatively low, being only 26.4. In confluent cases showing intra-vesicular haemorrhages, the death rate is very high reaching 67.5%. Those with intra-pustular haemorrhage, although less severe than those with intra-vesicular haemorrhage, are still very grave, having a percentage mortality of 60. We must therefore regard these haemorrhages, in confluent cases, as grave prognostic signs.

III. Discrete Smallpox.

The distinguishing feature of this variety is that the individual/

28 Sept. 1903

I hereby declare that this work
has been done and this Thesis
composed by myself.

Sign.d   R. Nivan

individual lesions throughout their whole course remains separate or discrete, each lesion being separated from its neighbours by portions of unaffected skin. In some cases the lesions are so numerous on the face as almost to touch one another in the stage of full pustular development, but the essential feature of this class is, that at no period of their development do they actually do so. In other cases, the lesions are much more discrete, each one being separated from its neighbours by large areas of healthy skin. Between these two extremes all degrees of discreteness are met with. In a community in which infant vaccination is general, this type of the disease is the most common, although as the average age of the population increases and the protective power of vaccination diminishes or disappears, more and more severe forms of the disease occur. The course of this form of the disease is benign, and except in infants and young children a fatal issue is rare. In 532 consecutive cases only 5 deaths occurred from discrete smallpox. Of these 5 two occurred in infants under 3 weeks old and two others in children of five weeks and seven months respectively. All four were cases of natural or unmodified smallpox in unvaccinated subjects. The remaining case was that of a man aged 32 years, who had been vaccinated in infancy, and who succumbed to an intercurrent disease quite independent of smallpox. In the severer cases there is, on the occurrence of/

of pustulation, a certain amount of secondary fever with its accompanying symptoms. There is also considerable oedema of the face, swelling of the eyelids, slight conjunctivitis, and dysphagia, due to the presence of the eruption on the faucial mucous membrane. On the occurrence of rupture and desiccation of the pustules the fever subsides, oedema disappears, and convalesence is rapid. In the milder cases there may be no secondary fever, and the patient may suffer no inconvenience apart from the local irritation of the lesions. Whilst the very mild modified cases with sparse and imperfectly developed lesions present little of interest from a clinical standpoint, their recognition is of prime importance from the point of view of the public health.

The symptoms, after the initial period is over, are so slight that the individual affected thinks he is quite well, goes about his ordinary avocations, and may scatter the disease broadcast. These, moreover, are the only cases which present real difficulty in diagnosis.

IV. Smallpox sine eruptions.

The probability of the occurrence of this form of the disease will be discussed under the head of modified smallpox.

Modified Smallpox. Under this heading I refer exclusive-
ly
to/

to cases the course of which is modified by vaccination.
There are other causes which produce changes in the individual
lesion, but these have already been discussed. Modification
may be produced by vaccination successfully performed at a
period long prior to the attack of smallpox, or may be pro-
duced by vaccination or revaccination after infection by
smallpox, provided this is performed in the early days of the
incubation period.

1. Modification due to previous vaccination.

All cases of smallpox occurring in vaccinated subjects
are not cases of modified smallpox. The protection imparted
by vaccination slowly but steadily diminishes, until in many
cases it apparently entirely disappears. The period during
which absolute protection exists varies within wide limits,
and depends mainly on the efficiency of the vaccination but
probably also in part on the natural susceptibility of the
individual. Partial protection or the existence of a
partial immunity to the disease varies within even wider
limits and depends on the same causes. For a certain period
after successful vaccination the individual is absolutely
immune to the contagion of smallpox, but in course of time
the immunity conferred gradually diminishes until a point
is reached, varying according to the efficiency of the
vaccination and the susceptibility of the individual, at
which absolute protection ceases and the individual becomes
liable/

liable to attack by smallpox. Although liable to infection
by the disease, however, he is only liable to contract it
in a very mild form, the partial immunity still existing
being at a high point of protective power. This is the point
at which smallpox sine eruptione, if it occurs, should come
in.

That it should occur is quite within the bounds of
possibility. We must suppose the individual almost but not
quite insusceptible to smallpox. The period of absolute
immunity is just over and his partial immunity is at its
highest protective point. The contagion of smallpox enters
the system and a struggle for mastery takes place between
the immune bodies and the virus. The former have lost their
power of absolute protection but are still very powerful.
The period of incubation comes to an end and still the
immune bodies are unable to overcome the virus. Symptoms of
invasion occur, headache, lassitude, nausea and vomiting,
pains in back and limbs, and the disease has started. The
disease itself, however, now comes to the aid of the exist-
ing immune bodies as it is already manufacturing its own
immunising bodies. These fresh immunising agents coming to
the assistance of the existing protective powers of the in-
dividual establish an absolute immunity and the disease is
arrested before the eruption has time to appear. This
variety is merely a connecting link between the individual
who/

who is entirely protected and the one who developes half
a dozen highly modified lesions. This reasoning is purely
hypothetical, especially as the methods of the production
of immunity and its mode of action are still shrouded in
obscurity. But if we accept Ehrlich's theory of immunity
the hypothesis is rendered possible. MacCombie states that
he has seen such cases in vaccinated and re-vaccinated sub-
jects, and the observations of so acute an observer carry
great weight. According to that writer they present the
usual symptoms of invasion and may even show a partial
initial erythema. At the end of this period the temperature
falls, no eruption appears and in a day or two the patient
is quite well. During the recent epidemic of smallpox the
Lower Hospital at Gore Farm was greatly extended and numerous
additions were made to the Upper Hospital. For over three
months from 2,000 to 3,000 workmen were constantly employed
around the smallpox wards, which at one time contained over
1,200 cases. Many of them refused vaccination. A good
many of these men contracted smallpox, showing that there
were plenty of susceptible subjects, but although we attend-
ed them for all their ailments we never came across a case
which suggested the presence of this condition. One thing
is certain, namely, that if this condition exists it is very
rare, and its infectivity is probably slight. Passing from
theory to fact, we next come to a class of case in which
the/

the degree of immunity possessed by the individual is unable to protect him from infection by smallpox. It is able, however, to so far cope with the disease that the morbific manifestations are very slight and the course of the disease is very obviously modified. The whole course of the disease is mild, its duration is materially shortened, the lesions are few and their processes of development hastened, or even aborted, some of the later papules disappearing without vesiculation and the early lesions proceeding straight from vesiculation to incrustation and desiccation without any intervening pustular stage.

From this very highly modified variety all degrees of modification are met with until we arrive at a point where, although the patient has been vaccinated, we can observe no appreciable modification in the course of the disease or in the character of its individual lesions. Here we must conclude that the partial immunity to the disease has totally disappeared and we must regard the patient as one wholly susceptible to the disease and consider his case as one of natural or unmodified smallpox, as in the case of an individual who has never been vaccinated. It is unnecessary if not impossible to describe all the degrees of modification met with from the highly modified case to the one hardly, if at all, affected by a partial immunity. The process is similar in all merely varying in degree. The lines on/

on which modification proceeds may be recapitulated and summarised thus:-

a.   Occasionally the period of invasion appears to be shortened and the initial symptoms lessened in intensity. These are neither marked nor constant features.

b.   A diminution in the number of lesions; in highly modified cases rendering the eruption very discrete, in slightly modified cases producing little or no diminution.

c.   The lesions tend to be smaller, less regular in outline and not so dome-shaped.   They also appear to be less deeply set in the skin.   Inflammatory reaction is usually slight.

d.   A shortening of the life history of the lesion, causing it to pass through its stages with greater rapidity, the rapidity varying with the degree of immunity.

e.   In highly modified cases an aborting or cutting short of the development, some lesions progressing no further than the vesiculation stage, others, more rarely, stopping short at the papular stage.   It appears as if in these latter cases the morbid process soon produces sufficient immunity to supply the small amount necessary to entirely protect the individual and the disease is cut short before the later papules have time to develop.

In most cases modification results in the production of a discrete attack.   Some confluent pustular cases also show marked modification of the individual lesions, but in/

in confluent vesicular and toxic cases occurring in vaccina-
ted subjects we must conclude that the protection conferred
by vaccination has vanished and that the patient is, to all
intents and purposes, an unvaccinated individual. Re-vaccina-
tion fortunately entirely restores the immunity, and in most
cases primary or infant vaccination, followed by re-vaccina-
tion during adolescence, if efficiently performed, renders
the individual, if not entirely insusceptible to the disease
in laterlife, at least insusceptible to the disease in a
fatal form. A third vaccination when the effects of the
second are wearing off apparently protects the individual
absolutely throughout his whole life. I have never seen
an individual bearing the marks of three successful vaccina-
tions attacked by smallpox and out of 532 consecutive cases
only 4 patients carried the marks of a primary vaccination
and of re-vaccination. The following table gives a summary
of these 4 cases:

Age of patient in years	Evidences of vaccin. in infancy	No.of yrs. since re-vacc-ination	Evidence of re-vaccination	Nature of attack	Result
63	2 small fove-ated scars	un-known	1 small plain scar	Toxic smallpox	Death
40	2 fair fovea-ted scars	25	2 small plain scars	Modified discrete smallpox	Recovery
31	4 good fovea-ted scars	15	1 good fovea-ted scar	Modified confluent	Recovery
44	1 small plain scar	34	1 small plain scar	Discrete smallpox	Recovery

Remarks: Of these 4 cases numbers 1 and 2 showed evidence of fairly efficient infant vaccination, but the evidence of re-vaccination was inconclusive, consisting of small plain scars without foveation. In number 4 the evidence of both primary and secondary vaccination was unsatisfactory. Number 3 had good primary scars, and one good scar due to re-vaccination 15 years prior to the attack. This is unusual, and the patient must have been highly susceptible to the disease. The net result is that only one patient out of 532 showed conclusive evidence of efficient vaccination and revaccination. His attack was modified by vaccination and he recovered.

2. Modification due to vaccination or re-vaccination during the incubation period.

Vaccination or re-vaccination during the first three days after the susceptible individual has been exposed to the contagion of smallpox generally prevents the development of the disease. If performed later than this it is unable absolutely to protect the individual, but may confer a partial immunity and thus modify the attack of smallpox. This is due to the fact that the incubation period of vaccinia is much shorter than that of smallpox, being only three days in the former as compared with 12 days in the latter. Vaccinia therefore starts with a very considerable time allowance and if performed early enough is able to establish its/

its immunity against smallpox before the latter disease has
time to seize its victim. If performed on the 3rd day it
declares itself on the 6th and rapidly confers its immunity
on the individual. There are still 6 days left for the
rapidly increasing immunity to combat the contagion of
smallpox and this period appears, in most cases, to be
sufficient to prevent the development of the disease. In
my series of cases there were only two in which vaccination
performed as early as the third day of incubation was unable
absolutely to prevent the disease. These two cases occurred
in the 1-2 age period. Both attacks were discrete and high-
ly modified and terminated in recovery. The protective
power of vaccination performed immediately after exposure
to the contagion of smallpox is well exemplified in the
case of infants born of mothers suffering from smallpox,
and vaccinated immediately after birth. We had 5 such cases
at Gore Farm Hospital. The infants were vaccinated at birth,
vaccination was successful in all 5 and none of them con-
tracted smallpox, although they were reared in a smallpox
ward. They all survived except one who was a seven months
child and died with marasmic symptoms three weeks after
birth. Another infant 48 hours old was admitted with its
mother. It was successfully vaccinated on admission and
did not contract smallpox. Vaccination from the 4th to the
6th day of incubation, whilst unable to entirely protect
the/

the contact, confers on him a partial immunity and modifies the course of the disease.

Table I. Gives an analysis of 26 cases, occurring amongst 532 consecutive cases, which were successfully vaccinated or revaccinated after having been infected by smallpox. The most striking feature of the series is that all the cases were of the discrete variety and that they all terminated in recovery. Nine of them were not previously vaccinated and had a percentage recovery rate of 100, whilst the unvaccinated cases not so treated had a percentage recovery rate of 43.1. Further 6 of these cases were in children under 7 years of age a period of life in which smallpox is peculiarly fatal. In Class I. which includes cases vaccinated or re-vaccinated from the 11th to the 15th day before the eruption appeared, the protection against attack seems to be great as only 2 cases occurred in this class and they were highly modified discrete attacks in very young unvaccinated subjects.

Class II comprising cases vaccinated or re-vaccinated from the 8th to the 10th day inclusive before the eruption appeared, contains a greater number of cases, showing that at this period only a partial immunity to the disease is conferred. In previously vaccinated cases the incidence is entirely in the later age periods, whilst in those not previously vaccinated the earlier age periods are selected. In/

In all cases, however, young and old, the same protecting

power is manifested.

In Classes III and IV all but one case occurred in

previously vaccinated subjects. It is therefore difficult

to discount the modifying influence of the primary vaccina-

tion.

Class V. only contains one case. This, however, was

in an unvaccinated child of 5 years. Like the others the

attack was discrete and modified. Probably the vaccination

was performed early.

In conclusion then, persons vaccinated or revaccinated

within 3 days after exposure to infection generally escape

the disease, and a large number of those vaccinated from

the 4th to the 6th day of incubation have their attacks

modified. After the 6th day of incubation vaccination, even

if successful, probably has little effect on the course

of the disease.

Symptomatology.

Many of the symptoms have already been incidentally dis-

cussed in dealing with the several varieties of the disease,

but some are deserving of more detailed notice.

Symptoms produced directly by the specific eruption.

Pain. The eruption, especially when fully vesicular

or pustular, is productive of much discomfort, but pain is

not/

not so general or clamant as one would expect. When pain
is complained of it is mainly in the lesions occurring on
the fingers and toes, and in the hard corneified epidermis
of the palms and soles. In some cases the pain in hands and
feet is very acute, rendering sleep impossible, and calling
for local or general anodynes. When you consider the pain
and discomfort produced by a single pustule on the finger or
forehead in health, it is surprising that patients with a
profuse eruption of lusty pustules should experience so
little pain. In smallpox of some severity, however, the
patient's mental condition is dull and sluggish, and his
sensation to pain is probably also somewhat impaired. The
fingers are kept in a position of semiflexion in order to
render the skin less tense and so relieve the pressure.

Tenderness. The lesions are more tender than painful,
and the pressure of the bed-clothes must be as far as
possible minimised.

Oedema. When the eruption is at all profuse, as the
lesions approach full vesiculation, oedema of the cutaneous
and subcutaneous tissues becomes a marked feature. This
increases in amount as pustulation advances and inflammatory
reaction takes place round the lesions. It lasts until
rupture of the pustules and desiccation of their contents,
when it gradually subsides. It is always most pronounced
on face, neck, scalp and limbs. The arms and hands are
usually/

usually more oedematous than the legs and feet. There is
not much oedema of the trunk. In confluent cases oedema
of the face and neck is very marked. The nose and lips are
swollen enormously, and the eyelids are so swollen that
they cannot be opened voluntarily, the upper eyelid being
more oedematous than the lower and often bulging over the
latter. The neck is full and puffy. The nasal passages
are stenosed and often completely blocked, so that the
patient breathes noisily through half open mouth. In the
confluent vesicular variety, the delirious patient often
tears off the thin cuticle of the lesions, bloodstained
contents escape, and raw bleeding surfaces are exposed.
This is most marked on hands, wrists, and face.

Dermatitis. There is considerable inflammation of the
skin round the pustules. The areola becomes broader, lighter
in colour, raised, and indurated. The reaction is most
marked in young lusty subjects. It is hardly present at all
in old emaciated subjects.

Dysphagia. This is a common symptom, but is not so
pronounced as the condition of the fauces would lead one
to expect. It is caused by the presence of the eruption
on, and resultant oedema, inflammation, and ulceration of, the
faucial mucous membrane. In severe cases the faucial swel-
ling is so great that the faucial aperture is almost
obliterated.

Gland swelling. Swelling of the cervical, submaxillary and sometimes parotid glands occurs in severe cases during the pustular stage.

Salivation. This is a constant feature in cases of any severity. It is often profuse, saliva trickling continuously from between the swollen and parted lips. It probably results partly from reflex irritation produced by the eruption on the buccal mucosa, and partly from inflammation of the parotid and submaxilliary glands.

Aphonia. Modification in the tone of the voice, sometimes amounting to complete aphonia, is due to the presence of eruption on, and consequent oedema of, the lining membrane of the larynx. It only occurs in cases with profuse eruption.

Laryngitis and tracheitis. These conditions are common to most severe confluent cases. The cough is hoarse and toneless, and is accompanied by muco-purulent expectoration. Stridor is not marked, and I have never seen pronounced dyspnoea due to laryngeal or tracheal obstruction.

Conjunctivitis. This condition is so constant in confluent and severe discrete cases that it may be reckoned as a symptom rather than a complication. It is accompanied by more or less muco-purulent discharge.

General symptoms.

In the stage of secondary fever pyrexial symptoms are marked/

marked. Thirst is troublesome and in very severe cases unquenchable. The tongue, at first coated with a thick creamy fur, becomes later swollen, dry and cracked. The breath is foul, and sordes collect on gums and teeth. Although faucial swelling is often pronounced, liquid nourishment is taken easily, and the appetite remains fairly good. In discrete cases, nutrition is very little impaired, but in cases with prolonged secondary fever, emaciation is marked.

The <u>Mental Condition</u>. In dealing with the period of invasion, the mental condition during that stage has been discussed. In the milder cases, except for a certain dull listlessness, no further cerebral symptoms appear. In the graver confluent varieties, however, profound mental disturbance is frequent, usually taking the form of simple delirium, but occasionally assuming the graver character of acute or sub-acute mania with delusions of a transient nature and hallucinations of the senses. Melancholia with suicidal impulse, is rare, and is a sequela rather than a symptom. A patient may however attempt to throw himself out of a window when he imagines he is being ill-treated and conspired against. Such cases require very careful watching. In the variety showing confluence only in the puslular stage, delirium is not a constant feature, is relatively simple and of a short duration. It occurs during the/

the secondary fever of suppuration and then principally
at night, the patient being usually rational by day. As
night approaches he becomes restless and sleepless, mutters
and occasionally shouts out, gets out of bed and wanders
about the ward as if he were looking for something. He is,
however, amenable to discipline, returns readily to bed,
is easily humoured, and understands more or less perfectly
what is said to him. No sooner, however, is he left alone
than he is out of bed again. Except in alcoholic subjects
this delirium is of short duration, is easily controlled
and does not greatly exhaust the patient. In a few cases
of this type I have noticed a peculiar form of joyous de-
lirium. In one case it lasted without cessation for 48
hours. The patient laughed, sang, clapped his hands, and
kept continually swaying himself up and down on his spring
mattress. He made no attempt to get out of bed, took his
nourishment well and submitted to treatment, although he
was quite indifferent to his surroundings and to the calls
of nature and paid no heed when spoken to. As maturation
and rupture of the lesions proceeded he gradually became
quiet and rational. As far as I have seen this joyous de-
lirium is not an unfavourable sign. In the confluent vesi-
cular and very severe confluent pustular varieties, however,
delirium is a much more acute, prolonged and exhausting
condition. Early in the disease before vesiculation is
complete/

complete, the patient becomes restless, sleepless, tremulous,
tries to get out of bed and exhibits all the symptoms of
simple delirium. This usually starts at night and continues
in abated form throughout the day, only to become worse on
the following night. The simple delirium gradually merges
into acute or sub-acute delirious mania. He refuses to re-
main in bed, struggles violently when restrained, screams
and uses vile language, sees imaginery persons standing
round his bed, answers imaginery voices, insists that he is
at home or in some place equally unlike a hospital ward, and
in fact, presents all the symptoms of delirious mania. A
drayman sits up in bed and drives his team, a grocer runs
imaginary sugar through his fingers, a labourer sits up in
bed, shouts loudly for his clothes, saying it is time he was
up and off to work, and becomes very violent and abusive
when he cannot have his way. After a wild outburst he
occasionally becomes maudlin and weeps. In favourable
cases the delirium gradually subsides, the tremor ceases and
the patient becomes rational, but in the majority of cases
the exhausting delirium continues. Some of these patients
imagine that their food is poisoned, and that the Doctor
and Nurses are conspiring against them. They refuse to take
any nourishment, and struggle violently if the nasal or
stomach tube is resorted to or rectal alimentation is at-
tempted. The patient gradually becomes weaker, he can no
longer/

longer get out of bed, low muttering delirium, with marked muscular tremor and plucking at the bed-clothes sets in, breathing becomes laboured, hypostatic congestion of the lungs occurs, the pulse becomes rapid, irregular and weak, the first sound of the heart is almost inaudible, and death supervenes after a longer or shorter interval.

In alcoholics, delirium is much more frequent, sets in earlier, and is more violent and prolonged.

Temperature. There are two distinct febrile stages. There is first the initial or prodromal fever which occurs during the period of invasion. The temperature rises rapidly, and on the first day of invasion may reach 104°F. or even higher registers. It is of the continuous type, and lasts throughout this stage with only slight morning remissions. On or about the 3rd day of disease the specific eruption appears, and the temperature, simultaneously or soon afterwards, falls, with greater or less rapidity, the defervescence lasting 24 to 48 hours. In very discrete and modified cases no further febrile manifestation occurs throughout the disease. This febrile state is accompanied by the usual pyrexial symptoms and the more or less characteristic symptoms of invasion which have been already described. In severe discrete and mild confluent pustular cases the temperature in its fall does not quite reach the normal line but remains mildly febrile ranging between about 99°F in the morning and 100°F or 100.5°F at night, until the secondary/

secondary fever of suppuration sets in. This secondary fever commences when the first signs of pustular change appear in the vesicles, and rises until pustulation is complete. The height to which the temperature rises varies from about 102°F in the discrete to 104°F or higher in the confluent cases. The temperature is of the septic remittent type, with a daily excursion of 1 to 2 or 3 degrees. On rupture of the pustules and desiccation of their contents, the temperature falls by lysis unless any complication is present which disturbs the normal course of events.

In confluent vesicular smallpox, defervescence also occurs but is less marked. The temperature soon rises again and maintains a high level throughout the disease. The morning remissions are less, and the fever more continuous in type. In toxic smallpox, the temperature seldom exceeds 100°F, and often runs in sub-normal registers. It may rise to hyperpyretic registers just before death but this is rare.

The Pulse.

In the stage of invasion the pulse rate is accelerated, and in character the pulse is full and bounding. With the appearance of the eruption and the fall of temperature the pulse becomes smaller and its rate is lessened. In mild cases it may even assume its normal character and rate. The occurrence of suppuration with the accompanying rise of/

of temperature again imparts a febrile character to the
pulse.   In severe confluent cases, as the disease progresses,
the pulse becomes very rapid, asthenic, and, later, irregular,
or intermittent.   In toxic smallpox, the pulse is small
and running.

The Lungs.

In severe confluent cases a certain amount of bronchitis
is generally present.   Towards the end of the pustular stage
in confluent pustular cases, or in the milder cases of con-
fluent vesicular smallpox, hypostatic congestion of the
basis is common.   If the patient recovers this soon clears
up.   In fatal confluent vesicular cases hypostatic congestion
is an almost invariable attendant on the fatal issue.

The Blood.

Hayem in his work "Du Sang" states that the destruction
of red corpuscles during an attack of smallpox is in excess
of that occurring in any of the other eruptive fevers, and
that, in a moderately severe case, about 2,000,000 corpuscles
are destroyed during the attack.   The corpuscles remain
normal during the eruptive stage, increase in number during
suppuration and rapidly decrease after subsidence of the
temperature.   In toxic cases, the diminution of corpuscles
occurs immediately after, and is proportional to, the amount
of haemorrhage.   Discussing leucocytosis with reference to
this disease, he states that in highly modified cases there
may/

may be no increase in the number of leucocytes, but that

in moderate and severe cases the white cells are increased,

and in confluent cases, towards the end of suppuration, may

reach 28,000 to 30,000 per cubic millimetre.   In toxic

forms there may be pronounced leucocytosis.   During the

suppurative period the fibrin is also increased.

Hayem considers that leucocytosis when not due to

suppuration indicates a severe form of infection.   Personally

I have little knowledge of the blood changes in smallpox, as

pressure of work in the wards rendered steady laboratory

work impossible.   If one, however, may draw an analogy from

what happens in Scarlet Fever and Diphtheria, increase   in

the number of leucocytes during the presuppurative stage

would rather point to strong reactive power in the patient,

and to a healthy action of the blood forming tissues en-

deavouring by excessive production of white cells to combat

the virus of smallpox.

φ   Hayem.   "Du Sang."   Paris 1889.

Von Limbeck.   "Grundriss einer Klinischen Pathologie

des Blutes."   Jena 1896.

Haemorrhage.

This symptom has already been discussed in dealing with

the several varieties of the disease.   It is merely an

expression/

expression of the toxicity of the attack. In women menstruation generally sets in, independently of the usual menstrual periods. In the graver forms, pregnant women abort, or premature labour is induced.

The Urine.

During the period of invasion the urine presents the usual febrile characters. With the appearance of the eruption and fall of temperature it assumes in greater or less degree, according to the severity of the attack, the characters of the urine in health, but on the occurrence of pustulation with secondary fever it becomes dark in colour, the specific gravity rises, urates are present in considerable excess, and the elimination of urea in increased. In severe cases, albuminuria is common, and albumen may be present in considerable amount. Except in toxic cases haematuria is very rare.

The Bowels.

Constipation is a marked feature in all forms of the disease. Very occasionally diarrhoea is a prodromal symptom. It occurred, as a symptom of invasion, in only 2.8% of my cases. Occasionally diarrhoea occurs in the later stages of severe confluent attacks. It is then a persistent, exhausting, and usually intractable condition causing great prostration, and hastening, if not directly inducing, the fatal issue.

Complications.

Compared with the other common infectious disorders, scarlet fever, diphtheria, enteric fever, and measles, complications in smallpox are relatively uncommon. They are mainly septic in character and are causally related to the pustular eruption. If early evacuation of the contents of the lesions is accomplished, that is if they are opened as soon as pustulation commences, the incidence of complications can be greatly reduced. In about 100 cases treated by me on the principle of treating every lesion as a miniature abscess and evacuating its contents, no septic complications arose with the exception of a few boils in one instance. In the very severe vesicular confluent cases this treatment is hardly applicable, but these cases die of intense toxaemia, and not of septicaemia consequent on suppuration.

Cutaneous, subcutaneous, muscular and intramuscular tissues.

In cases not treated on surgical principles, boils and superficial abscesses are very common. They occurred in 10.5% of cases. They appear in the incrustation stage and during convalescence. They often occur spread over a considerable period of time, one appearing after another, and greatly prolong the average detention rate. The more severe the attack the greater the liability to boils and abscesses.

In/

In one severe vesicular confluent case I opened sixty abscesses, their occurrence extending over a period of 3 months. They are rather sluggish, and do not cause much pain.

Deep Abscesses occurring in the intramuscular strata are less common. They present the usual signs and symptoms.

In six cases I observed a peculiar hard swelling in the muscular tissue closely resembling a gumma. These swellings occurred exclusively in the upper arm on its inner aspect and in the calf muscles. They were very hard, almost painless, of fairly regular outline, usually circular, with sharply defined margins, and varying in size from a tangerine to a large orange. They were freely moveable over the underlying bone and were not adherent to the skin. They were invariably solitary. They all resolved completely without breaking down with the exception of one which became attached to and involved the skin. It was incised, a little serous fluid escaped and it ultimately resolved like the others. The resolution was materially hastened by the administration internally of iodide of potassium.

Cellulitis is relatively uncommon occurring only in 1.6% of cases. The scrotum is a favourite site.

Erysipelas usually occurs in the incrustation stage and generally affects the face and scalp. In one case it was/

was confined to and completely involved the trunk. In no case did it lead to a fatal issue. The percentage incidence was 1.1.

Bedsores are uncommon. They occurred to a slight extent in two cases.

Glands.

Inflammation of the parotid and submaxillary glands occurs in severe cases, probably resulting from direct infection along the ducts. There was one case of suppurative parotitis. In the late pustular and incrustation stages, cervical adenitis about the angle of the jaw, occasionally suppurative in character, sometimes occurs.

Bones and Joints.

Periostitis occurs but is rare. It did not occur in my series of cases. Amongst my other cases, I have seen it affect the long bones in 3 cases, the tibia being the bone selected probably on account of its superficial position.

Periostitis and ostitis of the mandible, affecting the body, usually unilateral and giving rise to great thickening of the jaw, occasionally occurs during the incrustation stage. I have observed it 6 times in about 2.000 cases. It is a tedious condition, and, unless incised, early leads to partial necrosis of the jaw and troublesome discharging sinuses.

The incision can usually be made from the mouth.

Subacute rheumatism complicated by pericarditis occurred in one case.

Eyes.

Conjunctivitis is so common, in cases of any severity, as to be almost a symptom. It varies in intensity from slight conjunctival injection with lachrymation and photophobia, to purulent conjunctivitis with profuse yellow discharge, marked chemosis of ocular and palpebral conjunctivae and great oedema of eyelids. If treated early on principles of surgical cleanliness, it is usually trifling, but in very severe cases with great oedema of the eyelids, especially in young children, treatment is difficult.

Ulceration of the cornea is of fairly frequent occurrence, but in all except very severe cases is preventable. It may be superficial and soon heal under treatment, but occasionally, in very severe cases with marked asthenia, it rapidly spreads both superficially and deeply in spite of treatment. It may open into the anterior chamber and may cause prolapse of the iris and complete anterior staphyloma. In one case I have seen it lead to panophthalmitis rendering enucleation necessary. It is accompanied by pain, photophobia, lachrymation, and circumcorneal injection.

Inflammatory keratitis occasionally occurs in severe cases. It may yield to treatment, but again may be accompanied by sloughing of a portion of the cornea with the formation/

formation of a deep ulcer with ragged edges. Occasionally
hypopyon results rendering paracentesis of the anterior
chamber necessary. The inflammation may even extend further
and cause complete disintegration of the eyeball. It is
accompanied by the usual inflammatory signs and symptoms,
pain, photophobia, lachrymation, and circumcorneal in-
jection. Healing of the ulcer leaves an opacity, which
however often to a large extent, or even completely,
disappears. This condition is usually confined to one eye,
but both may be affected.

Non-inflammatory keratitis, as the name implies, is a
more sluggish condition being atrophic in character, and
presenting no signs of inflammation. It occasionally occurs
in severe cases, expecially in those of the vesicular con-
fluent variety. Children are especially liable. The per-
centage incidence in my series of cases was .56. It occurs
mainly in the pustular stage and is insidious in onset. The
patient does not complain of pain or photophobia and there
is no conjunctival injection, but the cornea is noticed to
be dull and lustreless, and rapidly becomes whitish in colour
and opaque. The opacity is usually partial, but may extend
over the whole cornea. Usually the affection goes no further
than this, and during convalescence gradually yields to
treatment, the opacity becoming smaller and less dense. If
limited in extent it usually clears up completely, but in
cases/

cases where the whole cornea is involved, more or less permanent opacity generally results. Unfortunately a few cases are less favourable, and sloughing of a portion, or of the whole, of the cornea may result, with protrusion of the iris, complete anterior staphyloma, and even panophthalmitis. This fortunately is very rare. This condition like the inflammatory variety is usually unilateral. If bilateral, one eye is usually more extensively diseased than the other.

Iritis occasionally occurs during convalscence. It is usually highly amenable to treatment, complete recovery taking place within three weeks. In my series of cases there were only three cases of corneal ulcer and three of non-inflammatory keratitis. They completely recovered with the exception of one who presented a slight corneal opacity on discharge. Beyond conjunctivitis there were no other ocular complications. This freedom from eye complications I attribute to the fact that these cases were placed in large well-ventilated wards and were nursed by the most experienced and efficient members of our staff. In the crowded wards at the Hospital Ships, where nursing was more difficult, serious eye complication were much more numerous, four single and four double enucleations being performed.

Ears.

Otitis is rare and takes the form of otitis media purulenta.

It occurred in .7% of cases, all of whom were children. The infection was probably from the throat through the Eustachian tube, and the affection followed the usual course of perforation of the tympanic membrane with resulting otorrhoea. In all cases the discharge ceased after varying periods, and in no case did mastoid disease or intracranial complications supervene.

Respiratory system.

Narrowing or even complete blocking of the nasal passages is common in all smallpox cases with profuse eruption. It is due to, and consequent on, the presence of the specific eruption with resultant oedema and inflammation. The patient lies with parted lips, breathing heavily through the mouth. Laryngitis of greater or less severity is a constant feature in severe cases. It is evidence by hoarse cough, husky and toneless voice, and occasionally by dyspnoea. Dyspnoea, however, is not a prominent symptom, and I have never seen a case in which laryngeal obstruction was sufficiently pronounced to render tracheotomy necessary. Such cases, however, are reported. Bronchitis is the invariable accompaniment of all severe confluent cases. It is general and there is frequent cough with mucopurulent expectoration. In severe cases it often largely contributes to the fatal issue. Severe bronchitis occurred in 4.9% of cases.

Hypostatic congestion of the pulmonary bases is also common in severe cases and is often the precursor of death.

Broncho-pneumonia is fairly common in severe confluent cases, especially in children. Lobar pneumonia occasionally occurs in adults. It is most common during the incrustation stage. 50% of cases with lobar pneumonia died.

Pleurisy with effusion and subsequent empyema occurs, but is uncommon. It occurred in 3 out of about 10,000 cases. Two recovered after resection of ribs but the third died.

Circulatory System.

Myocarditis is a common condition, and is present in most vesicular confluent and severe pustular confluent cases. Resultant cardiac failure is often the immediate cause of death.

Pericarditis and endocarditis are rare. I have only seen one case of pericarditis in about 2,000 cases. It was accompanied by subacute rheumatism. Endocarditis I have not seen.

Alimentary System.

Glossitis occurs but is rare. Faucial ulceration is usually quite superficial and rapidly heals. Digestive disturbances are very uncommon, patients as a rule digesting large quantities of fluid nourishment readily.

Constipation is the rule. Diarrhoea is rare. It occasionally/

occasionally occurs in the later stages of severe confluent attacks. It is then a most troublesome, intractable, and exhausting condition hastening if not directly contributing to a fatal issue. It occurred in 1.1% of cases.

Genito-urinary system.

Acute Nephritis is very rare. I have only seen it on one occasion amongst 2,000 cases. It occurred during convalescence. The temperature was slightly raised. Haematuria and albuminuria were present, the latter condition lasting for a considerable time after the haematuria ceased, but ultimately disappearing. The urine was scanty, high coloured, and contained epithelial and blood casts and epithelial debris. Slight anasarca was present. There was considerable consequent anaemia.

In six out of 2,000 cases, all six being cases of moderate severity, there occurred towards the end of the third week when decrustation was well advanced, haematuria with hardly more albuminuria than was accounted for by the amount of blood present. The urine was bright red and clear rather than smoky. The temperature was not raised, the quantity of urine passed and the specific gravity were normal. Microscopic examination revealed no tube casts, only altered blood cells. There was no anasarca, nor was there any change in the cardio-vascular system. There were no symptoms of vesical disease. The haematuria and albuminuria gradually cleared/

cleared up, diminishing proportionately fast, and both ulti-
mately disappearing at the same time. The condition lasted
about 3 weeks and did not induce any appreciable anaemia.
All the patients recovered, so I had no opportunity of in-
vestigating the exact pathological condition present.

Albuminuria occurs in a considerable proportion of
confluent cases. In those which recover, it disappears with
incrustation and subsidence of the temperature.

Orchitis, often with considerable effusion into the
tunica vaginalis, occurs in a small proportion of cases.
It may be single or double. The cases which came under my
observation were all in the late pustular and incrustation
stages of severe confluent attacks.

Ovaritis I have not seen.

Menstruation usually commences independently of the
regular periods.

Premature labour and abortion.

Of women known to be pregnant one arrived at full
time, another was prematurely confined at $8\frac{1}{2}$ months, one
aborted at 5 months, one at 4 months and one at 2 months.
Three women who were 7 months pregnant did not abort. No
septic complications followed on child-birth or abortion.

Nervous System.

The mental condition during the period of invasion
and during the eruptive period has already been discussed.
The percentage incidence of marked delirium in the eruptive
period/

period was 12.1.

Out of 532 cases only 3 presented symptoms of cerebral disturbance during convalescence. One, a man,50 years of age, recovering from a confluent pustular attack,developed melancholia with suicidal impulse. Another man developed subacute mania with delusions. Both rapidly and completely recovered. The third case was that of a young woman who, after a sever pustular confluent attack, developed left-sided facial paralysis, right sided hemiplegia and aphasia. The aphasia and facial paralysis completely disappeared, and power in arm and leg was partly regained prior to discharge.

Very various paralyses and nervous disturbances have been described as occurring during the acute period and during convalescence. Of these I have no personal experience.

Co-existant infectious diseases.

MacCombie states that, in his large experience, he has not seen smallpox and scarlet fever incubating together. In my small series of 532 cases, however, there were two such cases. Both presented all the classical symptoms of scarlet fever at the 5th to 6th day, when the specific eruption of smallpox appeared. Both cases occurred in children and both recovered.

In addition to these 8 patients contracted Scarlet Fever/

Fever during an attack of smallpox. They were all cases
of simple Scarlet Fever with mild anginous symptoms and
all recovered.

One case developed diphtheria. It was a case of
faucial diphtheria with typical clinical signs, and the
Klebs-Loeffler bacillus was isolated.

There were no cases of co-existent enteric fever,
measles, chickenpox, rotheln, or pertussis.

Erysipelas as already stated occurred in 1.1% of
cases.

Diagnosis.

Smallpox is one of the most definite of the eruptive
fevers and presents much less difficulty in diagnosis than
typhus fever, enteric fever, scarlet fever, or diphtheria.
It runs a definite course, it has a definite specific
eruption which passes through a regular and characteristic
series of changes, is present throughout the whole course
of the disease, except in the period of the invasion, and which
possesses a distribution peculiar to itself. Only in a
very small proportion of cases does real difficulty in
diagnosis arise, and these are cases of very discrete
highly modified smallpox, especially if seen for the first
time in the late pustular or incrustation stages.

Diagnosis may be considered under two headings:

1.   Diagnosis during the period of invasion.

2.   Diagnosis during the eruptive period.

1.   Diagnosis during the period of invasion.

It is not possible to make an absolute diagnosis during
the period of invasion unless there is a characteristic
initial rash. In the case of a contact with febrile symptoms,
there may be strong presumptive evidence of smallpox, but
in the absence of a characteristic initial rash, we must
wait for the appearance of the true eruption before making
a definite diagnosis.   The practice of notifying and
removing/

removing contacts with febrile symptoms may be advantageous from the standpoint of the Public Health, but is unfair to the individual who is compulsorily removed from his home, and who may require to be removed a long distance by ambulance, when he may be suffering not from smallpox but from some other acute disease e.g. acute pneumonia.

The following is an instance of such a case occurring during the London epidemic.

A case of smallpox was removed from a common lodging house. Twelve days afterwards, two men occupying adjacent beds suddenly developed acute febrile symptoms. They were both notified as suffering from smallpox, and were conveyed by ambulance to the Receiving station. One man developed smallpox, the other acute pneumonia. The latter died, and his chances of recovery were certainly not enhanced by a long ambulance journey.

Moreover, as Dr. Ricketts pointed out in his annual report to the Metropolitan Asylums Board, the practice imposes a somewhat unfair burden on the hospital authorities, as in these cases it is often impossible either to confirm or refute the diagnosis without waiting two or three days until the eruption appears. Consequently if this practice is widely followed, extensive isolation accommodation is necessary at the Receiving Stations, unless the authorities assume the responsibility of sending back all cases which

do/

do not present definite evidence of smallpox on admission to the station. The practice, moreover, is fruitful of error, as the diagnosis can never be more than presumptive.

Much stress has been laid on the value of backache as a characteristic initial symptom. Whilst admitting that it is a common manifestation, and is probably more frequently present in smallpox than in any other infectious disease, except influenza, it is not an absolutely constant symptom and is present in very varying degrees of severity. Amongst 532 consecutive cases, backache was an initial manifestation in 72.4% of the cases. It is thus not invariably present, and whilst suggestive, its importance may be overrated.

Regarding the initial erythematous rashes, they are seldom sufficiently definite to form the basis of a sound diagnosis. To the experienced observer they might be sufficient, along with the symptoms of invasion and a history of contact, to render him almost certain that the case was one of smallpox, but even he would hesitate to admit such a case to a smallpox ward without previous vaccination or re-vaccination.

The petechial initial rash on the other hand is much more characteristic. I know of no other disease in which a condition occurs resembling a well marked petechial groin rash. This rash along with the symptoms of invasion is/

is quite sufficient evidence on which to base a diagnosis of smallpox.

2. Diagnosis during the eruptive period.

The specific eruption having appeared in greater or less profusion, and the symptoms of invasion having abated synchronously with or soon after its appearance, diagnosis becomes possible and in most cases easy.

In examining any eruption, and particularly that of smallpox, the following conditions are of paramount importance.

1. To obtain simultaneously a view of as much of the skin as possible.

2. A good diffuse light, preferably daylight, but failing that a powerful electric light.

A good but not very powerful magnifying glass is often useful.

The following points should receive careful attention:

1. Possible source of infection.

2. History of present illness.

3. Characters of the individual lesion.

4. The distribution of the eruption.

5. Condition of the individual as regards vaccination and re-vaccination.

1. **Possible source of infection.**

In the case of a patient coming under observation
during the eruptive period a careful enquiry should be made
regarding the possible sources of infection. Reliable
evidence on this point is not always available. In insti-
tutions, common lodging houses, factories, schools &c.,
definite information regarding a previous case or previous
cases may be obtained. The patient's comings and goings
during the probable period of infection should be carefully
enquired into. In women and children this is often easy,
but amongst men, especially those of the wandering and home-
less class, their movements are difficult to trace, and the
determination of the source of infection becomes difficult,
if not impossible. Further, it is this latter class which
is most liable to the ravages of smallpox, and is the most
potent factor in its dissemination. The exact date of
exposure to infection should if possible be determined.

2. **History of present illness.**

Granted that the patient is intelligent, and his state-
ments reliable, the history of the case from the onset of
symptoms is very important and very suggestive. A history
of a febrile attack of two or three days' duration, of
considerable severity and sudden onset, accompanied by the
usual symptoms of fever and the more or less characteristic
initial/

initial symptoms of smallpox, possibly accompanied by an initial rash and followed by an eruption of "spots," on the appearance of which the fever and distressing symptoms subside or abate, is very strongly suggestive of smallpox. Whilst, however, such a definite history as the foregoing is very strong presumptive evidence of smallpox, it is not conclusive, and unless the individual and collective characters of the eruption are those of smallpox we cannot diagnose the disease as such.

For example, although a short febrile attack may be followed by an eruption of "spots," the one may be quite independent of the other. Thus, an individual may have an attack of simple febricula or a mild attack of influenza, and simultaneously with the abatement of the symptoms, a crop of acne spots may appear. So that the history merely serves to suggest smallpox or to confirm the diagnosis. On the other hand, the absence of a history of an initial febrile attack strongly negativises smallpox. In three out of 532 cases, initial symptoms were apparently absent.

In the class of patients most commonly affected by smallpox, however, it is often difficult to obtain a reliable history. Many of these patients are singularly non-observant and take very little intelligent note of their symptoms, and it is difficult or impossible to obtain a consecutive account of their illness. Even regarding the/

the time of appearanceof the eruption their statements are
often obviously at fault.

There is another class of case in which the patient
deliberately attempts to mislead and purposely misinforms
you.   The following is such a case.   A man has a sharp
febrile attack during which he feels seriously ill.   This
is followed by a very discrete smallpox eruption, his un-
quieting symptoms disappear, and he feels comparatively well.
On the appearance of the eruption his condition is diag-
nosed as smallpox, and much against his will, he is removed
to the Receiving Station.   There he is again examined, and,
thinking he may escape detention, he purposely minimises
his previous symptoms.   Such cases are rare, but they do
occur.

We must, therefore, avoid giving undue prominence to
the previous history of the case, not founding our diag-
nosis thereon, but merely using it as a suggestive and con-
firmatory factor in diagnosis, resting our diagnosis purely
on the individual and collective character of the smallpox
eruption itself.

3.   <u>Charactersof the individual lesion.</u>

The specific eruption itself, with its characteristic
lesions passing through their progressive stages to
maturation and incrustation, the relations of the lesions
and/

and groups of lesions to each other, and their characteris-

tic distribution on the surface of the body, constitute the

factors necessary to confirm the diagnosis of smallpox.

The individual and collective characters of the lesions

have already been described. On those characteristics the

diagnosis must be made, although much important confirma-

tory evidence may be obtained from the history of the

patient's illness and from the remains of an initial

petechial rash.

With the exception of toxic smallpox without specific

eruption and of the problematical "smallpox sine eruptione,"

the eruption is an invariable and constant feature in all

varieties of the disease. It is true that the characters

of the eruption are subject to modification due to the

presence of a partial immunity to the disease and to other

general and local causes. The effect on the eruption of

these modifying agents has already been considered, and the

possibility of their presence being remembered, and the

lines on which they proceed appreciated, their effect can

be estimated and discounted. One all-important feature

is that the eruption persists until the termination of the

disease, and in all cases presents characteristic stages

in its life history.

4/

4. <u>The distribution of the eruption.</u>

The distribution of the eruption is of even greater importance in diagnosis than the individual characters of the lesion. It is practically free from variation, and apparently remains as true in modified as in natural smallpox. Local irritation and pressure, as already described, may cause the eruption to be specially dense at the seat of irritation and pressure, but this disturbing factor is easily recognized and eliminated. Modification, due to a partial immunity to the disease, may produce very extensive changes in the individual lesion, shortening its life history and otherwise modifying its features, but has little or no disturbing influence on the distribution. This is an exceedingly important point, as it is in highly modified cases that difficulty in diagnosis arises, and the individual lesions in these cases are often far from being characteristic. Thus, there may be a very close resemblance between the individual lesions of chickenpox and those of highly modified smallpox, especially in those lesions situated on the forearms, hands, legs, and feet, so much so that diagnosis between the two would be difficult or impossible, were it not for the fact that the distribution of the one is exactly the opposite of that of the other, and this characteristic is as easy of recognition in the late desiccation stage as in the early vesicular.

Further/

Further it is a matter of simple observation, and requires no special skill in recognition.

5. Condition of the individual as regards vaccination and re-vaccination.

In a limited number of cases, important evidence, negativing the presence of smallpox, may be obtained from the examination of vaccination or re-vaccination cicatrices. If the patient carries well foveated pigmented scars, we may safely conclude that he has been efficiently vaccinated, or re-vaccinated within a year. The foveation is evidence of the nature of the scars and of the efficiency of the vaccination, whilst the presence of pigmentation proves that the operation has been recently performed. In such cases, whatever disease the patient may be suffering from, it is almost certainly not smallpox.

However numerous, extensive, and well foveated the cicatrices are, if pigmentation has disappeared, we have no ocular evidence of the approximate time that has elapsed since vaccination was performed, and consequently cannot be certain that the immunity conferred by the operation is still complete. If, however, the patient carries the marks of three separate vaccinations performed at suitable intervals of time, he is probably immune to smallpox. I have never seen smallpox in an individual bearing the marks of/

of 3 successful vaccinations.

Diseases commonly mistaken for smallpox.

Attention to the points mentioned under diagnosis, and a due appreciation of the relative importance of each, renders a definite and correct diagnosis comparatively simple. Diseases of all kinds have been mistaken for smallpox, but a due appreciation of the foregoing points renders most cases easy of diagnosis and mistakes relatively few. Amongst the local cases sent direct to Gore Farm Hospital, on notification as smallpox, errors in diagnosis were relatively infrequent. This was probably due mainly to the fact that the infected district was small, and the certification was largely in the hands of the local Medical Officer of Health who had opportunities of seeing many cases of smallpox.

Out of 547 cases sent direct to Gore Farm Hospital, certified to be suffering from smallpox the diagnosis was revised in 13 cases. This gives the small percentage error in diagnosis of 2.7.

Of these cases 4 were suffering from varcella, 4 from acne, 2 from measles, 1 each from generalised vaccinia and scabies, and 3 from indefinite dermatites. In London, on the other hand many practitioners called to a case had never had an opportunity of studying smallpox from a

clinical/

Clinical standpoint and probably they often certified a
patient to be suffering from smallpox when they had doubt
as to the correctness of the diagnosis, realising that,
from a hygienic standpoint, it was much safer to certify
one case too many than one too few. A more general idea,
therefore, of the relative frequency with which various
diseases are mistaken for smallpox may be gathered from
the following table which appeared in Dr. Rickett's annual
report to the Managers of the Metropolitan Asylums Board.
This series of cases comprises all patients dealt with at
the Receiving Station during 1901 and shows the percentage
error in diagnosis to be 13.2

Table/

Urticaria	9
Drug rashes	6
Febricula	6
Lichen	5
Impetigo	5
Scabies	4
Scarlet fever	4
Measles	4

Table showing the different diseases mistaken for smallpox amongst 1,867 cases notified, with the number of cases of each disease so mistaken.

Disease	No. of cases.
Smallpox	1,600
Varicella	77
Acne	25
Dermatites, various	18
Syphilis	17
Erythemata	14
Eczema	11
Furunculus	10
Vaccinia	9
Acute uninfectious diseases without eruption	9
Urticaria	9
Drug rashes	6
Febricula	6
Lichen	5
Impetigo	5
Scabies	4
Scarlet fever	4
Measles	4
Herpes	3
Pemphigus	2
Nil, including infants admitted with mothers.	29
Total	1,867

As will be seen from the foregoing table varicella is
the disease most frequently mistaken for smallpox, account-
ing as it does for nearly one-third of the total errors in
diagnosis. Nor is this surprising, as there is often a close
resemblance between the lesions of chickenpox and those of
highly modified smallpox.

The following points are of importance in the differ-
ential diagnosis between chickenpox and smallpox.

In varicella. 1.   Initial symptoms, if present at all, are
slight and of short duration. Fever is
absent or trifling.

2.   The lesions have a tendency to appear in
crops, and thus lesions of varying ages may
be congregated together on a small area of
skin. This is never seen in smallpox.

3.   The individual lesion is situated more
superficially in the skin than that of
smallpox and is usually fully vesicular
within 24 hours of its appearance.

4.   The pellicle of the vesicle is thin, and
the vesicle is easily ruptured by slight
pressure between the finger and thumb,
whereas in smallpox very considerable
pressure is necessary.

5.   The vesicles and pustules on the trunk are
more/

more or less oval in outline. Those of

smallpox are circular.

6.The distribution of the eruption is entirely

different. In varicella,the eruption is

present in greatest profusion on the trunk,

next on the scalp, next on the face, and is

relatively sparse on the limbs. Further,

the greater the distance along the limbs

from the trunk the more rare is the eruption.

Exactly the opposite obtains in smallpox.

The eruption is most profuse on the face,

next on the limbs, and is most sparse on

the trunk. Moreover, the density of the

eruption on the limbs increases, instead

of diminishing, with distance from the trunk.

Next to varicella, acne was the disease most frequently

mistaken for smallpox. Here there is an absence of the

symptoms of invasion. The lesions may bear a certain re-

semblance to those of highly modified smallpox, but are more

accuminate, more variable in size, and generally show a

central comedo. Further, the distribution is totally dif-

ferent, the lesions in acne being congregated mainly about

the face and shoulders, and being absent or very sparse

elsewhere.

A detailed consideration of the differential diagnosis

between /

between smallpox and the other diseases which may be mistaken for it appears to me unnecessary, entailing merely a repetition of the factors on which diagnosis in smallpox is based, an account of the leading symptoms of the other diseases, and a comparison between them.

The only other condition which appears to me to call for special remark is the early eruption of measles, especially as seen in adults. Here the eruption on the face, if very dense and coarsely papular, as it sometimes is, bears a fairly close resemblance to the early smallpox eruption. The spots, however, are more irregular in shape, are flatter, and the surface is velvety in character. The distribution of the eruption about the roots of the hair and behind the ears is also suggestive. Still, a few cases occur which at first present great difficulty in diagnosis, but with the lapse of 12 hours or less the eruption definitely declares itself on the face, trunk, and limbs, and a definite diagnosis may be arrived at. With the aid of a magnifying glass, search should be made for early vesiculation. In measles, moreover, the temperature does not fall with the appearance of the eruption, coryza and bronchial catarrh are usually marked, and Koplik's spots may be present even after the appearance of the specific eruption.

PROGNOSIS.

Prognosis /

Prognosis during the period of invasion is seldom called for, as few cases can be definitely diagnosed until the specific eruption appears, and further, that period is generally passed before the patient comes under observation.

In my series of cases, a shortening of this period seemed to indicate a mild type of the disease.   Of 12 cases in which the specific eruption appeared within 24 hours of the onset of symptoms, 11 developed modified discrete attacks, and the twelfth a modified confluent attack. All twelve patients recovered. The numbers, however, are too small to permit of any reliable inferences being drawn.

The severity of the initial symptoms is of slight value in prognosis. If they are not severe the attack will probably be mild. The converse, however, is not equally true, as, although severe initial symptoms generally preceed a severe attack, they may also preceed a mild one. The character of the initial rashes, if present, forms a fairly reliable factor in prognosis. The erythematous rashes are usually of favourable import. They are, however, very evanescent and probably often escape notice, having faded before the patient comes under observation. In 532 consecutive cases they were observed in 7 cases only. In every case they ushered in a discrete attack. There were no deaths. Petechio-erythematous or mixed rashes indicate a severe or mild/

mild attack according to which element of the rash is more pronounced. If the erythema is in preponderence and the petechiae are few, scattered, and of the bright red variety, the prognosis is usually good. If, on the other hand, the petechial element is the more pronounced and the petechiae are numerous, thickly set, and of deep colour, the prognosis is grave. Petechio-erythematous rashes were observed in 10.7% of cases showing an initial rash. In all the cases the erythematous element predominated, and the attacks were benign.

The purpuric initial rashes, on the other hand, are of much graver significance, and, if at all pronounced, point to a severe toxaemia. Haemorrhage in smallpox is, in my opinion, merely an expression of toxicity. The purpuric initial rash therefore is largely an indication of the extent of intoxication. This is by no means invariably true as many fatal cases show no initial purpuric rash, but where the rash does exist, it apparently has this significance. In cases where the toxaemia is not very pronounced, haemorrhage into the skin, as its visible expression, is limited to the appearance of a few scattered petechiae of light colour. The varying shades of the petechiae are probably due to the depth of the haemorrhage in the skin, those of bright red or light maroon colour being superficial, and the darker purple or black petechiae extending more deeply, and being therefore more extensive. All degrees of toxicity and consequently all/

all degrees of skin haemorrhage are met with, from the mild cases showing a few scattered light-coloured petechiae in the initial stages to the toxic cases with general skin haemorrhage and haemorrhage from mucous surfaces, which kills by the intensity of its toxaemia before the specific eruption has time to appear. The value, as a prognostic sign, of the initial purpuric rash is thus explained. Where the petechiae are few and superficial, the toxaemia is probably slight, and the consequent attack will probably be benign. When, however, the haemorrhages are numerous and extensive, the toxaemia is greater, and the attack will be severe. Thus, a case which shows a moderately extensive groin rash, if the petechiae are of the bright red or light maroon shades, will not necessarily be severe. When, however, the petechiae are numerous, of large size, confluent, of deep colour, and widely spread over the surface of the body, the attack will probably be fatal.

Cases showing the dusky black irregular haemorrhages, aptly likened to inkspots, are invariably fatal.

Initial purpuric rashes of varying intensity were observed in 56 out of 532 consecutive cases giving a percentage incidence of 10.5. Of these cases 44.6% developed discrete benign attacks. The remaining 55.4% developed confluent or toxic smallpox. Of these latter 48.4% recovered and 51.6% died. The percentage mortality in all cases showing initial purpuric/

purpuric rashes in any degree was 28.5, whilst the percen-
tage mortality in the whole series of 532 cases was only 15.4

The percentage mortality in the 476 cases which did not

show an initial purpuric rash was 13.8. So, the death rate

in those cases with an initial purpuric rash was more than

double that of those without one.

The following table shows this more clearly:-

1. Percentage mortality of cases showing an
    initial purpuric rash   28.5

2. Percentage mortality of cases not showing
    an initial purpuric rash   13.8

3. Percentage mortality of all cases, i.e.
    Nos. 1 and 2 combined   15.4

Influence of previous vaccination on prognosis.

The value and mode of operation of vaccination as an

immunising and modifying agent has already been considered.

It remains here to discuss its effect on prognosis. First

will be considered the prognosis in vaccinated as compared

with unvaccinated subjects, and second, the prognostic in-

ferences that may be drawn from an examination of the nature

of the cicatrices resulting from vaccination.

Table 2. gives an analysis of all the cases in the

series I am specially considering with reference to their

condition as regards previous vaccination, subdividing the

vaccinated cases according to the character of the vaccination

cicatrices/

cicatrices as regards number of scars, total superficial area of scars, and the proportion of foveated to non-foveated scar tissue.

The cases are first of all divided broadly into vaccinated and unvaccinated cases.

The following table gives the percentage mortality in each class:-

	Admissions	Deaths	Percentage mortality.
Unvaccinated Class	79	45	56.9
Vaccinated Class	444	36	8.1

From this table, it is seen that the death rate in unvaccinated subjects is seven times greater than in vaccinated subjects.

Inferences drawn from study of vaccination cicatrices.

1.   Number of Cicatrices.

Table showing the number of admissions and deaths amongst vaccinated cases divided according to the number of cicatrices, with the percentage mortality in each class.

Number of Cicatrices	Admissions	Deaths	Percentagemortality
Four or more	175	11	6.2
Three	130	10	7.6
Two	96	10	10.4
One	43	5	11.6

It is seen from this table that the number of cicatrices alone/

alone, quite independent of their total area and of the extent of foveation, influences the protective power of vaccination. Cases with four or more scars had the low percentage mortality of 6.2, whilst those with three, two, and one scar had a progressively increasing mortality, the death rate of those with one scar being nearly double that of those with four or more.

2.   Total superficial area of cicatrices.

Table showing the number of admissions and deaths amongst vaccinated cases,divided according to the total superficial area of cicatrices,with the percentage mortality in each class.

Total superficial area of Cicatrices.	Admissions.	Deaths.	Percentage mortality.
One-half and upwards of one-half sq. in. total area.	332	22	6.6
One-third but less than one-half sq. inch total area	57	8	14.0
Less than one-third sq. inch total area.	55	6	10.9

This table shows that cases having vaccination cicatrices with a total superficial area of one-half and upwards of one-half sq. inch have the low percentage mortality of 6.6, whilst those with less than one-half sq. inch total area have a percentage mortality of 12.5 or nearly double that of those with one-half and upwards of one-half sq. inch.

It/

It is somewhat strange that those with less than one-third sq. inch total area should have a lower percentage mortality than those with from one-third to one-half sq. inch, but the small numbers dealt with probably accounts for this apparent contradiction. We may then infer from this table, that, independent of the number of cicatrices and of the extent of foveation, the greater the superficial area of the cicatrices, (within limits), the more lasting is the immunity conferred by the vaccination.

3.   Proportion of foveated to non-foveated scar tissue.

Table showing the number of admissions and deaths amongst vaccinated cases divided according to the proportion of scar tissue foveated, with the percentage mortality in each class.

Proportion of scar tissue foveated	Admissions	Deaths	Percentage mortality.
One-half or more than one-half foveated.	106	4	3.7
Less than one-half foveated.	163	9	5.5
Plain scars	185	23	12.4

The value of foveating in estimating the efficiency of vaccination is well shown in this table, for whereas those cases with one-half and more than one-half of the scars foveated have a percentage mortality of 3.7, and those with even less than one-half of the scar tissue foveated have still/

still the low percentage mortality of 5.5, those with plain scars showing no foveation have the high percentage mortality of 12.4

Again the percentage mortality of cases whose cicatrices show foveation in any degree is 4.7, as against a percentage mortality of 12.4 in those without foveation.

In order to show the combined effect of total superficial area of cicatrices and of the proportion of foveated scar tissue I have prepared the following table.

Total superficial area.	Proportion of foveated scar tissue.	Admissions.	Deaths.	Percentage Mortality.
A. One-half and upwards of one-half sq. inch total area.	One-half and more than one-half foveated	77	2	2.6
	Less than one-half foveated	138	7	5.07
	Plain scars	127	13	10.2
B. One-third but less than one-half sq. inch total area.	One-half and more than one-half foveated	12	1	8.3
	Less than one-half foveated	16	2	12.4
	Plain scars	29	5	17.2
C. Less than one-third sq. inch total area.	One-half and more than one-half foveated	17	1	5.9
	Less than one-half foveated	9	0	0.0
	Plain scars	29	5	17.2

This table demonstrates very clearly the superiority of large superficial area and extensive foveation over small superficial area and little or no foveation. In each division the total superficial area is the same, but the proportion of foveated to non-foveated scar tissue varies.

Class A. shows, in all points, a marked superiority over classes B. and C.

When we compare classes B. and C. the superiority of well foveated over poorly foveated and plain scars is again apparent. As regards the total superficial area of scar, however, Class B. with one-third but less than one-half sq. inch total area shows us superiority over Class C. with less than one-third sq. inch total area.

From these statistics, therefore, we may conclude that all three factors, namely, number of cicatrices, total superficial area of cicatrices, and proportion of foveated to non-foveated scar tissue, are important: that the most important factor is foveation, next in importance is total superficial area, and less important, but still of some value, is the number of scars.

The result to aim at in vaccination, therefore, is to produce four or more scars having a total superficial area of not less than one-half sq. inch, and having at least one-half of the scar tissue foveated. If this is obtained, we may, as shown in the foregoing tables, reasonably hope to reduce the/

the percentage mortality of vaccinated cases to less than 3.

The value of an examination of vaccination cicatrices in prognosis is thus explained. If a patient has four or more cicatrices with a total area of not less than one-half sq. inch, at least one-half of which is foveated, the outlook as regards recovery is very favourable. As the total area, and more especially the foveation, decline from this standard, the prognosis becomes steadily more graver.

Re-vaccination fortunately restores the immunity, and, if performed at puberty when the effects of infant vaccination are wearing off, usually renders the individual immune to smallpox throughout life. Amongst 532 cases, only 4 carried the scars of two separate vaccinations and only one died. In the case that was fatal, the patient was 63 years of age, and the evidence of re-vaccination was not conclusive.

A third vaccination, when the effects of the second are wearing off, apparently confers a life-long immunity. I have never seen smallpox in an individual who bore evidence of three successful vaccinations.

Therefore, as regards prognosis, a patient bearing the marks of two successful vaccinations will almost certainly recover.

Vaccination or re-vaccination during the incubation period

Vaccination or re-vaccination sufficiently early in the incubation/

incubation period influences the prognosis. This subject
has been discussed under the head of modification.

<u>Age</u>.

<u>Unvaccinated cases</u>.

Table 2 shows that the fatality rate amongst unvaccinated
patients during the first two years of life is very high.
The percentage mortality was 88.8.

From 2 to 20 years of age the prognosis is more favour-
able, the percentage mortality being 31.2. From 20 years
onwards the outlook becomes much more grave. Of unvaccinated
patients over 20 years of age, 71.04% died.

Unvaccinated patients therefore under 2 and over 20
years of age have a very high mortality over two-thirds of
the patients dying. From 2 to 20 years of age over two-
thirds recover.

<u>Vaccinated cases</u>.

Under 15 years of age there were 21 cases and no deaths,
and under 25 years of age 149 cases and only 2 deaths or a
percentage mortality of 1.3 The prognosis up to 25 years
of age is therefore very favourable.

After 25 years the prognosis becomes more grave. Amongst
295 patients over 25 years of age, 44 died giving a percen-
tage mortality of 14.9.

The percentage mortality in the different age periods
from 25 onwards was as follows.

Age period	Percent. Mortal.	Age Period.	Percent. Mortal.
25 to 30	7.7	40 to 50	18.4
30 to 35	8.3	50 to 60	16.6
35 to 40	9.7	60 and upwards	25.0

The prognosis therefore becomes steadily more grave from 25 to 40, and after 40 becomes much more grave, the percentage mortality rising from 9.7 in the 35-40 age period, to 18.4 in the 40 to 50 period, and reaching its maximum over 60 years of age when it rises to 25.0.

Co-existent diseases.

The co-existence with smallpox of chronic disease of the kidneys, liver, heart and lungs influences the prognosis unfavourably. Chronic alcoholism is also of very grave significance, delirium often setting in early and being very difficult to control.

Prognosis in the several varieties of smallpox.

1. Toxic smallpox without specific eruption: Patients with this variety of smallpox invariably die.

2. Toxic smallpox with specific eruption: Out of over 10,000 cases of smallpox, occurring during the epidemic, only one patient with this type of the disease recovered.

3. Confluent and discrete smallpox: In these types of the disease, due consideration having been given to the factors/

factors already discussed as influencing prognosis, the profuseness of the specific eruption is the criterion of severity. The more profuse is the eruption and consequently the more closely set are the lesions the more grave is the prognosis. The face being the region in which the lesions are most closely set, and being also the region in which any slight priority of eruption occurs, an estimation of the density of the lesions in this situation is the most reliable guide in prognosis. Where the lesions are so numerous as almost to touch in the papular stage, a fatal issue is almost invariable. Universal confluence on the face in the vesicular stage indicates a type of disease almost equally fatal. As the vesicular confluence becomes less marked the prognosis becomes more hopeful, and, other conditions, such as age, and previous vaccination, being favourable, recovery may take place. As the vesicular confluence becomes slight, the prognosis steadily improves. Cases showing confluence only in the pustular stage are hopeful, if the patient is young (the very early age periods being excepted), has been vaccinated, has no serious co-existent disease, and has a good history as regards alcohol. If, however, the patient is at one of the extremes of life, or is unvaccinated, or is an alcoholic, the prognosis is still grave. As confluence becomes slight, prognosis becomes good except in very young and in unvaccinated senile cases. Patients with discrete

smallpox/

smallpox invariably recover unless under 2 years of age or
unless suffering from some severe co-existant disease.
Amongst 532 cases of smallpox only 5 patients with discrete
smallpox died. Four of these cases were in unvaccinated
infants under 7 months old, and the remaining one in an
adult who died, during an attack of smallpox, from an inter-
current illness quite independent of smallpox.

Untoward symptoms occurring during an attack of smallpox.

The following symptoms occurring during an attack of
smallpox are of unfavourable omen: a temperature never below
100° F. in the papular or vesicular stages, very profuse
eruption on mucous membranes, large flat confluent vesicles
with bloodstained contents and little accompanying oedema,
extensive intra-vesicular or intrapustular haemorrhages,
profuse haemorrhage from mucous surfaces, marked laryngeal
obstruction, severe bronchitis, hypostatic conjestion of
lungs, evidence of myocarditis, rapid, irregular, or inter-
mittent pulse, very high continued fever in the pustular
stage, hyperpyrexia, diarrhoea, early and prolonged delirium,
floccitatio and subsultus tendium. In the late pustular
and incrustation stages, extensive cellulitis, erysipelas,
and pulmonary complications are all unfavourable.

Treatment/

Treatment.

From the standpoint of the Public Health.

In all communities where large numbers of individuals
are congregated together in close proximity to one another,
permanent isolation accommodation for smallpox cases should
be provided. This permanent accommodation should be suffi-
cient to meet any sudden outbreak of the disease, and should
be capable of rapid expansion to cope with epidemic needs.
The administrative department, therefore, should be much
more extensive than is necessary for the efficient adminis-
tration of the permanent wards, and should be capable of
supplying the needs of the temporary wards which can be
rapidly constructed to meet epidemic outbreaks. Officer's
quarters, kitchens, stores, laundries, disinfectors, des-
tructors, and pathological departments cannot be rapidly
improvised as can temporary wards, and they should, therefore,
be sufficiently large to supply the needs of the temporary
as well as the permanent wards. It follows from this that a
sufficient area of spare ground, suitable for the erection
of temporary wards, should be available immediately around
the administrative offices and permanent wards. A suit-
able number of single-bedded observation wards should also
be provided for the isolation of doubtful cases, and sit-
uated as far as possible from the smallpox wards. The re-
ceiving-room should be near the gate. It should be a sep-
arate building with doors at opposite sides capable of
admitting a stretcher, so that the ambulance can deliver the
patient/

patient at one door and receive him again at the other, and

a rapid succession of ambulances be efficiently dealt with.

The room should be floored with some impermeable material,

capable of rapid and thorough cleansing, and the walls should

be lined with glazed tiles. The roof should be of glass, and

the best possible artificial light should be available. A

bad or unequally diffused light is responsible for many

mistakes in diagnosis. The discharge-room should be near

the gate and built in the ordinary way with undressing rooms,

bathrooms, & Dressing rooms, built in series.

As regards the site of the hospital it should be within

easy access of the centre of population, but at the same time

must be, as laid down in the orders of the Local Government

Board, not within quarter of a mile of any hospital, work-

house or similar institution or of a population of 150 to

200 persons, or within half a mile of a population of 500

to 600 persons, whether in one or more institutions or in

dwelling houses. Any considerable aggregation of inhabi-

tants just outside the half mile radius should also be avoid-

ed if possible.

As the question of the aerial convection of smallpox is

still sub-judice it would be well, other more important

considerations permitting, to have the hospital situated so

that the prevailing wind blows from the centre of population

to the hospital.

Where /

Where the isolation hospital is a considerable distance from the centre of population, as in London, it is necessary to establish a receiving-station within convenient reach. This station should be under the control of a resident medical officer expert in the diagnosis of smallpox. Every case should be examined by him immediately on arrival, and the diagnosis confirmed or revised. The station should be equipped with a sufficiency of single-bedded observation wards for the reception and observation of doubtful cases, and of contacts with symptoms, if it is deemed inadvisable to send the latter home. All doubtful cases should be vaccinated before admission to the observation wards, and all cases of other diseases, wrongly certified as smallpox, should be vaccinated before being sent home. If isolation accommodation for doubtful cases is not available they may be admitted into smallpox wards after being vaccinated. This, however, is eminently undesirable, as, for some reason, the vaccination may be unsuccessful. A useful precaution against unsuccessful vaccination is to employ two different strains of lymph in each case, thus greatly minimising the risk of the vaccination being unsuccessful.

All persons should be denied admission within the hospital boundaries unless they will submit to vaccination. The question of admitting the relatives of patients dangerously ill who refuse to submit to vaccination is a difficult one/

one. In the present state of public feeling, and with a very weak and inefficient Vaccination Act, all that can be done is to endeavour by argument and moral suasion to overcome their objections. If they refuse to be convinced before visiting the wards, they are usually not only willing but anxious to be vaccinated after.

Visitors should be compelled to cover their clothing and heads with linen overalls to be provided by the hospital authorities, to keep at a suitable distance from the patients bed, and to wash their hands and faces before leaving the hospital. The risk of contamination of the visitors boots is often overlooked, and, in view of the fact that the ward floor is certainly highly infectiferous by reason of separated crusts and epidermic debris, it appears to me very essential that stout linen coverings should be supplied to cover the boots.

As soon as a case is diagnosed, it should be removed by ambulance. All contacts should be traced and, if possible, vaccinated. The ideal is to isolate all susceptible contacts until the incubation period is over, but this is seldom possible in epidemic times.

Did we possess an efficient Vaccination Act providing for compulsory infant vaccination and re-vaccination at puberty, with no loopholes for evasion, smallpox would soon become a disease relatively unknown.

General/

General treatment.

The provision of ample cubic space, sufficient floor area, efficient ventilation, and direct sunlight, so necessary in the treatment of all infectious diseases, are equally essential in smallpox.

Toxic smallpox without specific eruption is invariably fatal and toxic smallpox with specific eruption is almost equally so. I have only seen one patient with the latter variety recover. The duration of life is short, and all that can be done is to render the patient as comfortable and free from pain as possible. Many local and general styptics have been tried to arrest the haemorrhage, but all have signally failed. Pain is not a constant feature but is at times agonising. When pain is clamant, morphia by hypodermic injection is the only drug which gives relief. Sometimes morphia, even in dozes of one grain, affords no relief. Fortunately this is exceptional. In these cases, morphia may shorten life slightly, but, in a condition which is hopeless, this is of little moment, if the patients end can be rendered more peaceful thereby. Again, with a patient in full possession of his senses and facing a certain and often painful death, it appears to me not only humane but justifiable to employ morphia even in large dozes. Beyond this nothing can be done. In the discrete variety and in highly modified cases on the other hand, except in very young/

young unvaccinated and senile debilitated subjects, life is not endangered and all that is necessary is to treat the patient on ordinary nursing principles, relieve local discomfort, combat constipation, and prevent or minimise subsequent scarring. In the severe confluent varieties, however, much may be done. Life and death often hang in the balance, and skillful treatment and, especially, intelligent and patient nursing, may do much to turn the scales in the desired direction.

The patient should be lightly clothed and the pressure of the bedclothes minimised as far as possible. The bed and body linen requires frequent changing, in most cases daily, and should be of as fine texture as is compatible with durability. The diet in the acute stage should be largely fluid, consisting of milk, beeftea, light farinaceous puddings, plasmon and eggs, with lemonade, made from fresh lemons, to quench or allay thirst. Provided the patient is taking a good quantity of nourishment, he may be allowed and even encouraged to drink large quantities of fluids such as lemonade, imperial drink, or water, to act as diluents and flush out the kidneys. With the exception of acutely delirious and deluded patients liquid nourishment is taken freely and is readily digested, digestive disturbances being very infrequent. Acutely and delirious and deluded patients often refuse all nourishment and alimentation becomes very difficult. So fiercely

do /

do they resist nasal or aesophageal forced feeding or any attempt at rectal alimenation that the exhaustion consequent on struggling more than counter-balances the good effects of the nourishment administered. In these cases it is well to endeavour to quiet the delirium with drugs and baths, if practicable, and by persuasion to induce the patient to take small quantities of nourishment frequently.

The question of the value of alcohol is an important one. Those patients with very acute and prolonged delirium and signs of exhaustion are often alcoholics, and, as in acute pneumonia in such patients, alcohol in heroic doses appears indicated. Smallpox in a severe form, however, differs from acute pneumonia in that the acute stage of the disease is more prolonged and indefinite. In pneumonia we merely strive to stimulate the failing circulation for a very definite and limited time, knowing that the crisis is imminent, and that alcohol will only be required for a very limited period. In smallpox on the other hand, we have to look forward to a longer illness, and, bearing in mind the fact that alcohol does not conserve the power of the heart to any appreciable extent and is not really a cardiac tonic, but rather serves to drive it faster and give it more work to do ultimately leading to cardiac exhaustion, we must use great caution as to when and in what quantities we will exhibit alcohol. I have tried it in heroic doses, tried it early /

early and late, and again have withheld it, in such cases,
and have come to the conclusion that although alcohol has
its use in smallpox, still, its field of application is limit-
ed. I consider that in severe confluent cases, and these
are practically the only ones in which alcohol is called
for, it is well to keep a discriminating finger on the
pulse and to auscultate over the cardiac apex night and
morning. A slight softening and want of tone in the first
cardiac sound, and possibly a less perceptible apex beat,
with a slight fall in the force and tension and rise in
the rapidity of the pulse, call for cardiac stimulation.
At this stage, I think it is well to administer strychnine
hypodermically every few hours and, possibly, to supplement
it with tincture of Strophanthus by the mouth, giving also
sedatives to quiet delirium if present. The great indi-
cation is to subdue the delirium and give the heart an oppor-
tunity of recovering its tone under the influence of direct
and indirect cardiac tonics. When the patient is getting
on to the 8th. 9th. and 10th. day of disease and the termin-
ating of the disease by death or recovery is approaching,
then, if at all, is the time for the exibition of alcohol.
The question of death or recovery will be settled within
the next few days, and if the heart is showing signs of fail-
ure, the first sound becoming indistinct, the apex beat dis-
placed outwards or becoming imperceptible, and the pulse
small/

small, rapid, irregular, or intermittent, alcohol is called for. It should be started in small doses, say one drachm of good whisky in two drachms of water every two hours, and if necessary, steadily increased to half an ounce at the same intervals of time. It is best given in small dilution, and as far as possible on an empty stomach, in order to obtain the reflex stimulation from the gastric nerves. I can recall one or two cases in which alcohol so administered seemed to avert an impending fatal issue. I never could persuade myself that alcohol started early and in large doses did good. It appeared sometimes to have an effect in quieting the delirium and making the patient less restless, but only when administered in such doses as to put the patient mentally under its influence. In these cases it appeared to me that the stuperose condition induced was more than counteracted by the cardiac exhaustion induced by too great stimulation.

Too much attention cannot be paid to the kind of alcohol employed. It is not the alcohol, but the volatile (byeproducts) ethers, and aldehydes, that are beneficial.

The best form is genuine old Cognac (Grande Champagne), but this is exceedingly costly and quite impracticable for hospital use. Failing that, well matured Scotch pot-still whisky, made from malted barley and matured for years in wood, is the best. It is rich in ethereal bodies. Cheap brandy and immature whisky are worse than useless.

Hypostatic/

Hypostatic congestion of the lungs is very apt to occur in severe cases and can best be avoided by frequent change of posture, the nurse being instructed to turn the patient frequently from side to side. When it has set in, Belladonna in full doses appears to have a beneficial effect in checking bronchial secretion. Constant attention must be paid to the state of the bowels. Constipation is the almost invariable rule, and the disease being essentially an intoxication, it is important that no emunctuary should be closed. Daily action of the bowels should therefore be obtained.

In favourable cases, with rupture of the pustules and desiccation, the temperature falls and general improvement rapidly sets in. Oedema subsides, the crusts separate, and convalescence, unless delayed by complications, is rapid. As soon as the temperature falls, the diet may be rapidly increased, through fish and white meats, until in a few days the ordinary diet of health is taken. The appetite is usually very keen, and large quantities of food are taken and assimilated. If the appetite is poor, bitter tonics are useful, and alcohol in the form of whisky well diluted, port wine, and malt liquors may be advantageously given with meals. Anaemia, if present, should be combated with Iron and Arsenic. The patient rapidly puts on flesh, and, in most moderately severe cases, is able to be up for a little within ten days of the subsidence of the temperature.

Treatment/

Treatment of the Specific Eruption.

The important question to decide in this connection is:-
is pustulation a necessary consequence on vesiculation or is
it preventable? I am strongly convinced that,granted second-
ary pyogenic infection through the skin is prevented, the
vesicles will desiccate without pustulation.

I had no opportunity of trying the effects of Finsen's
Red Light treatment, so strongly advocated by that writer,
as a means of preventing pustulation in smallpox, but I
understand that experiments carried out at Long Reach Hospital
do not bear out Finsen's statements, and that no good re-
sults were obtained from the treatment. One of my friends
in practice in China, however, informs me that he treats
annually about 200 cases of smallpox, and gets admirable re-
sults from the red light treatment. With the object of
preventing pustulation,I painted the faces of all my patients
immediately after admission with Collodium Flexile contain-
ing $2\frac{1}{2}\%$ of pure Carbolic Acid, and repeated the treatment
every four hours until the period of full pustulation.
This treatment was quite unsuccessful,and I came to the con-
clusion that I was merely imprisoning under an antiseptic
coating the organisms already on the skin. I therefore
carefully sterilized the skin as for an operation and then
applied the following paint:-

paint:-

Collodium Flexile

Acid Carbolic Pure $2\frac{1}{2}\%$

Fuchsin. Sufficient to impart a deep red colour.
This paint was renewed every four hours, so as always to
have the part covered with an impermeable antiseptic coat-
ing. The treatment was continued until the period of full
pustulation. I found that in all cases in which this treat-
ment was commenced in the papular and very early vesicular
stages the results were excellent. On peeling off the paint
at the period of full pustulation, the lesions on the face
were found to be shrunken, and merely to consist of the thin
shrunken pellicular covering of the vesicle (covering) a healed
surface, the contents of the vesicle having been absorbed.
The lesions had never gone beyond the vesicular stage. The
picture was most striking. Lesions on the neck, ears, and
trunk were fully pustular, whereas those on the face were
quite shrunken. No trace of scarring was left behind.
The only lesions which pustulated were those bordering on
mucous surfaces, such as the mouth and eyes, where it was im-
possible to prevent contamination for a short distance under
the edge of the coating of paint. I tried confirmatory ex-
periments by painting one side of the face, one arm, and one
leg, leaving the corresponding parts on the other side quite
untreated, and obtained equally good results. For success
in/

in this treatment it is essential that it be commenced in the papular or very early vesicular stages and that thorough sterilization of the skin be obtained. The antiseptic covering must be kept intact, the paint being frequently removed, one coating being superimposed on another. The face must not be washed. Provided those conditions are satisfied, the results obtained are uniformally excellent. When, however, the lesions had gone beyond the stage of early vesiculation the treatment was useless. Secondary pyogenic infection had already taken place.

My procedure was as follows:-

1. Scrub the part thoroughly with potash soap and water using a very soft nail brush.

2. Wash thoroughly with turpentine.

3. Wash with ether.

4. Apply a wet dressing of Lotio Acid Carbolic (1 in 40) and renew the compress in two hours.

5. At the end of another two hours remove the second compress and apply a thick coating of the paint all over the sterilized surface with a sterilized brush.

6. Renew the paint every four hours until the period of full pustulation.

It is obvious that such a line of treatment is of very limited applicability, the portion of skin so treated being thrown/

Thrown out of action as an eliminating surface. Only limi-
ted areas, therefore, can be so treated, and, as it absol-
utely prevents subsequent scarring, I always reservedit for
the face thus preventing much disfigurement.

The most successful treatment for the rest of the
lesions was as follows:- I left them entirely alone, ex-
cept for the application of local anodynes when necessary,
until the first signs of pustulation appeared. I then had
every lesion snipped through the middle transversely with
small pointed scissors curved on the flat, (small curved
iridectory scissors were most serviceable) and the contents
evacuated. If possible, the patient was then placed in a
warm bath and all the incised lesions bathed. On removal
from the bath, trunk, arms and legs were swathed in moist
boracic dressings, and the fomentations were renewed twice
or thrice daily as occasion required. It was only necess-
ary to continue the fomentations for two or three days, by
which time the lesions were practically healed and anbint-
ment dressing could be applied. Each lesion was thus re-
garded as a miniature abscess and treated on ordinary surgi-
cal principles. I found this treatment,although entail-
ing the expenditure of much time and patience, amply re-
paid the trouble taken. The secondary fever was rendered
relatively slight, the pain and discomfort consequent on
full pustulation and surrounding inflamation were avoided,
and/

and the patients comfort greatly enhanced. The occurrence

of boils, abscesses, and other pyogenic complications was

reduced to a minimum. Of all my cases so treated, number-

ing about 100, one case, only, developed pyogenic complica-

tions in the form of a few boils. In cases showing marked

vesicular confluence, this treatment was hardly applicable, as,

on the occurrence of pustulation, face, arms and legs were

covered with confluent pustules. In cases, however, show-

ing confluence only in the pustular stage, the lesions were

more discrete, and the treatment could be carried out with

considerable success. In moderately severe confluent pustu-

lar cases, and in severe discrete cases, the treatment is emin-

ently applicable, and the results were most satisfactory.

The hundred cases referred to were mainly in this group.

Should a patient not come under treatment until the incrus-

tation stage, it is necessary to speedily remove any adherent

crusts. If this is not done there is a tendency towards

ulceration beneath the crusts with destruction of skin and

the formation of fibrous tissue, which, on contraction, leaves

depressed permanent scars. Also, on the side of the nose and

adjacent portions of the cheeks, in severe confluent cases,

the adherent crusts become partially organised and leave a

permanent verrucose condition of the skin which causes much

disfigurement. Nothing is so effectual in removing crusts

as linseed meal poultices, made from crushed linseed

with/

with the addition of hot olive oil. In applying these poultices to the face, it is well to spread the poultice on lint or old linen, being much lighter than tow, and to cover the surface of the poultice with a single layer of gauze. Should verrucose projections unfortunately occur they should be covered with accurately fitting pieces of Unna's Salicylic Acid Plaster, the plaster renewed night and morning and all dead tissue gently rubbed off with a piece of pumice stone between each application. The warty excrescences can be greatly reduced in this way.

Baths.

Before leaving the subject of the treatment of the specific eruption, I should like to point out the advisability of furnishing every smallpox ward with several full-sized portable baths. I felt very much the want of these in my own wards. I should recommend that each bath be fitted with a strong upright post about 2 ft. high and at each end of the bath, and the posts furnished with a stout hook at either extremity of the post. The baths should stand nearly as high as the bed. In addition, hammocks made of stout canvas should be supplied, of sufficient size to furnish a comfortable support on which the patients whole body could rest. These hammocks could be slipped under the patient, in the same way as a fresh sheet, after he has been divested of his clothing, the top end of the hammock hooked

on/

on to the top hook of the upright post at the top of the
bath, the lower end held firmly by a couple of nurses and
the patient gently swung over the top of the bath and then
gently lowered into the water, the ends of the hammock being
ultimately fixed to the hooks at the lower extremity of the
uprights and the patients whole body be thus completely
immersed in the bath and comfortably supported in the
hammock, his head being supported and held above water by
a broad pneumatic belt stretched across the surface of the
water. In this way, without any exhaustion, he could have a
warm bath night and morning, his comfort would be greatly
enhanced, all discharges would be softened and rendered
easy of removal, sleep would be induced, and a ready means
of safely and effectually reducing temperature would be at
hand.

Hot and cold water taps could be fitted in the wall
of the ward bathroom, the portable bath filled there, and
wheeled to the bedside.

As far as circumstances permitted, I used baths in the
treatment of my patients and found them a most useful
adjunct to treatment. I found them especially useful for
giving the patient a thorough cleansing after the lesions
had been opened prior to the application of moist antisep-
tic dressings. The patients themselves took very kindly to
the baths.

Delirium.

This is a most troublesome, exhausting and dangerous symptom, and its treatment demands special consideration. Not only does it greatly exhaust the patient, but under its influence he is, at times, a danger to himself and to others. As has already been described, it varies from transient delirium, present only at night, to the most acute maniacal excitement. The patient must be very carefully watched and never allowed out of sight. All accessible windows must be screwed down and all doors carefully watched.

The delirium of the initial period is of short duration, is usually of the quiet stuperose variety and generally calls for no special treatment. It may at times, however, be very acute. The delirium of the eruptive period is a much graver manifestation. In severe or even moderately severe cases, especially in alcoholics, delirium should be anticipated, and the premonitory symptoms of wakefulness and restlessness watched for. This is the period at which the administration of sedatives should be commenced. At this period no drugs gave such good results as the mixed bromides of Sodium, Ammonium, and Potassium, in doses of 10 grains of each administered every 2, 3 or 4 hours and perseveringly pushed. The patient becomes very drowsy, sleeps for long intervals, and when roused, drinks largely of fluid nourishment, his thirst being augmented by the bromides. He is easily/

easily roused, and soon goes to sleep again. To be effect-
ual, the bromides must be started as soon as wakefulness and
signs of approaching delirium appear, or even sooner in
alcoholics who will almost certainly become delirious, and
be unhesitatingly pushed. If there are signs of exhaustion
or of cardiac weakness, the depressant effect of the drugs
may be counteracted by strychnine, or diffusable stimulants,
such as ether and ammonia. If depression is feared, strych-
nine may be combined from the start without apparently
lessening the soporific effect of the bromides. If the
bromides are unsuccessful, or if the patient is acutely de-
lirious when he comes under observation, opium in some form is
the only reliable hypnotic. Nepenthe in 20 or 30 minimum
doses sometimes acts well, but it is generally preferable to
employ morphia by hypodermic injection. Sometimes it acts
like a charm, but often very large doses fail to quieten the
patient. Morphia has the disadvantage of diminishing the
patient's appetite but this may be risked if much-needed rest
is to be obtained. The soporific value of sponging, baths
and of malt liquors, especially bottled stout, must not be
lost sight of.

In many cases, however, all these measures fail to con-
trol the delirium, and then nursing becomes very difficult and
trying, and the resource and patience of the nurse are put
to the test.

In the milder forms the patient is amenable to
discipline/

discipline, and, if tactfully dealt with, is easily persuaded
to lie down or return to bed. Soon, however, he is up
again, and much patience and tact are required in nursing him.
He may be permitted to sit in an arm chair or even to walk
about with the aid of an attendant, if there is no risk
of him getting beyond control. In this form the value of
skilled and intelligent nursing cannot be over-rated.

In the acuter forms, however, persuasion is unavail-
ing. The patient insists on getting up and struggles
violently when restrained. Further, the more he is restrain-
ed the more violent he becomes. For this reason I am
strongly averse to the practise of placing one or several
male attendants in charge of such a case with instructions
to prevent him getting out of bed. He realizes that he is
being forcibly restrained, any existing delusions of per-
secution are enhanced and, not appreciating the cause of
his restraint, he naturally struggles as long as he is able,
greatly exhausting himself, damaging his already weakened
heart, getting the thin pellicle of his lesions ruptured
and raw bleeding surfaces produced, and running the risk of
severe bodily injury. Further, the male staff required
to deal effectively with a large number of delirious patients
is very numerous, as nothing is more futile and dangerous
than to permit one attendant to struggle with a delirious
patient. The patient is not effectively restrained and is
liable/

liable to grave injury by some sudden output of force on the part of the attendant. It is fair neither to patient nor attendant. For these reasons I strongly advocate the employment of some form of mechanical restraint in such cases. The restraint employed must satisfy two conditions. It must effectually prevent the patient from getting out of bed without at the same time impeding his respiration or causing him any bodily injury. The best form of mechanical restraint I have seen is the following. It consists of a stout leather belt about 10 ins. broad, carefully padded, and completely encircling the patient's body in the lower thoracic or upper abdominal regions. It is fastened in front with buckles and should not compress the patient, allowing him to turn his body slightly within the belt. A long strap passes through rings at the back and sides of the belt and the two ends are buckled together underneath the bed. Attached to the front of the belt are two canvas bags into which the patient's hands are placed and the bags are fastened round the wrists by means of padded leather straps. The apparatus must be made of very stout leather, carefully padded and lined with very soft pliable leather. This arrangement permits perfect freedom of respiration, allows the patient to shift his position to a considerable extent whilst preventing him from sitting up, and does not exercise injurious pressure on any part, but still absolutely prevents/

prevents him from getting out of bed. It does not control the legs but this is seldom necessary and if it is, can be easily accomplished by means of padded anklets attached to the foot of the bed. In this form of restraint the patient experiences no resistance so long as he is quiet, when he attempts to get up he is met by efficient and properly proportioned restraint, he soon recognizes that struggling is futile, and, except for occasional outbursts of violence, in which he is unable to injure himself, he lies fairly quiet. This result is impossible of attainment with manual restraint.

Treatment of eye complications.

Eye complications are to a large extent preventable, In my series of 532 consecutive cases, 136 developed more or less severe conjunctivitis , 3 developed small corneal ulcers, all of which healed and left no opacity, and 3 developed slight keratitis. In one of the latter cases a small opacity existed on discharge. Amongst these cases there were no other eye complications, which immunity from serious complications I attribute largely to the fact that all our acute cases were placed in large well ventilated walls and the most experienced and reliable nurses were detailed for their treatment. In the Hospital Ships on the other hand where ventilation was imperfect, cubic space was limited and individual attention could not be so frequently given,

on/

on account of pressure of work, eye complications were much more frequent and severe, four single and four double eneucleations being necessary.

Conjunctivitis. By painting the face after sterilization as I have advocated conjunctivitis is rendered much less common and severe. When it occurs the eyes should be frequently irrigated with warm boracic lotion, the edges of the eyelids smeared with vaseline and the eye covered with an eye shade. Should marked chemosis occur scarification may be necessary and iced compresses, frequently repeated, are serviceable. If there is great oedema of the eyelids and much pain hot boracic fomentations may be applied, but, in ordinary cases, they are contra-indicated serving merely to enhance the incubating properties of the ocular sac for bacterial growth. Should corneal ulcer occur the eye must be frequently irrigated with a weak antiseptic lotion. Ung. hydrarg. oxid. flav. (Grains 4 to the ounce) with Atropine is usually the best application.

Keratitis, inflammatory and non-inflammatory, perforating ulcer, hypopyon, anterior staphyloma, etc., must be treated on ordinary principles of ophthalmic surgery. The occurrence of panophthalmitis renders instant eneucleation necessary.

Faucial swelling and oedema are often very marked. Considerable relief may be obtained by giving ice to suck and/

and by spraying with a 2% solution of cocaine hydrochlorate.
When the pustules have ruptured and small dirty ulcers re-
sult frequent syringing with chlorine solution containing
free hydrochloric acid. Lot. Sod. Chlor., or Lig. Potassae
with Acid Carbol. Pur. (one part of each in 80 of water),
as recommended by MacCombie, are serviceable.

Little need be said concerning the treatment of com-
plications other than those already described. Their treat-
ment is the same as in other diseases. Bronchitis generally
calls for expectorants and laryngitis and tracheitis, if
severe, for steam inhalations or a half steam tent. Boils
and abscesses must be opened as soon as they appear and
cellulitis freely incised and treated on antiseptic princi-
ples. Deep abscesses, erysipelas, periostitis, pneumonia,
empyema thoracis and other complications which are mainly
septic in character must be treated on ordinary medical and
surgical principles.

Detention rate.

With a view to estimating the rapidity with which
patients can be safely passed through hospital in times
of epidemic stress, I have calculated the average detention
rate. This rate in the case of those who were discharged
recovered was 37.4 days, and of those who died 8.7 days.

As our isolation accommodation was taxed to its utmost
limits/

limits patients were discharged as rapidly as was consistent
with the public safety. That the period of detention was
sufficiently long is amply proven by the fact that although
about 10,000 cases were discharged recovered to their
homes, there was no instance of any of them giving rise to
a return case, and this at a time when special attention
was being paid to the investigation of alleged return cases.
Before a patient was discharged he was obliged to satisfy
the following requirements:-

1.   His skin must be absolutely clear, no breach of
      surface being present anywhere. There must be no
      crusts, "seeds," boils or abscesses. The scalp
      must be free from any scales or scurf.

2.   All mucous membranes must be healthy and free from
      pathological discharge , special attention being
      paid to eyes, nose, ears and fauces and,in young
      female patients, to the vulva and vagina.

It is not necessary to wait for spontaneous separation
of the crusts. Their removal is greatly facilitated and
hastened by poulticing, hot baths and gentlefriction. By
soaking the hands and feet in Lotio Sodae Chlor., and apply-
ing poultices of potash soap at night the cornefied epider-
mis of palms and soles is softened and easily removed,
bringing away the buried crusts or "seeds" along with it.
Deeply buried "seeds" may, with advantage, be dug out by
means/

means of some pointed instrument. If these measures are not employed, the detention rate is materially lengthened.

We may safely conclude that, when the skin is clear and all mucous surfaces appear healthy, the individual has ceased to be infective, and may be discharged, without risk, after being thoroughly bathed.

The disposal of the dead.

Whilst cremation is undoubtedly the ideal method of dealing with the bodies of those who have died of smallpox, in the present state of public feeling, earth burial in some form has, in most cases, to be resorted to. It is advisable, if possible, to set aside a portion of ground within or immediately without the hospital grounds for purposes of interment. The friends being willing, all persons who have died in hospital should be buried in this ground, and as an inducement to the friends to consent to this arrangement, it is advisable for the authorities to defray the cost of the interment. Should the friends insist on burying the body in a private burial-ground there is one danger which should be anticipated and avoided.

We discovered, at Gore Farm Hospital, that it was customary for the friends, after receiving the coffin at the hospital, to repair to their homes and in some cases to carry the coffin into their houses whilst a burial service was/

was held. We circumvented this by an arrangement with the managers of the cemeteries. On the corner of the burial certificate we noted the time at which the body left hospital and by comparing it with the time at which the body arrived at the cemetery it was easy to determine whether or not there had been any delay in transmission. When we had reason to suspect that the body had been delayed, we notified the Medical Officer of Health who investigated the matter. The knowledge that this course was pursued soon put a stop to the practice.

This thesis has already considerably exceeded the length I proposed, and I have been obliged to omit all reference to the post mortem appearances and the pathological histology, which I had intended to touch on lightly.

Whilst studying smallpox I read all the literature of the subject at my disposal, but in writing this thesis I have endeavoured, as far as possible, to avoid reference to books and to describe the disease as it presented itself to me in the wards.

The statistics and tables have been prepared by me exclusively for this thesis and have never been published before in any form.

I must ask the forebearance of the examiners for having used many words where few might have served. My inexperience in the art of literary composition must be my excuse.

Photograph.

A case of chickenpox showing a very unusual distribution of the eruption, the distribution following the lines of smallpox rather than those of chickenpox.

Description.

The lesions are most closely set on the face and scalp, next on the limbs and are very few and widely scattered on the trunk. Further, the density of the lesions on the limbs increases with distance from the trunk. This is the typical distribution of the smallpox eruption and exactly the reverse of that usually obtaining in chickenpox.

The patient was an unvaccinated boy aged 4 years, and, so far as was known, had not been exposed to the contagion of smallpox or of chickenpox. The symptoms of invasion were trifling. During the first 18 hours the individual lesions closely resembled those of smallpox, being deeply set in the skin, firm and circular. They, however, matured rapidly and in the later stages were typically those of chickenpox.
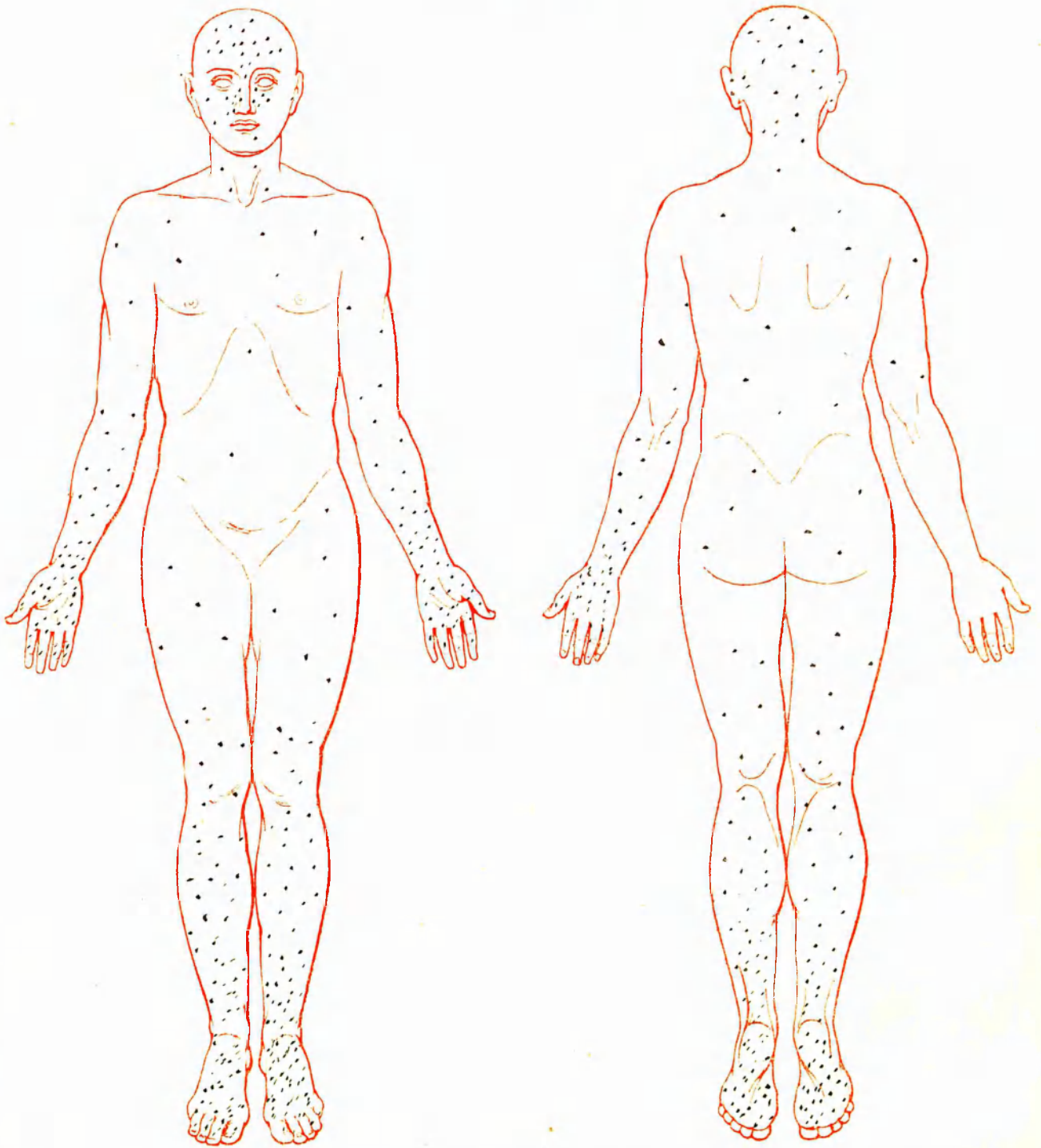
I have never seen another case at all resembling this, but Dr. Wanklyn, the smallpox expert to the London County Council, has seen two such cases occurring in members of the same family.
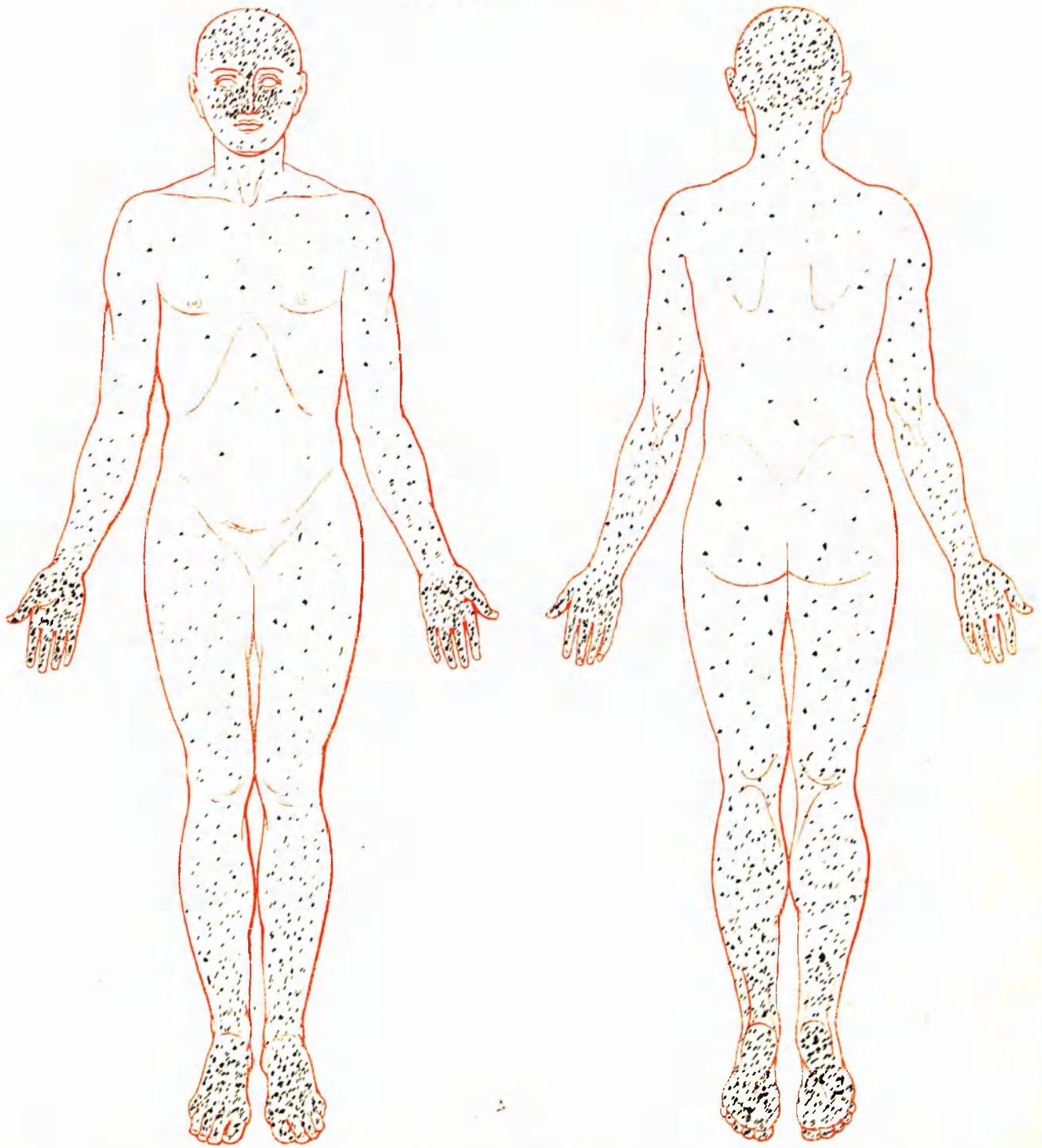
Typical Small-pox eruption in a moderately severe case.
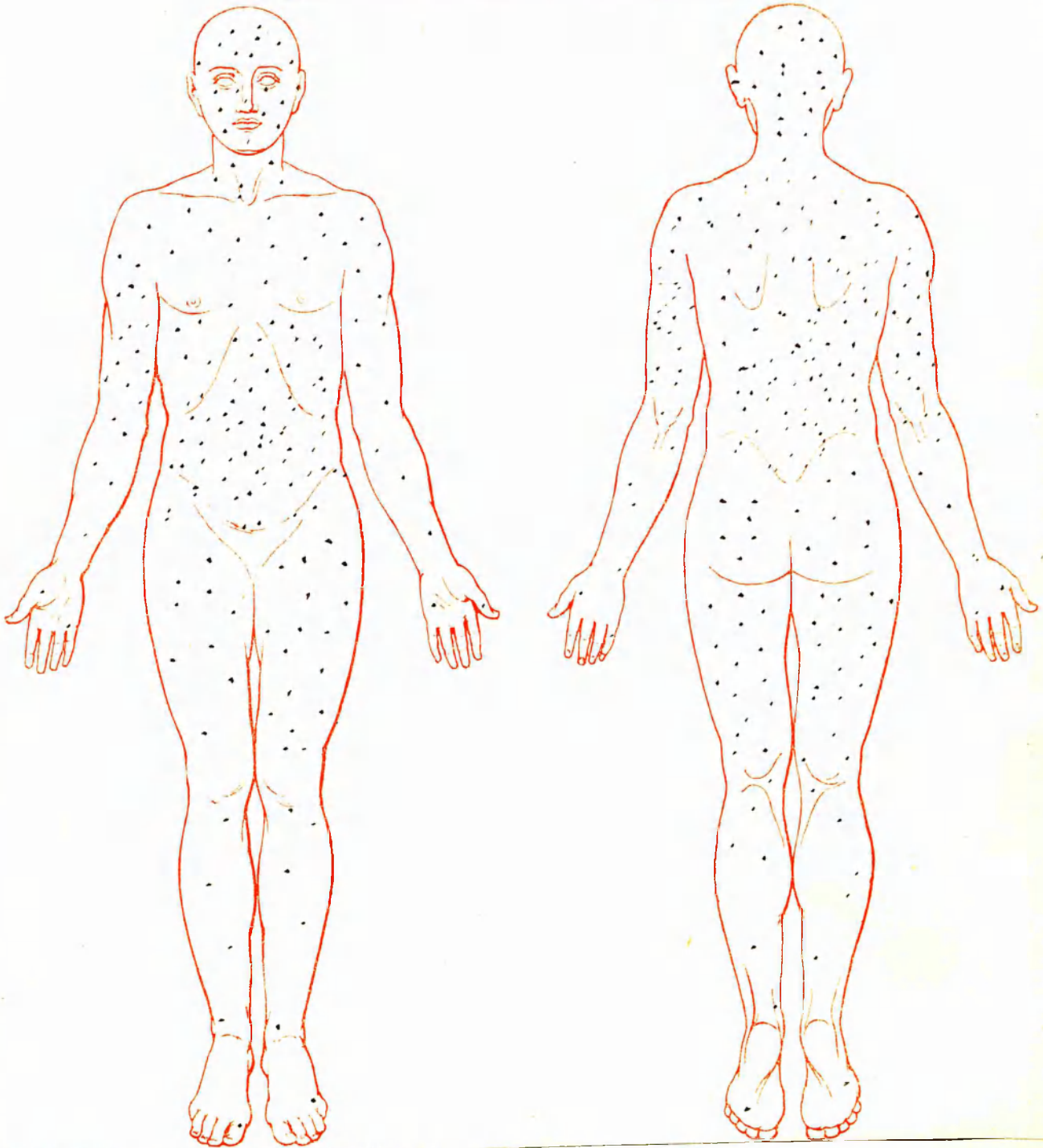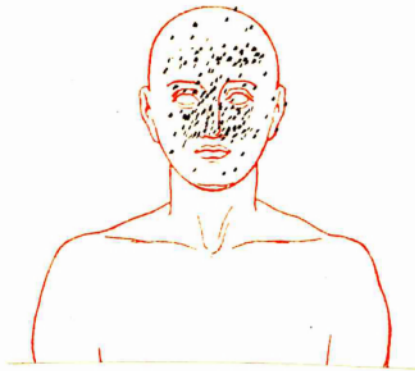
Typical Small-pox eruption in a mild discrete case.
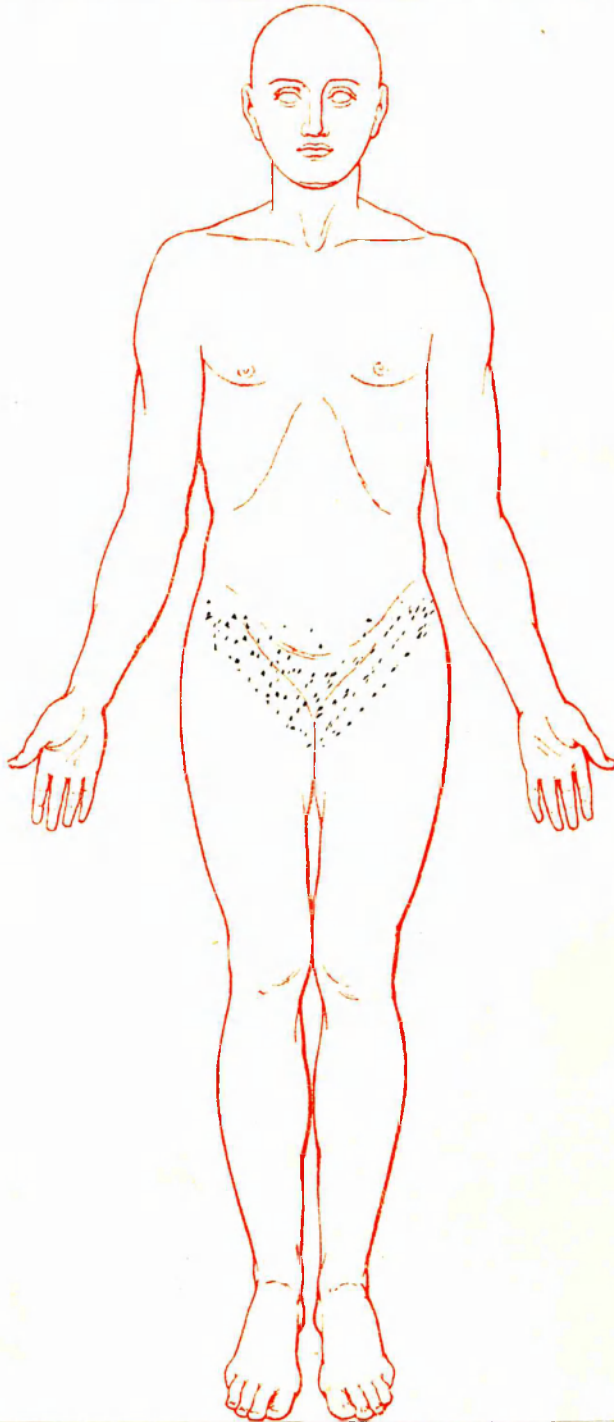
THE DISTRIBUTION OF THE ERUPTION.

Typical Chicken-pox eruption.
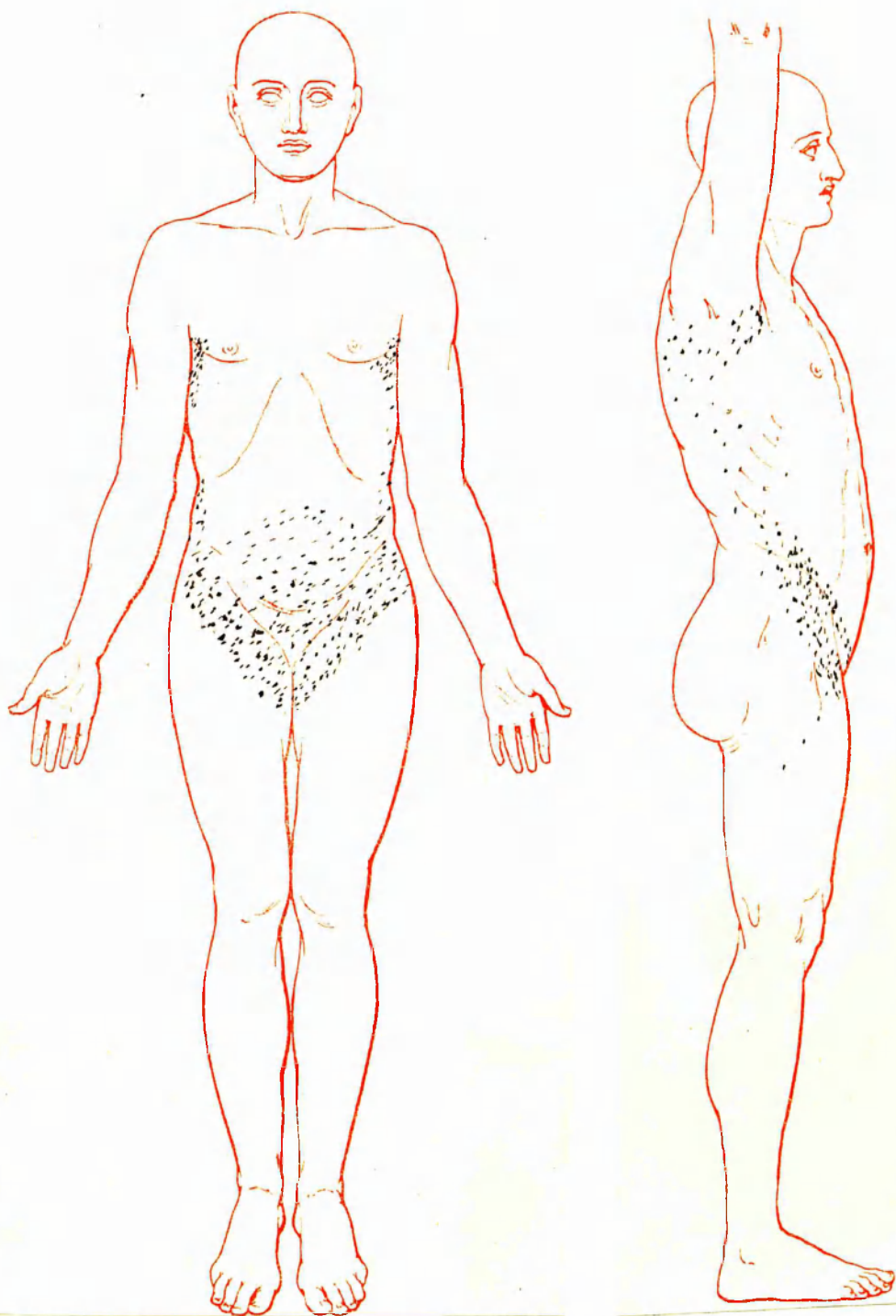
THE DISTRILUTION OF THE ERUPTION.

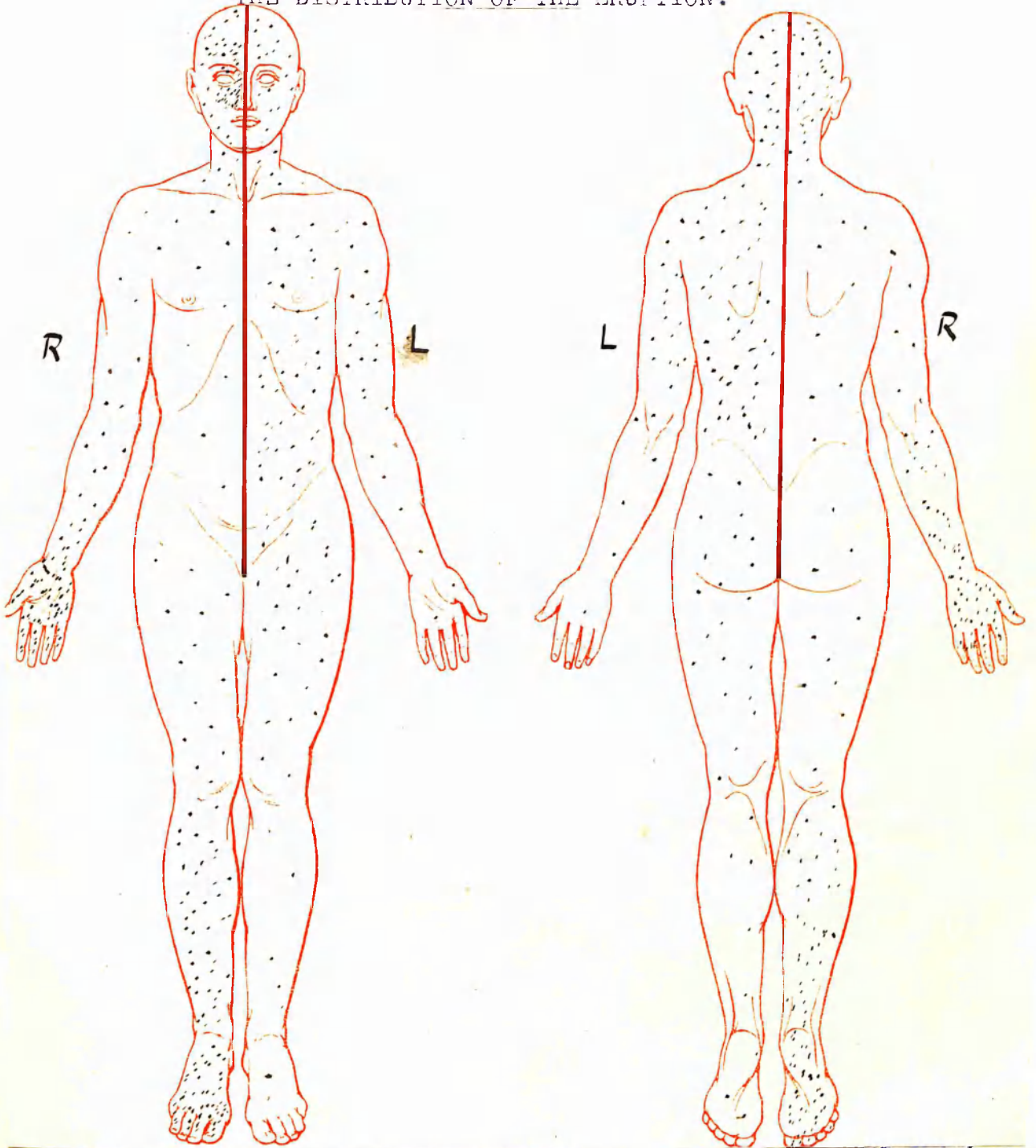To show grouping of the lesions on the face.

The petechial initial groin rash in a benign case.

THE DISTRIBUTION OF THE ERUPTION.

The petechial rash in a severe case.

THE DISTRIBUTION OF THE ERUPTION.

R   L   L   R

7. Comparison of the grouping of the lesions in Small-pox and Chicken-pox.

Right side = Small-pox.   Left side = Chicken-pox.

TABLE I.

Analysis of cases which were successfully vaccinated or revaccinated, after having been infected by smallpox. Included in Table II.

Age Periods	Class I — Vaccination performed 11th to 15th day before rash. Previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Not previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Class II — Vaccination performed 8th to 10th day before rash. Previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Not previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Class III — Vaccination performed 5th to 7th day before rash. Previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Not previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Class IV — Vaccination performed on 4th day before rash or later. Previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Not previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Class V — Cases in which day of incubation could not be ascertained. Previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Not previously vaccinated — Admitted Discrete	Confluent or Toxic	Died	Total Admiss.	Deaths
Under 1										1																				1	
1 to 2				2						1																				3	
2 " 3																															
3 " 4																															
4 – 5																															
5 – 6																											1			1	
6 – 7										1																				1	
7 – 8																															
8 – 9																															
9 – 10																															
10 – 15													1																	1	
15 – 20							2												1											3	
20 – 25										2			1																	3	
25 – 30							4						2																	6	
30 – 35													1																	1	
35 – 40							1						1																	2	
40 – 50							3																							3	
50 – 60																															
60 upwards							1																							1	
Total				2			11			5			5			1			1								1			26	

TABLE II.

	Vaccinated Class. i.e. cases with vaccination cicatrix or cicatrices present.															Unvaccinated Class.			
	Area of cicatrix or cicatrices															i.e. cases in which vaccination cicatrices were absent or which were not stated to be vaccinated.			
	Class A¹ = ½ or upwards of ½ sq. inch total area.				Class A² = ⅓ but less than ½ sq. inch total area.				Class A³ = less than ⅓ sq. inch total area.											
	Number of scars				Number of scars				Number of scars											
	Four or more	Three	Two	One	Four or more	Three	Two	One	Four or more	Three	Two	One	Total vaccinated class admitted	Deaths amongst Vaccinated cases. Class A¹ A² A³	Total deaths amongst vaccinated cases	C₁ Admissions / Deaths	C₂ Admissions / Deaths	Total in unvacc. class C₁ & C₂ combined Admissions / Deaths
Age Periods	(Formation of scars: ½ or more ½ ovated / less than ½ ovated / Plain scars)																	
Under 1																8 / 7	1	9 / 7
1 to 2																1 / 1	3	4 / 1
2 „ 3																4 / 1		4 / 1
3 „ 4											1		1			2 / 1		2 / 1
4 „ 5																1		1
5 „ 6																2	1	3
6 „ 7																3 / 1		4 / 1
7 „ 8																1 / 1		1 / 1
8 „ 9	2 / 1										1		4			2 / 1		2 / 1
9 „ 10	1 / 1			1			1 / 1			1			6			2		2
10 „ 15	2 1 1	3	1 1			1							10			8 / 3	1	9 / 3
15 „ 20	5 10 3	2 5 1	1	1						1		1 1	31	1	1	7 / 2		7 / 2
20 „ 25	7 20 17	4 12	5 4 7	1		1 1 1	2	1 1 2	1			2	97	1	1	7 / 5	2	9 / 5
25 „ 30	8 18 16	3 17 7	5 3 3		1 1	2	2	1		1	2 1		91	6 1	7	6 / 4		6 / 4
30 „ 35	9 16 4	2 6 13	1 4	1	1 2	3	2 2			1	1 1 1		72	3 2 1	6	5 / 4		5 / 4
35 „ 40	6 4	4 4 4	2 1 3	1 1 1	1	2	1		1		1 1	1	41	3 1	4	4 / 1		4 / 1
40 „ 50	1 3 3	3 5 7	1 4 5	1 1	1 2	3	1 3		1		1 2	5 1 6	65	8 2 2	12	11 / 9		11 / 9
50 „ 60	1	1		1		1	1	1			2 6	1	18	1 1 1	3	5 / 4		5 / 4
60 upwards						2		1			1	1 1 1	8	2	2			
Total.	38 70 52 (5 5 4)	19 49 42 (2 1 4)	15 17 20 (1 1 2)	5 2 3	1 4 6	4 2 8 (2)	5 7 12 (1 2 2)	2 3 3	1 – 3	1 1 4	2 5 13 (2)	13 3 9 (2)	444	22 8 6	36	79 / 45	9 / –	88 / 45