A Thesis on the Value of Vaccination
at, and after infection with Small-pox,
with some reference to the duration of
protection afforded by vaccination.

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Smallpox is said to have existed in China many centuries before Christ. The Peste Magna described by Galen of which Marcus Aurelius died is believed to be Smallpox.

In 450 AD Smallpox broke up the Abyssinian army at the Siege of Mecca, also in the 6th Century Smallpox was known in Europe being repeatedly imported from Asia Minor and Africa.

The term Variola was first used by Bishop Marcus of Avenches in the Sixth Century.

Its contagious and fatality was known in Great Britain and Ireland by the Monkish Chronicles during the 9th Century. "The skin becoming ultimately black with a dreadful sores'.

The first accurate account was given by Rhazes an Arabian Physician in the 9th.
Centurius who died 926 AD. He maintained it was a disease natural to children. In his book de Variolis et Morbilis, has the following title to the first chapter: "Quare finit ut hunc Officiis nisi unus et alle et Hominibus"

In the Netherlands the first accurate account dates from the 10th Century. Count Leo Elfreda died of Smallpox 967 AD and Count Arnold of Flanders 961 AD. A Harleian M.S. in the British Museum, end of 10th Century, has an exorcism and prayer in Latin "Pete angelorum milia me salvent et de Poletite Variolae.

During the 11th-16th Century a list of sixteen European Physicians has been given by Gruner who wrote on Smallpox de Variolis et Morbilis Fragmenta—Medicorum Arabitarum Jena 1790.
Iceland was first invaded in 1241
Smallpox in 3 years costing 20,000 lives,
in a scanty population, about this time
the disease spread to Greenland and
so ruined its small settlement that
the existence of Greenland was forgotten
for three centuries.

Smallpox was imported into Mexico
in 1520 according to Toribio Causing
3-5,000,000 deaths.

Sydenham in 1624-1689 carefully
distinguished measles from smallpox and
made a thorough study of smallpox.

Von Helmont (Belgium 1578-1644) asserted
that the disease was contagious and was
followed by an increased resisting power
of the tissues.

Father Kercher of Rome 1601-1680 used
his rough microscope to examine the contents
of the foetus.
we now approach the era of statistics when the great mortality from Smallpox is more accurately known. From 1788-64 during a period of 36 years in Kilmainnock the Smallpox deaths were nearly 3/5 of the deaths from all causes. In London the ratio was 1/2. In Glasgow from 1783-1800 as high as 3/5. In Berlin 3/5.

According to Dr. Guy in the 48 recorded years of the 19th Century, there were less Epidemic years giving about 20 Epidemics for the whole Century.

In the eighteenth Century there were 32 Epidemics. The era of vaccination may be said to have begun with the 19th Century, taking an epidemic year when Smallpox caused to of the deaths in the 19th Century there was not one Epidemic.

In Chart I. I have reproduced and brought up to date. The Annual
death rate per million of population in London as represented by A. R. Wallace before the Royal Commission on Vaccination. The mortality for the London Epidemic of 1901 and 1902 sinks into insignificance when compared to the outbreaks of old. This Chart clearly portrays the history of smallpox since the introduction of Vaccination. There were only two epidemic outbreaks during the century one in 1838 when the registrar general’s statistics commenced; the other in 1841, but these were very small when compared to the average yearly rate of the first quarter of the century before the introduction of vaccination being then 2000.

Turning to Chart II I have represented the successful and unsuccessful vaccinations after infection with smallpox of the London Epidemic of 1901 and 1902 according to the day previous or day
of the Eruption on which the operation of vaccination was performed. The total number of all cases is 1229, or about 1 in 9 of all cases admitted into the Smallpox hospitals.

I propose first to deal with the 805 successive cases previous to Eruption. Counting the day previous to Eruption as one, it will be observed the small number of cases admitted during the 15-14th day previous to Eruption, and the rapid but gradual increase from one on the 14th to 68 on the 10th day, the intermediate increase being to 3 on the 13th, 12 on the 12th, and 26 on the 11th day previous to Eruption.

More persons it will be acknowledged were vaccinated on the 14th and following days up to the 10th day than on the 10th and succeeding days previous to Eruption.

The rule of the several Medical Officers
of Skene for London during the Epidemic was on a case of smallpox being notified to immediately isolate and vaccinate the other members of the family or dwelling. This being done within a few hours of the patients removal. Taking the recognised incubation period of smallpox 14 days which I have found to vary but very little during the past epidemic; if those persons were not fully protected by vaccination or exposure to infection and the following days. Especially up to the 4th day after exposure, we should have had instead of a smaller number, admitted vaccinated during the early days of incubation a larger number than on the proceeding days.

The evidence that vaccination on exposure to infection and subsequent few days gave protection was of a like nature at the receiving Hospitals - London.
There were during the epidemic admitted into the receiving rooms and exposed to
the infection of smallpox from the receiving rooms and ambulances, 732 persons
suffering from other diseases, or in some cases supposed disease, other than smallpox.
On their disease being diagnosed they were immediately vaccinated, and although
45 of these cases were vaccinated for the first occasion on exposure to infection
all were protected from smallpox.

The protection afforded on exposure to protection was equally efficient at
Long Beach Hospital and the Hospital Ships; of workmen admitted into the Hospital and
grounds 337 were vaccinated on the day of admission 3 out of this number were
primary vaccinations, none of these workmen contracted smallpox. It was also found
necessary during the severe strain through
were of efficient keep during the early days of the epidemic to engage and admit a certain number of the staff direct into the wards after undergoing the operation of vaccination, of staff that engaged 28 were revaccinated for the first occasion since infancy, and were afterwards exposed daily to the infection of Smallpox. I must mention considerable care was exercised with these cases if at the end of three days time a perceptible reaction was not present they were revaccinated. This makes up the large number of 1094 persons vaccinated during the Epidemic at the Hospitals on exposure to infection without one misstep, out of this number 50 had never been vaccinated previously.

I think this is also to the credit of the several Medical Officers responsible for the vaccinations.
Further showing the small number admitted vaccinated during the early days of vaccination being due to protection by vaccination from Smallpox I have collected the unvaccinated children admitted at the receiving rooms during the Epidemic with mothers suffering from Smallpox and being at the mothers breast. There were 22 in all unvaccinated. These children were at once vaccinated on arriving at the receiving rooms, and 15 out of the 22 cases afterwards escaped Smallpox. In the following two tables I have shown the children who escaped Smallpox and those who contracted the disease.

Table A: showing children who escaped Smallpox on respective days after exposure to infection
| No. Children | 3 | 6 | 2 | 1 | 3 |

It will be seen there were three children protected vaccinated as late as the 5th day of mother's eruption, that is on the 5th day of exposure to infection. The consensus of opinion being there is little if any infection before eruption, this would correspond to the 10th day previous to eruption Chart II.

All other cases which escaped were vaccinated previous to 5th day.

Table B. Showing children who developed smallpox.

| No. Children | 1 | 3 | 3 |

On referring to Table B three cases were admitted as late as 7th day of mother's eruption all afterwards developed.
Smallpox. On the other hand one child vaccinated on the first day of mother's eruption also developed smallpox. This child was 10 days old on the appearance of the eruption, having contracted smallpox in utero, and so was the 4th day of incubation when vaccinated, 2 out of the 3 who developed smallpox, vaccinated on the 2nd day of mother's eruption also developed the disease in utero, one being 7 days old on the appearance of the eruption and the other 13 days old. I had to classify them under this heading seeing they were unvaccinated on admission, however it will be observed nearly 80% of those vaccinated previous to 5th day of mother's eruption escaped smallpox. All these cases point to those vaccinated before the 5th day of exposure to infection, the greater number being fully protected.
and also helps to explain the small number of vaccinated cases admitted during the first days of incubation Chart II.

On looking again at Chart II, after the number of cases already mentioned protected on exposure to infection, it will be noticed there were five cases admitted vaccinated on the 15th day previous to eruption, this under normal conditions and from the evidence I have already shewn I do not think feasible.

On looking at the vaccination history of these cases, I find in one the vaccination was delayed 11 days before it showed signs of taking, another was a child suffering from marasmus, who although it had a febrile attack died shortly after admission, the normal reaction of the tissues would naturally be delayed, in two others brothers.
admitted with a sister, all three were
vaccinated on the same day, and exposed
to the same source of infection, the sister's
 rash was dated as appearing two days
earlier than the brothers, making the date
of vaccination fall on the 13th day, previous
to eruption. It will also be noticed that
one case was admitted successfully vaccinated
on the 14th day previous to eruption, that
would be on the day of exposure to infection.
This also is quite contrary to my experience
at the smallpox hospitals, and to the
figures I have collected of those cases,
vaccinated on exposure at the hospitals
during the epidemic.

In Chart III I have divided those
cases vaccinated successfully previous to
eruption shown in Chart II into 4
periods, I think this will show more
clearly the striking increase in the
Number of cases admitted vaccinated after the fourth day of incubation, only 49 of those attacked developing smallpox; on the 16-11" day as compared to 290 on the 16-8" day previous to eruption; almost a similar number were attacked on the three following days after the eight; on the 4-18" day previous to eruption there is again a diminution in the number of cases this I will refer to later.

From the figures already quoted of the unvaccinated and vaccinated being protected alike if vaccinated at time of exposure to infection, "I have represented in chart iv the primary and secondary successful vaccinations performed during incubation," as would be expected the gradual increase in both as incubation advanced closely follows each other.
unvaccinated being protected during the
first days of incubation equally with those
vaccinated as well previous to incubation.

In order to explain the decrease in the
number of those successfully vaccinated during
the last days of incubation that is the
4-1st day previous to eruption Chart III
I have charted the unsuccessful vaccinations
during incubation, see Chart II, it will
be seen the rapid increase in the unsuccessful
cases during the last 4 days of incubation.
The curve of the unsuccessful Chart reaching
higher than the successful on the last day
previous to eruption, 43 out of Total of 74
or 60 p.c. were immune to vaccination on
the day preceding the eruption, and 21
or 33.8 p.c. on the second day, 14.7 on
the 3rd and 10.8 on the 4th day preceding
the eruption, this fully accounts for the
drop in Chart III on the 4-1st day preceding eruption.
I have also continued in to tabulate the unsuccessful and successful vaccinations performed after the appearance of the eruption, shewing to what day after eruption it is possible to successfully vaccinate a person suffering from Smallpox.

On the first day of eruption 49 out of a total of 109 or 44.4% were immune to vaccination, on the second day 78.0% and on the 3rd 91.4%, on the 4th and 5th day of eruption there was respectively one case successfully vaccinated, immunity to vaccination may be said to be complete on the 3rd day of eruption over 90% being immune on the 3rd day, seeing that immunity to vaccination is complete in 60% of the cases on the day preceding the eruption, it is somewhat easy to understand the now success of so called Smallpox antitoxins, an antitoxin to be of any
advantage would have to be injected
in the greater number of cases previous
ly the eruption and before the diagnosis of
smallpox is completed.

The early immunity produced in
smallpox interested me during the past
episode, in all cases being complete
before the secondary fever.

The opinion being so often expressed
that the secondary fever of smallpox was
caused by pus-producing organism other
than the smallpox organism itself. I
tried a series of unvaccinated children
in Antiseptic packs, with sufficiently severe
attacks to produce a secondary fever. The
treatment was begun on the first day of
eruption. Before vesiculation had commenced
unvaccinated children were taken so that
any modification produced by previous
vaccination might be eliminated, also.
in conjunction with one of my colleagues.
Six more cases, the skin of whom were
first made aseptic, then packed in dry
Cyanide gauze - in no case was the secondary
fever or the purulescent modified by the
treatment. The clinical evidence tending
to prove the organism of Smallpox to be
a supplicative organism. That immunity
to vaccination was produced in all cases
was found of practical importance during
the Epidemic in verifying the diagnosis
in cases in whom the lesions were of some
duration and not infrequently intentionally
removed when scanty.

Immunity may be conferred from
the mother to the child in utero is
seen from the Vaccination of the following
children. I have collected born in Hospital
during the Epidemic. There were 17 children
born in Hospital 5 of whom were immune.
to vaccination and did not subsequently develop smallpox.

Table showing children born in hospital:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14-30</th>
</tr>
</thead>
</table>
|   |   |   |   |   |   |   |   |   | 3  | 1  | 1  | 1   | 4 days of mother's eruption on which the children were born and vaccinated.

No children

Vaccination successful.

Vaccination unsuccessful.

It will be seen immunity is produced later in the child— all cases born before the 7th day of mother's eruption being successfully vaccinated; also that immunity is not a constant factor in those children born during the later days of mother's eruption, one case being successfully vaccinated as late as the 12th day. I also found on looking through the registers of the Epidemic of 1893-1894 the case of a child who was born as late as the 18th.
day of mother's eruption, being successfully vaccinated and afterwards escaping smallpox.

The greater number of those children born during the first days of the mother's eruption developed smallpox, I do not wish to infer seeing that 6 children out of the 6 born after the 4th day of the mother's eruption were immune to smallpox and vaccination that if all those cases who developed smallpox had remained some days further or later they would have received sufficient anti-toxin from the mother to abort the attack before the eruption developed, as the medical Superintendent informs me he has in his possession the photograph of a child born with the eruption of smallpox during a previous epidemic. I have endeavored in the past epidemic to find such a case, and with that object in view I made Post Mortem examinations on pregnant women dying during the secondary fever of smallpox but was
unable to find such a case.

The evidence certainly is in favour of those born after the 7th day of mother's eruption becoming immune or escaping smallpox. The case born and vaccinated successfully on the 12th day of mother's eruption did not develop smallpox. I found immunity was produced in the child independent of the severity of the attack on the mother, thus I also found to be so in those persons immune to vaccination before the appearance of the eruption, both discrete and confluent being immune alike.

It is interesting to note the relation between the infection of children born of smallpox mothers, and children born of mothers suffering from specific disease.
Immunity to vaccination may be conferred for a considerable time as seen in the following 85 cases I have been able to collect with reliable evidence of having had smallpox during some period of their lives.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>5-7</th>
<th>7-10</th>
<th>11-15</th>
<th>15-20</th>
<th>20-30</th>
<th>30+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>1</td>
<td>41</td>
</tr>
<tr>
<td>No. Successful</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>15</td>
<td>19</td>
<td>20</td>
<td>78</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>5</td>
<td>12</td>
<td>23</td>
<td>21</td>
<td>20</td>
<td>81</td>
</tr>
</tbody>
</table>

Of those vaccinated from 6 months to 5 years, after smallpox, 7 were unsuccessfully vaccinated and 2 successful, from 5-10 and 10-20 years. The successful and unsuccessful show only a difference of one, from 20 years and upwards there were seven unsuccessful and 34 successful. These figures although small point to the immunity afforded by smallpox to vaccination; as lapsing earlier than that afforded by vaccination to smallpox, see.
Table 11 Page, only 24 being attacked under 10 years, I make this statement without reference to inoculated Smallpox - it will be seen 8 out of the 21 cases vaccinated before the 10th year after Smallpox being successfully Vaccinated. My experience during the past epidemic the length of time to which immunity to vaccination could be conferred by Smallpox was exceedingly variable. Two nurses who came under my personal observation one had had Smallpox 19 years previously and was still both immune to vaccination and Smallpox, she had never been vaccinated previous to her attack of Smallpox, the other although the period elapsed since her attack was only ten years took vaccination successfully in one place, both had had severe attacks of Smallpox.
I now propose to show the attack rate per centage of those vaccinated successfly during incubation divided into periods as in Chart iii. In Chart iii as has been already seen the incubation period of Smear was divided into 4 periods of almost equal duration two previous to the 7thday of eruption and 2 later.

The classification of these cases was made on the 5th day of eruption, according to the number of pox on the face. The saying of Sydenham "if upon the face they lie as thick as sand it is no advantage to have them few and far between on the rest of the body" still remains good for the present day. All cases dying before the 5th day of eruption that is during the primary fever are classified as hemorrhagic. Under the heading of mild discrete I have classified all those cases having 100 or more pox or under on the face.
Their attack of smallpox was certainly very mild in the case during the past epidemic. Have I known the secondary fever to have been present, their illness confining them to bed only for a few days during the initial symptoms. Some not even that. The mildness of the attack will possibly be better understood by reference to the Photographs.
This photograph represents a type of the class termed mild discrete, this patient had between 80-100 pock on the face, on comparing it with the Photograph next page, the meanness of the attack of those with 100 Pock and under, on the face will be seen.
This patient had between 300 and 400 pox on the face and comes under the class of discrete cases.
Table A. Showing the attack rate in those cases vaccinated successfully during incubation.

<table>
<thead>
<tr>
<th>Day previous to eruption</th>
<th>Cases.</th>
<th>Enfluenz</th>
<th>Dicezte</th>
<th>Mild dicezte</th>
<th>P.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-11°</td>
<td>47</td>
<td>8.3</td>
<td>14.8</td>
<td>76.5</td>
<td></td>
</tr>
<tr>
<td>10-8°</td>
<td>290</td>
<td>11.6</td>
<td>29.6</td>
<td>58.9</td>
<td></td>
</tr>
<tr>
<td>7-5°</td>
<td>280</td>
<td>19.5</td>
<td>33.2</td>
<td>47.5</td>
<td></td>
</tr>
<tr>
<td>4-1°</td>
<td>188</td>
<td>19.5</td>
<td>37.5</td>
<td>42.0</td>
<td></td>
</tr>
</tbody>
</table>

Taking the per cent age of mild dicezte on the 15-11" day previous to eruption no less than 76.5 P.C. of those attacked had 100 or under pock on the face. On the 10-8" day 58.9. This is a considerable diminution in the per cent age of mild attacks from the previous 5 days. Yet the advantage is great over the following day, that is the 7-1" day. There is very little difference in the attack rate on the 7-6" day over the 4-1" day previous to eruption. The attack rate, in the mild dicezte, dicezte and the severer forms being very near, in those vaccinated after the 7" day of incubation.
On looking at the per centage attack of the discrete, confluent, and haemorrhagic at the different periods of incubation, it will be seen there is an increase in the attack rate up to the 7th day of incubation after which it is almost stationary. The per centage attack rate being doubled in severity after the 7th day, in comparison to the 10-11th day, also the advantage will be seen in the attack rate of those successfully vaccinated on the 10-8th day previous to eruption over the 7th 1st day.
Table B. Showing the attack rate in those vaccinated during incubation only.

<table>
<thead>
<tr>
<th>Day Previous to Eruption</th>
<th>15-11&quot;</th>
<th>10-8&quot;</th>
<th>7-5&quot;</th>
<th>4-1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>30</td>
<td>166</td>
<td>123</td>
<td>44</td>
</tr>
<tr>
<td>Confluent</td>
<td>13.3</td>
<td>13.8</td>
<td>30.5</td>
<td>29.6</td>
</tr>
<tr>
<td>Discrete</td>
<td>16.6</td>
<td>36.7</td>
<td>42.2</td>
<td>51.3</td>
</tr>
<tr>
<td>Mild Discrete</td>
<td>70.0</td>
<td>49.3</td>
<td>26.8</td>
<td>18.6</td>
</tr>
<tr>
<td>P.C.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By eliminating the factor of those previously vaccinated the figures are even more striking. There is an increase in the haemorrhagic and confluent from 13.3 in those vaccinated during the early days of incubation to 29.6 in the last days, and an increase in the discrete from 16.6 to 51.3 as in the previous table the mild discrete show more clearly the benefit derived from vaccination during the early days of incubation. 70 p.c. of those vaccinated on the 15-11" day previous to eruption having 100 pox or less on the face, falling to 18.6 p.c on.
The 4-1st day, it will also be noticed the benefit derived from vaccination, as late as the 10-8th day over the later days. 49.3 per. having mild attacks. It might be thought seeing the advantage of vaccination up to the 4th day of incubation, that immunity would be produced earlier the greater the number of insertions, and still a further advantage so derived. This is however, erroneous as may be seen from the following table.

Table showing the attack rate and the number of successful insertions previous to 7th day of eruption.

<table>
<thead>
<tr>
<th>Successful insertions</th>
<th>Haemorrhagic Confluent</th>
<th>Discrete</th>
<th>Mild Confluent</th>
<th>Discrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2</td>
<td>14.2</td>
<td>25.6</td>
<td>60.8</td>
<td>63.6</td>
</tr>
<tr>
<td>3</td>
<td>10.5</td>
<td>25.6</td>
<td>63.6</td>
<td></td>
</tr>
<tr>
<td>4 and 5</td>
<td>8.8</td>
<td>30</td>
<td>61.1</td>
<td></td>
</tr>
</tbody>
</table>

The difference between the attack rate of 1 and 2 insertions and 4 and 5 in the mild discrete is almost imperceptible. This is only in accordance.
with those vaccinated previously to incubation one successful insertion for the time being affording sufficient protection against smallpox.

The advantage is not in the number of successful insertions but in the shortness of the period allowed to elapse after infection.

In the following two tables I have shown the attack rate in the vaccinated and unvaccinated admitted into Hospital during the year 1901. These tables really include those cases admitted during the first six months of the recent epidemic, the number previously admitted during the year being only about 20 in number.

It is somewhat interesting in comparing the attack rate with those vaccinated during incubation see Table A and B.
This table includes the analysis of 1858 cases and shows the p.c. attack of mild discrete cases, according to the year area the p.c. proportion of mild cases, being under those vaccinated during incubation previous to the 7th day, and closely approximates those vaccinated after 7th day of incubation.

<table>
<thead>
<tr>
<th></th>
<th>No. of mid disease, otherwise</th>
<th>P.C. proportion of mild cases to total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cases area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 sq. m. or over</td>
<td>633</td>
<td>483</td>
</tr>
<tr>
<td>&lt; 2 sq. m.</td>
<td>130</td>
<td>226</td>
</tr>
<tr>
<td>Unvaccinated</td>
<td>38</td>
<td>348</td>
</tr>
</tbody>
</table>

The following page shows the p.c. attack rate at the different age periods. I do not propose to go into the details of this table or subsequent tables as I fear I have already wearied my reader with figures. The comparison in the
S.C. of med distroto with those vaccinated during incubation will be seen. The S.C. among vaccinated attack rate of the med distroto during the first two decades of life being very high, in no period of life does the S.C. of med distroto amongst the unvaccinated approach those vaccinated during the first 7 days of incubation only.

<table>
<thead>
<tr>
<th>Years</th>
<th>Vaced</th>
<th>Unvaced</th>
<th>Haemorrhagic</th>
<th>Disroto</th>
<th>Mild distroto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 0-10</td>
<td>24</td>
<td>192</td>
<td>0</td>
<td>39.0</td>
<td>8.3</td>
</tr>
<tr>
<td>10-15</td>
<td>84</td>
<td>67</td>
<td>4.5</td>
<td>61.2</td>
<td>24.6</td>
</tr>
<tr>
<td>15-20</td>
<td>186</td>
<td>43</td>
<td>8.1</td>
<td>67.4</td>
<td>32.0</td>
</tr>
<tr>
<td>20-30</td>
<td>452</td>
<td>42</td>
<td>24.0</td>
<td>52.3</td>
<td>33.4</td>
</tr>
<tr>
<td>30-40</td>
<td>305</td>
<td>22</td>
<td>25.5</td>
<td>60.8</td>
<td>33.4</td>
</tr>
<tr>
<td>40 and</td>
<td>269</td>
<td>23</td>
<td>29.3</td>
<td>60.8</td>
<td>25.6</td>
</tr>
<tr>
<td>Total</td>
<td>1322</td>
<td>389</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table III. Showing the per cent age mortality amongst vaccinated and unvaccinated at different age periods; in cases admitted during the year 1901.

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Vaccinated</th>
<th>Unvaccinated</th>
<th>P.C. Mortality Vaccinated</th>
<th>P.C. Mortality Unvaccinated</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>0</td>
<td>49</td>
<td>0</td>
<td>43.4</td>
</tr>
<tr>
<td>5-10</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>20.0</td>
</tr>
<tr>
<td>10-15</td>
<td>1</td>
<td>16</td>
<td>11</td>
<td>32.8</td>
</tr>
<tr>
<td>15-20</td>
<td>2</td>
<td>14</td>
<td>1.0</td>
<td>32.5</td>
</tr>
<tr>
<td>20-30</td>
<td>32</td>
<td>14</td>
<td>7.0</td>
<td>33.3</td>
</tr>
<tr>
<td>30-40</td>
<td>46</td>
<td>4</td>
<td>14.6</td>
<td>18.1</td>
</tr>
<tr>
<td>40 &amp; upwards</td>
<td>46</td>
<td>6</td>
<td>14.1</td>
<td>26.0</td>
</tr>
</tbody>
</table>

There were no deaths amongst the vaccinated under 10 years, and at no period did the p.c. mortality of the vaccinated approach the unvaccinated. The p.c. mortality amongst the vaccinated 9.6 and amongst the unvaccinated 30.5 p.c. The p.c. mortality in the vaccinated greatly increased after the 30th decade of life.
Table 10

Showing the P.C. mortality in, vaccinated with total scar area over ½ sq. inch, and in those with scar area under ½ sq. inch, in Table 11

<table>
<thead>
<tr>
<th>Age</th>
<th>No. 2½ sq. inch upwards</th>
<th>No. less than 2½ sq. inch</th>
<th>P.C. more than ½ sq. inch</th>
<th>P.C. less than ½ sq. inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-10</td>
<td>14</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-15</td>
<td>55</td>
<td>32</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>15-20</td>
<td>159</td>
<td>26</td>
<td>2</td>
<td>12.0</td>
</tr>
<tr>
<td>20-30</td>
<td>380</td>
<td>71</td>
<td>20</td>
<td>5.2 16.9</td>
</tr>
<tr>
<td>30-40</td>
<td>220</td>
<td>85</td>
<td>26</td>
<td>118</td>
</tr>
<tr>
<td>40 &amp; upwards</td>
<td>129</td>
<td>140</td>
<td>21</td>
<td>162</td>
</tr>
</tbody>
</table>

It will be seen the benefit of the larger scar area after the 2nd decade. The P.C. mortality being doubled in those with scar area under ½ sq. in., up to 40 years of life, after this period the mortality is almost
equal, during the first two decades, the smaller scar area affords adequate protection, looking at the mortality Table V according to the number of scars. The P.C. mortality shows a similar result, the larger number of scars affording a more lasting protection.

**Table V.**

<table>
<thead>
<tr>
<th>Age Period</th>
<th>3+ more scars</th>
<th>No deaths</th>
<th>Per mortality</th>
<th>Per mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>2</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5-10</td>
<td>15 3</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10-15</td>
<td>59 28</td>
<td>0 1</td>
<td>- 4:1</td>
<td>-</td>
</tr>
<tr>
<td>15-20</td>
<td>140 45</td>
<td>2</td>
<td>- 14</td>
<td>-</td>
</tr>
<tr>
<td>20-30</td>
<td>326 126</td>
<td>18 14</td>
<td>5.5 11</td>
<td>-</td>
</tr>
<tr>
<td>30-40</td>
<td>212 93</td>
<td>23 23</td>
<td>10.8 24.7</td>
<td>-</td>
</tr>
<tr>
<td>40 upwards</td>
<td>132 137</td>
<td>16 30</td>
<td>121 219</td>
<td>-</td>
</tr>
</tbody>
</table>
In this paper I have desired to show that vaccination by which I mean successful vaccination performed at the same time as exposure to the infection of smallpox affords protection, and that vaccination if performed after infection, within a period of 4 days will in the greater number of persons also afford protection. Vaccination if performed before the 7th day of incubation will modify the severity of the attack, independent of the number of successful insertions, in proportion to the number of days previous to the 7th day of incubation on which the operation was performed. On the 8-10th day of incubation vaccination has no influence in diminishing the eruption.

I am of opinion vaccination on the last 4 days of incubation is to the disadvantage of the person attacked. That the duration of the protective influence of vaccination depends on the size of the scar or number of scabs after the second decade of life.
Reference.


7. and Simon's Papers of 1867. Appendix to "Report Royal Commission".
10. Sydenham Vale P. 37.
12. "Vale - Smallpox in Kilnamock. Report Royal Commission"
Annual Death Rate: proportion of population in London from small pox. 1760-1902.
Black curve denotes unsuccessful during incubation & eruption.
Red curve denotes successful during incubation & eruption.

Days previous to eruption
Day after eruption

Chart 11