

reference to the clouded days and hours of sunshine. The tables on this point are quite full (see Table III). In the year 1892, we see that there were 59 days that were totally clouded, which is somewhat in excess of the average obtained by a previous table. Glancing through the table, it is seen that this is in excess of that which existed in El Paso and Santa Fé, but that it is greatly under San Diego, San Antonio, Los Angeles, Jacksonville, Augusta and Tucson, and still

Table IX.  
Cloudy Days—Winter, 1884-5.

Months	Denver Time				
	9:08 Am.	108 Pm.	5:08 Am.	10:08 Pm.	11:08 Pm.
September	2	0	3	0	0
October	7	2	5	1	1
November	1	4	6	1	1
December	1	3	9	1	1
January	8	3	3	1	1
February	9	9	5	1	1
March	4	5	1	3	3
April	12	5	6	3	3

Table X.  
Sunrise and Sunset for the first day of January.

Stations	Sunrise	Sunset
Malaga	9:35 am	3:45 pm
Wichita	10:35 am	3:45 pm
Portland	8:50 am	3:10 pm
St. Louis	10:00 am	3:05 pm
San Antonio	11:03 am	3:00 pm
Albuquerque	11:45 am	3:15 pm
Denver	7:30 am	4:37 pm

more decidedly under Washington, Philadelphia, New York, Chicago and Boston, maintaining in this particular the reputation of Denver as a resort characterized by an open sky. It will be of interest, however, to study the question still more closely; and the table for the winters of 1884 and 1885 (see Table IX) will show the number of days in the month that were clouded (in the interpretation of the signal service) at each one of the three observations, 9, 1 and 5 o'clock,

Table XI.  
Duration of Sunshine (Hours and Tenths)—1892.

Stations	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Denver	5.9	6.0	6.6	8.8	6.0	11.1	8.7	9.4	9.6	7.0	6.7	6.4	7.8
Philadelphia	5.3	5.8	6.6	8.2	6.6	8.2	8.2	8.4	7.1	5.2	4.5	4.5	6.9
Portland, Ore.	4.4	2.5	4.0	3.5	7.3	8.5	8.7	4.7	2.0	2.0	2.0	2.0	4.9
San Antonio	2.8	4.0	5.6	4.5	8.0	11.0	12.4	11.1	10.8	7.0	5.5	3.2	7.2
San Diego	5.9	4.6	7.1	9.2	6.4	8.2	9.4	8.3	9.0	7.4	7.6	7.0	7.5
Santa Fé	4.4	6.7	7.2	9.8	10.9	13.3	11.4	9.9	9.8	7.0	7.2	6.9	8.7
Tucson	xxx	xxx	xxx	xxx	13.0	10.2	10.3	10.7	9.5	8.7	8.1	9.6	9.6
Washington	3.6	3.7	5.0	5.8	7.9	9.6	9.0	9.2	8.1	7.8	4.3	4.5	6.5

xxx—no record, x—for 16 days, 0—for 2-8 days.

and the number of days that were clouded all day long at each one of these three observations, which shows that in the eight months under consideration, from September to April inclusive, there are only 11 days that were completely clouded; that is, 11 days out of 242 that were clouded all day long, which is certainly a very great showing in favor of a possibility to an out-of-door life in Colorado.

I wish to introduce now another table to illustrate

Table XII.  
Duration of Sunshine (Percentage of Possible)—1892.

Stations	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Denver	60	56	55	66	42	74	59	69	77	62	67	52	62
Philadelphia	37	33	47	44	46	55	55	59	70	64	42	42	49
Portland, Ore.	15	24	34	26	49	47	56	63	38	xx	xx	46	36
San Antonio	30	37	47	34	55	73	83	81	76	62	56	35	57
San Diego	58	42	60	71	78	78	66	62	69	66	75	70	62
Santa Fé	44	62	61	76	78	82	78	73	61	70	70	70	70
Tucson	xx	xx	xx	xx	xx	92	73	77	80	83	82	80	82
Washington	36	34	42	44	57	65	62	67	65	65	48	48	52

xx—no record, x—for 16 days, 0—for 2-8 days.

the absolute number of hours of sunshine in Denver and other stations in the United States for the twelve months of the year 1892 (Table XI). The observations are recorded by photographic instruments and are scientifically obtained. The table shows clearly the great excess of hours of actual sunshine in Denver over either Philadelphia or Washington, though not as great as are found in Santa Fé or Tucson. If we compare the hours of sunrise and sunset of the first days of January in Denver with those of the favored resorts of the Engadine, it will be seen that we have nearly

two hours to their one of possible sunshine (Tables X and XII). Another table giving the percentage of possible hours of sunshine shows that in January, 1892, we had an average of 60 per cent. of our possible sunshine as against 37 in Philadelphia and 36 in Washington. A somewhat similar and favorable comparison will run through the table, so that we learn that seasonally Denver's climate affords favorable opportunities for an out-of-door life as regards the dryness of the air, the small amount of precipitation, the temperature and the number of clear days, the large amount of possible hours of sunshine and an equally large amount of actual hours of sunshine.

SEASONAL WINDS.—The question of winds remains staring us in the face (see Table IV). Examining with reference to seasons we find the same relative small daily velocity of wind as we found to exist by a previous table. While this might be granted, we are constantly being reminded of our occasional high winds and dust storms, so that this really demands a closer attention. If by high wind is meant a gale in which the wind blows forty miles an hour or more, we see that in the year 1892 we only had 3 such winds in Denver, as against 15 in El Paso, 3 in Santa Fé, and 7 in Tucson; and as against 3 in Washington, 5 in Philadelphia, 6 in New York, 59 in Chicago and 8 in Boston; which fact would possibly astonish our critics. If, however, we take a wind of much less velocity, to quote from a previous article, we learn that even in Denver the days in which there was a wind of 18 miles or over for two consecutive observations of the three (nine, one and five P. M.) in 1886, were as shown in Table VIII.

We also learn that there were about an equal number of days when there was a wind of 18 miles or over at only one of the three observations, a showing that is very favorable to the Colorado climate, so that we learn from this table that while the average daily velocity is small, there is also a very favorable showing with reference to the number of days to which we are subjected to wind of any great velocity.

A statistical report must perforce be somewhat prolix and dry; I feel, therefore, that I should beg your indulgence for having detained you with a consideration of figures; but I cannot but hope that the tables introduced may be of service to the members of this Association in assisting them to a knowledge, not only of the climate of Denver, but of the other centres and other resorts throughout our country.

## THE TECHNIQUE OF VACCINATION.<sup>1</sup>

BY WILLIAM N. SWIFT, M.D., NEW BEDFORD.

I HAVE collected a few statistics in regard to the manner of performing the operation of vaccination in different localities.

I have answers to a list of questions on this subject from the health officers of ninety-nine of the largest cities in the United States and Canada.

**Question 1.** Have you any prescribed rules in regard to the manner of performing the operation of vaccination?

I find twelve cities have such rules, while eighty-seven have no prescribed regulations and the matter is left to the physicians who are detailed to this work.

<sup>1</sup> Read before the Massachusetts Medical Society, June 12, 1894, and recommended for publication by the Society.

**Question 2.** Is it the custom of vaccinators in your city to wash the skin before vaccinating?

In thirty-nine cities it is the custom to wash the skin; in sixty cities this is not done.

**Question 3.** Are any other antiseptic precautions used?

There were eighty-eight negative and eleven affirmative answers to the question, and in only four cities is it the custom to use any antiseptic solution. The other seven affirmative answers referred to the cleaning of instruments.

**Question 4.** At how many points is the virus inserted?

In fifty-one cities it is the custom to vaccinate at one point; in twenty-six cities at two points; in eleven cities at one or two points; in three cities at three points; in one at four points; in one at five points; in one at one to four points; in one at two to five points, and in two the answer was variable.

The cities where it is the custom to vaccinate at one point include Chicago, New York, San Francisco, Philadelphia, Washington, New Orleans, Brooklyn, Detroit, New Haven, Portland, Me., Richmond, Va., Lowell and Lynn, Mass.

It is the custom to vaccinate at two points in Quebec, St. Louis, Milwaukee, Pittsburgh, Pa., Worcester, Mass., Savannah, Ga. At three points in Boston, Providence, and Toronto, Canada. In St. Paul, Minn., two to five insertions are made, and at Minneapolis, Minn., five.

**Question 5.** Is any bandage or dressing used to protect the point of inoculation?

In seventy cities no bandage or dressing is used. In only twenty-two is it the custom to apply one, and in seven it is sometimes used.

**Question 6.** Have you in your experience seen septic infection follow vaccination? In what proportion of cases does septic trouble follow vaccination?

To the first part of the question sixty-two had never seen septic infection follow vaccination, while twenty-six answers were in the affirmative. The statements in regard to the proportion of cases in which septic trouble occurs varied very much from five per cent. in Allentown, Pa., and three cases in three hundred and fifty in Newton, Mass., to one case of erysipelas in 30,000 in Providence, R. I.

Vaccination in England is controlled entirely by an act of the Privy Council, and is under the direct supervision of the Local Government Board. The public vaccinators are appointed by guardians of the poor in the different parishes. The rules require the careful registration of all cases and the results in each case. In all primary vaccinations such insertions of lymph must be made as will produce at least four separate good-sized vesicles or groups of vesicles, not less than an inch from one another. The total area of vesiculation on the same day, in the week following the vaccination, should not be less than half a square inch. The rules advise against the use of any needless means of protection or of dressing to the vaccinated arm.

I have an answer to my letter from Dr. Robinson, public vaccinator in Birmingham. He said patients must come clean, no especial washing is done. Sometimes a boracic-acid solution is used. No bandage is applied. The virus is inserted at two points on each arm. He has seen sepsis from filthy clothing and from wounds other than those of vaccination. He

thinks sepsis occurs in about one to five or seven hundred from unclean applications.

In Glasgow, Scotland, there are no rules. Washing is only done when plainly needed. No other antiseptic precaution is taken. The lymph is inserted at from twelve to sixteen points. No sepsis is seen except from filth.

An answer from Belfast, Ireland, states that they have no prescribed rules; that it is not the custom of vaccinators to wash the skin. The virus is inserted usually at two points, but frequently at three or four. No bandage is used. Sepsis only comes from gross carelessness and filth.

In Stockholm, Sweden, there are no regulations. They wash carefully. No other antiseptic precautions are taken. Five insertions of lymph are made on each arm. No dressing is applied. They see no sepsis.

In Amsterdam, there are no rules. No washing is done or other antiseptic precaution taken except to have clean instruments. The virus is inserted at ten points. No septic infection follows vaccination.

In Antwerp, there are no regulations. Washing the skin is sometimes done, usually no other antiseptic precautions are taken. From three to six insertions are made. A dressing is used, cotton with a light bandage. Sepsis is very seldom seen; perhaps one case in 1,000.

In Hamburg the regulations for Germany are in force. Filthy subjects are not treated, but no washing is done. No other antiseptic precautions are taken, except to have aseptic instruments. The lymph is inserted at six points. No dressing is used. Septic infection can only come from impure lymph or from filth coming in contact with the ruptured pustule. Sepsis is very rare. Careful registration is kept of all vaccinations made and the result. The patient is required to report at the end of seven days, and any one who does not report at the end of ten days without sufficient reason is subject to a fine.

In Berlin the regulations for Germany are in force. They sometimes wash the skin with soap and water, and sometimes with antiseptic solutions. They insert the virus at six points. They use no dressing, and see no septic trouble.

In Dresden the German regulations apply. The patients must come with clean arms and clean clothing, otherwise they are refused. The instruments used are sterilized. Three to five insertions are made on each arm. No dressing is used and no sepsis seen.

In Vienna they have the Austrian regulations. The arm is washed with soap and water, and a two-per-cent. solution of carbolic acid. They insert the lymph at two or three points on each arm, and use no dressing or bandage. No fatal case following vaccination is on record, but a relatively small number of cases of erythema, erysipelas or phlegmonous inflammations occur.

In all the departments in the city of Paris the vaccinating is under the direction of the Institute of Animal Vaccine. Vaccination is always done directly from the heifer to the patient.

It is a regular rule in all the Paris schools that the skin shall be washed. This precaution is becoming little by little a custom with doctors. No other antiseptic precautions are taken. They vaccinate at two points on each arm, use no bandage, and never see sepsis.

In Lisbon, there are no rules. They seldom wash the skin and no antiseptic precautions are taken. The

virus is inserted at three points on each arm. No dressing is used, and septic infection is rarely seen.

In Rome the regulations for Italy are in force. The skin is not usually washed, and the only antiseptic precaution is to use clean instruments. They vaccinate at two points on each arm. Usually no bandage is used, but sometimes a gelatine plaster is applied. At the time of the popes, when the humanized virus was used, syphilis was not uncommon. Now that animal lymph is used no bad results are seen. Careful records are kept of the results of vaccination. The whole matter of supplying lymph is in the charge of the National Vaccine Institute. One regulation is that no one shall be allowed to use vaccine lymph that is more than ten days old.

The evidence I have collected shows important differences in the manner of performing the operation of vaccination in the different localities.

Only a small proportion of public vaccinators take the precaution to wash the skin before vaccinating.

The number of points at which the vaccine lymph is inserted varies very much.

Marson's statistics based on 5,000 cases of small-pox in the London Small-Pox Hospital give the following results:

Classification of Patients.	Per cent. of Deaths in each class.	Dr. MacCombie's statistics for 11,724 cases.	Mort. p. c.
1. Unvaccinated . . . . .	35.		
2. Stated to have been vaccinated, but having no cicatrix . . . .	23.5		
3. Vaccinated:			
a. Having one vaccine cicatrix . . . . .	7.73	{ Good, 6.4 Indifferent, 16.7	
b. Having two vaccine cicatrices . . . . .	4.70	{ Good, 3.7 Indifferent, 11.2	
c. Having three vaccine cicatrices . . . . .	1.95	{ Good, 3.7 Indifferent, 7.4	
d. Having four or more vaccine cicatrices . . . . .	0.55	{ Good, 2.7 Indifferent, 4.8	
A. Having well-marked cicatrices . . . . .	2.52		
B. Having badly-marked cicatrices . . . . .	8.82		
4. Having had small-pox . . . . .	19.		

In patients with one well-marked vaccine cicatrix the death-rate was 3.83 per cent. Among cases where it was badly marked the death-rate was 11.91 per cent.

In patients with two well-marked cicatrices the death-rate was 2.32 per cent. Among cases badly marked 8.34 per cent.

Dr. Seaton in quoting these figures says: "In regard, therefore, to the expectation of any case of small-pox turning out badly, the question is not merely whether the patient has been vaccinated or not, but also how he has been vaccinated."

Dr. Seaton and Dr. Buchanan, during the epidemic of small-pox in London in 1863, made observations on upwards of 50,000 children in various national and parochial schools and workhouses:

Classification of Children Examined.	Proportion marked with Small-Pox per 1,000 Children.
1. Having no vaccine marks . . . . .	360.00 in 1,000
2. Vaccinated:	
a. Having one vaccine cicatrix . . . . .	6.80 in 1,000
b. Having two vaccine cicatrices . . . . .	2.49 in 1,000
c. Having three vaccine cicatrices . . . . .	1.42 in 1,000
d. Having four or more vaccine cicatrices . . . . .	0.67 in 1,000
1. Having cicatrix or cicatrices of bad quality . . . . .	7.60 in 1,000
2. Having cicatrix or cicatrices of tolerable quality . . . . .	2.35 in 1,000
3. Having cicatrix or cicatrices of excellent quality . . . . .	1.22 in 1,000

The evidence is conclusive, as Dr. Seaton states, "that the liability of any individual to take small-pox severely after vaccination, and probably the liability to take it at all, will be inversely as the goodness and amount of the vaccination."

He also says: "To produce at least four perfect vesicles, leaving four characteristic cicatrices, should be the aim of every vaccinator."

Dr. J. S. Billings writes me: "The character of the vesicle is more important than the number, but there seems to be a definite relation between the extent of surface involved in the vesicle or vesicles to the amount of protection afforded."

With such strong evidence as I have quoted in favor of multiple vaccination, it is astonishing that in fifty-one out of ninety-seven cities in the United States it is the custom to vaccinate at only one point.

It is proved by statistics that such vaccination does not give the protection from small-pox that vaccination is capable of doing.

There has been lately a great outcry against severe vaccination. This comes, perhaps, from the fact that small-pox is so uncommon, the public and physicians also have almost forgotten what a terrible disease it is. Any one who has seen small-pox in an unvaccinated subject must hold the opinion that no vaccination can be too severe if its severity aids in protecting the individual from this disease.

In regard to a dressing, I think it is much better to use one in spite of the almost universal custom of public vaccinators not to do so. It is certainly most desirable that the vesicles should not be ruptured and the crusts should be allowed to dry up; but, I think, a small dressing of sterilized gauze and a light bandage help very much in securing this object. Any form of adhesive plaster is, I think, very injurious. Primary sepsis, that is sepsis immediately following the operation of vaccination, I believe does not occur. The bad results are all secondary, caused by the infection of broken vesicles or pustules. Such complications can be avoided if the points of inoculation be kept perfectly clean by an antiseptic dressing through the whole process. Septic infection from vaccination is certainly surprisingly rare considering the careless way in which vaccinations are made and the cases left to take care of themselves. It is my opinion, however, that sepsis to a greater or less extent is more common than statistics show. I have noticed that the smaller cities have reported a larger proportion of cases. This may be because in the larger cities the cases are lost sight of. A careful record ought to be kept certainly of each public vaccination, and the result. This is especially important when our lymph comes to us, as it does, from private individuals and about the freshness of which there is often doubt.

In a communication from the secretary of the Local Government Board the following statement is made in regard to the occurrence of sepsis and the use of dressings after vaccination: "The official data on these matters have been stated in evidence before the Royal Commission on Vaccination which may be expected shortly to issue its report." This shows the English authorities have considered these matters of sufficient importance for investigation by the royal commission.

Except in epidemics of small-pox, children should only be vaccinated when in good health. Cutaneous eruptions of all kinds are a contraindication.

Vaccination should be done with the same care as any minor surgical operation. The skin should be carefully washed with soap and water.

The vaccine lymph must be fresh, certainly not more than one week old.

The virus should be inserted at more than one point. The point of inoculation should be kept perfectly clean throughout the whole course of the disease, and protected from friction. The patient, meanwhile, should be considered as suffering from a mild disease.

My observations show that public vaccination in this country is not, as a rule, done as it ought to be. The question of a proper technique for vaccination is a matter of very great importance, and the whole subject needs careful investigation and revision.

### RADICAL DIFFERENCES IN METHODS OF PRODUCTION AND CULTIVATION OF VACCINE LYMPH.<sup>1</sup>

BY SAMUEL W. ABBOTT, M.D., WAKEFIELD.

In this paper I shall point out briefly some of the different conditions under which vaccine lymph is cultivated and produced for the purposes of vaccination, at the present day, having special reference to that which is termed animal or bovine vaccination.

Biologically speaking, all vaccination is animal vaccination. At the present day vaccination with non-humanized or bovine lymph is the rule in the United States, and probably ninety per cent. of all vaccinations throughout the country are made in this manner. With the exception of the infinitesimal liability to infection by syphilis or other human disease, as was conclusively proven by Dr. Cory, of London, in July, 1881, by submitting himself for experiment, there can be no objection to the method with humanized lymph.

In many countries of Europe humanized vaccination is practised to a considerable extent. The old Jennerian method has taken so strong a hold in England that it is not an easy task to change it. Another reason exists in the peculiarity of the English law, which requires every child vaccinated at the public expense to be presented again to the vaccinator for inspection at the end of a week, under a penalty of £1, the vaccinator having the legal right in every case to obtain a supply of lymph from the child for future use. The tendency of this law is to make the change from humanized to non-humanized lymph somewhat difficult. The use of bovine lymph, however, is steadily gaining ground in England.

In France, on the contrary, the fact that it was lawful to pay to the mothers of children a fee of several francs for the privilege of taking lymph from the arms of infants may have been one of the minor causes which proved a hindrance to "arm-to-arm" vaccination, and may have led to the more rapid introduction of animal vaccination.

The greatest advance in use of calf lymph in foreign countries has been in Germany, where the ratio of such lymph used increased from about 2.5 per cent. in 1879 to 7 per cent. in 1882, and then still more rapidly to 78 per cent. in 1888, and 89 per cent. in

1889, and will probably soon entirely displace the use of humanized lymph.

The radical differences in the methods in use in different countries for the production of calf lymph may be stated as follows:

(1) The existence to a greater or less extent of *government supervision or control* in nearly every foreign country.

In England the Local Government Board, which constitutes the general sanitary authority of the country, established a station in London about 12 years since, which has been constantly under the supervision of Dr. R. Cory.

In Belgium a National Vaccine Institute was established by the government in 1865, under the direction of Dr. Warlomont, who is one of the highest authorities on the subject in Europe. His works are accepted as standards as to the technique of calf vaccination.

In France Dr. Lanoix introduced the practice in 1865, having learned its value from Dr. Negri of Naples while the former was on a visit to that city. As a result of the efforts of Dr. Lanoix several private establishments followed the introduction of the practice at Paris, and some of the French cities have establishments maintained at the public cost. There are also one or more societies in Paris which maintain calf vaccination and furnish vaccination free to those who apply for it.

In Germany the government provides by law for the establishment of public stations for the production of calf lymph in all of the large cities, at present twenty-five in number. It also provides for the general supervision of all these establishments under the most careful and minute regulations. Each establishment is required to give an annual report of its operations, a summary of which may be found in the reports of the Imperial Board of Health. These stations furnish annually enough lymph to vaccinate about two million persons.

Similar though not so careful regulations exist in Holland, Austria, Italy, and in Japan.

Contrast with the foregoing statements the methods in vogue in the United States. With the exception of one station in Minnesota, now successfully conducted under the direction of the State Board of Health by Dr. Hewitt, I know of no establishment which has any supervision whatever.<sup>2</sup> As a consequence there must be a great diversity in the methods employed and in the material produced.

(2) *Vaccine Lymph as an Article of Commerce or Trade.* Partly as a consequence of submitting quietly to the method of production of vaccine lymph by private parties in this country, the business has become very largely commercial in its character, the private producer conducting his operations in such a manner as to secure the greatest possible returns with the least possible outlay of money. Vaccine lymph is bought and sold, and competition in prices naturally leads to deterioration in the quality of this important article, which should be freed from every influence which may in any way lead to its impairment. But the danger lies not only in the fact that it is an article of commerce, but still more in the *methods* of its sale. The business is entrusted to druggists, middlemen and travelling agents who solicit orders very much after the manner in which boots, shoes, dry goods and patent medicines are sold. But vaccine lymph is an extremely

<sup>1</sup> Read before the Massachusetts Medical Society, June 12, 1894, and recommended for publication by the Society.

<sup>2</sup> At the time of writing this paper this statement was correct.